Appendix 7-D: Foothill Municipal Water District Recycled Water Project

Supporting Documents

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NEWS RELEASE

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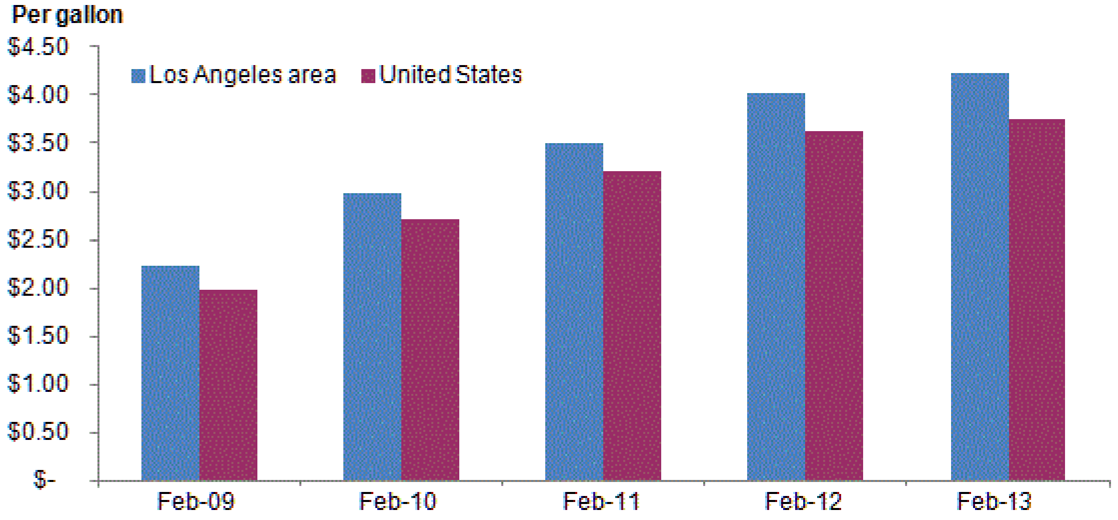
AVERAGE ENERGY PRICES, LOS ANGELES-RIVERSIDE-ORANGE COUNTY– FEBRUARY 2013

Gasoline prices averaged $4.236 a gallon in the Los Angeles-Riverside-Orange County area in February 2013, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were up 22.3 cents compared to last February when they averaged $4.013 per gallon. Los Angeles area households paid an average of 23.2 cents per kilowatt hour (kWh) of electricity in February 2013, up from 20.4 cents per kWh in February 2012. The average cost of utility (piped) gas at $1.039 per therm in February was more than the $0.931 per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

At $4.236 a gallon, Los Angeles area consumers paid 13.0 percent more than the $3.748 national average in February 2013. A year earlier, consumers in the Los Angeles area paid 10.8 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by more than 8.0 percent in the month of February in each of the past five years. (See chart 1.)

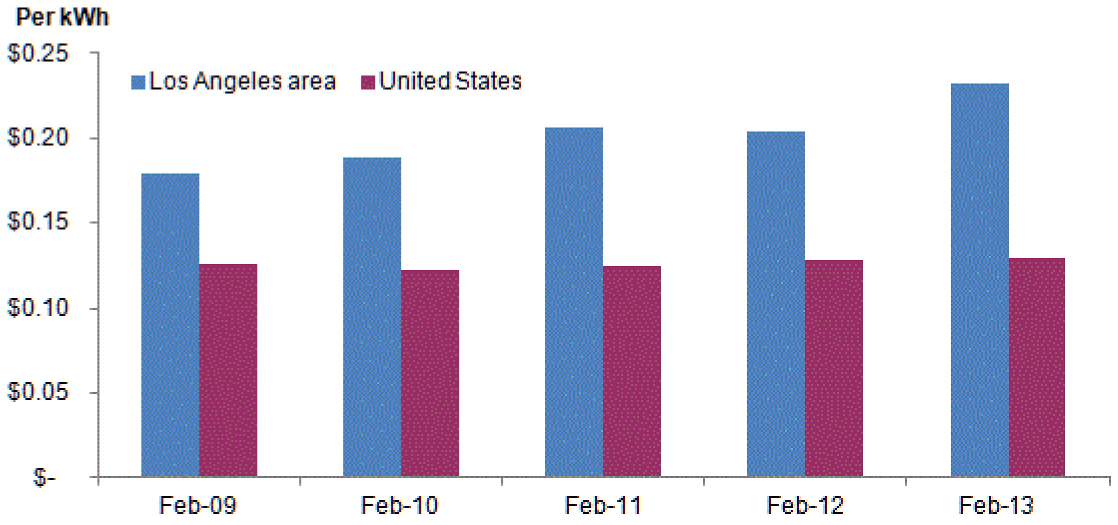
Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2009-2013 (as of February)



SOURCE: U.S. Bureau of Labor Statistics.

The 23.2 cents per kWh Los Angeles households paid for electricity in February 2013 was 79.8 percent more than the nationwide average of 12.9 cents per kWh. Last February, electricity costs were 59.4 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by more than 42 percent in the month of February. (See chart 2.)

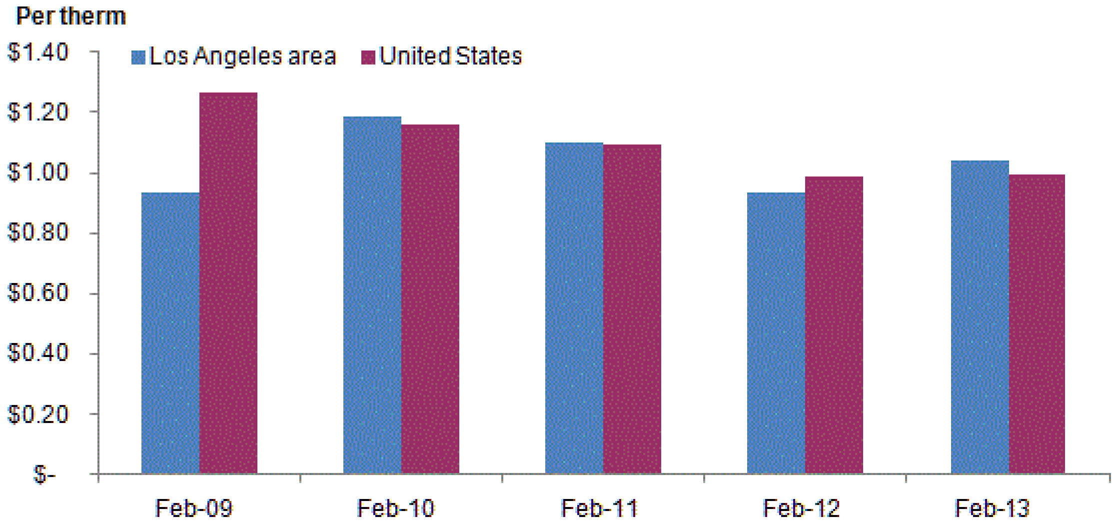
Chart 2. Average prices for electrictity, Los Angeles-Riverside-Orange County and the United States, 2009-2013 (as of February)



SOURCE: U.S. Bureau of Labor Statistics.

Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.039 per therm, or 4.2 percent more compared to the national average in February 2013 ($0.997 per therm). A year earlier, area consumers paid 5.6 percent less per therm for natural gas compared to the nation. In the past five years, the per therm cost for natural gas in February in the Los Angeles area ranged from 26.4 percent less to 4.2 percent more compared to the U.S. average. (See chart 3.)

Chart 3. Average prices for utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, 2009-2013 (as of February)



SOURCE: U.S. Bureau of Labor Statistics.

The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits. This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Service: 800-877-8339.

Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, February 2012-February 2013, not seasonally adjusted

	Gasoline per gallon		Electricity per kWh		Utillity (piped) gas per therm	
	Los Angeles area	United States	Los Angeles area	United States	Los Angeles area	United States
2012						
February	$4.013	$3.622	$0.204	$0.128	$0.931	$0.986
March	4.394	3.918	0.204	0.127	0.931	0.978
April	4.257	3.976	0.204	0.127	0.883	0.951
May	4.333	3.839	0.204	0.129	0.978	0.907
June	4.037	3.602	0.193	0.135	1.054	0.927
July	3.800	3.502	0.193	0.133	1.053	0.943
August	4.073	3.759	0.193	0.133	1.072	0.960
September	4.175	3.908	0.193	0.133	1.027	0.953
October	4.499	3.839	0.211	0.128	1.052	0.962
November	3.924	3.542	0.211	0.127	0.995	0.994
December	3.677	3.386	0.211	0.127	1.042	1.004
2013						
January	3.749	3.407	0.232	0.129	1.013	0.996
February	4.236	3.748	0.232	0.129	1.039	0.997

California Climate Action Registry General Verification Protocol

Verifying Entity-Wide Greenhouse Gas Emissions

Version 3.0 | August 2008

Acknowledgements

The California Registry would like to thank and acknowledge the many experts who have helped make both the General Verification Protocol and the California Registry a reality. While it is impossible to properly acknowledge everyone who contributed to this document, the following organizations have provided valuable guidance and insightful feedback throughout the duration of this project:

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Pew Center on Global Climate Change

Science Applications International Corporation (SAIC)

U.S. Department of Energy

U.S. Energy Information Administration (1605b Program)

U.S. Environmental Protection Agency

U.S. EPA Climate Leaders

World Business Council for Sustainable Development

World Resources Institute

The California Registry is also grateful to all of the individuals who participated in the California Registry's public workshops and meetings. Most notably, Rachel Tornek, Robyn Camp, Jill Gravender, Pierre duVair and Jeff Wilson should be singled out for their extensive contributions in the drafting and finalization of this report.

The California Energy Commission has been instrumental in providing technical policy guidance to the California Registry's staff and board of directors.

The California Registry wishes to extend a special thank you to SAIC for their help preparing the General Verification Protocol.

Finally, the California Registry wishes to thank the California Energy Commission and the Energy Foundation for their generous financial support of the California Registry.

Version 1 of the General Verification Protocol was released in October 2002. Version 2 was released in July 2003. Version 3 was released in August 2008.

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Abbreviations and Acronyms

CARB	California Air Resources Board
CARROT	Climate Action Registry Reporting Online Tool
CDF	California Department of Forestry and Fire Protection
CEMS	Continuous Emissions Monitoring Systems
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COI	Conflict of Interest
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
N_2O	nitrous oxide
PFC	perfluorocarbon
RFA	Request for Applications
SAR	IPCC Second Assessment Report (1996)
SF_6	sulfur hexafluoride
TA	Technical Assistance Provider
TAC	Technical Advisory Committee
TAR	IPCC Third Assessment Report (2002)

Part I Introduction

1.1 Overview

The California Climate Action Registry created this General Verification Protocol to provide California Registry-approved verifiers with clear instructions for executing a standardized approach to the independent verification of greenhouse gas (GHG) emissions baselines and annual emissions reported by California Registry participants. This standardized approach defines a verification process that promotes the relevance, completeness, consistency, accuracy and transparency of emissions data reported to the California Registry. While this Protocol is written for verifiers, California Registry participants who are interested in understanding and preparing for the verification process may also find it useful.

This Protocol is intended to be used in combination with the California Registry's General Reporting Protocol and web-based calculation and reporting tool (CARROT—Climate Action Registry Reporting Online Tool). **Approved verifiers will verify participants' GHG emissions reports to the standards of the California Registry's General Reporting Protocol, and sector-specific protocols using the process outlined in this General Verification Protocol**.

At a minimum, each emissions report must contain all of an entity's emissions of CO_2 in the state of California for a calendar year, reported in five categories: indirect emissions from purchased electricity, imports of steam, district heating/cooling, and direct emissions from mobile combustion, stationary combustion, manufacturing processes, and fugitive emissions. Where a participant is reporting their U.S. emissions, the report must contain all of their emissions nationally. Starting with the fourth year of reporting, each emissions report must contain all emissions of all six greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6).

Emissions reports may also contain other information about an organization and its emissions that does not require verification. For instance, this could include information about a company's environmental goals, programs, policies, etc. Participants may also choose to report other indirect emissions, like business travel or employee commuting. In the emissions reports, optional information will be clearly distinguished from information that is verified.

Activities for each specific verification will differ based on the length and complexity of a participant's emissions report, but the verification process will include at least the following steps:

- Case-by-case evaluation of Conflict of Interest
- Scoping and planning a participant's verification activities
- Conducting verification activities
    1. Identifying emissions sources
    2. Reviewing methodologies and management systems
    3. Verifying emission estimates
- Preparing a participant's Verification Report and Verification Opinion

- Submitting a participant-authorized electronic Verification Form and Verification Activity Log to the California Registry via CARROT

Upon completion of the above steps, the California Registry will review the emissions report before accepting a participant's verified emissions report into its emissions database. This process is repeated every year of an organization's participation in the California Registry.

To help decrease the potential for conflict of interest between a verifier and a participant, a verifier can verify the same participant for a maximum of six consecutive years. After six years, a participant must choose another verifier for at least three years. After that time, the original verifier would again be eligible to verify the participant's emissions for up to six consecutive years.

The California Registry assumes that the verifiers will use their best professional judgment when conducting verification activities.

1.2 Organization of this General Verification Protocol

This General Verification Protocol is divided into four parts which outline the necessary steps a verifier must follow to initiate and complete the verification of a participant's emissions report.

Part I, *Introduction* (this section), provides a brief overview of the purposes and requirements of the verification process, describes the principles of verification, highlights important definitions, and answers some key questions.

Part II, *Preparing for Verification*, focuses on activities that take place prior to beginning verification activities, including bidding for a contract with participants, determining conflict of interest, negotiating a contract with participants, providing required notifications, and designing appropriate verification activities for each participant.

Part III, *Core Verification Activities*, provides guidance on conducting the primary activities that the verifier will complete, including: identifying sources, reviewing management systems and methodologies, and verifying emission estimates.

Part IV, *Completing the Verification Process*, covers procedures for completing the verification process including: preparing a Verification Report and Verification Opinion, completing the Verification Form to submit a participant's verified data to the California Registry, and recording and retaining proper records.

1.3 Principles of Verification

The purpose of verification is to provide an independent review of data and information being submitted to the California Registry to ensure that they meet minimum quality criteria. To fulfill this purpose, the independent verification process maintains the criteria of completeness, consistency, accuracy, comparability and transparency as its underlying principles.

Relevance. Verification should ensure that GHG inventories submitted to the California Registry appropriately reflect the GHG emissions of the entity and include emissions information produced in accordance with the program rules on defining reporting boundaries and sources.

Completeness. Verification should ensure accounting of all material GHG emissions sources and activities within the specified scope of the participant's inventory (a minimum of 95%). Baseline and annual emissions results should include all sources for which the participant is responsible.

Consistency. An emissions report should allow for meaningful comparison of emissions performance over time and across similar organizations. Independent verification should ensure that consistent methodologies and measurements are used between the baseline results and annual emissions results. Additionally, changes to participant emission baselines are verified to ensure appropriate comparisons.

Accuracy. Entity-wide reported data should be within the materiality threshold of 5% of the verifier's estimate of total emissions. Calculations and estimates need to be as accurate as possible to prevent material errors.

Transparency. Verification should be a transparent exercise. The data used for verification and the verification activities should be clearly and thoroughly documented to allow for outside review by the California Registry or potential review by the State of California (the State) in the context of overseeing verification activities.

1.4 Verification Principles and Definitions

1.4.1 Verification Standard

Verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. If a participant is reporting process or fugitive emissions, a separate industry-specific protocol may also be used and cited, where available. Some participants may wish to use their GHG emissions report for additional purposes such as registering in another registry, participating in emissions trading schemes, crediting programs, etc., and thus may add additional standards for verification.

1.4.2 Minimum Quality Standard

A verified emissions report submitted to the California Registry must be free of material misstatements, achieving a level of at least 95% accuracy. It is possible that during the verification process, differences will arise between the emissions totals estimated by participants and those estimated by verifiers. Differences of this nature may be classified as either material (significant) or immaterial (insignificant). A discrepancy is considered to be material if the overall reported emissions differ from the overall emissions estimated by the verifier by 5% or more. A difference is immaterial if it is less than 5%.

1.4.3 Reporting Uncertainty vs. Inherent Uncertainty

When evaluating participants' emissions reports, verifiers are to determine if the reporting uncertainty (vs. the inherent uncertainty) is less than the minimum quality standard.

Reporting uncertainty entails the mistakes made in identifying emissions sources, managing data or information, and calculating GHG emissions. Inherent uncertainty refers to scientific uncertainty associated with measuring GHG emissions. The California Registry is aware that there is inherent uncertainty in emissions factors and measurement of activity data through metering and instrumentation (even after the calibration of meters and other data collection methods are verified as accurate), but determining scientific accuracy is not the focus of the California Registry or its General Reporting Protocol.

1.5 Professional Judgment

Approved verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. The California Registry asks verifiers to use their professional judgment when executing the verification activities described in this General Verification Protocol. The purpose of the verifier approval process is to find verification firms that demonstrate, through their staff's professional qualifications and relevant GHG experience, their ability to render sound professional judgments about GHG emissions reports.

Application of a verifier's professional judgment is expected in the following areas:

- Implementation of verification activities with appropriate rigor for the size and complexity of a participant's organization and with regard to the uncertainty of calculations associated with the participant's emissions sources;
- Review of the appropriateness of a participant's GHG emissions tracking, monitoring, and management systems for providing information to the California Climate Action Registry;
- Evaluation of participant compliance with the California Registry's General Reporting Protocol;
- Assessment of methods used for estimating emissions from sources for which the General Reporting Protocol does not provide specific guidance, such as process and fugitive emissions, and indirect emissions from sources other than electricity, imported steam, district heating/cooling; and
- Appraisal of assumptions, and estimation methods and emission factors that are selected as alternatives to those provided in the General Reporting Protocol.

The General Verification Protocol and training provided by the California Registry are intended to explain to the verifier the California Registry's guidelines and expectations and thus what types of professional judgments are appropriate for this program. In addition to these resources, verifiers may contact the California Registry at any time for clarification of California Registry guidelines, expectations and policies.

1.6 Conflict of Interest

In order to ensure the credibility of the emissions data reported to the California Registry and its potential utility under any future regulatory regime, it is critical that the verification process is completely independent from the influence of the participant submitting the emissions report. While conducting verification activities for California Registry participants, verifiers must work in a credible, independent, nondiscriminatory and transparent manner, complying with applicable state and federal law and the current version of the State of California's *Conflict of Interest Process and Requirements for State and California Registry-Approved Verifiers*. This document is posted on the California Registry's website**.**

Any pre-existing relationship between the verifier and participant must be acknowledged to the California Registry, which will evaluate the potential for a conflict of interest (COI) between the two organizations.

Verifiers must provide information to the California Registry about its organizational relationships and internal structures for identifying potential conflicts of interest (organizational COI). Then, on an individual basis, the California Registry will review any pre-existing relationship between a verifier and participant and will assess the potential for conflict of interest (case-by-case COI). When the California Registry determines there is a low risk of COI, the participant and verifier can finalize negotiations of their contract. Following completion of a verification, the verifier must monitor for the next year if any new business relationship may create a COI (emerging COI).

As an added protection, a verifier may provide verification services to a California Registry participant for, at most, six consecutive years. After a six-year period, the California Registry participant must engage a different verifier. The original verifier may not provide verification services to that participant for three years. This three year hiatus begins with any lapse in providing annual verification services to a California Registry participant.

In the event that a verifier violates these conditions, the California Registry, in consultation with the State and at its discretion, may disqualify an approved verifier for a period of up to five years.

This conflict of interest clause does not preclude a verifier from engaging in consulting services for other clients that participate in the California Registry for whom the verifier does not provide any verification activities.

Part II Preparing for Verification

2.1 Verification Process Overview

Before any verification activities begin, a number of procedural steps must be taken to ensure that the obligations and responsibilities of both the verifier and participant are clear.

The following summary of the major steps of verification is provided as a reference.

1. **Verifier receives California Registry approval**: Verifier meets all accreditation requirements and completes a California Registry-sponsored verification training workshop.

2. **Participant selects verifier**: Participant contacts one or more State/California Registry-approved verifiers to discuss verification activities. Participant selects an organization to verify its GHG emissions results and begins to negotiate contract terms.

3. **Verifier submits case-specific Evaluation of Conflict of Interest (COI) and State Notification Form**: After a participant chooses a verifier, the verifier must submit a Conflict of Interest Evaluation and State Notification Form to the California Registry to establish that the likelihood of a COI between parties is low or that risk of any conflict can be sufficiently mitigated by the verifier. The form must be submitted at least 10 working days prior to the first scheduled verification meeting.

4. **California Registry sends COI determination to verifier**: The California Registry reviews the Evaluation of COI Form and supporting information to determine the level of risk associated with the proposed participant/verifier relationship, and notifies the verifier of its determination.

5. **Verifier & participant finalize contract**: When the California Registry provides a favorable COI determination between a participant and verifier, verifiers may finalize their contract with a participant.

6. **Verifier conducts verification activities**: Verifier follows the guidance in the General Verification Protocol to evaluate a participant's annual GHG emissions report.

7. **Verifier prepares Verification Report and Verification Opinion for participant**: Verifier prepares a detailed summary (Verification Report) of the verification activities for the participant. Verifier also prepares a Verification Opinion for participant's review, prior to sending opinion electronically to the California Registry via CARROT.

8. **Verifier & participant discuss Verification Report and Opinion**: Verifier meets with participant to discuss Verification Report and Opinion.

9. **Verifier completes Verification Form via CARROT**: Once authorized by a participant, a verifier completes the Verification Form via CARROT. Participant then submits the original Verification Opinion to the California Registry.

10. **California Registry Conducts Final Review**: California Registry reviews the Verification Opinion and Verification Activity Log and evaluates the participant's

emissions reports. Once accepted by the California Registry, a participant's aggregated entity-level emissions become available to the public via CARROT.

Even in multi-year verification contracts, verifiers must repeat steps 3-11 for each annual verification before submission to the California Registry.

2.2 Becoming an Approved Verifier

Only those firms approved by the California Registry, the State or those involved in the American National Standards Institute (ANSI) accreditation program may provide verification services to California Registry participants. In order to become approved, a verifier must complete a two-step process: 1) Obtain accreditation as a GHG verifier from either the California Air Resources Board or from the American National Standards Institute (or other approved accreditation body as specified on the California Registry website) and 2) achieve California Registry approval by attending a verification training workshop facilitated by the California Registry.

Information on ANSI GHG Verifier Accreditation is available at www.ansi.ghg.org.

Information on CARB GHG accreditation is available at arb.ca.gov.

The second step of the approval process requires that lead verifiers one of the California Registry's verification training workshops. A lead verifier is any verifier from the firm who will sign their firm's Verification Opinion. After completing the training workshop, the verification firm becomes an "approved verifier." Following the training session, the California Registry will provide verifiers with a notification of their full approval. Upon receiving this notice, a firm may approach current or prospective California Registry participants to market their services and capabilities, and advertise that they are "approved verifiers for the California Climate Action Registry". All approved verifiers are listed on the California Registry's website.

Approvals are valid for three years from the date of the California Registry approval. At the end of this period, the California Registry will send a notification to each firm's primary contact. If for any reason the State, ANSI or the California Registry finds that a verifier has failed to meet the standards of either the General Reporting Protocol or the General Verification Protocol, it may disqualify a verifier for a period of up to five years.

2.3 Updates to the General Verification Protocol

Periodically, the California Registry may update the General Verification Protocol. The California Registry will advise all verifiers of any changes, and any new requirements that may affect them. Where any changes are significant, the California Registry may require that lead verifiers attend the next verification training workshop.

2.4 Adding or Deleting Designated Staff

During the application process, verification firms will identify all staff members who will be designated verifiers for the California Registry. An applicant who is State-approved may add or delete staff to their roster. To add or delete designated staff after being approved, the verifier should submit the Designated Staff Form (available on the California Registry's Verifiers Only webpage), with the names and contact information for any personnel changing from the roster, and note if staff are to be deleted or added to the roster. When adding staff, the firm should describe each individual's job classifications, relevant experience, education, academic degrees, professional licenses for technical staff members and their respective roles.

2.5 Bidding on a Verification Contract

The California Registry recommends that those participants with complex GHG emissions reports solicit competitive bids for verification services from at least three approved verifiers. Those participants with simpler GHG emissions reports who do not seek, or are not eligible for, batch verification may wish to secure competitive bids or may wish to sole source the verification contract in order to reduce costs and expedite the verification process.

When preparing to send out a request for bids from verifiers, participants should first review the list of approved verifiers and select some (or all) as prospective bidders. Due to the possibility of access to proprietary information, participants may want to send each prospective bidder a non-disclosure agreement. The California Registry suggests that participants distribute requests for bids to prospective verifiers only after they have received a signed non-disclosure agreement from verifiers.

The California Registry recommends that participants include the following information in their requests for bids from verifiers:

1. The expected contract duration;
2. A general description of the participant's organization;
3. The geographic boundaries of the participant's emissions report;
4. The number and locations of facilities and operations;
5. The GHGs reported in the participant's emissions report;
6. The emission source categories (and possibly emission sources) in the participant's emissions report;
7. The password to a read-only (Reviewer) version of the participant's emissions report in CARROT; and
8. A list and description, by category, of how emissions data is organized and calculated (either using CARROT or another methodology).

The California Registry suggests that participants request that commercial proposals from potential verifiers include the following components:

1. History and description of verification company;
2. Explanation of core competencies;
3. Proposed price for verification services;
4. Proposed staff;
5. Statement of verifier liability;
6. Confidentiality policy; and
7. Duration of contract.

The California Registry expects only limited variation in the technical proposals since all of the approved verifiers are trained to implement the California Registry's standardized verification process.

2.6 Conflict of Interest (COI)

2.6.1 Objective of the Conflict of Interest Process

This COI process was developed by the State of California and adopted, with modifications, by the California Registry to assess the risk of potential COI between verifiers and California Registry participants. This process gives verifiers the ability to demonstrate that their organization is capable of identifying and mitigating situations that would impair their ability to render an impartial verification opinion.

Through this process, applicants and any partners must demonstrate:

1. Clearly-defined organizational boundaries, internal structures, and relationships with other companies that have management or financial control over the applicant.
2. The presence of internal mechanisms to identify and mitigate organizational and personal COIs with any potential clients.
3. The ability to be objective in providing verification activities.

To protect the credibility and rigor of the California Registry verification process, the relationship between verifiers and California Registry participants must not create or appear to create a COI. While conducting verification activities for California Registry participants, the verifier must work in a credible, independent, nondiscriminatory and transparent manner, complying with applicable state and federal law and the current version of the California Registry's conflict of interest process

2.6.2 Process and Requirements

In the verification process, all verifiers must demonstrate they do not have significant conflicts of interest with participants:

1. **Organizational COI** – in the application process, each verifying organization shows that they have internal mechanisms in place that help maintain their objectivity in verification activities.

2. **Case-by-Case COI** – in each case where verification services are requested, before a contract is signed with a participant, each verifier demonstrates that any pre-existing relationship between the verifier and participant will not impair impartiality in verifying a GHG emissions report.

3. **Emerging COI** – for a period of one year following a verification, verifiers will monitor their relationship with the participant to ensure impartiality has been protected in the verification process.

These are each discussed in greater detail below.

2.6.2.1 Organizational COI

As part of the application process, a verifier has already documented the ability of its organization to identify and react to COI due to organizational relationships. Verifiers have also submitted the form *Conflict of Interest Declaration of Ability and Intent to Comply*, declaring the applicant and each partner's ability to subsequently perform and submit a case-by-case evaluation of COI to the California Registry. This form also conveys the applicant's intent to comply with the California Registry's COI process and requirements.

2.6.2.2 Case-by-Case COI

As an early step in the contract negotiation process between verifiers and participants, a verifier must demonstrate on a case-by-case basis that it, its partners, and the individuals performing verification activities do not have any actual or potential conflict of interest with the California Registry participants for which it has been selected to carry out verification functions.

A verifier will have a high risk of COI if the verifier and participant share any management, or if any of the California Registry participant's managers of GHG-related activities were previously employed with or by the verifier within the last three years, or vice versa. A verifier will have a high risk of COI if the verifier or its related companies (e.g., parent company, subsidiaries of a parent company, affiliates) has provided any GHG management or advocacy services (as identified on the list below) to the California Registry participant within the last three years. If a verifier has performed these services, they have a high potential COI, as they would be: 1) verifying their own work, 2) performing management functions for the client, or 3) acting as an advocate for the client. Where a high risk of COI is determined, the verifier is not approved to conduct the verification.

2.6.2.3 Incompatible Services

- Designing, developing, implementing, or maintaining a GHG emissions inventory
- Designing or developing GHG information systems
- Developing GHG emissions factors or other GHG-related engineering analysis
- Designing energy efficiency, renewable energy, or other projects which explicitly identify GHG reductions as a benefit
- Preparing or producing GHG-related manuals, handbooks, or procedures specifically for the California Registry participant
- Appraisal services of carbon or GHG liabilities or assets
- Brokering in, advising on, or assisting in carbon or GHG-related markets
- Management over health, environment and safety functions
- Legal and expert services unrelated to California Registry verification

If the verifier identifies a potential or actual COI, the verifier must also submit a plan to avoid, neutralize, or mitigate the COI situation. The California Registry will review the information submitted to determine if the verifier provided enough information to make a COI determination. If not, the California Registry may request additional information. Once the information is found to be complete, the California Registry will review and evaluate the case, and will issue a written determination within ten working days.

Once the case-by-case evaluation is complete, a verifier may provide verification services to a California Registry participant for, at most, six consecutive years. After a six-year period, the California Registry participant must engage a different verifier. The original verifier may not again provide verification services for at least three years. This three-year period is triggered following any lapse in providing annual verification services to a California Registry participant.

This cycling of verifiers will help to avoid potential COI situations due to lengthy and ongoing relationships. Also, this guarantees that another firm will review material previously reviewed by another verifier, thus providing another "check" on the consistency and appropriateness of professional judgments made.

2.6.2.4 Emerging COI

Verifiers agree to monitor their activities for one year after the verification, and seek the approval of the California Registry and the State before entering into arrangements or relationships during that time that may present COI. The verifier may not enter into any contract with a California Registry participant or related entity that the California Registry and/or the State determines would create an unacceptable level of risk of COI.

In order to obtain this determination, the verifier must submit *Form COI-AB: Notification of Verification Activities And Request for Evaluation of Potential for Conflict of Interest Between Verifier and California Registry Member* (available on the California Registry's Verifiers Only webpage) to the California Registry detailing the specifics of their situation and request a determination. The California Registry will use a similar procedure to determine the risk for COI during that period.

2.6.2.5 Confidentiality

The California Registry will enter into confidentiality agreements with verifiers and California Registry participants as necessary to evaluate potential COI. Any organization that must provide confidential information to support the evaluation should clearly indicate what information is confidential, and the California Registry will follow its standardized procedures to do its utmost to protect confidential business information.

2.7 Negotiating a Contract with the Participant

After a verifier has been selected by a California Registry participant, the two parties should negotiate and complete contract terms. This contract is exclusively between the participant and the verifier, and the particulars of any given contract are at the discretion of the two parties. However, contracts for verification services typically include the following components:

- **Scope of the Verification Process.** This component of the contract should outline the exact geographic and organizational boundaries of the participant's emissions inventory to be examined. This should, but may not necessarily, match the boundaries used in the GHG emissions report to the California Registry. This scope should indicate whether a participant's California-only emissions are included or if both California and U.S. emissions are included. It should also identify whether the participant has used the management control, equity share, or other methods based on contractual relationships to determine organizational boundaries.

- **Confirmation of Approved Verifier Status.** This is a simple statement that the verifier has been approved by the California Registry to verify emissions reports covering the scope listed above.

- **Verification Standard.** Verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. If a participant is reporting process or fugitive emissions, a separate industry-specific protocol may also be used and cited, where available. Some participants may wish to use their GHG emissions report for additional purposes such as, registering in another registry, participating in emissions trading schemes, crediting programs, etc., and thus may add additional requirements into their contract for verification.

- **Non-Disclosure Terms.** The verifier and the participant should agree in advance on methods for identifying and protecting proprietary and confidential business data that may be revealed during verification.

- **Site Access.** The verifier and the participant should agree in advance to the time, place, and conditions of a verifier's site visits, if any are required.

- **Documentation and Data Requirements.** The verifier and participant should agree on how and when the participant will provide activity and emissions data to the verifier. The range of required documentation will largely be determined by the size and complexity of participant operations, and whether the participant has used the online calculation tools available through CARROT.

- **Period of Performance.** The period of performance for verification services may be up to six years. Where a participant's operations do not significantly change from year to year, they may wish to work with a verifier on a three-year cycle. However, the participant has discretion as to whether to sign a one or multi-year contract.

- **Performance Schedule.** Participants and verifiers may wish to agree on a schedule to complete the verification process and for the verifier to deliver a Verification Report and Verification Opinion. Verification should be completed by October 31 of the same calendar year when the emissions report was submitted.

- **Payment Terms.** Typical payment terms include total value, schedule of payments, and method of payment (e.g., electronic funds transfer).

- **Re-Verification Terms.** If the verifier identifies material misstatements, the participant may choose to revise its GHG emissions report. At that time, the participant may ask the verifier to re-verify the portions of the report with material misstatements or seek verification from another provider. *A verifier may not provide guidance, technical assistance, or implementation work on the remediation of material misstatements, as this constitutes consulting services and results in a conflict of interest.* Contracts should also specify the length of time a participant will have to correct material misstatements.

- **Liability.** All verifiers are subject to minimum liability associated with completing the verification per the terms of the verification contract. The participant may require and the verifier may agree to additional liability under this contract.

- **Contacts.** Parties should identify technical leads for both the participant and verifier, as well as responsible corporate officials of each party.

- **Dispute Resolution.** Both parties must state their consent to submit irreconcilable differences for review to the California Registry-convened Dispute Resolution Committee.

- **Acknowledgement of State Site Visits.** Both parties must sign an acknowledgement that, on a random basis, the State may accompany a verifier for purposes of monitoring the verification process.

2.8 Batch Verification

In an effort to minimize the transaction costs of verification for small organizations with relatively simple emissions, the California Registry will contract with an approved verifier to undertake the verification work for interested participants with limited GHG emissions. The California Registry calls this batch verification. Emissions reports verified under batch verification must meet the same standards as non-batch reports. Eligible participants include those with:

- Less than 500 metric tons of CO_2e emissions per year;
- No significant process or fugitive emissions (significance threshold is 5% of total CO_2e emissions) ;
- Indirect emissions from purchased electricity at four or fewer sites; and/or
- Direct emissions from five or fewer passenger vehicles only; and/or
- Direct emissions from stationary combustion at one site.

Upon the recommendation of the batch verifier, the California Registry reserves the right to deem a participant's GHG emissions inventory too complex for batch verification. The California Registry also reserves the right to grant batch verification eligibility on a case-by-case basis.

2.8.1 Procedures

Each year, the California Registry will solicit competitive bids for batch verification services from all eligible approved verifiers.

Participants interested in batch verification will contact the California Registry to express their interest. After confirming the participant's eligibility, the California Registry will keep track of interested participants.

Each participant will sign a standardized contract with the verifier that has been developed by the California Registry. If participants require non-standard contract language, they cannot participate in batch verification.

Once the contracts are signed, the California Registry will work with the verifier to identify all necessary documentation, as requested by the verifier and as required in the General Reporting and General Verification Protocols. The California Registry will collect the necessary supporting documentation from the participants and forward it to the verifier. It is expected that batch verification will not require a site visit, but will consist of document review and telephone interviews.

The verifier will contact each participant to understand their operations. Then, the batch verifier will review and assess the emissions reports and documentation and prepare the Verification Report and Opinion. The verifier will then discuss the findings with each participant and upon authorization, will submit the electronic Verification Form to the California Registry via CARROT.

To minimize any potential conflict of interest, the California Registry will contract with a batch verifier on an annual basis and the designated batch verifier will perform all eligible verifications for that calendar year of emissions. The batch verifier will be ineligible to bid on batch verification for the following three years. Because of this term limit, the limited nature of emissions and operations of the participant and the elevated level of oversight by the California Registry, the potential for COI is deemed low, and the requirement to request determination of COI is waived.

2.9 Notification of Planned Verification Activities

After verifiers and participants have completed contract terms, the verifier must notify both the California Registry and the State of California 10 business days prior to the beginning of verification activities, using Form D, *Notification of Verification Activities*. This form is available on the California Registry's Verifiers Only webpage. Notification should include:

- Verifying company information;
- Participant information;
- Year and types of greenhouse gas emissions data being verified;
- Schedule of verification activities; and
- Names of approved staff members conducting the verification activities

This notification period is necessary to allow the State the opportunity to accompany verifiers on visits to participants' sites. The State will observe, evaluate, and report on the quality and consistency of verification activities. A verifier that does not provide proper notification to the California Registry and the State may be disqualified as an approved verifier.

2.10 Kick-off Meeting with the Participant

After contract terms have been completed and the California Registry and State have been notified of planned verification activities, verifiers should conduct a kick-off meeting with participants. For some verifications, this may consist of a telephone call. The agenda for that meeting should include:

1. Introduction of the verification team;
2. Review of verification activities and scope;
3. Transfer of background information and underlying activity data (See Table 2); and
4. Review and confirmation of the verification process schedule.

Based on the information provided in agenda items 2 and 3, the verifier should determine the most effective, efficient, and credible detailed verification approach tailored to the particular characteristics of the participant.

2.11 Online Reporting

All participants must report their emissions using the California Registry's online calculation tool, CARROT. Participants may also opt to use CARROT to calculate their indirect emissions and direct emissions from stationary and mobile combustion. Where participants have used CARROT to calculate their emissions, the verifier needs to verify that data have been collected properly and entered accurately. The verifier should assume CARROT's calculations are correct and do not need to re-calculate the emissions. Due to the time savings, this should result in a less expensive and expedited verification process.

It is the participant's responsibility to provide the verifier with access to CARROT. A verifier will have read-only access to the participant's Total Emissions Summary, which provides a detailed summary of all the information that the participant has reported. Because the verifier needs to be able to evaluate any operational changes, access is also provided to the previous year's total emissions summary, as well as emissions reported in the baseline year if this has been specified and if it is different than the current emissions year. For example, for a participant who has set a baseline year of 2002, has reported data from 2002 – 2006, and is contracting with a verifier for evaluation of their 2007 emissions; the verifier will be able to access their 2007 report, their 2006 report, and their 2002 report. They would have public access to emissions reported in the intervening years.

Additional assistance with navigating and using CARROT is provided in the California Registry's Verification Training Workshops and by contacting the California Registry at 213-891-1444 or **help@climateregistry.org**. Verifiers may also request temporary access to CARROT for training purposes.

Part III Core Verification Activities

3.1 Overview

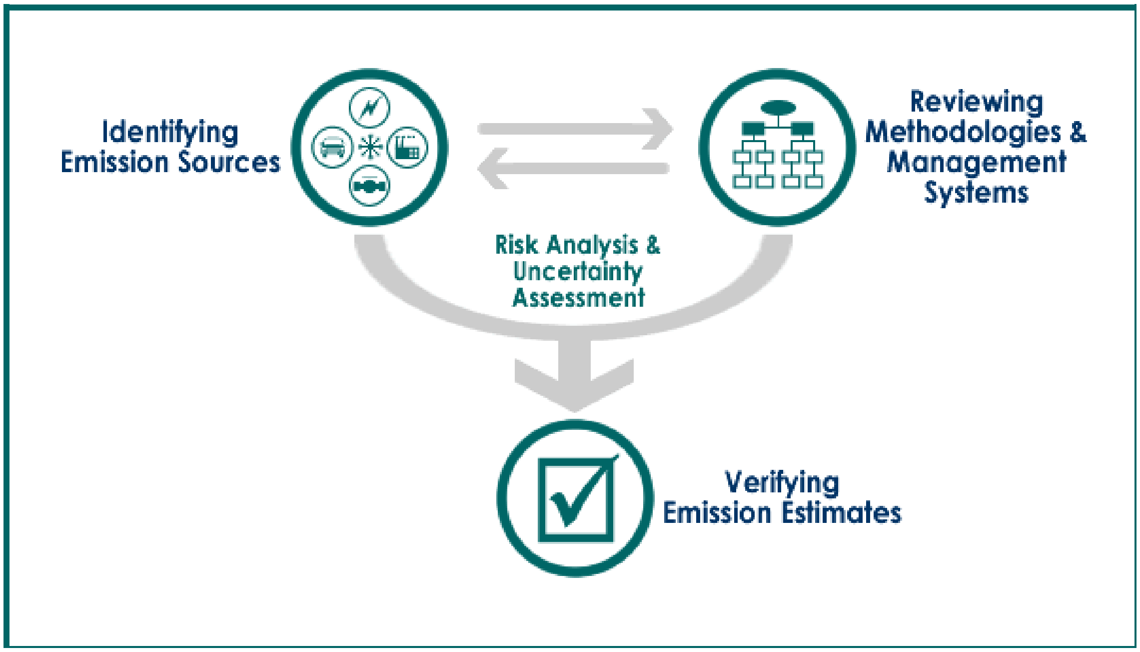
Once verifiers have completed the preparations for verification, they are ready to begin the core verification activities.

The core verification activities include three primary elements:

1. Identifying emissions sources in five emission source categories (indirect, mobile, stationary, process, and fugitive emissions);
2. Understanding management systems and estimation methods used; and
3. Verifying emission estimates.

The core verification activities are a risk assessment and data sampling effort aimed at ensuring that no material sources are excluded and that the risk of error is assessed and addressed through appropriate sampling and review. The complete core verification process is illustrated in Figure 1 below.

Figure 1. The Core Verification Process



3.2 Verification Activities Based on Participant Characteristics

Verifiers must apply the verification activities consistently for all participants. However, based on the size and complexity of participants' operations and management systems, verification activities and the duration of the process will vary. The documents that will need to be reviewed during verification will also vary depending on the nature of the emission sources contained in the participant's emissions report.

3.2.1 Determining Appropriate Verification Activities

To guide verifiers in their determination of appropriate verification activities, the California Registry divides participants into three general groups, based on the level of effort necessary to verify their emissions. The characteristics of the verification approach for each of these groups are listed below. Of course, verifiers are expected to use their professional judgment to augment or narrow these approaches based on uncertainty in emissions estimates and other items affecting material accuracy.

Group 1: Small participants with simple operations. This group includes participants who have only the following material emissions sources:

- Indirect emissions from electricity consumption, steam imports, and district heating/cooling at four or fewer buildings; and/or
- Direct emissions from stationary combustion at one site; and/or
- Direct emissions from five or fewer passenger vehicles.

In an effort to minimize verification costs, small participants who also have total emissions that are less than 500 metric tons of CO_2e per year may elect to be batch verified with similar organizations. The California Registry will assist this batch of participants in bidding and negotiating contracts with the verifier. Standard terms and conditions will apply for all contract elements. Verification for these participants will usually not require a site visit, but rather, activities will be conducted via a telephone interview.

Alternatively, small participants may choose to contract out verification services through a sole source procurement or competitive bidding process.

Group 2: Larger participants with more complex operations. These include participants with only the following material emissions sources:

- Indirect emissions from electricity consumption, steam imports, and district heating/cooling at more than four sites;
- Direct emissions from stationary combustion at more than one site;
- Direct emissions from more than five vehicles; and/or
- No material process or fugitive emissions.

For these participants, most verifications will require at least one site visit. Additional visits may be required when characteristics of the participant changes between reporting periods (e.g., new sites, changed location, began new operations). Site visits are used to ensure that all material GHG emission sources have been included and appropriately accounted for in the greenhouse gas emissions report.

Group 3: Participants with process or fugitive emissions. For participants with material process or fugitive emissions or other emissions not covered above, verification activities must be more detailed. Because these emission calculations are not currently included in the General Reporting Protocol, the verifier is required to use their professional judgment as to the appropriateness of the calculations used by the participant.

3.3 Verification Cycle

For participants whose operations do not change significantly, verification can be a three-year cycle. In Year 1, a verifier will need to form a detailed understanding of a participant's operations and resulting GHG emissions. If there have been no significant changes in a participant's boundaries, GHG emissions sources and/or management systems, a verifier may streamline and expedite the verification activities in Years 2 and 3 by focusing on verifying emissions estimates. To ensure data integrity, all of the core verification activities should be completed again in Year 4, followed by streamlined activities in Years 5 and 6.

The minimum core verification activities for each year are:

Year 1: Identify emission sources, review management systems, verify emissions estimates

Year 2: Verify emissions estimates

Year 3: Verify emissions estimates

Year 4: Same as Year 1

3.4 California Registry's Expectations for Verification Activities

Through these verification activities, verifiers are to verify that the annual emissions reports submitted to the California Registry via CARROT meet the standards of the General Reporting Protocol:

1. The participant has reported all material emissions, broken out into the following five categories:

    - Indirect emissions from purchased electricity, imported steam, district heating/ cooling;
    - Direct emissions from mobile combustion;
    - Direct emissions from stationary combustion;
    - Direct emissions from process activities; and
    - Direct fugitive emissions.

2. Total emissions reported as de minimis are less than 5% of the total emissions.

3. From the fourth year of reporting to the California Registry, all material emissions from all six greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) are reported.

4. All California emissions are identified separately from the rest of a participant's U.S. emissions, where the participant has chosen to report their U.S. emissions.

5. All emissions were emitted during the calendar year specified.

6. Reported emissions meet the minimum quality standard of 95% accuracy.

Emissions reports may also contain other information about an organization and its emissions that does not require verification. This could include, for instance, information about a company's environmental policies and goals, and emission reduction projects. Participants may also choose to report other optional indirect emissions (e.g., business travel, employee commuting). In the report generated by CARROT, optional information will be clearly distinguished from verified information.

To verify information is accurately reported, the verifier will want to review, at a minimum, the documents listed in Table 1. To facilitate this review, once the participant reports their emissions using CARROT, the participant and the verifier can generate a Verification Checklist. Based on the types and categories of emissions they have reported, CARROT will provide participants and verifiers with a list of documents they will need for verification.

Table 1. Documents to be Reviewed during Verification

Activity or Emissions Source	Documents
Identifying Emission Sources	
Emission Source Inventory	Facility Inventory
	Emission Source Inventory Stationary Source Inventory Mobile Source Inventory Fuel Inventory
Understanding Management Systems and Methodologies	
Responsibilities for Implementing GHG Management Plan	Organization Chart, Greenhouse Gas Management Plan, Documentation and Retention Plan
Training	Training Manual, Procedures Manual, Consultant Quals Statement
Methodologies	Protocols Used (if in addition to the California Registry's General Reporting Protocol)
Verifying Emission Estimates	
Indirect Emissions from Electricity Use	Monthly Electric Utility Bills, Emission Factors (if not default)
Direct Emissions from Mobile Combustion	Fuel Purchase Records, Fuel in Stock, Vehicle Miles Traveled, Inventory of Vehicles, Emission Factors (if not default)
Direct Emissions from Stationary Combustion	Monthly Utility Bills, Fuel Purchase Records, CEMs Data, Inventory of Stationary Combustion Facilities, Emission Factors (if not default)
Indirect Emissions from Cogeneration	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from Imported Steam	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Heating	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Cooling	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Direct Emissions from Process Activities	Raw Material Inputs, Production Output, Calculation Methodology, Emission Factors
Direct Fugitive Emissions	
Refrigeration Systems	Refrigerant Purchase Records, Refrigerant Sales Records, Calculation Methodology, Emission Factors
Landfills	Waste-in-Place Data, Waste Landfilled, Calculation Methodology, Emission Factors
Coal Mines	Coal Production Data Submitted to EIA, Quarterly MSHA Reports, Calculation Methodology, Emission Factors
Natural Gas Pipelines	Gas Throughput Data, Calculation Methodology, Emission Factors
Electric Transmission and Distribution	Sulfur Hexafluoride Purchase Records, Calculation Methodology, Emission Factors

Step 1: Identifying Emission Sources

Verifiers should review a participant's reported emission source inventories (facility, source, and fuel) to ensure that all sources are identified. Verifiers should then determine the GHGs that will result from the identified sources and estimate their magnitude. GHGs that are not required to be reported can be disregarded. Finally, verifiers should rank the remaining reported emissions by CO_2e (using the Global Warming Potentials [GWPs] contained in the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR) - see Table 2, below) to assess the environmental risk associated with the emissions.

Table 2. GWPs from IPCC's Second Assessment Report

Greenhouse Gas	GWP (SAR, 1996)
CO_2	1
CH_4	21
N_2O	310
HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,000
C_6F_{14}	7,400
SF_6	23,900

Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003 (April 2005).

When the emission source inventory is complete, verifiers should review participant's GHG emissions report and document answers to the following questions to assess if the GHG emissions report reflects the geographic, organizational, and operational scope of the participant:

1. Does the GHG emissions report include all processes and facilities under the management control of the participant? If not, why?

2. Does the report include all sources of GHG emissions within the geographic and organizational boundaries of the participant?

3. Does the report include all applicable types of GHGs from each emission source within the geographic and organizational boundaries of the participant?

4. Have any mergers, acquisitions, or divestitures occurred during the current reporting year? Have any activities been outsourced in the current year? If yes, has the participant specified a baseline? If so, has it been adjusted?

After these questions have been answered, verifiers will be able to determine if the GHG emissions report accurately reflects the geographic, organizational, and operational scope of the participant. Once all emission sources have been identified, verifiers may proceed to Step 2 to review the calculation methods used and the management systems employed.

Step 2: Reviewing Methodologies and Management Systems

After the scope and comprehensiveness of the participant's emission sources has been confirmed, verifiers should review the methodologies and management systems that the participant used to calculate their emissions. This is principally a risk assessment exercise, in which the verifier must weigh the relative complexity of the scope of the participant's emissions, the participant's methodologies and management systems used to prepare the GHG emissions report, and the risk of calculation error as a result of reporting uncertainty or misstatement. Through these steps, the verifier should determine the appropriateness of the management systems to provide required data to the California Registry. For example, the absence of a comprehensive GHG management system for a participant with a single retail outlet and solely indirect emissions from electricity purchases may not add significant risk of material misstatement. In contrast, a large vertically-integrated manufacturing company with facilities in 31 states would require a much more robust management system for tracking and reporting its GHG emissions.

A verifier's general review of a participant's GHG management systems should document answers to the following questions:

1. Are calculation methodologies/procedures used to manage GHG emissions at the source level? Are they appropriate given the uncertainty/risk associated with the emissions? Are these methodologies/procedures standard within this industry?

2. Are appropriate methods used to manage and implement entity-wide GHG emissions reporting programs? If the participant has more than one facility, are the emissions data correctly aggregated and monitored?

3. Is someone responsible for managing and reporting GHG emissions? Is this individual qualified to perform this function?

4. Is appropriate training provided to personnel assigned to GHG emissions reporting duties? If the participant relies on external staff to perform required activities, are the contractors qualified to undertake such work? Is there internal oversight to assure quality of the contractor's work?

5. Are appropriate documents created to support and/or substantiate activities related to GHG emissions reporting activities, and is such documentation retained appropriately? For example, is such documentation maintained through reporting plans or procedures, utility bills, etc.?

6. Are the mechanisms used to measure and review the effectiveness of GHG emissions reporting programs appropriate for this purpose? For example, are policies, procedures, and practices evaluated and updated at appropriate intervals?

Verifiers should also consider how the participant's management systems are designed to support reporting five categories of emission sources (indirect, mobile, stationary, process and fugitive). Consequently, in reviewing a participant's Total Emissions Report, verifiers should document answers to the following questions:

1. Does the management system capture the diversity of the sources that comprise each emission category? For example, are there multiple types of vehicles and other transportation devices that require different emission estimation methodologies?

2. Does the system capture all the diversity of GHGs emitted from each emission source category?

3. Has the participant used the default emission factors and standardized estimation methods in the California Registry's General Reporting Protocol to calculate emissions in each source category? Has the participant or its technical assistance provider developed estimation methods independently? If the participant uses alternative emission factors, are they documented and explained appropriately?

4. Does the participant's GHG management systems appropriately track emissions in all of the emission source categories?

Once the verifier has assessed the overall risk associated with the management systems, the risks should be assessed in conjunction with the weighted CO_2e estimates determined in Step 1 (Identifying Emission Sources). Verifiers should then identify the areas with the greatest potential for material misstatements (either based on volume of emissions, lack of management systems, or both) to determine the best risk-based strategy to identify a representative sample of emissions to recalculate.

Step 3: Verifying Emission Estimates

Based on a participant's identified emission sources, management systems, and corresponding risk profile of GHG emissions, verifiers should select a representative sample of calculations to verify and sites to visit. Sampling procedures may entail conducting site visits, but should include reviewing documents such as utility bills or emissions monitor results, and recalculating emission estimates based on underlying activity data. In Table 3, below, the California Registry specifies the minimum number of sites that should be visited based on the size of the entity. The verifier should use professional judgment to assess if additional visits are needed.

Table 3. Minimum Site Visit Sample Size

Total Sites	Minimum Sample Size
2-10	30%
11-25	20%
26-50	15%
51-100	10%
101-250	5%
251-500	3%
501-1,000	2%
Over 1,000	1-2%

3.5 Potential Site Visits by the State of California

As part of the State of California's oversight of the verification process, the State will randomly accompany verifiers on site visits. The California Registry's enabling legislation directed the State to observe the verifier during verification visits, evaluate whether the participant has a GHG accounting program consistent with California Registry-approved procedures and protocols, and evaluate the reasonableness of the emissions information being reported. The State may send an employee or a contractor to accomplish this responsibility. The purpose of any site visit is to oversee the verifier's activities, and to evaluate the reasonableness of the participant's reported data. The State will report on its findings to the California Registry.

To accomplish this, during a site visit, the State will need to access the same information and sources as that of the verifier. The State will work with the verifier and participant to obtain this access. This may involve requesting access to on-site locations that may have GHG emission sources or related activities and participant information, data, records, or copies of records; observing verifiers during any exchange of participant data or data analyses; and/or asking the verifier to provide specific information related to their on-site and off-site data analyses. The State will also make every effort to not impede the normal activities of either the participant or the verifier. All costs for the State site visit are borne by the State.

Before the end of a site visit, the State will discuss its preliminary observations and evaluations with the verifier and participant. The State will also contact and discuss with the verifier and participant any findings that identify either party before reporting this to the California Registry.

As the Participant requests, a representative from the State, and/or the Verifier that will view confidential information should sign the Standard Nondisclosure Agreement (NDA). Rules covering State confidentiality can be found in the *California Code of Regulations, Title 20, Sect. 2501 et seq*.

3.6 Targeted Review & Recalculation of GHG Emissions

The California Registry does not expect nor require verifiers to review all of the participant's documents and recheck all their calculations. To ensure that data meet a minimum quality standard on an entity-wide basis, verifiers should concentrate their activities in the areas that have the greatest uncertainty and amount of emissions. Verifiers should calculate emissions for these sources and compare those calculations to emission levels reported by the participant. If they are free of material misstatement (have a difference of <5%), the verifier should declare that the participant's report conforms to the California Registry's Protocols.

If the reported data is not free of material misstatement, the verifier should include this information in its Verification Report and should complete its sampling effort of other sources. Once verifiers have confirmed that a sample of data is free of material misstatements, they should estimate total emissions and confirm that all material GHG emissions are reported.

3.7 De Minimis Emissions

De minimis emissions are a quantity of GHG emissions from one or more sources, for one or more gases, that when summed equal less than 5% of an organization's total CO_2e emissions. The percentage applies to California emissions for the purposes of California-only emissions reporting, and applies to U.S. emissions for national reporting. Participants have some discretion in choosing which sources and/or GHGs are de minimis, but are expected to disclose all de minimis emission sources in their emissions report. Verifiers should review participant's documentation and explanation of how de minimis emissions were calculated to confirm that not more than 5% of total CO_2e emissions are considered de minimis.

3.8 Identifying Material or Immaterial Misstatements

In order for verifiers to verify a GHG emissions report, a sample of data must be free of material misstatement. It is possible that during the verification process differences will arise between the emissions estimated by the participant and those estimated by the verifier. Differences of this nature may be classified as either material or immaterial. A discrepancy is considered to be material if the overall reported emissions differ from the overall emissions estimated by the verifier by 5% or more. A difference is immaterial if this difference is less than 5%.

A verifier's verification of emissions estimates should document the answers to the following questions:

1. Are the reported electricity, steam, and district heating and cooling use consistent with utility bills?

2. Is the reported total stationary fuel use by fuel type consistent with the fuel use records?

3. Is the reported total consumption of fuels in motor vehicles consistent with available documentation and by vehicle type? If the entity calculates transportation emissions based on vehicle mileage, is the reported vehicle mileage consistent with vehicle mileage records?

4. Are the reported process and fugitive emissions consistent with activity data or maintenance records?

5. Are the emission factors used by the participant appropriate? If California Registry default factors are not used, do the alternative emission factors provide increased accuracy? Is their derivation and explanation of increased accuracy properly documented and reasonable?

6. Does a sample of the participant's calculations agree with your re-calculated direct (mobile, stationary, process and fugitive) and indirect emissions estimates? Have you documented your process for determining the appropriate sampling plan?

7. Are all material GHG emissions included? Are all emissions that are considered de minimis emissions documented and reported as such?

8. Are the current year's reported emissions significantly different from the prior year's emission levels? If so, what has changed from prior years?

9. Has the accumulated change in reported emissions, since the last baseline update, changed by more than ten (10) percent? If so, has the baseline, if any, been recalculated?

10. Are there any discrepancies between your emissions estimates and the participant's material?

Once verifiers have reviewed these activities and answered these questions, they are ready to complete the verification process.

Part IV Completing the Verification Process

4.1 Overview

Once a verifier has completed reviewing a participant's annual GHG emissions report, they must do the following to complete the verification process:

1. Complete a detailed Verification Report, and deliver it to the participant;
2. Prepare a concise Verification Opinion, and deliver it to the participant;
3. Conduct an exit meeting with the participant to discuss the Verification Report and Verification Opinion and determine if material misstatements (if any) can be corrected. If so, the verifier and participant should schedule a second set of verification activities after the participant has revised the GHG emissions report.
4. Submit an electronic Verification Form and Verification Activity Log to the California Registry via CARROT;
5. Return important records and documents to the participant for retention.

4.2 Completing a Verification Report

4.2.1 Verification Report Content

The Verification Report is a confidential document that is shared between a verifier and a participant, and is only available to the California Registry or the public at the participant's request.

The Verification Report should include the following elements:

- The scope of the verification process undertaken;
- The standard used to verify emissions (this is the California Registry's General Reporting Protocol, but may also include other protocols or methodologies for those sources for which the California Registry has yet to provide detailed guidance);
- A description of the verification activities, based on the size and complexity of the participant's operations;
- A list of emission sources identified, including de minimis sources;
- A description of the sampling techniques and risk assessment methodologies employed for each source;
- An evaluation of whether the participant's annual GHG emissions report is in compliance with the California Registry's General Reporting Protocol;
- A comparison of the participant's overall emissions estimates with the verifier's overall emissions estimates;

- A list of material misstatements, if any;
- A list of immaterial misstatements, if any; and
- A general conclusion to be reflected in the Verification Opinion.

4.2.2 Quality Assurance Check

When the Verification Report is completed, it should be forwarded to an independent senior reviewer within the verifier's firm for a quality assurance check. No Verification Report should be forwarded to a participant until it has had an independent internal review.

4.2.3 Participant Review of Verification Report

Once a participant receives a Verification Report from their verifier, they should have at least 30 days to review and comment on the Verification Report. At the end of that review, the verifier and the appropriate official at the participant's organization should hold an exit meeting to discuss the nature of any material or immaterial misstatements.

4.3 Preparing a Verification Opinion

Verifiers should prepare a Verification Opinion using the template shown in Figure 2. The Verification Opinion is a simple confirmation of the verification activities and outcomes for all stakeholders (participants, verifiers, the California Registry, and the public). The Verification Opinion must also follow the same internal review process as the Verification Report and consequently must be reviewed by an independent senior reviewer within the verifier's firm, and signed by a designated lead verifier. An electronic version of this template is available on the California Registry's Verifiers Only webpage or may be obtained from the California Registry by emailing **help@climateregistry.org**.

4.4 Verification Activity Log

In order to assess the consistency of professional judgments that verifiers have been asked to make, verifiers should also complete a Verification Activity Log (Table 4 below) and submit a completed copy to the California Registry, along with the electronic Verification Form, in CARROT.

Table 4 includes a step-by-step outline of the standardized verification activities that all verifiers must consider. Not all activities are required of all participants or during each year, depending on a participant's specific circumstances, but verifiers should review this list and note "not applicable" (or "N/A") where appropriate. The table also includes a series of yes/no questions. Any "no" response should be explained, without revealing a participant's confidential information.

The California Registry will consider both the Verification Opinion and the answers in Table 4 in its final review of emissions data, before accepting a participant's report into the California Registry. An electronic version is available for download in CARROT, on the California Registry's Verifiers Only webpage, and from the California Registry by emailing **help@climateregistry.org**.

Table 4. Verification Activity Log

Verifier Company:		
California Registry Participant:		
Preparing for Verification	**Date Achieved**	
Bid on a Verification Contract		
Request determination of COI from California Registry		
Negotiate Contract with California Registry Participant		
Notify State of California and California Registry of Planned Verification Activities		
Conduct Kick-off Meeting With Participant		
Plan Verification Activities Based on Participant Characteristics		
Core Verification Activities **Identify Emission Sources**	**Date Achieved**	
Identify and list all facilities in the entity		
Identify and list all emission sources (indirect, mobile, stationary, process and fugitive)		
Identify and list all fuel types		
Rank all sources by magnitude on a carbon dioxide equivalent basis		
Assess any changes in geographic and organizational boundaries		
	Yes	**No**
1. Does the GHG emissions report include all processes and facilities under the management control of the participant?		
2. Does the report include all sources of GHG emissions within the geographic and organizational boundaries of the participant?		
3. Does the report include all applicable types of GHGs from each emission source within the geographic and organizational boundaries of the participant?		
4. Have any mergers, acquisitions, or divestitures occurred during the current reporting year?		
5. Have any activities been outsourced in the current year?		
6. If a baseline has been specified, has it been adjusted accordingly?		
7. Does the GHG emissions report include all processes and facilities under the management control of the participant?		
Review Methodologies and Management Systems	**Date Achieved**	
Evaluate procedures and systems for preparing emissions report		
Evaluate personnel and training for preparing emissions report		
Consider the uncertainty associated with methodologies and management systems		
	Yes	**No**
8. Are appropriate calculation methodologies/procedures used to manage GHG emissions at the source level? Are they appropriate given the uncertainty/risk associated with the emissions?		
9. Are appropriate methods used to manage and implement entity-wide GHG emissions reporting programs?		
10. If the participant has more than one facility, is the emissions data correctly aggregated and monitored?		
11. Is someone responsible for managing and reporting GHG emissions?		
12. Is that person qualified to do so?		
13. Is appropriate training provided to personnel assigned to GHG emissions reporting duties? If the participant relies on external staff to perform required activities, are the contractors' qualified to undertake such work?		
14. Are appropriate documents created to support and/or substantiate activities related to GHG emissions reporting activities, and is such documentation retained appropriately?		
15. Are appropriate mechanisms used to measure and review the effectiveness of GHG emissions reporting programs? For example, are policies, procedures, and practices evaluated and updated at appropriate intervals?		

16. Does the system account for the diversity of the sources that comprise each emission category? For example, are there multiple types of vehicles and other transportation devices that require different emission estimation methodologies?		
17. Do you know the diversity of GHGs emitted from each emission source category?		
18. Has the participant used the default emission factors and standardized estimation methods in the California Registry's General Reporting Protocol to calculate emissions in each source category?		
19. Has the participant or its technical assistance provider developed estimation methods independently?		
20. If participant uses alternative emission factors, are they documented and explained appropriately?		
21. Does the participant's GHG management system appropriately track emissions in all of the emission source categories?		
Assess Risk of Material Misstatement Associated with Management Systems/Procedures	**Date Achieved**	
Develop sampling procedures for sources based on risk of material misstatement		
Verify Emission Estimates		
Confirm total fuel consumption		
Confirm vehicle miles traveled		
Confirm that appropriate emission factors are used. If not default factors, ensure the derivation and explanation of increased accuracy is properly documented		
Calculate direct (mobile, stationary, process & fugitive) & indirect emissions based on sampling procedures		
Compare estimates from sample calculations to reported emissions		
Determine if there are any discrepancies between sample calculation and reported emissions		
Confirm that all material GHG emissions are included (that all emissions not included are either de minimis or not required)		
Determine if Discrepancies are Material or Immaterial	**Yes**	**No**
22. Based on the following table, have you visited an appropriate number of sites?		

Total Sites	Minimum Sample Size
2-10	30%
11-25	20%
26-50	15%
51-100	10%
101-250	5%
251-500	3%
501-1,000	2%
Over 1,000	1-2%

Total number of sites:________

Total number visited:_________

23. Are the reported electricity, steam, and district heating and cooling use consistent with utility bills?		
24. Is the reported total stationary fuel use by fuel type consistent with the fuel use records?		
25. Is the reported total consumption of fuels in motor vehicles consistent with available documentation and by vehicle type? If the entity calculates transportation emissions based on vehicle mileage, is the reported vehicle mileage consistent with vehicle mileage records?		
26. Is the reported process and fugitive emissions consistent with activity data or maintenance records?		
27. Are the emission factors used by the participant appropriate? If California Registry default factors are not used, ensure that alternative emission factors provide increased accuracy and that the derivation and explanation of increased accuracy is properly documented and reasonable.		
28. Does a sample of the participant's calculations agree with your re-calculated direct (mobile, stationary, process & fugitive) & indirect emissions estimates? Have you documented your process for determining the appropriate sampling plan?		
29. Are all material GHG emissions included? Are all emissions that are considered de minimis emissions documented as such?		
30. Are the current year's reported emissions significantly different from the prior year?		
31. Has the accumulated change in reported emissions, since the last baseline update, changed by more than 10%? If so, has the baseline, if any, been recalculated?		
32. Are discrepancies between your emissions estimates and the participant's immaterial?		
Completing the Verification Process	**Date Achieved**	
Prepare a detailed Verification Report and submit to participant		
Prepare a Verification Opinion and submit to participant		
Conduct exit meeting with participant to discuss Verification Report & Opinion		
Provide records to participant for retention		

4.5 Completing the Verification Contract

4.5.1 Exit Meeting

Verifiers should prepare a brief summary presentation of their verification findings for the participant’s key personnel. At the exit meeting, verifiers and participants might exchange lessons learned about the verification process and share thoughts for improving the verification process in the future. Verifiers and participants may wish to consider joint feedback to the California Registry.

The goals of this meeting should be:

- Acceptance of the Verification Report and Opinion (unless material misstatements exist and can be remediated, in which case the verification contract may need to be revised and a second verification process scheduled). If the participant does not wish to retain the verifier for the re-verification process, the verifier shall turn over the participant’s relevant documentation to the participant within 30 days.

- Authorization for the verifier to complete the Verification Form in CARROT.

If the verifier is under contract for verification activities in future years, the verifier and participant may wish to establish a schedule for the next year’s verification activities.

Figure 2. Sample Verification Opinion

[*Insert Verification Firm Logo*]

California Climate Action Registry Verification Opinion

Name of Verification Firm: _____

This is to verify that _____ [*Name of Member Organization*] has had its greenhouse gas emissions report covering the period January 1, _____ [*Insert Reporting Year*] to December 31,_____ [*Insert Reporting Year*] verified according to the California Climate Action Registry's General Verification Protocol against a standard of the California Registry's General Reporting Protocol.

Organizational Boundary of Verification

☐ Financial Management Control ☐ Operational Management Control ☐ Equity Share

GHGs Verified

☐ CO_2 ☐ CH_4 ☐ $N_2$0 ☐ HFCs ☐ PFCs ☐ SF_6

Total Direct Emissions: _____

Total Indirect Emissions: _____

Geographic Scope of Verification

☐ California Emissions ☐ U.S. Emissions

Baseline Year (if specified)

_____ (Direct) _____ (Indirect) Year, if specified

Verification Opinion

☐ Verified without Qualification

☐ Unable to Verify

Attestation

_________________________________ _____________

[*Insert Name*], Lead Verifier Date

_________________________________ _____________

[*Insert Name*], Senior Internal Reviewer Date

Authorization

I _____ [*Name of Member Representative*] authorize the above named verifier to submit this Verification Opinion to the California Climate Action Registry for _____ [*Name of Member Organization*].

____ _____________

[Member Representative Signature] Date

4.5.2 Limits to Verifier Feedback

If a participant's emissions report is not verifiable due to material misstatements, a *verifier must not provide guidance on how to remediate the identified misstatements*. Such guidance would be considered a consulting activity and therefore, a conflict of interest. However, verifiers may provide any existing documentation that may be useful to participants in preparing remediation plans. A verifier should also enumerate any shortcomings in a participant's GHG tracking and management systems.

The California Registry will retain the participant's unverified emissions report in the California Registry database for up to two years pending verification. After two years, if the emissions report is still not verifiable, the California Registry will render the emissions report inactive.

4.6 Submitting the Verification Opinion to the California Registry

Once the Verification Opinion is complete and has been authorized by the participant, the verifier must complete the Verification Form and Verification Activity Log electronically in CARROT and the participant must email a Portable Document File (PDF) copy of the fully executed verification opinion to help@climateregistry.org. The participant may also elect to send a hard copy of the verification opinion with wet signatures to the address listed below:

Verification Opinion
California Climate Action Registry
523 W. Sixth Street, Suite 428
Los Angeles, CA 90014

Once the California Registry receives an electronic or hard copy of the Verification Opinion, the California Registry will perform a final review of the emissions report in CARROT. When successful, the participant's report will be formally accepted into the California Registry database and the annual verification process will be completed.

*Note: Participants are *not* required to submit their Verification Opinions to the California Registry for the first two years of their participation. However, it is important to note that a participant's emissions data will not be considered accepted by the California Registry unless the California Registry receives a Verification Opinion indicating a "verified without qualification" assessment.

4.7 Record Keeping and Retention

While the California Registry views the verification process essentially as a private exchange between the verifier and the participant, the verifier should remind the participant to retain sufficient records to enable an ex-post verification of the participant's emissions. The California Registry recommends that the following records be retained for a minimum of seven years as specified by contract with the participant.

Verifiers should retain hard and electronic copies, as applicable, of:

- The participant's GHG emissions report (printable from CARROT);
- The Verification Report; and
- The Verification Opinion.

The participant should maintain the following documentation for a minimum of seven years:

- Contact information for the lead verifier and a responsible corporate officer at the participant's organization;
- A general description of the participant's organization;
- The geographic boundaries;
- The number of facilities and operations assessed in the verification activities;
- The GHGs evaluated;
- The sources of emissions identified;
- Assessment of emission factors, demonstrating greater accuracy if not default emission factors;
- Copies of fuel use, mileage, or other activity data records used in sample recalculations;
- Verification methodology used based on the size and complexity of the participant;
- Sampling procedures for selecting site visits;
- Dates of site visits;
- The verifier's evaluation of the participant's management systems; and
- The verifier's estimates of the participant's emissions.

Copies of the original activity data records are necessary to perform an ex-post verification.

4.8 Timeline of Verification Process

Incorporating all of the steps and procedures involved in reporting, reviewing and verifying credible emissions data may be a lengthy process. The following table gives you an overview of the consecutive steps and necessary lapses of time between steps in the verification process.

Table 5. Verification Process Timeline

Activity	Elapsed Time
Preparing for Verification	
Contacted by participant to submit proposal for services	Where no consulting activities for 3 years prior to contract
Selected by participant	Varies
Submit request for case-by-case determination of COI to California Registry	Prior to contract negotiation
California Registry evaluates case and issues notification of low risk for COI	One month
Negotiate contract with participant	Varies
Notify State of California and California Registry of verification activities	One month
Core Verification Activities	
Begin verification activities	Maximum one year
Completing the Verification Process	
Submit Verification Report and Opinion to participant	Varies
Participant reviews Verification Report and Opinion and returns comments to verifier	One month
Verifier discusses findings with participant	Varies
Participant authorizes submission of electronic Verification Form to the California Registry	By October 31 of data year +1
Monitor emerging COI	One year
Verifier cannot provide consulting services to participant	One year
Participant chooses a new verifier	After a maximum of six years

Glossary

Applicant	A firm, or lead firm (if part of a team), responding to a State-issued RFA for Verifiers.
Baseline	Datum against which to measure greenhouse gas emissions performance over time, usually annual emissions in a selected base year.
Batch Verification	Verification process arranged by the California Registry for multiple participants with relatively simple GHG emissions (less than 500 tons of CO_2e emissions and typically only indirect emissions from electricity consumption and/or direct emissions from stationary or mobile combustion).
Verification	The process used to ensure that a given participant's greenhouse gas emissions inventory (either the baseline or annual result) has met a minimum quality standard and complied with the California Registry's procedures and protocols for calculating and reporting GHG emissions.
Verified Member	A California Registry participant that has submitted at least one verified annual emissions report to the California Registry.
Verifier	A firm or team of firms that has been State- and California Registry-approved to conduct verification activities under the California Registry program. A verifier may also refer to a single employee within a State- and California Registry-approved firm who conducts verification activities.
CO_2 equivalent*	(CO_2e) The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of harm which can be caused by different GHGs.
Conflict of Interest	A situation in which, because of other activities or relationships with other persons or organizations, a person or firm is unable or potentially unable to render an impartial Verification Opinion of a potential client's greenhouse gas (GHG) emissions, or the person or firm's objectivity in performing verification activities is or might be otherwise compromised.
Datum	A reference or starting point.
De Minimis	A quantity of greenhouse gas emissions from one or more sources, for one or more gases, which, when summed equal less than 5% of an organization's total CO_2e emissions.
Direct Emissions	Emissions from sources that are owned or controlled by the reporting organization.
Emerging COI	A potential or actual COI situation that arises, or becomes known, during verification or for a period of one year after the completion of verification activities.

Emission Factor*	A factor relating activity data and absolute GHG emissions.
Equity Share	Fractional percentage or share of an interest in an entity based either on ownership interest, or on some other contractual basis negotiated among the entity's stakeholders.
Fugitive Emissions*	Unintended or incidental emissions of GHGs from the transmission, processing or transportation of fossil fuels or other materials, such as HFCs from refrigeration leaks, SF_6 from electric power distribution equipment, methane from mined coal, CO_2 emitted incidentally with geyser steam and/or fluid used in geothermal generating facilities.
Global Warming Potential*	(GWP) The ratio of radiative forcing (degree of harm to the atmosphere) that would result from the emission of one unit of a given GHG to one unit of CO_2.
Greenhouse Gases	(GHGs) For the purposes of the California Registry, GHGs are the six gases identified in the Kyoto Protocol: carbon dioxide (CO_2), nitrous oxide (N_20), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
Indirect Emissions	Emissions that are a consequence of the actions of a reporting entity, but are produced by sources owned or controlled by another entity.
Inherent Uncertainty	The scientific uncertainty associated with measuring GHG emissions due to limitations on monitoring equipment, or measurement methodologies.
Lead Verifier	An individual who has completed a California Registry-sponsored verification training workshop and who has the authority to sign a verification firm's Verification Opinion.
Management Control	The ability of an entity to govern the operating policies of another entity or facility so as to obtain benefits from its activities.
Material misstatement	An error (for example from an oversight, omission or miscalculation) that results in the reported quantity being significantly different from the true value to an extent that will influence performance or decisions.
Member	A California Registry participant that is preparing its annual GHG emissions report, but has not yet submitted its verified report to the California Registry.
Minimum Quality Standard	Data that is free of material misstatements, and meets the California Registry's minimum level of accuracy of at least 95%.
Mobile Combustion*	Burning of fuels by transportation devices such as cars, trucks, airplanes, vessels, etc.
Organizational COI	Instances where the ability to render objective GHG verification services may be affected by the services provided by, shared management and/or financial resources with, or other situations created by a parent company or other related entities.

Outsourcing*	The contracting out of activities to other businesses.
Partner	An organization working through a lead firm (applicant) to respond to a State-issued RFA for Verifiers. A partner may or may not be a related entity. If the applicant submits an application wherein staff or financial capability is shared with either a parent firm or subsidiary of a parent firm, then that parent or subsidiary is considered a partner. If the applicant is part of a larger organization, but the application does not include any staff or financial capability from the larger organization, then the larger organization is not considered a partner.
Personal COI	A relationship of an employee or a partner employee that may impair the objectivity of the employee in performing a verification.
Process Emissions	Emissions from physical or chemical processing rather than from combustion, such as CO_2 emissions from cement manufacturing and PFC emissions from aluminum smelting.
Related Entity	An organization that is linked to the verifier by: common ownership or directors, contractual arrangement, a common name, informal understanding, or other means such that the related organization has a vested interest in the outcome of an assessment or has a potential ability to influence the outcome of an accredited management system assessment, greenhouse gas validation, or verification.
Reporting Uncertainty	The errors made in identifying emission sources and managing and calculating GHG emissions. This differs from inherent uncertainty due to incomplete understanding of climate science or a lack of ability to measure greenhouse gas emissions.
Stationary Combustion*	Burning of fuels to generate electricity, steam, or heat.

**Definitions of key terms obtained from "The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard," World Business Council for Sustainable Development and World Resources Institute, Switzerland, March 2004.*

Key Questions

Verifier Approval: *Who may qualify as a verifier?*

Only those firms accredited by the California Registry, the State of California, or The Climate Registry may provide verification services to California Registry participants

To become approved, a verifier must complete a two-step process: 1) Obtain accreditation as a GHG verifier from either the California Air Resources Board or from the American National Standards Institute (or other approved accreditation body as specified on the California Registry website) and 2) achieve California Registry approval by attending a verification training workshop facilitated by the California Registry.

Information on the ANSI GHG Verifier Accreditation is available at www.ansi.ghg.org. Information on CARB GHG accreditation is available at arb.ca.gov.

Applicants who wish to be qualified as approved verifiers need to demonstrate experience in GHG verification and verification of financial data, technical data, quality control, and/or environmental management systems. Verifiers must also demonstrate the means to accept financial liability for verification activities undertaken for a participant. *Firms providing verification services to a participant may not provide any non-verification services that create a high risk of COI to the same participant for three years prior to and one year after verification.*

Liability: *What liability will a verifier incur? What liability coverage must a verifier accept?*

At a minimum, a verifier is responsible for planning a participant's verification activities, conducting the verification activities, preparing a Verification Report and Opinion, and submitting authorized Verification Opinions to the California Registry via CARROT. If a California Registry-approved verifier fails to complete the contracted activities, they may be financially liable for the cost of hiring a different California Registry-approved verifier to complete a proper verification from start to finish (as defined in the contract between a verifier and a participant). The verifier may incur additional liability based on the negotiated terms of the contract. This liability may include the future value of GHG emissions or emission reductions, damages, or any other element agreed to by the verifier and the participant.

In their initial application, verifiers must demonstrate the means to accept financial liability for verification activities undertaken for a California Registry participant, specify such liability in any contract for verification activities, and make adequate arrangements (e.g., professional liability insurance coverage) to cover liabilities arising from its activities or operations. However, verifier liability may also be limited in the contract with the California Registry participant.

Resolution of Disputes: *What recourse is available if the participant does not accept the findings of the verification?*

There may be instances where a verifier and a participant cannot agree on identification of material misstatements and/or the findings of the Verification Opinion. In such instances, both parties can request the Dispute Resolution Committee, composed of qualified representatives from California state agencies, the California Registry, and one non-voting verifier, who serves pro bono on an annual, rotating basis. The participant and the verifier will each pay a filing fee equal to 5% of the participant's annual membership fee to submit the matter to the Dispute Resolution Committee.

The Dispute Resolution Committee will interview the participant and the verifier, review the area of dispute and reach a unanimous, binding decision concerning verifiability. The California Registry will notify the verifier and the participant of the Committee's decision. Thus, as part of contract negotiations, each California Registry participant and verifier will need to sign a form agreeing to this Dispute Resolution policy.

"Batch Verification": *How does it work? How will it affect bidding, contracting, and the overall verification process?*

In an effort to minimize the transaction costs of verification, the California Registry will help eligible participants with simple GHG emissions contract for "batch verification". Eligible participants have relatively simple GHG emissions (indirect emissions from purchased electricity and/or emissions from limited stationary and mobile sources) and produce less than 500 metric tons of CO_2e per year.

In batch verification, the California Registry will work with one verifier each year to verify the emissions reports of multiple organizations at one time. Emissions must be verified to the standards of the General Reporting Protocol. Because of the nature of the emissions, batch verification activities will consist of document review and phone conversations, but will not require a site visit. The California Registry will assist in negotiating a standardized contract and a flat fee for each organization. Standardizing the contract language will help to minimize the transaction costs of verification for small, office-based organizations.

A new batch verifier will be chosen each year. This finite verifier term is to minimize the risk from COI and to eliminate the cost associated with a case by case COI.

Verification Deadlines: *What is the deadline for completing the verification process?*

Emissions should be reported to the Registry no later than June 30 following the emissions year. Verification should be completed by October 31 following the emissions year. For instance, 2008 emissions should be reported by June 30, 2009 and verified by October 31, 2009.

Verification Report and Verification Opinion: *What are the Verification Report and Verification Opinion and how are they different?*

The Verification Report is a detailed report that a verifier prepares for a participant. The Verification Report should describe the scope of the verification activities, standards used, emission sources identified, sampling techniques, evaluation of a participant's compliance with the General Reporting Protocol, assumptions, and a list of material and immaterial misstatements, if any. The Verification Report is a confidential document between the verifier and the participant, and is only shared with the California Registry or the public at the participant's request.

The Verification Opinion is a brief, one-page summary of the verifier's findings that simply states if the participant's emissions report is verifiable or not. The Verification Opinion is submitted in hard copy by the verifier to the participant for approval.

Verification and Remediation: *What if a participant's emissions report is not verified?*

After completing verification activities, the verifier will prepare a Verification Report and forward it to the responsible official representing the participant. The responsible official includes anyone authorized by the participant to approve the GHG emissions report for submission to the California Registry and will typically be a corporate official or the technical manager of the verification contract.

If the verifier identifies material misstatements that prevent a favorable Verification Opinion, those material misstatements should be listed and described in the Verification Report. If possible, the participant may correct those material misstatements and resubmit the emissions report for verification within a reasonable amount of time. The participant may seek technical assistance to correct material misstatements but the verifier may not provide such technical assistance as it would constitute non-verification services, and create a conflict of interest.

The California Registry will retain the participant's unverified data in the California Registry database for up to two years, pending correction. After that time, the participant will need to re-enter the data.

Confidentiality: *Are the results of the verification kept confidential? Will emissions data be kept confidential?*

All aggregated entity-level emissions data and metrics reported to the California Registry will be available to the public. However, the California Registry will keep confidential all reported emissions, activity data, methodologies, and emissions factors that are reported at facility, project, or source levels. Confidential information will only be accessible to the participant, the California Registry, and the verifier, unless the participant allows others access to such information or wishes to have it available to the public. In instances where the State of California accompanies verifiers on site visits, the State may have access to confidential information as needed to oversee verification activities and evaluate the reasonableness of the participant's data and systems to track emissions. Representatives from the State, the Verifier, and the Participant who will view confidential information will all be required to sign the Standard Nondisclosure Agreement (NDA). As noted in an earlier question, the Verification Report is a private document between a participant and verifier, while the Verification Opinion is shared with the California Registry. A majority of the contents of the Verification Opinion will also be shared with the public.

General Verification Protocol Revision Policy: *Will this General Verification Protocol change over time? How can verifiers provide feedback to the California Registry?*

The California Registry expects to regularly review, revise, update, and augment this General Verification Protocol. The California Registry invites all parties, verifiers, California Registry participants, California State agencies, and the public to provide insights and experiences that will help improve the General Verification Protocol. Anyone with suggestions or concerns is encouraged to contact the California Registry at any time at 213-891-1444 or by email at info@climateregistry.org**.**

Stakeholders will also be able to present suggestions directly to the California Registry's Board of Directors for consideration at their meetings. All suggestions and requests for modifications must be made by utilizing the "Protocol Comment Form" available on the California Registry's website at **www.climateregistry.org/protocols**.

California Registry-Approved Technical Assistance Providers: *What role do they play?*

Some participants may desire outside assistance, either in terms of expertise or human resources, to collect, document and report their emissions to the California Registry and/or otherwise manage their GHG emissions. To assist participants in identifying a firm qualified to help them, the State and the California Registry approve firms qualified to serve as technical assistance providers (TAs). Participants are not required to use only approved TAs. However, approved companies have been approved as firms experienced in providing GHG emissions services, and many of them have attended California Registry-sponsored training sessions. Where a participant has retained the services of a TA, the participant may ask the TA to play a role in the verification process. Neither the California Registry nor the State is responsible for any consulting services or recommendations they may provide, nor do they specify any role that TAs should or should not play.

All firms approved as verifiers also are automatically qualified to act as TAs. However, a firm cannot provide both technical assistance and verification services to the same client at the same time.

Role of California State Agencies: *What is the relationship between the California Registry and state agencies?*

The Registry was established by California statute as a non-profit voluntary registry for greenhouse gas emissions inventories, to help organizations establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. The State of California was directed to offer its best efforts to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international GHG regulatory scheme.

The California Registry and state agencies work together and keep each other informed about current activities. The State of California continues to provide technical guidance to the California Registry and plays a direct oversight role in the verification process. The California Registry gives great weight to state agency guidance and relies in large part on these recommendations when developing California Registry policies, procedures and tools, including reporting and verification protocols and the online reporting tool. However, final policy and technical decisions are made independently by the California Registry's Board of Directors.

Updated Emissions Reports: *Once a report has been verified, will it ever change?*

Following verification of an annual GHG emissions report, there may be situations in which a verified report may change. A participant may wish to add information beyond the minimum reporting standards (add non-CO_2 gases during the first three years of reporting, report facilities outside of California, change the emission factor used, etc.). Participants can update their report at any time. However, any changes will need to be re-verified, and this information will need to be documented in CARROT. As understanding and sophistication of GHG accounting principles develops, the California Registry may elect to update accounting principles (e.g., alternate emission factors, Global Warming Potentials). Where participants have used CARROT to calculate their emissions, these changes do not need to be re-verified.

CARROT: *Am I required to use CARROT to communicate with the California Registry?*

Participants are required to report their emissions to the California Registry using CARROT. The participant-entered annual GHG emissions report generated by CARROT is the document on which the verifier provides its Verification Opinion to the California Registry. The Verification Opinion is submitted in separately by the participant. Verifiers are not restricted to only communicating with the California Registry via CARROT, but must use the online tool to submit an electronic Verification Form and Verification Activity Log. Questions about using CARROT may be directed to the California Registry at 213-891-1444 or **help@climateregistry.org**.

Additional Questions?

If you have any questions regarding GHG emissions reporting or verification under the California Registry Protocols, please contact the California Registry by phone (213-891-1444) or email (**help@climateregistry.org**).

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www.climateregistry.org

Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Note to Readers

This report for West Basin Municipal Water District is an update and revision of an analysis and report by Robert Wilkinson, Fawzi Karajeh, and Julie Mottin (Hannah) conducted in April 2005. The earlier report, *Water Sources "Powering" Southern California: Imported Water, Recycled Water, Ground Water, and Desalinated Water*, was undertaken with support from the California Department of Water Resources, and it examined the energy intensity of water supply sources for both West Basin and Central Basin Municipal Water Districts. This analysis focuses exclusively on West Basin, and it includes new data for ocean desalination based on new engineering developments that have occurred over the past year and a half.

Principal Investigator: Robert C. Wilkinson, Ph.D.

Dr. Wilkinson is Director of the Water Policy Program at the Donald Bren School of Environmental Science and Management, and Lecturer in the Environmental Studies Program, at the University of California, Santa Barbara. His teaching, research, and consulting focuses on water policy, climate change, and environmental policy issues. Dr. Wilkinson advises private sector entities and government agencies in the U.S. and internationally. He currently served on the public advisory committee for California's 2005 State Water Plan, and he represented the University of California on the Governor's Task Force on Desalination.
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Overview

Southern California relies on imported and local water supplies for both potable and non-potable uses. Imported water travels great distances and over significant elevation gains through both the California State Water Project (SWP) and Colorado River Aqueduct (CRA) before arriving in Southern California, consuming a large amount of energy in the process. Local sources of water often require less energy to provide a sustainable supply of water. Three water source alternatives which are found or produced locally and could reduce the amount of imported water are desalinated ocean water, groundwater, and recycled water. Groundwater and recycled water are significantly less energy intensive than imports, while ocean desalination is getting close to the energy intensity of imports.

Energy requirements vary considerably between these four water sources. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from the varying processes needed to produce water to meet appropriate standards. This study examines the energy needed to complete each process for the waters supplied by West Basin Municipal Water District (West Basin).

Specific elements of energy inputs examined in this study for each water source are as follows:

- Energy required to **import water** includes three processes: pumping California SWP and CRA supplies to water providers; treating water to applicable standards; and distributing it to customers.
- **Desalination of ocean water** includes three basic processes: 1) pumping water from the ocean or intermediate source (e.g. a powerplant) to the desalination plant; 2) pre-treating and then desalting water including discharge of concentrate; and 3) distributing water from the desalination plant to customers.
- **Groundwater** usage requires energy for three processes: pumping groundwater from local aquifers to treatment facilities; treating water to applicable standards; and distributing water from the treatment plant to customers. Additional injection energy is sometimes needed for groundwater replenishment.
- Energy required to **recycle water** includes three processes: pumping water from secondary treatment plants to tertiary treatment plants; tertiary treatment of the water, and distributing water from the treatment plant to customers.

The energy intensity results of this study are summarized in the table on the following page. They indicate that recycled water is among the least energy-intensive supply options available, followed by groundwater that is naturally recharged and recharged with recycled water. Imported water and ocean desalination are the most energy intensive water supply options in California. East Branch State Water Project water is close in energy intensity to desalination figures based on current technology, and at some points along the system, SWP supplies exceed estimated ocean desalination energy intensity. The following table identifies energy inputs to each of the water supplies including estimated energy requirements for desalination. Details describing the West Basin system operations are included in the water source sections. Note that the Title 22 recycled water energy figure reflects only the *marginal* energy required to treat secondary effluent wastewater which has been processed to meet legal discharge requirements, along with the energy to convey it to user

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
	35,843										
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

[1] Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

[2] Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

Energy Intensity of Water

Water treatment and delivery systems in California, including extraction of "raw water" supplies from natural sources, conveyance, treatment and distribution, end-use, and wastewater collection and treatment, account for one of the largest energy uses in the state.[1] The California Energy Commission estimated in its 2005 Integrated Energy Policy Report that approximately 19% of California's electricity is used for water related purposes including delivery, end-uses, and wastewater treatment.[2] The total energy embodied in a unit of water (that is, the amount of energy required to transport, treat, and process a given amount of water) varies with location, source, and use within the state. In many areas, the energy intensity may increase in the future due to limits on water resource extraction, and regulatory requirements for water quality, and other factors.[3] Technology improvements may offset this trend to some extent.

Energy intensity is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

The Water-Energy Nexus

Water and energy systems are interconnected in several important ways in California. Water systems both provide energy – through hydropower – and consume large amounts of energy, mainly through pumping. Critical elements of California's water infrastructure are highly energy-intensive. Moving large quantities of water long distances and over significant elevation gains, treating and distributing it within the state's communities and rural areas, using it for various purposes, and treating the resulting wastewater, accounts for one of the largest uses of electrical energy in the state.[4]

Improving the efficiency with which water is used provides an important opportunity to increase related energy efficiency. (*"Efficiency"* as used here describes the useful work or service provided by a given amount of water.) Significant potential economic as well as environmental benefits can be cost-effectively achieved in the energy sector through efficiency improvements in the state's water systems and through shifting to less energy intensive local sources. The California Public Utilities Commission is currently planning to include water efficiency improvements as a means of achieving energy efficiency benefits for the state.[5]

Overview of Energy Inputs to Water Systems

There are four principle energy elements in water systems:

1. primary water extraction and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)

4. wastewater collection, treatment, and discharge

Pumping water in each of these four stages is energy-intensive. Other important components of embedded energy in water include groundwater pumping, treatment and pressurization of water supply systems, treatment and thermal energy (heating and cooling) applications at the point of end-use, and wastewater pumping and treatment.[6]

1. Primary water extraction and supply delivery

Moving water from near sea-level in the Sacramento-San Joaquin Delta to the San Joaquin-Tulare Lake Basin, the Central Coast, and Southern California, and from the Colorado River to metropolitan Southern California, is highly energy intensive. Approximately 3,236 kWh is required to pump one acre-foot of SWP water to the end of the East Branch in Southern California, and 2,580 kWh for the West Branch. About 2,000 kWh is required to pump one acre foot of water through the CRA to southern California.[7] Groundwater pumping also requires significant amounts of energy depending on the depth of the source. (Data on groundwater is incomplete and difficult to obtain because California does not systematically manage groundwater resources.)

2. Treatment and distribution within service areas

Within local service areas, water is treated, pumped, and pressurized for distribution. Local conditions and sources determine both the treatment requirements and the energy required for pumping and pressurization.

3. On-site water pumping, treatment, and thermal inputs

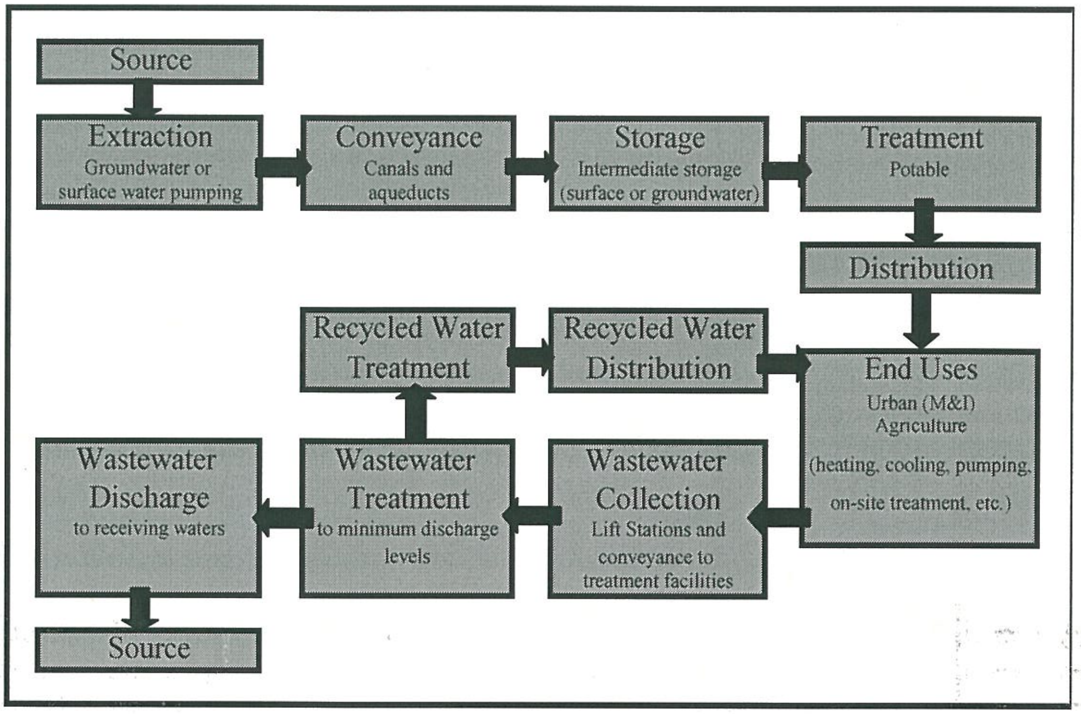
Individual water users use energy to further treat water supplies (e.g. softeners, filters, etc.), circulate and pressurize water supplies (e.g. building circulation pumps), and heat and cool water for various purposes.

4. Wastewater collection, treatment, and discharge

Finally, wastewater is collected and treated by a wastewater authority (unless a septic system or other alternative is being used). Wastewater is often pumped to treatment facilities where gravity flow is not possible, and standard treatment processes require energy for pumping, aeration, and other processes. (In cases where water is reclaimed and re-used, the calculation of total energy intensity is adjusted to account for wastewater as a *source* of water supply. The energy intensity generally includes the additional energy for treatment processes beyond the level required for wastewater discharge, plus distribution.)

The simplified flow chart below illustrates the steps in the water system process. A spreadsheet computer model is available to allow cumulative calculations of the energy inputs embedded at each stage of the process. This methodology is consistent with that applied by the California Energy Commission in its analysis of the energy intensity of water.

Simplified Flow Diagram of Energy Inputs to Water Systems



Source: Robert Wilkinson, UCSB[8]

Calculating Energy Intensity

Total energy intensity, or the amount of energy required to facilitate the use of a given amount of water in a specific location, may be calculated by accounting for the summing the energy requirements for the following factors:

- imported supplies
- local supplies
- regional distribution
- treatment
- local distribution
- on-site thermal (heating or cooling)
- on-site pumping
- wastewater collection
- wastewater treatment

Water pumping, and specifically the long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity as noted above. Water use (based on embedded energy) is the next largest consumer of electricity in a typical Southern California home after refrigerators and air conditioners. Electricity required to support water service in the typical home in Southern California is estimated at between 14% to 19% of total residential energy demand.[9] If air conditioning is not a factor the figure is even higher. Nearly three quarters of this energy demand is for pumping imported water.

Interbasin Transfers

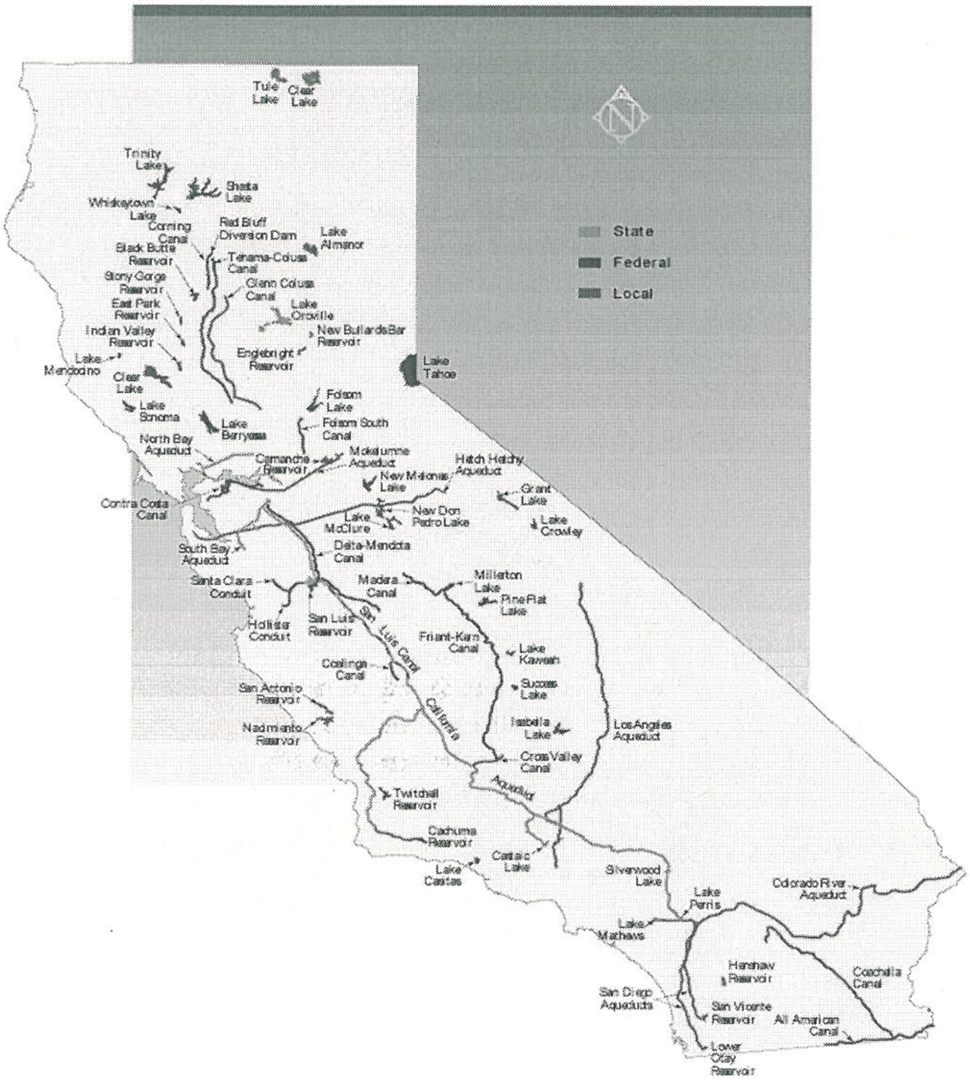
Some of California's water systems are uniquely energy-intensive, relative to national averages, due to the pumping requirements of major conveyance systems which move large volumes of water long distances and over thousands of feet in elevation lift. Some of the interbasin transfer systems (systems that move water from one watershed to another) are net energy producers, such as the San Francisco and Los Angeles aqueducts. Others, such as the SWP and the CRA require large amounts of electrical energy to convey water. On *average*, approximately 3,000 kWh is necessary to pump one AF of SWP water to southern California,[10] and 2,000 kWh is required to pump one AF of water through the CRA to southern California.[11]

Total energy savings for reducing the full embedded energy of *marginal* (e.g. imported) supplies of water used indoors in Southern California is estimated at about 3,500 kWh/af.[12] Conveyance over long distances and over mountain ranges accounts for this high marginal energy intensity. In addition to avoiding the energy and other costs of pumping additional water supplies, there are environmental benefits through reduced extractions from stressed ecosystems such as the delta.

Imported Water:
The State Water Project and the Colorado River Aqueduct

Water diversion, conveyance, and storage systems developed in California in the 20th century are remarkable engineering accomplishments. These water works move millions of AF of water around the state annually. The state's 1,200-plus reservoirs have a total storage capacity of more than 42.7 million acre feet (maf).[13] West Basin receives imported water from Northern California through the State Water Project and Colorado River water via the Colorado River Aqueduct. The Metropolitan Water District of Southern California delivers both of these imported water supplies to the West Basin.

California's Major Interbasin Water Projects



The State Water Project

The State Water Project (SWP) is a state-owned system. It was built and is managed by the California Department of Water Resources (DWR). The SWP provides supplemental water for agricultural and urban uses.[14] SWP facilities include 28 dams and reservoirs, 22 pumping and generating plants, and nearly 660 miles of aqueducts.[15] Lake Oroville on the Feather River, the project's largest storage facility, has a total capacity of about 3.5 maf.[16] Oroville Dam is the tallest and one of the largest earth-fill dams in the United States.[17]

Water is pumped out of the delta for the SWP at two locations. In the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay

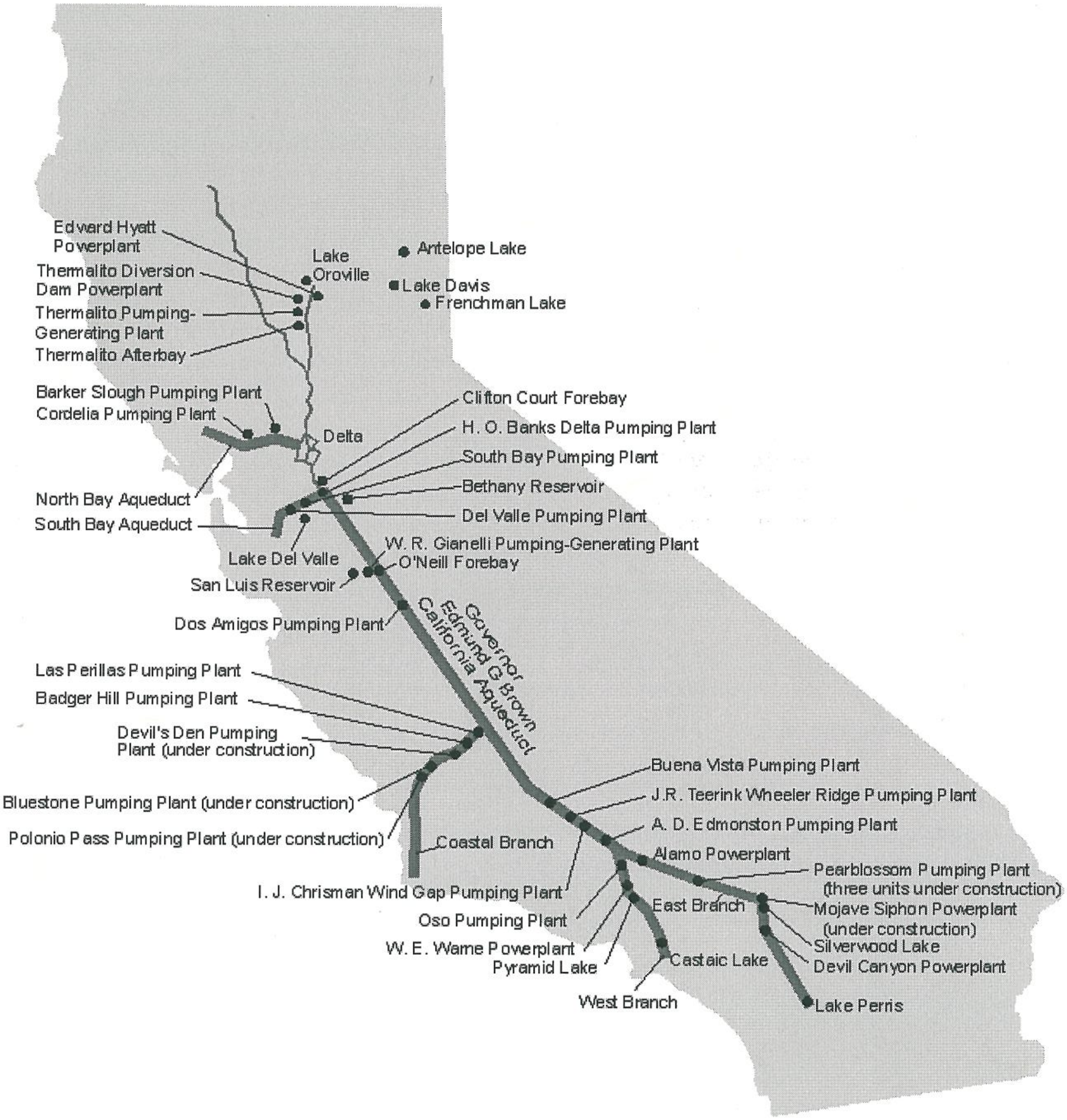
Aqueduct.[18] Further south at the Clifton Court Forebay, water is pumped into Bethany Reservoir by the Banks Pumping Plant. From Bethany Reservoir, the majority of the water is conveyed south in the 444-mile-long Governor Edmund G. Brown California Aqueduct to agricultural users in the San Joaquin Valley and to urban users in Southern California. The South Bay Pumping Plant also lifts water from the Bethany Reservoir into the South Bay Aqueduct. [19]

The State Water Project is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year.[20] The energy required to operate the SWP is provided by a combination of DWR's own hydroelectric and other generation plants and power purchased from other utilities. The project's eight hydroelectric power plants, including three pumping-generating plants, and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power.

Energy requirements would be considerably higher if the SWP was delivering full contract volumes of water. The project delivered an average of approximately 2.0 mafy, or half its contracted volumes, throughout the 1980s and 1990s.[21] Since 2000 the volumes of imported water have generally increased.

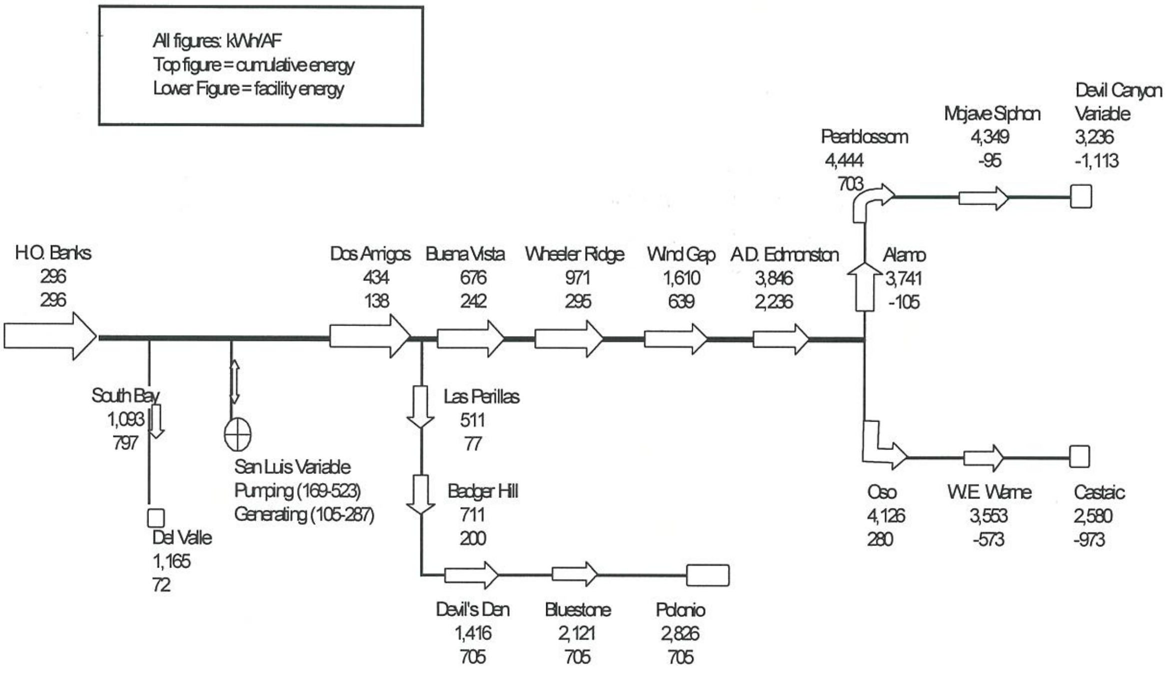
The following map indicates the location of the pumping and power generation facilities on the SWP.

Names and Locations of Primary State Water Delivery Facilities



The following schematic shows each individual pumping unit on the State Water Project, along with data for both the individual and cumulative energy required to deliver an AF of water to that point in the system. Note that the figures include energy recovery in the system, but they do not account for losses due to evaporation and other factors. These losses may be in the range of 5% or more. While more study of this issue is in order, it is important to observe that the energy intensity numbers are conservative (e.g. low) in that they assume that all of the water originally pumped from the delta reaches the ends of the system without loss.

State Water Project
Kilowatt-Hours per Acre Foot Pumped
(Includes Transmission Losses)



Source: Wilkinson, based on data from: California Department of Water Resources, State Water Project Analysis Office, Division of Operations and Maintenance, *Bulletin 132-97*, 4/25/97.

The Colorado River Aqueduct

Significant volumes of water are imported to the Los Angeles Basin and San Diego in Southern California from the Colorado River via the Colorado River Aqueduct (CRA). The aqueduct was built by the Metropolitan Water District of Southern California (MWD). Though MWD's allotment of the Colorado River water is 550,000 afy, it has historically extracted as much as 1.3 mafy through a combination of waste reduction arrangements with Imperial Irrigation District (IID) (adding about 106,000 afy) and by using "surplus" water.[22] The Colorado River water supplies require about 2,000 kWh/af for conveyance to the Los Angeles basin.

The Colorado River Aqueduct extends 242 miles from Lake Havasu on the Colorado River to its terminal reservoir, Lake Mathews, near Riverside. The CRA was completed in 1941 and expanded in 1961 to a capacity of more than 1 MAF per year. Five pumping plants lift the water 1,616 feet, over several mountain ranges, to southern California. To pump an average of 1.2 maf of water per year into the Los Angeles basin requires approximately 2,400 GWh of energy for the CRA's five pumping plants.[23] On average, the energy required to import Colorado River water is about 2,000 kWh/AF. The aqueduct was designed to carry a flow of 1,605 cfs (with the capacity for an additional 15%).

The sequence for CRA pumping is as follows: The Whitsett Pumping Plant elevates water from Lake Havasu 291 feet out of the Colorado River basin. At "mile 2," Gene pumping plant elevates water 303 feet to Iron Mountain pumping plant at mile 69, which then boosts the water another 144 feet. The last two pumping plants provide the highest lifts - Eagle Mountain, at mile 110, lifts the water 438 feet, and Hinds Pumping Plant, located at mile 126, lifts the water 441 feet.[24]

MWD has recently improved the system's energy efficiency. The average energy requirement for the CRA was reduced from approximately 2,100 kWh /af to about 2,000 kWh /af "through the increase in unit efficiencies provided through an energy efficiency program." The energy required to pump each acre foot of water through the CRA is essentially constant, regardless of the total annual volume of water pumped. This is due to the 8-pump design at each pumping plant. The average pumping energy efficiency does not vary with the number of pumps operated, and MWD states that the same 2,000 kWh/af estimate is appropriate for both the "Maximum Delivery Case" and the "Minimum Delivery Case."[25]

It appears that there are limited opportunities to shift pumping off of peak times on the CRA. Due to the relatively steep grade of the CRA, limited active water storage, and transit times between plants, the system does not generally lend itself to shifting pumping loads from on-peak to off-peak. Under the Minimum Delivery Case, the reduced annual water deliveries would not necessarily bring a reduction in annual peak load, since an 8-pump flow may still need to be maintained in certain months.

Electricity to run the CRA pumps is provided by power from hydroelectric projects on the Colorado River as well as off-peak power purchased from a number of utilities. The Metropolitan Water District has contractual hydroelectric rights on the Colorado River to "more than 20 percent of the firm energy and contingent capacity of the Hoover power plant and 50 percent of the energy and capacity of the Parker power plant."[26] Energy purchased from utilities makes up approximately 25 percent of the remaining energy needed to power the Colorado River Aqueduct.[27]

Minimizing the Need for Inter-Basin Transfers

For over 100 years, California has sought to transfer water from one watershed for use in another. The practice has caused a number of problems. As of 2001, California law requires that the state examine ways to "*minimize the need to import water from other hydrologic regions*" and report on these approaches in the official State Water Plan.[28] A new focus and priority has been placed on developing *local* water supply sources, including efficiency, reuse, recharge, and desalination. The law directs the Department of Water Resources as follows:[29]

> The department, as a part of the preparation of the department's Bulletin 160-03, shall include in the California Water Plan a report on the development of regional and local water projects within each hydrologic region of the state, as described in the department's Bulletin 160-98, to improve water supplies to meet municipal, agricultural, and environmental water needs and *minimize the need to import water from other hydrologic regions.*

(Note that Bulletin 160-03 became Bulletin 160-05 due to a slip in the completion schedule.)

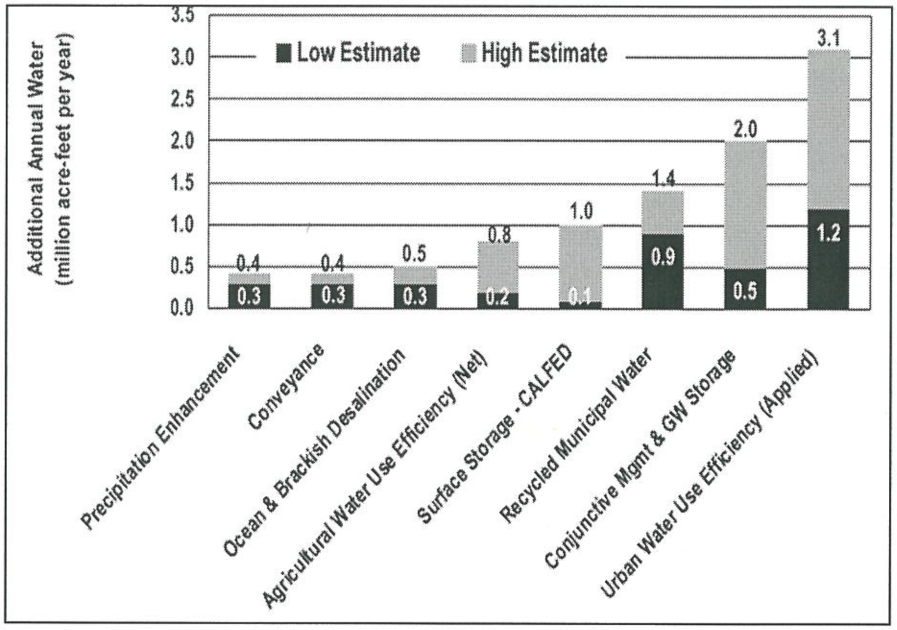
The legislation set forth the range of local supply options to be considered:

> The report shall include, but is not limited to, regional and local water projects that use technologies for desalting brackish groundwater and ocean water, reclaiming water for use within the community generating the water to be reclaimed, the construction of improved potable water treatment facilities so that water from sources determined to be unsuitable can be used, and the construction of dual water systems and brine lines, particularly in connection with new developments and when replacing water piping in developed or redeveloped areas.

This law calls for a thorough consideration in the state's official water planning process of work that is already going on in various areas of the state. The significance of the legislation is that for the first time, local supply development is designated as a priority in order to minimize inter-basin transfers.

The Department of Water Resources State Water Plan (Bulletin 160-05) reflects this new direction for the state in its projection of water supply options for the next quarter century. The following graph clearly indicates the importance of local water supplies from various sources in the future.

California State Water Plan 2005
Water Management and Supply Options for the Next 25 Years



Source: *California Water Plan Update 2005.*[30]

Energy Requirements for Treatment of State Water Project and the Colorado River Aqueduct Supplies

Imported SWP and CRA supplies require an estimated 44 kWh/af for treatment before it enters the local distribution systems. Water pressure from MWD's system is sufficient to move supplies through the West Basin distribution system without requiring additional pressure.

Groundwater and Recycled Water at West Basin MWD

Nearly half of the water used in the service area of the Metropolitan Water District of Southern California (from Ventura to Mexico) is secured from *local* sources, and the percentage of total supplies provided by local sources is growing steadily.[31] This figure is up from approximately one-third of the supply provided by local resources in the mid-1990s.[32] MWD has encouraged local supply development through support for recycling, groundwater recovery, conservation, groundwater storage, and most recently, ocean desalination.

Groundwater and recycled water are important and growing supply sources for West Basin. Water flows through natural hydrologic cycles continuously. The water we use today has made the journey many times. In water recycling programs, water is treated and re-used for various purposes including recharging groundwater aquifers. The treatment processes essentially short-circuit the longer-term process of natural evaporation and precipitation. In cities around the world water is used and then returned to natural water systems where it flows along to more users down stream. It is often used again and again before it flows to the ocean or to a terminal salt sink.

Groundwater at West Basin MWD

Groundwater reservoirs in West Basin are replenished with four water sources; natural recharge, SWP supplies, CRA supplies, and recycled water supplies. The largest portion (approximately 40%) of groundwater supplies is derived from natural recharge. The energy associated with recovering this naturally recharged supply is estimated at 350 kWh/af for groundwater pumping.

Imported water, from both the SWP and CRA, is injected into the groundwater supply in West Basin. The imported water remains at sufficient pressure for injection, so no additional energy is required. The energy requirements for importing water are significant, however, primarily due to the energy associated with importing the water from northern California and the Colorado River. The imported water also passes through MWD's treatment plant, incurring additional energy requirements. The total energy intensity for West Basin's imported water used for recharge of groundwater storage from the SWP is 3,394 kWh/af and from the CRA is 2,394 kWh/af.

Recycled water is also used to recharge groundwater in the basin. West Basin replenishes groundwater by injecting RO treated recycled water from the West Basin Water Recycling Facility (WBWRF). The total energy use is 1,565 kWh/af. Details for the recycled water energy are described in the next section.

Recycled Water at West Basin MWD

Many cities in California are using advanced processes and filtering technology to treat wastewater so it can be re-used for irrigation, industry, and other purposes. In response to increasing demands for water, limitations on imported water supplies, and the threat of drought, West Basin has developed state-of-the-art regional water recycling programs. Water is increasingly being used more than once within systems at both the end-use level and at the municipal level. This is because scarce water resources (and wastewater discharges) are increasing in cost and because cost-effective technologies and techniques for re-using water have been developed that meet health and safety requirements. At the end-use, water is recycled within processes such as cooling towers and industrial processes prior to entering the wastewater system. Once-through systems are increasingly being replaced by re-use technologies. At the municipal level, water re-use has become a significant source of supplies for both landscape irrigation and for commercial and industrial processes. MWD of Southern California is supporting 33 recycling programs in which treated wastewater is used for non-potable purposes. [33]

West Basin provides customers with recycled water used for municipal, commercial and industrial applications. Approximately 27,000 AF of recycled water is annually distributed to more than 210 sites in the South Bay. These sites use recycled water for a wide range of non-potable applications. Based in El Segundo, California, the WBWRF is among the largest projects of its kind in the nation, producing five qualities of recycled water with the capacity at full build-out to recycle 100,000 AF per year of wastewater from the Los Angeles Hyperion Treatment Plant.

In 1998, West Basin began to construct the nation's only regional high-purity water treatment facility, the Carson Regional Water Recycling Facility (CRWRF). A pipeline stretching through five South Bay communities connects the CRWRP to West Basin's El Segundo facility. At the CRWRF, West Basin ultra-purifies the recycled water it gets from the El Segundo facility. From the CRWRF, West Basin uses service lines to transport two types of purified water to the BP Refinery in Carson. The West Basin expansion also includes a new disposal pipeline to carry brine reject water from the CRWRF to a Los Angeles County Sanitation District's outfall.

In order to provide perspective on the energy requirements for the WBWRF, two water qualities and associated energy intensity are presented. "Title 22" water, produced by a gravity filter treatment system, requires conveyance pumping energy from Hyperion to WBWRF at 205 kWh/af. The water flows through the filters via gravity, thus no additional energy is required for treatment. The final energy requirement is 285 kWh/af for distribution with a total energy requirement of 490 kWh/af. This is the lowest grade of recycled water that WBWRF produces. Contrasting the Title 22 water, WBWRF produces RO water with a total energy requirement of 1,280 kWh/af. This includes 205 kWh/af for conveyance from Hyperion, 790 kWh/af for treatment with RO, and 285 kWh/af for distribution.

More than 210 South Bay sites use 9 billion gallons of West Basin's recycled water for applications including irrigation, industrial processes, indirect potable uses, and seawater barrier injection. West Basin has been successful in changing the perception of recycled water from merely a conservation tool with minimal applications to a cost-effective business tool that can reduce costs and improve reliability.

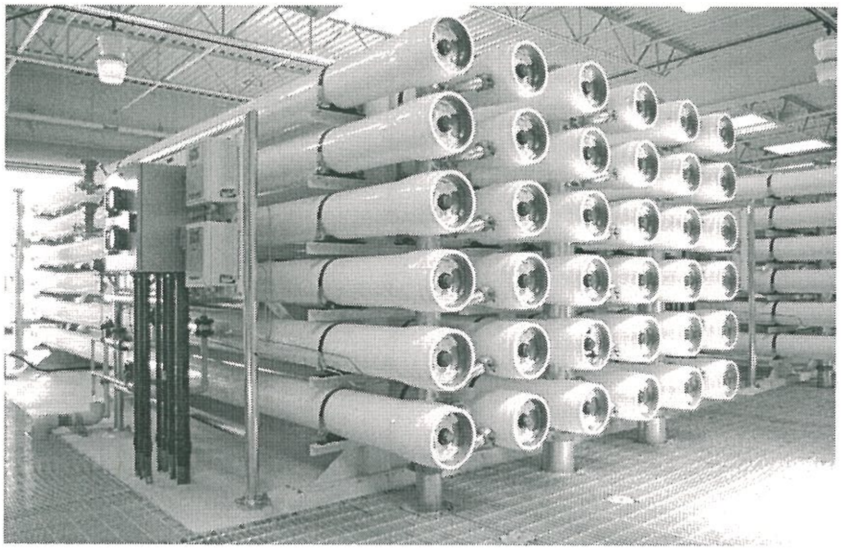
Local oil refineries are major customers for West Basin's recycled water. The Chevron Refinery in El Segundo, the Exxon-Mobile refinery in Torrance, and the BP refinery in Carson use recycled water for cooling towers and in the boiler feed systems.

Ocean Water Desalination Development

Desalination technologies are in use around the world. A number of approaches work well and produce high quality water. Many workable and proven technology options are available to remove salt from water. During World War Two, desalination technology was developed as a water source for military operations.[34] Grand plans for nuclear-driven desalination systems in California were drawn up after the war, but they were never implemented due to cost and feasibility problems.

Desalination techniques range from distillation to "reverse osmosis" (RO) technologies. Current applications around the world are dominated by the "multistage flash distillation" process (at about 44% of the world's applications), and RO, (at about 42%).[35] Other desalting technologies include electrodialysis (6%), vapor compression (4%), multi-effect distillation (4%), and membrane softening (2%) to remove salts.[36] All of the ocean desalination projects currently in place or proposed for municipal water supply in California employ RO technology.

Reverse Osmosis Membranes



A recent inventory of desalination facilities world-wide indicated that as of the beginning of 1998, a total of 12,451 desalting units with a total capacity of 6.72 afy[37] had been installed or contracted worldwide.[38] (Note that *capacity* does not indicate actual operation.) Non-seawater desalination plants have a capacity 7,620 af/d[39], whereas the seawater desalination plant capacity reached 10,781af/d.[40]

Desalination systems are being used in over 100 countries, but 10 countries are responsible for 75 percent of the capacity.[41] Almost half of the desalting capacity is used to desalt seawater in the Middle East and North Africa. Saudi Arabia ranks first in total capacity (about 24 percent of the world's capacity) followed by the United Arab Emirates and Kuwait, with most of the capacity being made up of seawater desalting units that use the distillation process.[42]

The salinity of ocean water varies, with the average generally exceeding 30 grams per liter (g/l).[43] The Pacific Ocean is 34-38 g/l, the Atlantic Ocean averages about 35 g/l, and the Persian Gulf is 45 g/l. Brackish water drops to 0.5 to 3.0 g/l.[44] Potable water salt levels should be below 0.5 g/l.

Reducing salt levels from over 30 g/l to 0.5 g/l and lower (drinking water standards) using existing technologies requires considerable amounts of energy, either for thermal processes or for the pressure to drive water through extremely fine filters such as RO, or for some combination of thermal and pressure processes. Recent improvements in energy efficiency have reduced the amount of thermal and pumping energy required for the various processes, but high energy intensity is still an issue. The energy required is in part a function of the degree of salinity and the temperature of the water.

West Basin is in the process of developing plans to construct an ocean desalinating plant. Estimated energy requirements have been calculated by Gerry Filteau of Separation Processes, Inc for each step in the process.[45] The values presented for desalination are based on his work. Since the proposed plant will tap the source water at the power plant, there is no ocean intake pumping required. The source water is estimated to require 200 kWh/af this energy will bring ocean water from the power plant to the desalination system, approximately one quarter of a mile in distance. Pre-treatment of the source water is estimated at 341 kWh/af. This figure includes microfiltration and transfer to the RO units via a 5-10 micron cartridge filter. The RO process requires 2,686 kWh/af if operated at the most energy-efficient level. A slightly less efficient but more cost-effective level of operation would require 2,900 kWh/af, or 214 kWh/af additional energy input according to Filteau. Finally, an estimated 460 kWh/af is required to deliver the product water to the distribution system, including elevation gain, conveyance over distance, and pressurization to 90 psi. No additional energy is required to discharge the brine, as it flows back to the ocean outfall line by gravity.

The energy intensity figures presented here for desalination are lower than previous estimates. This is mainly due to improved membrane technologies, efficiency improvements for high pressure pumps, and pressure recovery systems. It should be noted that the figures provided here are based on engineering estimates, not on actual plant operations.

The total energy required to desalinate the ocean water, including each of the steps above, is estimated to be 3,687 kWh/af. If the energy intensity is increased slightly to improve cost-effectiveness, the total figure increases to 3,901 kWh/af.

Summary

This study examined the energy intensity of imported and local water supplies (ocean water, groundwater, and recycled water) for both potable and non-potable uses for West Basin. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from varying pumping, treatment, and distribution processes needed to produce water to meet appropriate standards for different uses.

The key findings of this study are: 1) the marginal energy required to treat and deliver recycled water is among the *least* energy intensive supply options available, 2) naturally recharged groundwater is low in energy intensity, though replenishment with imported water is not, and 3) current ocean desalination technology is getting close to the level of energy intensity of imported supplies.

Further refinement of the data in this study, such as applying an agency's own energy values, may provide a more accurate basis for decision-making tailored to a unique water system. The information presented, however, provides a reasonable basis for water managers to explore energy (and cost) benefits of increased use of local water sources, and it indicates that desalination of ocean water is getting close to the energy intensity of existing supplies.

Sources

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[1] Water systems account for roughly 7% of California's electricity use: See Wilkinson, Robert C., 2000. Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[2] California Energy Commission, 2005. *Integrated Energy Policy Report*, November 2005, CEC-100-2005-007-CMF.

[3] Franklin Burton, in a recent study for the Electric Power Research Institute (EPRI), includes the following elements in water systems: "Water systems involve the transportation of water from its source(s) of treatment plants, storage facilities, and the customer. Currently, most of the electricity used is for pumping; comparatively little is used in treatment. For most surface sources, treatment is required consisting usually of chemical addition, coagulation and settling, followed by filtration and disinfection. In the case of groundwater (well) systems, the treatment may consist only of disinfection with chlorine. In the future, however, implementation of new drinking water regulations will increase the use of higher energy consuming processes, such as ozone and membrane filtration." Burton, Franklin L., 1996, *Water and Wastewater Industries: Characteristics and Energy Management Opportunities.* (Burton Engineering) Los Altos, CA, Report CR-106941, Electric Power Research Institute Report, p.3-1.

[4] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[5] California Public Utilities Commission, Order Instituting Rulemaking Regarding to Examine the Commission's post-2005 Energy Efficiency Policies, Programs, Evaluation, Measurement and Verification, and Related Issues, Rulemaking 06-04-010 (Filed April 13, 2006)

[6] An AF of water is the volume of water that would cover one acre to a depth of one foot. An AF equals 325,851 gallons, or 43,560 cubic feet, or 1233.65 cubic meters.

[7] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[8] This schematic, based on the original analysis by Wilkinson (2000) has been refined and improved with input from Gary Wolff, Gary Klein, William Kost, and others. It is the basic approach reflected in the CEC IEPR and other analyses.

[9] QEI, Inc., 1992, *Electricity Efficiency Through Water Efficiency*, Report for the Southern California Edison Company, p. 24.

[10] Figures cited are *net* energy requirements (gross energy for pumping minus energy recovered through generation).

[11] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[12] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[13] California Department of Finance. California Statistical Abstract. Tables G-2, "Gross Capacities of Reservoirs by Hydrographic Region," and G-3 "Major Dams and Reservoirs of California." January 2001. (http://www.dof.ca.gov/html/fs_data/stat-abs/toc.htm)

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[14] "The SWP, managed by the Department of Water Resources, is the largest state-built, multi-purpose water project in the country. Approximately 19 million of California's 32 million residents receive at least part of their water from the SWP. SWP water irrigates approximately 600,000 acres of farmland. The SWP was designed and built to deliver water, control floods, generate power, provide recreational opportunities, and enhance habitats for fish and wildlife." California Department of Water Resources, *Management of the California State Water Project.* Bulletin 132-96. p.xix.

[15] California Department of Water Resources, 1996, *Management of the California State Water Project.* Bulletin 132-96.p.xix.

[16] Three small reservoirs upstream of Lake Oroville — Lake Davis, Frenchman Lake, and Antelope Lake — are also SWP facilities. California Department of Water Resources, 1996, *Management of the California State Water Project.* Bulletin 132-96.

[17] California Department of Water Resources, 1996, *Management of the California State Water Project.* Bulletin 132-96. Power is generated at the Oroville Dam as water is released down the Feather River, which flows into the Sacramento River, through the Sacramento-San Joaquin Delta, and to the ocean through the San Francisco Bay.

[18] The North Bay Aqueduct was completed in 1988. (California Department of Water Resources, 1996, *Management of the California State Water Project.* Bulletin 132-96.)

[19] The South Bay Aqueduct provided initial deliveries for Alameda and Santa Clara counties in 1962 and has been fully operational since 1965. (California Department of Water Resources, 1996, *Management of the California State Water Project.* Bulletin 132-96.)

[20] Carrie Anderson, 1999, "Energy Use in the Supply, Use and Disposal of Water in California", Process Energy Group, Energy Efficiency Division, California Energy Commission, p.1.

[21] Average deliveries for 1980-89 were just under 2.0 mafy, deliveries for 1990-99 were just over 2.0 mafy. There is disagreement regarding the ability of the SWP to deliver the roughly 4.2 mafy that has been contracted for.

[22] According to MWD, "Metropolitan's annual dependable supply from the Colorado River is approximately 656,000 AF -- about 550,000 AF of entitlement and at least 106,000 AF obtained through a conservation program Metropolitan funds in the Imperial Irrigation District in the southeast corner of the state. However, Metropolitan has been allowed to take up to 1.3 maf of river water a year by diverting either surplus water or the unused portions of other agencies' apportionments." Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[23] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm.

[24] The five pumping plants each have nine pumps. The plants are designed for a maximum flow of 225 cubic feet per second (cfs). The CRA is designed to operate at full capacity with eight pumps in operation at each plant (1800 cfs). The ninth pump operates as a spare to facilitating maintenance, emergency operations, and repairs. Metropolitan Water District of Southern California, 1999, Colorado River Aqueduct: http://aqueduct.mwd.dst.ca.us/areas/desert.htm, 08/01/99.

[25] Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, p.5.

[26] Metropolitan Water District of Southern California, 1999, "Summary of Metropolitan's Power Operation". February, 1999, p.1, http://aqueduct.mwd.dst.ca.us/areas/desert.htm.

[27] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm. MWD provides further important system information as follows: Metropolitan owns and operates 305 miles of 230 kV transmission lines from the Mead Substation in southern Nevada. The transmission system is used to deliver power from Hoover and Parker to the CRA pumps. Additionally, Mead is the primary interconnection point for Metropolitan's economy energy purchases. Metropolitan's transmission system is interconnected with several utilities at multiple

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interconnection points. Metropolitan's CRA lies within Edison's control area. Resources for the load are contractually integrated with Edison's system pursuant to a Service and Interchange Agreement (Agreement), which terminates in 2017. Hoover and Parker resources provide spinning reserves and ramping capability, as well as peaking capacity and energy to Edison, thereby displacing higher cost alternative resources. Edison, in turn, provides Metropolitan with exchange energy, replacement capacity, supplemental power, dynamic control and use of Edison's transmission system.

[28] SB 672, Machado, 2001. California Water Plan: Urban Water Management Plans. (The law amended Section 10620 of, and adds Section 10013 to, the Water Code) September 2001.

[29] SEC. 2. Section 10013 to the Water Code, 10013. (a) SB 672, Machado. California Water Plan: Urban Water Management Plans. September 2001, (Emphasis added.)

[30] California Department of Water Resources, 2005. California Water Plan Update 2005. Bulletin 160-05, California Department of Water Resources, Sacramento, CA.

[31] Metropolitan Water District of Southern California, 2000. *The Regional Urban Water Management Plan for the Metropolitan Water District of Southern California*, p.A.2-3.

[32] "About 1.36 maf per year (34 percent) of the region's average supply is developed locally using groundwater basins and surface reservoirs and diversions to capture natural runoff." Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, Vol.1, p.1-2.

[33] MWD estimates that reclaimed water will ultimately produce 190,000 AF of water annually. Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[34] Buros notes that "American government, through creation and funding of the Office of Saline Water (OSW) in the early 1960s and its successor organizations like the Office of Water Research and echnology (OWRT), made one of the most concentrated efforts to develop the desalting industry. The American government actively funded research and development for over 30 years, spending about $300 million in the process. This money helped to provide much of the basic investigation of the different technologies for desalting sea and brackish waters." Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf

[35] Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf See also; Buros et al.1980. *The USAID Desalination Manual.* Produced by CH2M HILL International for the U.S. Agency for International Development.

[36] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5.

[37] Desalination systems with a unit size of 100 m3/d or more. Figures in original cited as 6,000 mgd.

[38] Wangnick Consulting GMBH (http://www.wangnick.com) maintains a permanent desalting plants inventory and publishes the results biennially in co-operation with the International Desalination Association, as the IDA Worldwide Desalting Plants Inventory Report. Thus far, fifteen reports have been published, with the latest report having data through the end of 1997; and see Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. The data cited are as of December 31, 1997.

[39] Cited in original as 9,400,000 m3/d.

[40] Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. (Cited in original in m3d (13,300,000 m3/d).

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[41] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts. The United States ranks second in over-all capacity (16 %) with most of the capacity in the RO process used to treat brackish water. The largest plant, at Yuma, Arizona, is not in use.

[42] Wangnick,Klaus.1998. *IDA Worldwide Desalting Plants Inventory Report No.15.* Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts.

[43] Salinity levels referenced in metric units.

[44] OTV. 1999. "Desalinating seawater." Memotechnique, Planete Technical Section, No. 31 (February), p.1; and Gleick, Peter H. 2000. *The World's Water: 2000-2001*, Island Press, Covelo, p.94.

[45] Gerry Filteau, Separation Processes, Inc., 2386 Faraday Ave., Suite 100, Calsbad, CA 92008, www.spi-engineering.com

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EPA

Water Conservation: Customer Behavior and Effective Communications

Subject Area: Management and Customer Relations

Water Conservation: Customer Behavior and Effective Communications

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About the Water Research Foundation

The Water Research Foundation (formerly Awwa Research Foundation or AwwaRF) is a member-supported, international, 501(c)3 nonprofit organization that sponsors research to enable water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to consumers.

The Foundation's mission is to advance the science of water to improve the quality of life. To achieve this mission, the Foundation sponsors studies on all aspects of drinking water, including resources, treatment, distribution, and health effects. Funding for research is provided primarily by subscription payments from close to 1,000 water utilities, consulting firms, and manufacturers in North America and abroad. Additional funding comes from collaborative partnerships with other national and international organizations and the U.S. federal government, allowing for resources to be leveraged, expertise to be shared, and broad-based knowledge to be developed and disseminated.

From its headquarters in Denver, Colorado, the Foundation's staff directs and supports the efforts of more than 800 volunteers who serve on the board of trustees and various committees. These volunteers represent many facets of the water industry, and contribute their expertise to select and monitor research studies that benefit the entire drinking water community.

The results of research are disseminated through a number of channels, including reports, the Web site, Webcasts, conferences, and periodicals.

For its subscribers, the Foundation serves as a cooperative program in which water suppliers unite to pool their resources. By applying Foundation research findings, these water suppliers can save substantial costs and stay on the leading edge of drinking water science and technology. Since its inception, the Foundation has supplied the water community with more than $460 million in applied research value.

More information about the Foundation and how to become a subscriber is available on the Web at **www.WaterResearchFoundation.org**.

Water Conservation: Customer Behavior and Effective Communications

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FOREWORD

The Water Research Foundation (Foundation) is a nonprofit corporation dedicated to the implementation of a research effort to help utilities respond to regulatory requirements and traditional high-priority concerns of the industry. The research agenda is developed through a process of consultation with subscribers and drinking water professionals. Under the umbrella of a Strategic Research Plan, the Research Advisory Council prioritizes the suggested projects based upon current and future needs, applicability, and past work; the recommendations are forwarded to the Board of Trustees for final selection. The Foundation also sponsors research projects through the unsolicited proposal process; the Collaborative Research, Research Applications, and Tailored Collaboration programs; and various joint research efforts with organizations such as the United States Environmental Protection Agency, the United States Bureau of Reclamation, and the Association of California Water Agencies.

This publication is a result of one of these sponsored studies, and it is hoped that its findings will be applied in communities throughout the world. The following report serves not only as a means of communicating the results of the water industry's centralized research program but also as a tool to enlist the further support of the nonmember utilities and individuals.

Projects are managed closely from their inception to the final report by the Foundation's staff and a cadre of volunteers who willingly contribute their time and expertise. The Foundation serves a planning and management function, and awards contracts to other institutions such as water utilities, universities, and engineering firms. The funding for this research effort comes primarily from the Subscription Program, through which water utilities subscribe to the research program and make an annual payment proportionate to the volume of water they deliver and consultants and manufacturers subscribe based on their annual billings. The program offers a cost-effective and fair method for funding research in the public interest.

A broad spectrum of water supply issues is addressed by the Foundation’s research agenda: resources, treatment and operations, distribution and storage, water quality and analysis, toxicology, economics, and management. The ultimate purpose of the coordinated effort is to assist water suppliers to provide the highest possible quality of water economically and reliably. The true benefits are realized when the results are implemented at the utility level. The foundation's trustees are pleased to offer this publication as a contribution toward that end.

Roy Wolfe, Ph.D.
Chair, Board of Trustees
Water Research Foundation

Robert C. Renner, P.E.
Executive Director
Water Research Foundation

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Evaluating communication campaigns requires large data collection efforts. Our partners made this possible for our project. In particular, the City of Durham Department of Water Management, City of Phoenix Water Services Department, City of Tempe Water Utilities Department, JEA – Jacksonville, Fla., Orange County Utilities Water Division, and Seattle Public Utilities worked with us to survey more than 6,000 customers. We thank each of the contacts at our partner utilities:

- Vicki Westbrook and James Lim of the City of Durham Department of Water Management
- Mary Lu Nunley and Brandy Kelso of the City of Phoenix Water Services Department
- Pete Smith of the City of Tempe Water Utilities Department
- Bruce Doueck of JEA – Jacksonville, Fla.
- Jacqueline Torbert of Orange County Utilities Water Division
- Al Dietemann of Seattle Public Utilities

We also thank Nancy Stalker and Margaret Beeston, who provided insights on lessons learned from the City of Calgary.

The comments and insights from our Project Advisory Committee (PAC) provided focused direction for the project and were much appreciated. We were fortunate to have the support of several AWWARF project managers, including India Williams, Shonnie Cline, and Susan Turnquist. The commitment of our project managers and our PAC members, Elizabeth Gardener, Mitch Basefsky, and Karen Snyder, is noteworthy and much appreciated by the project team.

ICF International led and managed this project with assistance from Aquacraft, Inc. ICF International researchers included Tony Silva, Diana Pape, and Ronald Szoc. Peter Mayer and Matt Hayden of Aquacraft, Inc., provided historical data on water use and conducted the statistical analysis of the survey results and the billing date. We are grateful to Peter Mayer for having archived the billing data from the 1990s and made it available for this study. The staff from ICF International and Aquacraft, Inc. are the primary authors of this report. Erin Caldwell from National Research Center, Inc., created the mailing lists, sent the postcard notifications, and implemented the survey. We thank Erin for her diligence in tracking responses and assisting with follow up mailings to our water utility partners’ customers.

EXECUTIVE SUMMARY

"When the well's dry, we know the worth of water."
─ Benjamin Franklin, *Poor Richard's Almanac*

Since the beginning of human civilization, communicating the concept and value of wise water usage, conservation, and efficiency has been a common endeavor. In the modern era, water utilities have often taken on the responsibility of informing and educating customers about the need and importance of wise water use and stewardship. Today, water providers regularly implement sophisticated education and marketing campaigns to promote water use efficiency and conservation behaviors, but little is known about the specific, measurable impacts of these efforts or what constitutes a successful program.

The process of communicating with the public in an effort to change people's behaviors for the benefit of an individual, group, or community is commonly known as social marketing. Water conservation social marketing campaigns are intended to educate customers about the importance and value of water, to encourage behaviors and practices that diminish water waste, and to reduce demands for the benefit of the individual customer and the community. Water conservation communication campaigns may promote a range of conservation behaviors–from installing more water-efficient fixtures to changing consumption habits, such as turning off the faucet while brushing teeth.

Water use patterns differ by region and customer, but the categories of end uses (toilet flushing, bathing, washing clothes, food preparation, landscape irrigation, etc.) are remarkably consistent across the country. Consequently, the conservation behaviors promoted by water utilities are often similar (e.g., replacing inefficient toilets, improving irrigation efficiency, and eliminating single-pass cooling). A key difference lies in the delivery channels and messages by which utilities promote water conservation. Utility sponsored water conservation campaigns leverage a variety of delivery channels, including bill stuffers, print and broadcast media, the internet, and outdoor advertising such as billboards or transit advertising.

What are the impacts of water conservation communication campaigns in terms of customer recognition, attitudinal changes, behavior modification, and verifiable water use reductions? What are the most effective methods and techniques for designing and implementing water conservation social marketing campaigns? This research study, Water Conservation: Customer Behavior and Effective Communications, seeks to answer these and other critical questions in an effort to help water providers improve the design and implementation of water conservation social marketing campaigns.

RESEARCH OBJECTIVES

The objective of this research study was to evaluate the linkages and relationships between the water conservation behavior of residential customers[1] and the communication approaches that seek to influence that behavior. The research team implemented this evaluation through a multi-method approach including: telephone interviews with water agency personnel,

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[1] Non-residential customers are important end users of water as well, but as most utility social marketing campaigns are targeted at the residential sector, this sector was the chosen emphasis of this study.

surveys of residential water customers, analyses of current and past billing records supplied by water agency partners, in-depth case studies of water agencies and their water conservation communication campaigns, and an evaluation of communication methods implemented by the six participating utilities. This study leveraged previous research, in particular AWWARF's Residential End Uses of Water Study (Mayer, et. al., 1999) as well as the knowledge gained from existing social marketing programs implemented in Durham, N.C.; Phoenix, and Tempe, Ariz.; Jacksonville and Orange County, Fla.; and Seattle, Wash.

The three primary research objectives were to:

- investigate through empirical research and literature review the relationships among the water conservation behaviors of customers, demographics and other factors, and effective communication that influence behavior;
- establish communication guidelines that water agencies can use to design effective, integrated communication approaches aimed at influencing water conservation behavior; and
- provide reference data and methods for evaluating the success of water conservation social marketing efforts.

This report also outlines key social marketing principles and explains how they can be applied in the water utility and conservation context. The literature review synthesizes information on the current knowledge concerning conservation communication and social marketing efforts. The review includes examples from the energy efficiency field in North America and resource conservation in general from around the globe.

This report presents a time-and-place view of conservation communication efforts in a number of water agencies in North America. Samples obtained from participating agencies were selected to be statistically representative of the customers in each service area and analysis on the pooled data set was performed. The researchers sought to include information and data from a diverse group of providers, but the results *should not* be interpreted as being statistically representative of all North American locations. Rather, the results from this research provide examples and guidance for water providers seeking to implement effective water conservation education and social marketing campaigns that resonate with customers and produce tangible water savings.

The report will assist water utilities in designing and implementing social marketing campaigns through three mechanisms: (1) sharing of informational resources on social marketing; (2) sharing lessons learned from other water utilities; and (3) sharing research on linkages between demographics and effective communications for use in designing targeted communications campaigns, in particular when budgets are limited.

APPROACH

A detailed and rigorous workplan to research conservation communication strategies and obtain data from each participating study site was developed by the project team. An in-depth literature review was the first task of the workplan to be implemented. The following data were collected from each of the six participating water agencies:

- interview with agency conservation staff
- detailed information about water conservation communication, education, and marketing efforts including examples of materials
- historic billing records from a systematic random sample of approximately 1,000 single-family detached residential accounts in each agency (6,051 in total)
- survey response data from 1,890 households (35.3% response rate)

Literature Review

The literature review served as an important foundation for all other tasks. The information collected and synthesized in the review influenced the direction and scope for subsequent components of the project. The subtasks for the literature review included:

- an examination of the state of knowledge regarding residential water use and the impact of conservation programs, and
- a review of the range of resource conservation communication strategies and tools put into practice.

Participating Water Agencies

During the proposal process, the research team contacted a number of water utilities that have implemented a significant water conservation communication campaign to solicit participation in the research project. Seven utility partners were included in the study. For six of the partners, a full case study was developed including analysis of historic water billing records, mail survey of customers, and evaluation of conservation communication program impacts. The seventh agency served in an advisory role. The participating utilities for this study were:

- City of Durham, North Carolina
- City of Phoenix Water Services Department, Arizona
- City of Tempe Water Utilities, Arizona
- JEA, Jacksonville, Florida
- Orange County Utilities, Florida
- Seattle Public Utilities, Seattle, Washington
- City of Calgary Water Services, Alberta, Canada (advisory agency)

Utility Interviews

To begin the process of evaluating conservation communication program efforts and developing detailed case studies, an interview was conducted with conservation staff members from each of the six primary participating water utilities. The research team developed a detailed utility interview protocol that sought information about past and current water conservation program activities as well as data about the utility itself. The following sections were included in the utility survey instrument:

- past experience and current responsibilities of utility conservation staff
- information about current conservation efforts with particular emphasis on communication and education programs
- characteristics of conservation program communications
- impact of program communications (if available)
- program metrics
- program outcomes
- lessons learned

The utility interview protocol contained 43 questions as well as a matrix completed by the interviewer summarizing the salient characteristics of the water conservation programs carried out by the utility. The following characteristics were included in the matrix:

- geopolitical factors
- demographics
- housing factors
- target audience for conservation programs
- size of target audience
- family factors
- message(s)
- media channels,
- type of outreach materials
- financial incentives
- outcomes
- estimated cost of program implementation

A copy of the complete utility partner interview protocol can be found in Appendix B.

Sampling and Billing Data

A systematic random-sampling approach was used to select a representative sample of approximately 1,000 single-family detached residential customers at each of the participating water utilities. The average annual water use of the sample was compared against the average annual water use of the population of single-family customers at each study site to ensure each sample was representative.

The participating agencies supplied available historic water consumption data for each customer in the sample. Some agencies were able to provide the five most recent years of consumption data. Others had only limited access to their consumption data and were only able to provide one or two years of historic data.

Customer Survey

The research team developed a detailed customer survey instrument, customized for each of the six participating water agencies. About half of the survey questions were the same across all six study sites and half were customized questions seeking customer response to specific conservation messaging campaigns in each agency. The survey instruments were circulated to the project advisory committee (PAC) and the utility partners in draft form. The instruments were modified and circulated again. This process continued until no additional changes were desired. Sample survey instruments are provided in Appendix C.

To maximize response rate, the research team employed a five-step survey administration process. Surveys were sent out to all 6,051 customers for which historic billing data were provided and an overall response rate of 35.3% was achieved. The five survey steps were:

1. A letter of introduction was mailed on utility stationary.
2. Within one week, a complete survey packet was mailed to the residential customers.
3. Two weeks after the initial mailing, a reminder postcard was mailed to the customers asking them to respond to the survey if they had not done so already.
4. After an additional two weeks, a second complete survey packet was mailed to all selected customers, asking customers to complete the questionnaire using the supplied materials.
5. Two weeks after the second survey packet was mailed, another reminder postcard was mailed asking customers to respond if they had not yet done so.

Copies of all the letters and postcards can be found in Appendix D.

Data Analysis

Data obtained from each of the mail surveys was linked with the historic billing data from the same household. This dataset was used to analyze survey results, examine the factors that significantly influence residential water use and evaluate communication strategies, and determine if the conservation communication strategies implemented by the six participating agencies had influenced demand.

The results obtained in this research were often analyzed against comparable results from the *Residential End Uses of Water* study (Mayer, et. al., 1999) as this provides a solid benchmark for evaluating differences in attitudes and water use patterns. In many instances, results from the data set developed for this behavior change study align closely with the results from the *Residential End Uses of Water* study (REUWS). The consistency of the findings suggests that the samples utilized in this study are reasonable and representative of single-family demand across the continent. The consistency also suggests that average water use patterns have not changed substantially over the past 10 years in the cities surveyed – an important finding in itself.

Research Findings

A summary of the key research findings from this study is presented below. For a more complete interpretation of these results, please read the Conclusions and Recommendations chapter of this report.

Literature Review: Key Principles of Social Marketing. Water utilities across North America have shown significant interest in social marketing as a useful approach for conservation programs. Marketing experts have promoted broad-based media communications campaigns as “the best way to hasten behavior change” and as “a cost-efficient way to reach the broadest audience” (Hoffman 2006). Prepackaged marketing programs such as *Water – Use It Wisely* (developed by Park and Co.) have been implemented in States ranging from California and Arizona to North Carolina. Programs such as *Water IQ* in Texas and the *Seattle 1% Program* represent substantial efforts to enlist social marketing principles in the search for water savings. Several of these programs were studied as part of this project.

The social marketer's job is complete when a behavior is performed consistently by the target audience. Although complete adoption of a behavior is ideal, it is not realistic. Therefore, social marketers must plan, evaluate, and refine their approaches and clearly identify measurable outcomes and performance measures.

Traditional commercial marketers often refer to the marketer's toolbox or the 4P's: product, price, place, and promotion. The 4P's are important because they remind social marketers that any marketing effort must apply a customer orientation to their strategy and message development. Following are descriptions of each tool within the context of social marketing:

Product. In the context of water conservation, one might think of "product" (i.e., what is being sold) as an idea and a set of actions (e.g., to conserve water and achieve a sustainable, healthy water supply). (Kotler and Lee 2007) Others see the "product" in this context as the programs and services offered by the utility to reach water conservation goals.

Price. "Price," in the context of social marketing, should be understood as the perceived costs of adopting the desired behavior (entry costs) and of abandoning the current behavior (exit costs). (Kotler et al. 2002) For water utility customers, the price of behavior change may be described as follows:

- paying the cost for replacing a toilet that still has useful life remaining
- changing the time of day when watering the lawn
- turning off the faucet when brushing one's teeth

Consumers usually are more responsive to making small, easily doable and maintainable changes. Focusing on one or two changes at a time is important in social marketing.

Place. In the context of water utilities, place is most likely the customer's home where the behavior change will take place or, in the commercial setting, the office or business locations where the behavior changes will take place. Place also may be related to where the utility's services and products are accessed.

Promotion. The term "promotion" refers to the manner in which the product (behavior change) will be communicated. Promotion may include bill stuffers, mass media advertising, public relations, or editorial content and even sales promotions with local retailers. Promotion means communicating messages using the most appropriate mix of media vehicles to reach the target audience.

Literature Review: Commitment, Norms, and Prompts: Tools for Social Change. Social marketing researcher and author Doug McKenzie-Mohr has identified a number of tools that can make social marketing efforts effective – the idea of commitment, norms, and prompts. McKenzie-Mohr developed an approach to social marketing called "community-based social marketing" (CBSM) that includes its own fundamental principles and concepts. CBSM has caught the attention of water conservation professionals and has been implemented in a number of utilities with favorable results (e.g., Region of Durham Canada, Los Angeles).

The following outlines several of the key concepts from CBSM (McKenzie-Mohr and Smith 1999):

- *Commitment.* Social marketing research has shown that people who make a nominal commitment to a cause (e.g., by wearing a button or signing a petition) are more likely to respond favorably to requests to adopt behaviors that support that cause than those who have not made such a commitment. Water utilities should consider obtaining a commitment to water conservation through a pledge campaign or community network. In doing so, utilities will establish a core group of individuals and businesses that see themselves as water conservation advocates and who are more likely to make changes in usage behaviors when asked to do so.
- *Norms.* Water utilities should seek to establish a water conservation ethic, or norm, that fosters desired behaviors.
- *Prompts.* People are more likely to take actions that are top-of-mind and that appeal to them personally. Water utilities should consider using prompts, or reminders, in their marketing campaigns to motivate behavior changes. Examples could include giveaways at festivals or events that will prompt people to change their behaviors.

In their 2007 book, *Marketing in the Public Sector*, Kotler and Lee present 12 key social marketing techniques that they believe will create the foundation for a successful social marketing campaign.

1. Take advantage of prior and existing successful campaigns.
2. Start with target markets most ready for action.
3. Promote single, simple, doable behaviors – one at a time.
4. Identify and remove barriers to behavior change.
5. Bring real benefits into the present.
6. Highlight costs of competing behaviors.
7. Promote a tangible object or service to help target audiences perform the behavior.
8. Consider non-monetary incentives in the form or recognition and appreciation.
9. Have a little fun with messages.
10. Use media channels at the point of decision making.
11. Get commitments and pledges.[2]
12. Use prompts for sustainability.

Marketing Water Conservation. Ideally, water conservation programs need a communications and marketing component. Every water conservation program must include some effort to communicate with the targeted audience. Some of the participating agencies in this project utilized (knowingly or unknowingly) a number of the principles described above in the marketing campaign studied by the researchers. The research results presented below document the measurable impacts of marketing efforts in these communities, given the limitations of the data set available. In a few cases, the research team was able to directly connect a particular conservation message with lower water use in customers familiar with the message. In most cases, such a connection was not possible to discern. While the results were often ambiguous, this research opens the door for further consideration of the importance of social marketing programs and techniques in the implementation of successful water conservation programs.

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[2] This element is discussed in greater detail in the section of this report focused on commitment, norms, and prompts.

Survey Results – Demographic Questions. The intent of this study was to survey detached single-family residential properties exclusively. The sample of customers to be surveyed, provided by the participating utilities, was screened to include only these customers. However, database records are imperfect. While 93% of the respondents lived in a single-family home (as intended for this study) the remaining 7% live in a townhouse, multi-family apartment, mobile home, duplex, or other similar dwelling. Respondents who reported living in something other than a single-family home were not excluded from subsequent analysis.

Most of the survey respondents (95%) own the home they live in. Only 5% of respondents indicated they rent their home and less than 1% did not know. Nearly three-quarters of the survey respondents (72%) reported living at the current address for seven or more years and another 19% reported living at the current address for 3 to 7 years. About 6% reported living at this address for between 1 to 3 years and only 2% had been at the current address less than one year.

The homes of the survey respondents were largely built prior to 1994 when the Federal plumbing code changed through the Energy Policy Act (EPAct) of 1992, which required more water-efficient toilets, showerheads, and faucets to be manufactured. The average home in this study was built in 1974 (using midpoints from question 19), and more than 25% of the homes were built prior to 1960.

The average home in this study had 2.20 bathrooms and 2.4 people per household year-round. Household income averaged $84,562 among survey respondents. The median household income in the US in 2006 was $48,000 according to the US Census Bureau. The median is of course different from the average. It is not possible to compute a precise median value from the survey data obtained in this study, but the median would fall at the upper end of the $50,000 to $74,999 category, a little below the average. The income data collected here proved a useful explanatory variable for water use.

Survey Results – Water, Conservation, and Environmental Questions. The primary purpose of the residential customer water survey was to determine attitudes and opinions about water, water use, water conservation messaging efforts, and general environmental concerns. A total of nine such questions were common across all six surveys. A summary of the results from this category of questions is presented here.

Water supply and demand stood alone as the biggest environmental concern among survey respondents. In this study, 88% of respondents agreed or strongly agreed with the statement, “Water is precious and in great demand for many uses.” Only 4% disagreed or strongly disagreed.

Air pollution and residential growth impacting water supplies were the second and third biggest concerns of survey respondents, with more than 80% agreeing with the statements. Other areas of high concern to respondents were:

- industrial pollution,
- lack of recycling,
- loss of fish and aquatic habitat,
- commercial growth,
- urban development,
- depletion of fossil fuels,
- climate change, and
- destruction of the ozone layer.

More than 70% of respondents agreed or strongly agreed with the statements on these issues.

The lowest-ranked environmental issue stated, “the quality of water is getting worse.” Only 45% of respondents agreed with this statement, 34% had no opinion, and 22% disagreed.

Water supply managers were cited as the most credible source for water conservation information with 92% of respondents calling them at least “somewhat credible”. In contrast, sales associates at home improvement stores were cited as the least credible source, with only 55% finding them at least “somewhat credible”. In general, respondents found those with a financial interest in a conservation product or service (plumbers, manufacturers, contractors, sales associates) to be less credible than sources such as water supply managers, professors, and family. The exceptions were landscapers or nurseries, which ranked more highly on water conservation credibility.

Which water conservation behaviors are practiced most frequently? In general, respondents reported practicing all of the conservation measures at least some of the time. A maximum of only 14% of respondents said they rarely or never practice any of the specific measures. The results suggest that most people believe they regularly practice water efficiency measures. Whether true or not, it does suggest a high level of awareness about conservation practices and a concerted attempt to integrate conservation practices into everyday life.

Using a garbage can rather than the toilet to dispose of trash was the most frequently practiced water conservation behavior practiced “most” or “all of the time” by 94% of respondents. In this study, 90% of respondents reported avoiding the heat of the day for watering most or all of the time and another 88% said they don’t irrigate when it is raining. Running the dishwasher and clothes washer only when full ranked highly as well.

The three conservation activities that respondents practiced least often were: water-wise landscaping techniques (50% – most or all the time, which is still quite high); a jug of water in the refrigerator (63% – most or all of the time); and tracking usage via monthly water bill (64% most or all of the time).

Which water conservation actions have been most frequently taken during the past year? Repairing leaking faucets and/or toilets was the most frequently taken action with 58% of respondents indicating that they had done this within the past year. The next most popular action taken was changing the “lawn watering schedule,” but only 37% of the respondents indicated doing this during the past year. 30% responded that they installed a “water-saving” showerhead in the past year, and 30% reported stopping irrigation of some or all of an existing lawn, possibly due to drought conditions.

One in five respondents (20%) reported installing an efficient clothes washer during the past year. Clothes washers have a expected useful life of 14 years, so it is anticipated that a little over 7% of the public will replace their clothes washer per year. This is much lower than the 20% replacement rate found in the survey group. The respondents appear to be installing new clothes washers at more than double the expected rate, perhaps due to incentive programs or to the anticipated water and energy savings associated with installing a new washing machine.

One in four respondents (25%) reported replacing a toilet or installing a toilet displacement device during the past year. Nearly one in five (19%) reported installing water efficient faucet aerators during the past year. Both of these reported installation rates exceed the expected natural replacement rate for these fixtures.

Only 10% of respondents have *ever* participated in a utility rebate program, so the increased installation rate for clothes washers, dishwashers, and toilet devices found in the survey is not likely due to utility-sponsored rebate programs. However, 13% of respondents said their utility offered a program that but they did not participate. A full 61% said they would have participated in a rebate program if one had been available.

These results suggest that rebate programs are useful but not always necessary to achieve a higher than expected installation rate of efficient fixtures. Many customers are installing efficient fixtures without a rebate incentive. Furthermore, if a rebate were available, these customers might well have taken advantage of the offering to get money back for an action they would have taken any way. This is commonly referred to as "free-ridership," and has been shown to be a real issue for many utility rebate programs (Whitcomb 2003).

Why do people take action to conserve water? Question 12 on the survey asked customer to select reasons why they took deliberate steps to conserve water sometimes or all the time. Three reasons stood out as the most important in influencing conservation steps: (1) saving money – 78%; (2) it is the right thing to do – 76%; and (3) concern about water availability – 75%.

About half of the respondents' conservation actions were brought about or prompted by drought (57%), climate change (53%), environmental impacts (50%), and drought restrictions (44%).

Water bill inserts (18%), TV shows (13%), peer pressure (2%), and utility workshops (1%), were at the bottom of the list for respondents in terms of supporting conservation steps. The rating of peer pressure as a motivating factor is interesting because other studies have found that peer pressure "...works better than trying to appeal to people's sense of social responsibility, desire to save money or even their hope of safeguarding the earth for the future generations."[3]

Drought can be a powerful motivator for water conservation activities. Question 14 on the customer mail survey asked respondents if drought is experienced, is water-use behavior changed and why. Most respondents (45%) reported changing their behavior, "because it is the right thing to do". Another 31% reported changing their behavior during drought because of governmental mandate (e.g., water-use restrictions). Another 11% reported conserving water above and beyond locally mandated drought restrictions, while 8% responded that their region has not experienced droughts. Only 3% of respondents indicated that "do not think about it".

Question 15 asked, "What would be the most effective way to reach you with information about water conservation that you will use?" Utility bill inserts about water conservation (68%) and TV ads demonstrating water conservation tips (55%) were the two most frequently chosen information delivery methods, followed by newspaper ads (35%), radio ads (26%), TV demos (25%) magazine articles (24%), the Weather Channel (23%), demonstrations (21%) and billboards (21%). Bill inserts are often criticized as an ineffective way to reach people, yet in this survey it was by far the most preferred method for receiving water conservation information.

The lowest-rated methods for delivering conservation information were irrigation contractors (4%), university extension services (4%), utility sponsored classes and workshops (4%), public meetings (5%), and plumbers (6%). Personal contact with a utility representative was selected by 7%.

The Internet received mixed reviews in this survey. Utility web sites (13%) are frequently used to provide conservation information, but apparently customers do not view this as a particularly effective communication method. E-mailed information also received a 13% response. These results should be of interest to utilities that strive to communicate conservation messages regularly to customers.

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[3] Quoted in Classen, Neal (2007). Peer Pressure: Conserving Water Because Everyone is Doing It, *Watermark Magazine*, Winter.

Water Use Comparison. The average annual single-family water use across all six study sites was 145.4 kgal per year and the median was 105.0 kgal per year. The standard deviation was 161.4 kgal. For comparison, the average annual single-family water use (from billing data) from 12,055 homes in the Residential End Uses of Water study (REUWS) was 146.1 kgal per year and the median was 123.3 kgal per year. Results are shown below in Table ES.1 and in Figure ES.1:

Table ES.1
Average annual water use and sample size – six study sites

		Total annual water use from billing records		
Site Location	Sample Size*	Mean** (kgal)	Median (kgal)	Std. Dev. (kgal)
All Sites	5,223	135.5	99.0	149.3
Tempe	1082	190.8	155.2	231.2
Durham	952	53.2	47.9	29.5
Phoenix	966	159.5	125.7	139.7
JEA	969	148.8	114.4	122.0
Orange County	969	141.8	111.5	109.6
Seattle	282	52.9	43.4	39.2

*Samples drawn from the population of single-family accounts in each study. The sample size presented is smaller than the original sample because of missing data.
**Based on most recent available complete year of historic billing data - 2006 for all sites except Seattle – (2008).

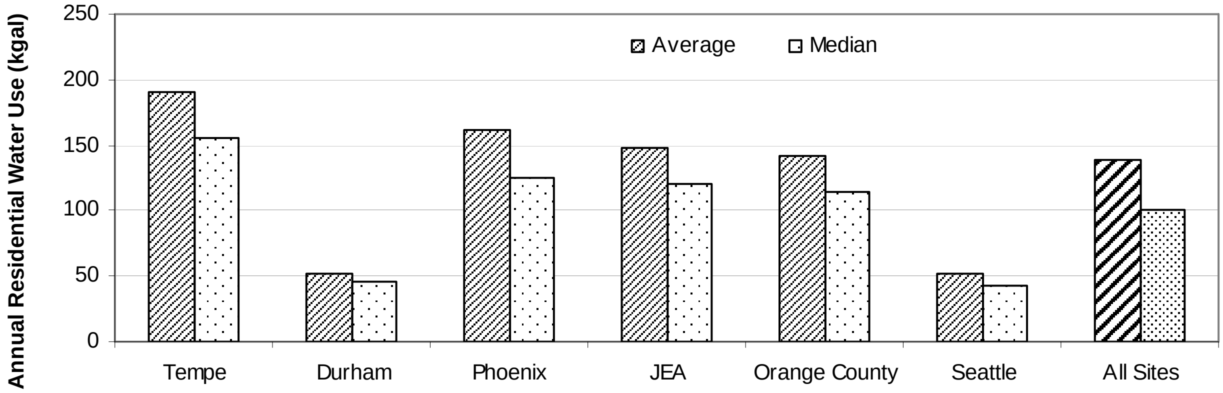

Figure ES.1 Annual residential water use (average and median) in six study sites

The consistency of results from this study and the REUWS indicates that about 135 to 145 kgal per year is a reasonable estimate of the average annual water use for residential properties. When considering “typical” single-family residential water use, the median is probably a better measure than the mean, which is strongly influenced by a few high water users. The median water use across all six study sites was 99.0 kgal per year, which is about 27% less than the mean.

Significant differences in demand between cities and regions exist. As shown in Table ES.1, the average annual use in Seattle was 52.9 kgal and in Durham it was 53.2 kgal. The average annual use in Phoenix is 159.5 kgal and in Tempe it is 190.8 kgal. These values are three to four times higher than the Seattle and Durham values. Water use in the two Florida study sites (Orange County and Jacksonville – JEA) was 141.8 kgal and 148.8 kgal per year, respectively.

The distribution of annual water use across all six study sites shown in Figure ES.2.Figure ES.2 clearly depicts the variability in water use consumption among the 5,223 homes for which billing data were available. Note that the bins in this graph are unequal. From 0 to 400 kgal per year the bins increase in increments of 20 kgal. The rise in the 500 kgal bin is caused by the shift in bin increments from 20 to 100 kgal at that point. This apparently lognormal[4] distribution includes the billed annual water consumption from all 5,223 homes for which adequate billing data were available.

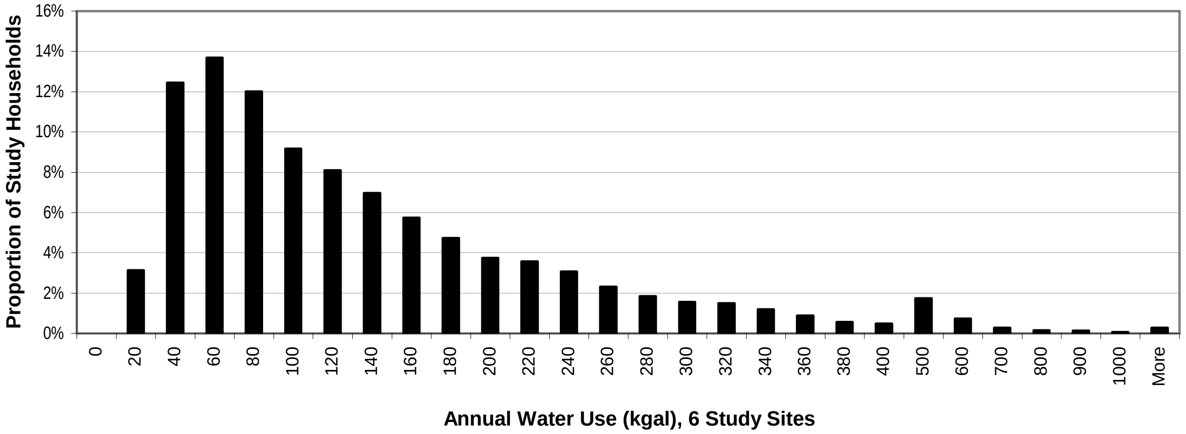

Figure ES.2 Annual water use distribution, 6 study sites, 5,223 homes

Factors That Influence Water Use. What are the significant factors that influence differences in water use? Using the dataset developed for this study and the logarithmic transformation multiple regression techniques described in detail in the body of this report, the factors that influence water use across all six study sites were examined.

The four basic factors found to influence water use at a 95% confidence level (in order of magnitude) were:

1. Type of residence (single-family or other)[5] – Single family residences used 35% more water annually than duplexes, apartments and other multi-family types of residence.
2. Number of bathrooms in the home – Each bathroom added about 29% more water use annually. This factor is often considered a surrogate for size and value of the home.

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[4] A “lognormal” distribution is one where the logarithms of numeric values have a normal distribution (e.g., the classic “bell-shaped” curve) rather than the values themselves. A number of real-world variables tend to be lognormally distributed, including: the size of silver particles in a photographic emulsion, the survival time of bacteria in disinfectants, the weight and blood pressure of humans, and the number of words written in sentences by George Bernard Shaw (Wolfram Research Mathworld, http://mathworld.wolfram.com/LogNormalDistribution.html, accessed on February 22, 2009).

[5] Although the intention was to study only detached single-family residences, 6% of the survey responses came from duplexes and multi-family properties that were mistakenly included in the sampling process. Since water use and survey data were available for these customers, it was decided to include these properties in the analysis.

3. Number of people in the home (capita) – Each additional person added about 11% more water use annually.
4. Household income – Each additional $1,000 of annual income added 0.3% more water use annually.

The other factor included in this basic model was the water agency that supplied the data. As shown in the preceding analysis, water use varied tremendously between different agencies due to differences in climate, demography, water rates, and a myriad of other factors. Including the water agency as a factor corrects for these and other systematic differences between providers. Ideally a model should include all of these different factors like rates and climate explicitly, but obtaining all of the data necessary for that level of analysis was beyond the scope of this study.

Key results from survey questions common to all six sites found to significantly impact differences in water use are presented below. Four of the five questions relate to outdoor water use and could indicate homes that are equipped with an automatic irrigation system:

- Question 9 asked, “Please indicate whether you performed any of the following actions during the past year”. Respondents who indicated that they stopped watering some or all of their existing lawn during the past year used 17.5% *less* water on average.
- Respondents to Question 9 who indicated that they changed their watering schedule during the past year used 14.6% *more* water on average.
- Respondents to Question 9 who indicated that they repaired leaking faucets or toilets used 12.8% *more* water on average.
- Question 15 asked which information sources would be most effective reaching out about water conservation. Respondent who indicated that an irrigation contractor would be an effective source used 23.9% *more* water on average.
- Question 7 asked respondents to, “Please indicate how often you perform any of the activities” listed. Respondents who indicated that they water their garden during hours to avoid the heat of the day use 19.3% *more* water on average.

It is expected that people who stopped watering some or all of their lawn would use less water than those who do not. The finding is a sensible and understandable finding, but why would people who changed their irrigation schedule and who don’t water during the heat of the day use more water?

One possible explanation is that these questions identify respondents who have automatic irrigation systems and those who don’t. Numerous studies have found that homes equipped with automatic in-ground irrigation systems use nearly twice as much water outdoors than homes that manually irrigate (Aquacraft, Inc. 2008), (Mayer, et. al., 1999), (Mayer 1995). To the extent that these questions identify automatic (vs. manual) irrigators, this could easily explain the difference in water use.

It is of interest that customers that repaired leaking faucets and toilets had statistically higher water use. The billing data used in this analysis covered calendar year 2006, but the customer survey was implemented in 2008. This suggests that any reported repairs to toilets and faucets noted on the survey might easily have been made after the billing data were obtained. If significant leaks were occurring, they would have been captured in the 2006 water use data utilized in this analysis, which could easily explain why this group of customers was found to use more water than those who did not repair a leak.

EVALUATION OF COMMUNICATION STRATEGIES AND WATER USE

The survey response and historic consumption database was used to more closely evaluate the linkages and relationships between the water conservation behavior of residential customers and the effectiveness of communication approaches that seek to influence that behavior. In each survey, specific questions that pertained to communication and conservation approaches were examined and relationships were evaluated to determine if water use was measurably impacted.

Using periodic billing data to try and measure potentially small and subtle differences in usage can be problematic. Therefore, the evaluation presented below should not be viewed as a critique of the communication campaigns implemented by the participating agencies. Rather, this analysis is intended to shed light on strategies that may be working so that they can be examined and possibly adopted by other water providers seeking to achieve water use reductions from their residential customers.

Tempe, Arizona

The City of Tempe (population of 165,000) has been implementing water conservation programs to single-family, multifamily, and industrial customers for more than fourteen years. Tempe has a $300,000 annual conservation program budget with $80,000 targeted to rebates and $10,000 targeted to the *Water – Use It Wisely* marketing campaign.

The City of Tempe's residential water conservation program seeks to educate residents about water use and to provide information about how to conserve water in their homes. In addition to Tempe-specific water conservation initiatives, Tempe, along with twenty other water providers in the region, contributes to the *Water – Use It Wisely* campaign. The collaborative campaign enables smaller water providers to leverage marketing dollars to reach more residents and ensures consistent messaging in the region.

Evaluation of Communication Strategies and Water Use in Tempe

Survey respondents in Tempe had a high degree of familiarity with many of the conservation communication messages promoted by the City. The *Water – Use It Wisely* message, "there are a number of ways to save water, and they all start with you," was familiar to 75% of survey respondents. A number of conservation messages were seen more than 10 times by respondents, indicating a positive familiarity with Tempe conservation communication programs.

Factors that Decrease Water Use in Tempe

Two factors unique to Tempe's conservation communication efforts were found to decrease water use at the 95% confidence level. These were: Question 10(i), choosing a low water use plants and Question 8(h), using drip irrigation[6]. Both of these questions are associated with efficient water-wise, non-turf landscaping practices promoted by the City of Tempe. Additionally, customers who reported that they monitor their outdoor water use used substantially less water. These results suggest that Tempe's outdoor conservation efforts promoting Xeriscape and alternatives to turf are having a measurable impact among residential customers.

Other conservation behaviors found to be associated with lower water use in Tempe include:

- using a broom rather than a hose to clean pavements,
- stopping irrigation of some or all of an existing lawn, and
- conservation actions taken in the past year: none of the above.[7]

Customers in Tempe that had lower water use also had the following characteristics and preferences:

- prefer demonstration in home improvement stores for conservation information,
- prefer the City of Tempe web site as a source of conservation information,
- prefer free home water audits,
- prefer TV ads for conservation communication,
- believe people do not recycle enough, and
- believe commercial/industrial growth is impacting local water supplies.

These results suggest that Tempe's broad communication approach to conservation messaging and program delivery is reaching customers, particularly those with an environmental consciousness concerned about growth in the community. This may be the "low-hanging fruit" for conservation in the Tempe area. As discussed later in this report, the small number of customers who are not being reached by Tempe's conservation communication and program efforts are associated with higher water use.

JEA – Jacksonville, Florida

JEA provides electric, water, and sewer services to the greater Jacksonville, Florida metropolitan area. JEA is part of the St. Johns River Management District and services much of Duval County and portions of three neighboring North Florida counties. Water conservation is an important part of JEA's communication efforts, and is integral to their mission of providing high-quality water service at the lowest possible price in an environmentally friendly manner.

JEA's budget for combined energy and water conservation efforts is between $600,000-$800,000 (including incentives). In addition, JEA allocates $1.4 million to conservation

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[6] While drip irrigation was associated with lower water use on Question 8, it was associated with higher water use on Question 6.

[7] This response does not necessarily indicate that no conservation actions were taken in the past year (although it could). Rather it indicates that if any conservation actions were taken, they were not included on the list of actions provided in the survey for this study. Since the list of actions was extensive, it could be an indication that no conservation action was taken over the past year.

advertising. Included in this is a contribution to St. John's Water Management District’s marketing efforts.

Evaluation of Communication Strategies and Water Use in Jacksonville

Survey respondents in the JEA service area had a high degree of familiarity with many of the conservation communication messages promoted by JEA. More than 80% of respondents were familiar with the message, “water lawn or garden during hours that avoid the heat of the day,” and in general more than 50% of respondents indicated at least some familiarity with most of the conservation messages presented in the survey.

Although customers expressed familiarity with JEA water conservation messages, only one factor from the survey was associated with statistically significant differences in water use among respondents. Respondents that viewed plumbers as a credible source of conservation information were associated with higher water use compared with those that did not view plumbers as a credible source. This was the only survey factor found to have a statistically significant association with water use at the 95% confidence level.

Orange County, Florida

Central Florida’s rapidly growing population depends upon rainfall for its freshwater supply. Orange County Florida, which includes the cities of Orlando and Winter Park, typically receives 52 inches of rainfall per year. Most of the rainfall is not available for consumption because much of it is lost to evaporation. Water that does not evaporate percolates into the Floridian Aquifer and is used as Central Florida’s primary supply of freshwater.

Because of stress on this aquifer, by 2013, the State of Florida will require that utilities draw water from other sources. Orange County has committed to reducing its overall water consumption by 5% as required by the Water Management District’s consumptive use permit. These water management policies coupled with significant population growth in the county (6 to 7% annually) have heightened the need for water conservation initiatives.

Orange County's largest water users are hotels and single-family homes belonging to affluent residents. Orange County has determined that at least 50% of water use goes to outdoor irrigation. The Orange County water conservation team seeks to reduce per capita water consumption and has piloted conservation programs to determine the most cost-effective solutions to achieve stated goals.

Orange County utilizes a variety of vehicles to market its water conservation programs including mass media advertising, direct mail, community outreach, school education, and rebate programs.

Evaluation of Communication Strategies and Water Use in Orange County

Survey respondents in Orange County had varied degrees of familiarity with the conservation communication messages promoted by the County. Results are shown below:

- “Florida Water – It’s Worth Saving” message was seen or heard by to 78% of survey respondents.

- “Saving Water Starts with You” message was seen or heard by 54% of survey respondents.
- “Free… Florida-Friendly Landscape Workshops” message was seen or heard by 37% of survey respondents.
- “If Water is Life Then Water Conservation Is the Way of Life” message was seen or heard by 23% or respondents.
- “Think Two – Water the Lawn Only 2 days a Week” message was seen or heard by 89% of respondents.

The range of recognition rates could be indicative of the maturity of different conservation messaging or could indicate that different communication methods were used for each message. Network TV was the most frequently reported vehicle for receiving these messages in almost all cases and in particular for the “Florida Water – It’s Worth Saving” message and for the “Think Two” message.

Factors that Decrease Water Use in Orange County

Two factors unique to Orange County’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were Questions 4 and 10. In Question 4, customers classified as “aware,” meaning that they heard or saw at least one Orange County conservation message were associated with lower water use at the 95% confidence level. Ninety-four percent of the survey respondents were classified as “aware.” This result is a positive indication that Orange County’s messaging efforts may be having an impact on water use. In Question 10, customers that were aware of the conservation message, “Free… Florida-Friendly Landscaping Workshops” were associated with lower outdoor water use. Only 1% of the respondents answered Question 10 in this manner, so the analysis sample is too small to determine if the lower water use is a result of the messaging. However, it is an encouraging finding.

Customers in Orange County that had lower water use also had the following characteristics and preferences:

- A small number (1%) do not want any conservation information.
- Some prefer conservation information from a nursery or landscape company (8%).
- The majority believe residential growth is impacting water supply (58%).
- The majority prefer TV ads for conservation communication (67%).

The age of the home was also found to be associated with differences in water use. In this case, older homes were associated with lower use.

These results suggest that Orange County’s communication messaging is effectively reaching customers. More than 90% of survey respondents had received at least one Orange County conservation communication, and this group of customers used less water than those who had not received any conservation communication.

Durham, North Carolina

The City of Durham Department of Water Management provides drinking water to more than 70,000 residential customers in North Carolina. In 1993, the City of Durham developed a water conservation team to help the growing population use water wisely and reduce the need for additional water and wastewater treatment facilities. The program has been active since that time and until a recent drought, the marketing budget has been $26,000 of which, $4,000 is dedicated to the *Water – Use it Wisely* social marketing campaign. The campaign is funded by a consortium of agencies in the region. In 2008, the budget was expanded significantly to improve messaging efforts related to conservation and mandatory water restrictions.

Evaluation of Communication Strategies and Water Use in Durham

Survey respondents in Durham had a varying degree of familiarity with the key conservation communication messages promoted by the City. Results from a few messages are presented here:

- “Water – Use it Wisely” message, was seen or heard by to 82% of survey respondents.
- “There Are a Number of Ways to Save Water and They All Start with You” message was seen or heard by 71% of survey respondents.
- “Resourceful Landscapes: Choose Drought-Tolerant/Low Water Use Plans for Landscaping” message was seen or heard by 67% of survey respondents.

Network TV, water bill inserts, radio, and newspapers/magazines were the most frequently reported vehicles for receiving these messages.

Factors that Decrease Water Use in Durham

Four factors unique to Durham’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were elements of Questions 4, 5, and 10 on the customer survey.

Customers who saw or heard any one (or more) of Durham’s water conservation messages via any medium were associated with statistically significant lower water use. Significantly, 94% of survey respondents saw or heard at least one of these messages indicating that Durham is doing an excellent job in reaching customers. Those 6% of customers who had not heard or seen any water conservation message from the City use more water.

Respondents who heard or saw the specific message, “There Are a Number of Ways to Save Water and They All Start with You,” via any delivery method, were associated with lower water use at the 95% confidence level. Seventy-one percent of the respondents had been exposed to this message.

Lower water use at the 95% confidence level was associated with hearing or seeing Durham conservation messages more frequently. The more frequently a message was heard or seen, the lower the water use. Ninety-two percent of the survey respondents were classified as "aware," indicating that they had heard or seen at least one Durham conservation message. This is a good indication that Durham's messaging efforts are having an impact on water use and that repeating the message in various places is likely to increase water savings.

Customers who were encouraged to take indoor conservation action(s) by the message, "There Are a Number of Ways to Save Water and They All Start with You" were associated with lower indoor water use. The number of indoor behaviors motivated by the message, as reported on the survey, was associated with differences in water use. The more behaviors taken by respondents, the lower the use. Twenty-nine percent of the survey respondents identified at least one indoor behavior that was motivated by this message.

These were the only four factors found to be associated with decreased water use at the 95% confidence level in Durham. The results suggest that the *Water – Use it Wisely* campaign and other conservation communications are reaching a large number of customers in Durham and are likely having a real impact by stimulating actions that result in lower water use. More than 90% of the respondents had seen or heard conservation communications from the City of Durham. The primary *Water – Use it Wisely* message, "There Are a Number of Ways to Save Water and They All Start with You," in particular was associated with lower water use by customers familiar with that communication.

Phoenix, Arizona

Since 1907, The City of Phoenix Water Services Department has provided high-quality water and wastewater services to Phoenix region. The City serves 1.7 million residents with 90% of the water drawn from the Salt, Verde, and Colorado rivers, and the remaining 10% drawn from groundwater sources.

Phoenix's water conservation program consists of mass media outreach, community outreach and education, and incentive programs to promote water conservation awareness and create a water conservation ethic among residents. The conservation program has an annual budget of $1.9 million with $500,000 allocated to communications and education outreach and $150,000 allocated to the *Water – Use It Wisely* social marketing campaign.

Evaluation of Communication Strategies and Water Use in Phoenix

Using the survey response data obtained through this study and the time series billing data provided by the City of Phoenix covering 1996–2007, it was possible to compare water use trends among customers. Respondents that heard or saw at least one water conservation message from the City (N=193) were compared with respondents who heard none of the water conservation messages (N=43).

In 1996, customers who reported "no message heard" used 170.7 kgal per year on average, which was 9.3% less water than those reporting "at least one message heard" who had used 188.3 kgal per year on average. In 2007, the situation was reversed and customers that reported "at least one message heard" used 149.2 kgal per year on average, which was 7.3% less than customers reporting "no message heard" who used 161.1 kgal per year on average. This simplistic analysis does not take into consideration changes in occupancy and a myriad of other factors that could be involved, but it indicates that a real change in water use occurred for the customers that "heard at least one message". Between 1996 and 2007 their use declined by 20.7% on average.

Next, Question 6 was used to divide survey respondents into two categories:

- Customers that took "no action" on water conservation (N=63)
- Customers that "took at least one action" on water conservation (N=173)

Comparisons of average annual water use in these two groups from 1996–2007 are shown in Figure ES.3. Customers in the "took at least one action" category used 7.8% *more* water on average in 1996 than those who "took no action". In 2007, customers who "took at least one action" used 16.2% *less* water on average than customers who "took no action."

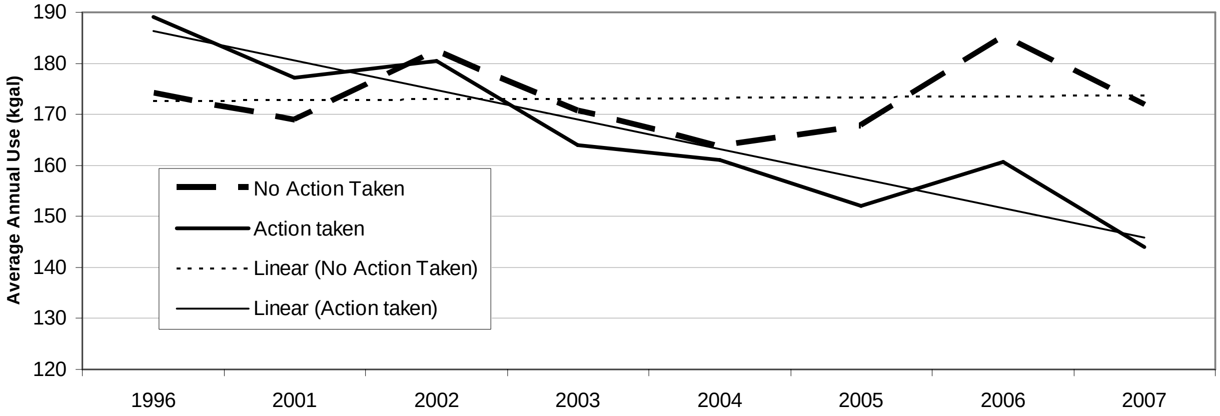

Figure ES.3 Annual water use Q6 survey respondents – Was conservation action taken?

Water use among respondents to Question 6 who "took at least one action" was examined over the time period from 1996–2007. Water use data from 1996 was used as a baseline since that was prior to the implementation of the *Water – Use it Wisely* social marketing campaign. Respondents that "took at least one action" as reported on Question 6 reduced their water use by 45 kgal (e.g., x–y) from 1996 to 2007 (not corrected for number of persons, income, bathrooms, etc.). This difference was found to be significant at the 95% confidence level. However, when this group of customers' demand patterns in 1996 was compared with the average water use over the 2001–2007 time period, no statistically significant change in use was identified.

This suggests that the water savings found in customers who "took at least one action" is sensitive to the end of the time span for which data were available. Reductions in water use that occurred in 2007 were enough to be statistically significant, but it appears to be recent changes in demand patterns that have had the most influence. In other words, if this time series ended in 2006 (rather than 2007), no statistically significant difference in water use would have been observed. In 2007, water use in these two groups diverged resulting in the finding discussed above. It is not known if any specific program or effort in Phoenix (such as voluntary drought restrictions) might have influenced the water use differences observed in 2007.

Seattle, Washington

Saving Water Partnership
Seattle and Participating Local Water Utilities

For more than 100 years, Seattle has been a growing and vibrant city known for its environmental stewardship. Seattle Public Utilities (SPU) serves 1.3 million residential and business customers in King County, Washington. Nearly two-thirds of SPU's customers reside within the Seattle city limits. Recent projections indicate that Seattle's population could increase 10% by 2010 and 27% by 2020. This significant population increase puts tremendous pressure on the fresh water supply necessary for residents and animal species, particularly salmon.

The Seattle Public Utility conservation program budget is divided as follows:

- National program support: $100,000 per year[8]
- Partnership for Water Conservation: $55,000 per year
- Saving Water Partnership and the 1% Water Conservation Program: $4 million per year ($550,000 operating budget. Future costs deferred to future rate payers.[9])
- Low income conservation program: $1.8 million per year ($300,000 operating budget. Balance is deferred to future rate payers.)

Communicating Conservation

SPU's water conservation programs represent an integrated approach to communication. Through its programs, SPU strives to establish a water conservation ethic among Seattle residents. Al Dietemann, Acting Resource Conservation Manager for SPU, believes that residents must recognize and understand the need for conserving all natural resources and they must want to conserve resources before they will be receptive to messages prompting them to take actions. Both components are critical to any marketing communication effort and are necessary to change residential water use behavior.

Residential water use in Seattle has declined significantly over the past 15 years. In 1994, the average single-family home in Seattle used approximately 81.3 kgal of water both indoors and out (Mayer, et. al. 1999). In 2008, the average single-family home in Seattle used 53.7 kgal of water, a difference of 27.6 kgal and a 33.9% reduction in average demand. This difference is statistically significant at the 95% confidence level.

Factors that Decrease Water Use in Seattle

Only one factor unique to Seattle's conservation communication efforts was found to decrease water use at the 95% confidence level using this data set. In particular, based on Question 8, customers that took indoor conservation actions were motivated by the messaging from the low income toilet program implemented in Seattle (2% of respondents), and these customers had lower water use.

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[8] Includes support for EPA WaterSense, the Alliance for Water Efficiency, the American Water Works Association Water Conservation Division, and other national efforts.

[9] Indicates that the future costs of the program are not built into the current rate structure. The program will be paid for each year by the rate payers, not through payments in advance or bonding.

Customers in Seattle that had lower water use also had the following characteristics and preferences as determined through the statistical analysis of water use and survey responses:

- Installed a water efficiency clothes washer (21% of respondents)
- Believe global climate change is an environmental concern (the 61% of respondents that “strongly agree” had lower water use)
- Reason for conserving: I am concerned about global climate change and how it may affect water supplies (68% of respondents)
- Stopped watering all or some of an existing lawn (41% of respondents)

These results suggest that Seattle’s communication messaging about the climate change issue as it relates to water supply availability are effectively reaching customers. Nearly 70% of respondents cited climate change as a motivating factor for conserving and those customers used less water on average than respondents who are not as concerned about climate change. Relevant factors such as installing an efficiency clothes washer and making landscape changes were also found to influence lower water use. While it was not possible to tie these actions to any specific conservation messaging effort, these results suggest that SPU’s communication efforts are having a real and measurable impact on customers and their water use. The decrease in demand documented from 1994 to 2008 is likely the result of Seattle’s ongoing conservation program efforts.

RECOMMENDATIONS AND CONCLUSIONS

Given the dearth of communication studies specific to water conservation and behavior change, some of the research findings can be immediately considered for current and future utility program efforts. Below are some of the findings that the authors believe to be noteworthy with regard to planning conservation communication efforts.

Conservation or Efficiency Behavior

Recommendation: Focus on cost-effective water efficiency measures that are underutilized such as fixture replacement.

This finding may help water agencies focus on other water saving measures not often reported or poorly adopted but would still garner significant savings. At the same time, water agencies could use this finding to support the approach of reinforcing and rewarding existing, well-adopted positive behavior.

Recommendation: Clothes washer rebate programs appear to be accelerating the adoption of water and energy efficient products. Target rebate messaging at customers with high indoor water demands and provide rebates only for the most efficient products.

This finding may help water agencies prioritize rebate programs and fine tune outreach regarding the combined water and energy savings attained by clothes washers because receptivity for this activity is seemingly favorable.

Recommendation: Many people believe they are conserving already, even if their water use suggests otherwise. Conservation communication efforts must effectively educate customers about what constitutes efficient use and where each customer’s demand fits on a spectrum of efficiency levels (e.g., highly efficient to not efficient).

To address this, effective communications should identify a conservation behavior "path" that water users can take. Communicating options to them will identify numerous ways to expand conservation.

Recommendation: Mine customer water billing records to identify good candidates for water conservation program efforts.

This could help water agencies better focus their efforts by further examining their customer account records and target marketing individuals who are high-use customers but have shown receptivity or adoption to a conservation or efficiency measure.

Recommendation: Use multiple communications channels to effectively deliver the right message to the right audience at the right time.

Findings in Relation to the 4P's of Social Marketing

While it may be difficult to associate changes in water use to social marketing efforts, lessons learned from the research results can be used to guide water utilities in designing a social marketing campaign around the four principles (4P's). The 4P's are best used as part of an overarching social marketing process. Social marketing is about being strategic in selling a behavior change to a targeted group of individuals to:

- Accept a New Behavior: Use monthly water bills to track usage.
- Reject a Potential Behavior: Don't let a faucet leak for a long period of time without fixing it.
- Modify a Current Behavior: Take shorter showers.
- Abandon an Old Behavior: Stop watering some or all of the existing lawn.

Product: In this context the "product" is the programs and services offered by the utility to reach water conservations goals. This is where the message to the customer is determined, that is defining the behavior or set of behaviors you want your audience(s) to adopt and sustain. Ideally, messaging should move consumers to action. The results indicate that water conservation messages have worked over time. Consumers already have a high level of awareness about water conservation practices, and they make a concerted attempt to integrate water conservation practices into everyday life.

Recommendation: The overarching water conservation message should address water supply and demand, which stood alone at the top as the biggest concern for consumers.

Price: In the context of social marketing, "price" is the perceived costs of adopting the desired behavior. For example, the cost of buying low-flow faucets. However, "price" does not solely rely on dollars, it should be looked at from monetary, time, effort, and psychological perspectives.

Recommendation: Educate consumers about the availability and financial advantages of utility rebate programs, since saving money is becoming a higher priority in households across the nation. In addition, education should focus on ease (low level of effort) related to adopting the behavior.

Place: Place refers to the channels through which the products or programs are available, the places where the behavior change can occur (e.g., in the home), or when a service is received. The greater access people have to the new behavior and the easier it is to do, the more chance there is of persuading people to change. In order to be effective, education and outreach messages must reach the consumer at the point of decision-making, so that it is convenient for the customer to get the message.

Recommendation: Disseminate messages to consumers where they live, work, and play. Non-traditional venues should be considered, such as movie theaters, supermarkets, shopping malls, retail and fast food outlets.

Promotion: Promotion is how and where you communicate to your audience about the behavior, price and place. It is using the most appropriate mix of media vehicles to best reach the target audience. Promotional channels can range from face to face contact to big budget advertising. The case studies present in this report illustrate that a portfolio approach of mixed media can be effective in reaching consumers. A media mix can include advertising (print, broadcast, Web), direct mail (utility bill inserts), outdoor, mass transit, or editorial outreach (article placement) to name a few.

Recommendation: Use multiple communications channels to effectively disseminate information about water conservation to consumers. The more times consumers receive the message, the more likely it is to influence their behavior.

CHAPTER 1
INTRODUCTION

Communicating the concept and value of wise water use, conservation, and efficiency has been a common endeavor since the beginning of human civilization. In the modern era, water utilities have often taken on the responsibility of informing and educating customers about the need and importance of wise water use and stewardship. Today, water providers regularly implement sophisticated education and marketing campaigns to promote water use efficiency and conservation behaviors, but little is known about the impact of these efforts or what constitutes a successful program.

The process of communicating with the public in an effort to change people's behaviors for the benefit of an individual, group, or community is commonly known as social marketing. Water conservation social marketing campaigns are intended to educate customers about the importance and value of water, to encourage behaviors and practices that diminish water waste, and to reduce demands for the benefit of the individual customer and the community. Water conservation communication campaigns may promote a range of conservation behaviors–from installing more water-efficient fixtures to changing consumption habits, such as turning off the faucet while brushing teeth.

Water use patterns differ by region and customer, but the categories of end use (toilet flushing, bathing, washing clothes, food preparation, landscape irrigation, etc.) are remarkably consistent across the country. Consequently, the conservation behaviors promoted by water utilities are often similar (e.g., replacing inefficient toilets, improving irrigation efficiency, and eliminating single-pass cooling). A key difference lies in the delivery channels and messages by which utilities promote water conservation. Utility sponsored water conservation campaigns leverage a variety of delivery channels, including bill stuffers, print and broadcast media, the Internet, and outdoor advertising such as billboards or transit advertising.

What are the impacts of water conservation communication campaigns in terms of customer recognition, attitudinal changes, behavior modification, and verifiable water use reductions? What are the most effective methods and techniques for designing and implementing water conservation social marketing campaigns? This research study, Water Conservation: Customer Behavior and Effective Communications, seeks to answer these and other critical questions in an effort to help water providers to improve the design and implementation of water conservation social marketing campaigns.

The objective of this research study was to evaluate the linkages and relationships between the water conservation behavior of residential customers[10] and the communication approaches that seek to influence that behavior. The research team implemented this evaluation through a multi-method approach including: telephone interviews with water agency personnel, surveys of residential water customers, analyses of current and past billing records supplied by water agency partners, in-depth case studies of water agencies and their water conservation communication campaigns, and an evaluation of communication implemented by the six participating utilities.

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[10] Non-residential customers are important end users of water as well, but as most utility social marketing campaigns are targeted at the residential sector, this sector was the chosen emphasis of this study.

The sections below present an overview of the principles of social marketing, outline the goal and approach for our research study, and present the organization of the remainder of our report.

SOCIAL MARKETING

Social marketing can be defined as the use of marketing principles and techniques to influence a target audience to voluntarily accept, reject, modify, or abandon a behavior for the benefit of individuals, groups, or society as a whole. (Kotler et al. 2002) Social marketing seeks to improve the quality of life for the target audience or the public. While commercial marketing seeks to sell a product or service, social marketing sells behavior change for the greater good. During the social marketing process, new products or services may be bought and sold that will aid in the behavior shift and ultimately a paradigm shift. Social marketing often includes influencing both upstream and downstream market actors. Upstream actors may include policymakers and product manufacturers. Downstream actors include end users. Therefore, one may think of social marketing as the nexus between conventional commercial marketing and public policy.

Behavior and commitment to maintaining behavior is the central focus of social marketing. (Kotler and Lee 2007) The challenge with social marketing is the fact that customers are constantly entering the education cycle at different stages. We can classify these stages as “knowing,” “believing,” and “doing.” Therefore, social marketing must continue–with appropriate modifications over time–until the accepted behavior is the *only* behavior considered and performed by the target audience. The social marketer’s job is complete when a behavior is performed consistently by the target audience. Although complete adoption of a behavior is ideal, it is not realistic. Therefore, social marketers must plan, evaluate, and refine their approaches and clearly identify measurable outcomes and performance measures.

Social marketing can be distinguished from education and social advertising in several ways. Traditional marketing can be defined as the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual (customer) and organizational objectives. (Wells, Burnett, and Moriarity 1992) The practice of marketing encompasses many strategies directed at the target audience. These can be narrowed to three key strategies: education, communication, and economics. (Kotler et al. 2002) Each is discussed in turn below.

Education is an important tool used in both traditional marketing and social marketing. Educators seek to inform the audience of a new skill or new information. Unlike a marketer, an educator’s job is complete when the target audience has been informed. (Kotler et al. 2002)

Advertising or communication is another strategy used to deliver messages to a target audience. But advertising alone will not motivate the audience to act. (Kotler and Lee 2007) Marketing, and social marketing in particular, has a greater chance of success when multiple communication strategies are integrated to reach the target audience at the right time (e.g., when the undesirable behavior occurs or could occur) through a variety of media vehicles with messages that are relevant and compelling.

Economic strategies also can be useful for stimulating behavior change. In the case of water efficiency, levying fines for watering the lawn during specific hours or reducing the sales tax on water-efficient technologies or other monetary incentives can aid in the adoption of the desired behaviors.

Some marketers described social marketing as “the toughest of all marketing assignments.” (Kotler and Zaltman 1971) Kotler explained, “You’re asking people to give up a pleasure, be uncomfortable, give up looking good, or go out of their way.”[11] Direct results from the requested behavior change are challenging to demonstrate to the target audience. In the case of water conservation, it is difficult to convince a customer that a future sustainable water supply or improved environmental conditions (such as cleaner water or higher minimum stream flows) are the direct result of specific behaviors or actions of an individual. Even demonstrating a lower water bill over time as a result of conservation can prove to be unsatisfying or insufficient motivation for the audience.

Identifying the target audience and developing a compelling set of value propositions for that audience is critical to the success of any social marketing effort. Without a compelling and relevant message, customers will not understand why they should take action. Some marketers argue that customers may respond more altruistically to incentives rather than to expectations that they will move outside their comfort zones to benefit society. Aldo Leopold maintains that “conservation is positive exercise of skill and insight, not merely a negative exercise of abstinence of caution.” (Leopold 1999) Understanding the target audience and the current economic and social climate will help marketers and water utilities determine the best marketing method and messaging to induce behavior change. Market research plays a critical role in helping marketers identify and understand their target audience.

Over the past few years, consumer attitudes toward the environment and social causes have shifted. Today the “environment” often is a mainstream concern among consumers. The concern cuts across psychographics, demographics, and political affiliations. In this marketing climate, environmentally focused social marketing programs are well positioned for success. Even more promising for corporations and utilities is the fact that consumers look favorably on companies who are environmentally responsible. In fact, research indicates that 91% of Americans have a more positive impression of a company when it is environmentally responsible, and one-third of Americans have a greater interest in the environment than just one year ago. (Lawrence 2007)

Water utilities across North America have shown significant interest in social marketing as a useful approach for conservation programs. Marketing experts have promoted broad-based media communications campaigns as “the best way to hasten behavior change” and as “a cost-efficient way to reach the broadest audience.” (Hoffman 2006) Prepackaged marketing programs such as *Water – Use It Wisely* [12] (developed by Park and Co.) have been implemented in States ranging from California and Arizona to North Carolina. Programs such as Water IQ in Texas and the *Seattle 1% Program* represent substantial efforts to enlist social marketing principles in the search for water savings.

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[11] For water conservation, this is not always true. Replacing an old toilet, for example, with a high-efficiency model does not result in discomfort or sacrifice.

[12] Launched in 1999, the *Water − Use It Wisely* campaign promotes an ongoing water conservation ethic through simple tips to help consumers save water in their home and throughout the community. The program originated in Arizona and has expanded nationwide

Key Social Marketing Principles

Traditional commercial marketers often refer to the marketer’s toolbox or the 4P’s: product, price, place, and promotion. As social marketing relies heavily on traditional marketing, the 4P’s are significant to the principles. The 4P’s are important because they remind social marketers that any marketing effort must apply a customer orientation to their strategy and message development. Following are descriptions of each tool within the context of social marketing.

Product

It is easy to conceive of treated, finished water as the “product” offered by municipal water utilities. Strictly speaking, this is correct, but in the social marketing context, the marketing goal is to motivate customers to use less of the “product.” This fact is antithetical to the goals of conventional marketing, which generally seek to sell as much product as possible. For water conservation, the product must be reconceived. In the context of water conservation, one might think of “product” (i.e., what is being sold) as an idea and a set of actions (e.g., to conserve water and achieve a sustainable, healthy water supply). (Kotler and Lee 2007) Others see the “product” in this context as the programs and services offered by the utility to reach water conservation goals.

Price

“Price,” in the context of social marketing, should be understood as the perceived costs of adopting the desired behavior (entry costs) and of abandoning the current behavior (exit costs). (Kotler et al. 2002) For water utilities’ customers, the price of behavior change may be described as follows:

- Paying the cost for replacing a toilet that still has useful life remaining
- Changing the time of day when watering the lawn
- Turning off the faucet when brushing one’s teeth

Consumers usually are more responsive to making small, easily doable and maintainable changes. Focusing on one or two changes at a time is important in social marketing.

Place

“Place,” in the context of product or service marketing, refers to the channels that move the product from the manufacturer to the buyer. For social marketers, “place” can take on many forms. In the context of water utilities, place is most likely the customer’s home where the behavior change will take place or, in the commercial setting, the office or business locations where the behavior changes will take place. Place also may be related to where the utility’s services and products are accessed.

Promotion

The term “promotion” refers to the manner in which the product (behavior change) will be communicated. Promotion may include bill stuffers, mass media advertising, public relations, or editorial content and even sales promotions with local retailers. Promotion means communicating messages using the most appropriate mix of media vehicles to reach the target audience.

The following example illustrates the application of *product, price, and promotion* in an actual water conservation program in Seattle. The example does not specifically define the campaign’s *place*, but how the program and services are delivered is implied in the explanation.

1% Water Conservation Campaign

Seattle, an area known for its many rainy days, in reality has significant water supply/demand challenges. Several water supply factors contribute to an urgent need to balance water availability.

Seattle Public Utilities (SPU) provides water to 26 suburban cities and water districts. SPU serves more than 1.3 million residential and business customers and is responsible for managing water resources for the region, while acting as an environmental steward. The following factors have a direct effect on water supply and demand in the greater Seattle area:

- Population: A 10% growth in population is expected over the next 10 years.
- Endangered Species Act: The federal government listed the Chinook salmon under the Endangered Species Act (ESA) This limits the amount of water SPU can use from rivers to meet its supply obligations.
- Summer peak: Summer is a very dry season in Seattle. This is also the time that the demand for water is at its peak, resulting from outdoor watering.
- Variations in snowfall: The Seattle area watershed is the main source of water to the Seattle region. Seasonal variations in snowfall affect the available water supply, and drought years can create extreme water shortages.

Establishing and marketing an aggressive conservation program has been selected as the best option to meet these challenges. It is the least expensive and most environmentally friendly option.

Program Objective and Goal

Campaign Objectives

Behavior	Knowledge	Belief
▪ Through the use of pricing, tangible products, and communications, influence residents and businesses to act as follows: ▪ Purchase high-efficiency appliances. ▪ Implement natural landscape and gardening practices. ▪ Practice water conservation actions, such as taking shorter showers.	▪ Know that 1% reduction every year for 10 years is the goal for all residents. ▪ Know about the different products and programs available to residents that can help achieve the 1% reduction.	▪ Water is precious and should never be wasted. ▪ Everyday actions have an impact on water supply, environment, and salmon. ▪ Water-efficient technologies and products consume less water while having little or no impact on lifestyles.

Campaign Goal

Reduce personal and business water consumption by 1% every year for 10 years.

Target Audiences

Almost 65% of the customers served by SPU are urban residential. The other 35% are businesses, commercial/industrial, and large organizations. Because this campaign crosses virtually all audiences, 1% Water Conservation should reinforce the ethic message with all audiences and target specific efforts to unique audiences.

Primary Audiences

Money is not available to simultaneously reach all audiences effectively, and given that some audiences will be more responsive than others, strategies will be tailored to appeal especially to these groups:

- Females
- Single-family homeowners
- 35- to 64 year-olds
- Household income above $50,000

Secondary Audiences

Commercial Sector

Strategies

A multidimensional strategy was developed to market 1% Water Conservation. The components of this strategy included the following elements.

Product

1% Water Conservation products include conservation tips and education, as well as professional services (landscape audits) and specific water-efficient appliances and technologies (tangible objects):

- Toilet rebates – A rebate program is targeted at homeowners and commercial customers to replace their existing toilets with low-flow models.
- WashWise – A point of purchase promotion and rebate is offered for high efficiency clothes washers.
- Landscape – Audits, financial incentives, and "natural landscaping education" is offered to residents and commercial customers.
- Schools program – An education effort that focuses on elementary schools.
- Water Smart Technology – Products and services are provided for commercial air-conditioning and laundry. Industries include hospitality, health care, school districts, and research organizations.

Price

Discount incentives and rebates were used to promote several appliances. Many jurisdictions imposed higher rates for excessive usage and seasonal surcharges during peak demand months to significantly lower demand.

Promotion/Communications Strategies

Because the program is a 10-year effort, the campaign to lay the foundation for the ethic and build support for the 1% Water Conservation program will be a multiyear effort.

Focus during the first 2 years will concentrate on communicating about the ethic. Later years will focus more on the "how" message and delivering the 1% programs. With the ethic established, the audience will be primed for long-term behavior changes to be suggested through the various 1% products and offerings.

Branding 1% Water Conservation**.** One of the most ambitious strategies is to brand conservation ethic. Creating a brand identity for the program and creating brand awareness so that a range of options, from simple behavior changes, such as taking shorter showers, to purchasing water efficient toilets, could ride on the strength and recognition of the brand.

The 1% logo and graphic were created with the tag ling: "What will you save today?" The question in the tag line speaks to the individual and addresses both altruistic and economic connotations and responsibilities. The visual depiction shows that all things in nature are connected: the individual's role, the water supply, the environment, and the regions salmon. This brand appears in everything from television ads and brochures to rebate offerings for businesses.

Public Relations**.** Several press and public events throughout the campaign are the key strategic emphasis of the marketing plan. This campaign is kept fresh through a variety of media events that focus on various aspects of the 1% Water Conservation program. Here are some examples of the public relations campaign:

1. A kick-off event at the start of the campaign in which the Mayors of Seattle and Bellevue change out existing appliances to water efficient ones in a family's home and demonstrate water conservation tips. Mayors watering lawns and changing toilets! It was in the news in all the regional TV stations, newspapers, and other press.
2. A recognition ceremony at the Pike Place Market, a Seattle icon, where the businesses in the market were showcased for their commitment to reducing water use.
3. A public offering of low-flow toilet rebates is anticipated to attract many homeowners turning in old toilets for new ones.

Advertising. Paid advertising is being used as a major vehicle to build the 1% Water Conservation brand, to establish the "why" in the minds of residents. It reinforces the ethic and establishes the value of water so that residents are motivated to participate in the programs. A media mix of print and television comprise the paid media portion of the campaign. The television ad appeared on network television through the months of peak water consumption in the summer; a newspaper insert emphasized why 1% was important to the region and gave program details and choices to consumers; and a print ad offered a rebate for efficient appliances and hastened consumers to "Act Now". An insert in major newspapers went to more than 600,000 households. Direct mail was used to provide program details and local information from participating utilities and was also planned for businesses and commercial customers to provide rebate offers and financial incentives. A Web site (savingwater.org) and a dedicated information telephone number were set up as integral tools to support the campaign. And tent cards were used in restaurants during drought periods.

Evaluation Strategy

In order to track the success of efforts and respond to the needs of the consumers in future campaigns, a comprehensive evaluation strategy is in place. This includes regular surveys, focus groups, and analysis of water consumption data.

Used with permission from Seattle Public Utilities and (Kotler et al.,2002) SAGE Publications, 2009.

Commitment, Norms, and Prompts: Tools for Social Change

In addition to the 4P's outlined above, social marketing researcher and author Doug McKenzie-Mohr has identified a number of tools that can make social marketing efforts effective–the idea of commitment, norms, and prompts. McKenzie-Mohr developed an approach to social marketing called "community-based social marketing" (CBSM) that includes its own fundamental principles and concepts. CBSM has caught the attention of water conservation professionals and has been implemented in a number of utilities with favorable results (Region of Durham, Los Angeles, and others).

The following outlines several of the key concepts from CBSM (McKenzie-Mohr and Smith 1999).

Commitment

Social marketing research has shown that people who make a nominal commitment to a cause (e.g., by wearing a button or signing a petition) are more likely to respond favorably to requests to adopt behaviors that support that cause than those who have not made such a commitment. Water utilities should consider obtaining a commitment to water conservation through a pledge campaign or community network. In doing so, utilities will establish a core group of individuals and businesses that see themselves as water conservation advocates and who are more likely to make changes in usage behaviors when asked to do so.

Norms

Research also shows that people seek to act in accordance with social norms. Water utilities should seek to establish a water conservation ethic, or norm, that fosters desired behaviors.

Prompts

People are more likely to take actions that are top-of-mind and that appeal to them personally. Water utilities should consider using prompts, or reminders, in their marketing campaigns to motivate behavior changes. Examples include giveaways at festivals or events that will prompt people to change their behaviors (e.g., timers for the shower).

In their 2007 book, *Marketing in the Public Sector*, Kotler and Lee present 12 key social marketing techniques that they believe will create the foundation for a successful social marketing campaign.

1. Take advantage of prior and existing successful campaigns.
2. Start with target markets most ready for action.
3. Promote single, simple, doable behaviors–one at a time.
4. Identify and remove barriers to behavior change.
5. Bring real benefits into the present.
6. Highlight costs of competing behaviors.
7. Promote a tangible object or service to help target audiences perform the behavior.
8. Consider non-monetary incentives in the form or recognition and appreciation.

9. Have a little fun with messages.
10. Use media channels at the point of decision making.
11. Get commitments and pledges.[13]
12. Use prompts for sustainability.

Potential Barriers to Social Change

As outlined above, the fundamental goal of social marketing is overcoming critical human barriers to engaging in sustainable behavior. McKenzie-Mohr outlines three important ideas related to behavior change and barriers (McKenzie-Mohr and Smith 1999):

- People naturally engage in behavior that has substantial benefits with few barriers.
- Understanding of barriers and benefits can vary among individuals.
- Behavior competes with behavior. Adopting a particular behavior (e.g., installing a high-efficiency toilet) frequently means rejecting another behavior (e.g., using an older but still functioning toilet).

For water conservation programs to be successful, they must remove barriers and enhance benefits for large segments of the population.

Behavior competes with behavior according to McKenzie-Mohr. Viewed from a different perspective, the prevalence of water-efficiency technologies such as high-efficiency toilets and low-flow faucet aerators make it easier for consumers to adopt new behaviors. These technologies empower people to perform tasks more efficiently without any significant changes in behavior. By installing a high-efficiency, low-flow toilet that inherently uses less water, consumers may be less inclined to take additional steps to conserve water, such as turning off the water while brushing their teeth. Thus one behavior competes with another.

Performing tasks more efficiently reduces their water demand and the linked energy demands for providing, treating, and heating water, and even leads to decreased greenhouse gas emissions. (Funk 2006, 2007) The latter two benefits alone may influence behavioral changes at a time when individuals are searching to understand how they can make a difference with respect to climate change. Contrary to Kotler (1971), these are quantifiable “direct results” that can be used “to show or promise in return for the requested behavior change.”

Economic barriers can pose crucial challenges to conservation programs. For example, rebate programs may not offer sufficient incentives to low-income customers to participate. Distribution programs can address these barriers by offering the incentive of receiving a device or fixture for free. (Funk 2006) Removing barriers to behavioral changes so social marketing can work also may involve reevaluating or developing regional water conservation plans that clearly define roles at multiple levels. That is, water utilities are more likely to successfully design and implement social marketing programs if barriers are removed at the State level, empowering water utilities to do so comprehensively by statute. (Funk 2006)

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[13] This element is discussed in greater detail in the section of this report focused on commitment, norms, and prompts.

STUDY GOALS AND APPROACH

As population increases, water conservation and demand management programs are playing an increasingly important role in utility supply planning. In many cases, conserved water is the cheapest and most easily obtained source of new supply, but relying on conserved water requires better understanding of customer demand patterns and behavior. Conservation programs typically rely on a two-pronged approach to affect water savings: (1) Public information and education programs to raise awareness and stimulate water efficient behavior; and (2) implementation of retrofit programs such as toilet and clothes washer rebates, landscape audits, and turf replacement to physically reduce demand.

Over the past 10 years the water industry has greatly improved its knowledge and understanding of customer demand patterns and the effectiveness of different conservation implementation programs. Studies such as the Residential End Uses of Water (Mayer and DeOreo et al. 1999) and the Commercial and Institutional End Uses of Water (Mayer and DeOreo et al. 2000) provide useful information about demand patterns and conservation potential. Research sponsored by the US EPA including the Seattle, East Bay Municipal Utility District, and Tampa Residential Retrofit Studies (Aquacraft, Inc. 2005) measured the impacts of replacing toilets, clothes washers, showerheads, and faucet aerators. A number of other studies have examined specific water efficiency measures such as turf replacement, irrigation system improvement and technology implemented in the commercial and industrial sector. There is an increasing body of knowledge about the conservation savings that can be obtained through various physical implementation efforts.

At least as important, if not more so, is the human element in water conservation. Water agencies all face many of the same challenges in this area: how to influence and eventually change behavior using efforts with a known and quantifiable impact. Public information and education campaigns are a necessary component of an effective water conservation program, but there has been no definitive information on the effectiveness of conservation communication. A number of utilities have implemented conservation social marketing campaigns, such as *Water – Use It Wisely* and Seattle Public Utilities' 1% Water Conservation Campaign, that go far beyond the traditional bill-stuffer insert, to include TV and radio spots, billboards, bus posters and other marketing avenues. How effective are these efforts? What communication and education programs have the largest impact on customer water use behavior? What motivates end users to implement water efficiency measures in their home and business?

The definitive data linking communication efforts and any changes in behavior has simply not yet been collected. This *lack of data* leaves a number of critical research questions open that are of great importance to water agencies as they increasingly rely on water conservation to meet future demand. Besides the lack of data, there is also *lack of theory*: there is currently no theoretical model that relates the success or failure of communication activities to residential customer demographics, and other factors.

The purpose of this research is to evaluate the impacts of public information and education campaigns and to assist utilities in developing conservation communication programs that achieve optimal results in the realm of behavior change. Doing so will provide greater insight into attitudinal and information barriers that prevent residential water users from adopting long-term water conservation behavior. Water agencies have limited resources for experimentation to see what works; they need guidelines on communication campaigns that have a *high probability of rate of return*. Our results will help guide communication strategies with regard to key communications components such as messages, information sources and channels.

Our approach to this project is based on the principles of partnership and research. In addition to the principal investigators and the Project Advisory Committee, our partnership consists of seven water utilities:

- City of Durham Department of Water Management
- City of Phoenix Water Services
- Department City of Tempe Water Utilities Department
- JEA - Jacksonville, Florida
- Orange County Utilities Water Division
- Seattle Public Utilities
- The City of Calgary

ORGANIZATION OF THIS REPORT

The remainder of this report is organized into the following sections:

- ***Status Knowledge: Review of the Literature on Conservation Communication and Behavior Change Efforts.*** This section summarizes the findings from our literature review. Readers can use this information as a primer on social marketing and as a resource on relevant case examples.
- ***Overall Research Approach and Methodologies Used for Survey.*** This section presents our approach to conducting the residential survey. Readers should become familiar with our research approach and methodologies as it forms the basis for our findings. The survey instrument illustrates the type of questions that water utilities could use in conducting their own surveys.
- ***Results.*** This section presents the quantitative results of the survey. We also summarized the information that we obtained during our interviews with our water utility partners.
- ***Case Studies of Two Large Conservation Campaigns.*** This section presents two case studies based on the residential survey and historical billing data prior to implementation of a water conservation campaign. These case studies demonstrate options for water utilities to consider in developing their own programs.
- ***Conclusions and Recommendations.*** This section presents our lessons learned and presents them as a ‘toolkit’ for water conservation managers to use in developing social marketing campaigns.
- ***References.*** This list contains all the references used for our research and evaluating the findings.
- ***Appendices:***
  - A. Master Reference List
  - B. Utility Partner Interview Protocol
  - C. Survey Instruments
  - D. Sample Survey Materials
  - E. Enumerated Survey Responses
  - F. Range of Communication Strategies and Tactics Used by Water Utilities

CHAPTER 2
REVIEW OF THE LITERATURE ON CONSERVATION COMMUNICATION AND BEHAVIOR CHANGE EFFORTS

The aim of this literature review is to capture and synthesize the current state of knowledge about communication and its impact on behavior, specifically behavior with regard to water conservation. Scope and budget prevent the authors from conducting an exhaustive review, however, the review is comprehensive and robust, meets the objectives, and identifies information gaps that can be addressed by subsequent research. The first section presents some findings related to water conservation campaigns. The next section presents a review of the application of communication strategies to influence conservation behaviors. This section is based on literature findings from specific environmental campaigns. The third section uses the literature findings to present residential water use and factors influencing consumption. The examples presented in that section are not communication specific; however, they do highlight specific behaviors and decision-making factors of significance to examination of communications and conservation behavior. The final section provides a range of communication strategies and tactics by water utilities. And finally, we offer a conclusion that summarizes the findings of the literature review.

WATER CONSERVATION CAMPAIGNS

A number of studies have sought to document the effectiveness of various communication strategies and tactics although the definition of what constitutes “effective” has been narrow, or has focused on attitudinal or perceptual data. For example, Boone (2005) documented a number of “best practices” with regard to communication campaigns targeting conservation by conducting interviews with water agency personnel. Although he derived several guidelines summarizing these best practices, the study did not provide any quantitative data from water agency commercial or residential customers. Without objective behavioral data, it is difficult to properly align the best practices described by Boone with activities in other water markets.

Alliance Professional Services (2003) presented the results of several intensive focus groups conducted around the themes of water conservation efforts, with special emphasis on the barriers and enablers of those efforts. This study represents a rich source of data that can be used as starting points for further research in the effectiveness of various communications in the context of other types of activities (e.g., rate incentives) in reinforcing water conservation behavior.

In a departure from documenting perceptions, Aquacraft’s end use studies (1995–2006) researched actual water use patterns in residential housing across the United States and provided support for a particular methodological approach, that of water flow trace analysis, in measuring cold and hot water use accurately, and thus providing a methodology that could be used to go beyond self-reported behavior.

In a number of studies released by the developers of the *Water – Use It Wisely* campaign, Park & Co. stated that the campaign was determined to be a success because of high campaign recall by residential customers, high retention of the campaign messages on various ways to conserve water, and high recall of campaign theme. But, high recall rates do not equate to changes in behavior. Many examples exist in advertising where an ad had a high recall or recognition rate, but did not result in any increase in consumer buying behavior.

Syme, Nancarrow & Seligman (2000) reviewed approximately 25 years of research on the effectiveness of information campaigns to promote household water conservation. They distinguished between campaigns enacted during “crisis situations” that required immediate and decisive actions, and longer-term efforts to conserve, without the external motivation of critical water shortages. They divided their review according to increasing scientific rigor of the study: narrative reviews, statistical approaches typically using regression analyses, quasi-experimental analyses, and experimental designs. They stated that the conclusions seemed to depend on the type of study conducted rather than the research questions asked. Several findings included:

- Passive information (e.g., brochures, flyers) seemed to have little effect on changes in water use behavior,
- Information in terms of feedback provided significant changes in energy consumptions, but not in water consumption, and
- Multiple method approaches could result in up to 25% in water savings, at least in short-term or crisis situations.

Campbell, Johnson & Larson (2004) examined the effectiveness of different types of policy instruments in water conservation in the city of Phoenix, Arizona, by modeling a regression equation with about 40 independent variables, and the dependent variable of water consumption. They found that:

- Pricing strategies can have a positive effect on water consumption
- The effectiveness of the installation of water saving devices can be severely reduced by “offsetting behavior”; and
- Person-to-person communication can have an enormous effect on reducing water usage.

Tatham, Tatham & Mobley (2004) conducted interviews of water agency personnel and a survey of 5,000 residential customers (1) to examine those factors influencing residential customers’ attitudes and behaviors toward water agencies; (2) to see whether various communication methods can be used to positively affect attitudes and behaviors; and (3) to identify the types of information that water agencies should communicate and the methods of those communications. Among the most valuable parts of this report are the description of basic guidelines for developing a good communication plan, and the types of information most desired by residential customers: water quality and safety, water availability, and water pricing issues. In general, Tatham et al. found that customers who were better informed by the water agency also tended to feel the most positive about that utility and the water it provided.

Consumer research in Florida revealed awareness and concern about growth, development, and water resources issues. Although the study participants perceived that changes in the region affected their water conditions, they were reluctant to admit any personal connection to the problem. (DeLorme et al. 2003) This sentiment echoes the findings of other market-oriented research on water efficiency that found that people had a hard time seeing their own behavior as part of the problem, even if they were targeted as a high-volume water user (BBC 2007), (PMSI 2003).

Customer attitudes and awareness prior to the implementation of an education/ information program appear to be important (although not necessarily predictive) factors in success. Trumbo and O'Keefe (2001) found that simple exposure to messages and information about water efficiency will not necessarily influence knowledge, attitude, or behavior change. Rather, people must be engaged and, to some extent, predisposed to the information presented. Carefully targeted programs that involve community (as opposed to individual) participation can be influential. (Trumbo and O'Keefe 2001) Trumbo and O'Keefe (2005) found that customers with existing pro-environmental values, as well as a track record of environmental behavior, are more likely to seek and attend to information on water conservation. They also found a significant level of inconsistency between past intention and present behavior. However it does appear the customers who actively seek information on water efficiency are far more likely to take action and implement some measure(s). (Trumbo and O'Keefe 2005)

APPLICATION OF COMMUNICATION STRATEGIES TO INFLUENCE CONSERVATION BEHAVIORS

A number of studies have sought to quantify the impacts of water efficiency outreach campaigns that provide information and education to consumers. The results are mixed, but it is common to find that an education and information campaign for water conservation heightens awareness and increases knowledge but often does not impact behavior. Two examples, one from Australia and the other from Jordan, illustrate this point.

A seven-year study of attitudes toward water conservation and behavior conducted by the University of Ballarat and Swinburne University of Technology (both in Australia) found some indoor savings were achieved as a result of an initial education and media promotion strategy. The second phase of the study emphasized the price structure of water rather than education. Although there were "signs of deterioration[14] overall the level of water conservation remained higher than it was at the start." (Watson et. al. 1999) This study also found that customer attitudes about conservation did not directly affect reported behavior. A weakness of the study was the apparent lack of water consumption data to use as a measure of the impact of the education and pricing programs.

A study of a three-year water conservation campaign in the Kingdom of Jordan used focus groups to compare knowledge, attitudes, and practices among people who were exposed to the conservation campaign and among those people who were not. The study found that the campaign succeeded in increasing knowledge of water issues and had slightly affected attitudes; however, its effect on practices was insignificant. (Abu-Taleb and Murad 1999)

The sections below describe the impact of several specific social marketing and CBSM conservation programs in the United States and Canada. The CBSM program implemented in the region of Durham in Ontario, Canada, appears to be one of the most successful examples of an education campaign for water conservation. The analytic methodology used in the studies summarized below varies, as do the results. Great care should be taken when evaluating these results to ensure an "apples to apples" comparison.

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[14] Deterioration refers to "some decline in positive attitude and intentions" towards water conservation that occurred during the "price structuring" phase of the study. (Watson et. al. 1999)

Social Marketing Research Example: Water Conservation Awareness, Attitudes, and Behaviors

The Arizona Municipal Water Users Association (AMWUA) contracted BBC Research & Consulting in 2006 to test for water conservation awareness, attitudes, and behaviors in nine cities: Chandler, Gilbert, Glendale, Goodyear, Mesa, Peoria, Phoenix, Scottsdale, and Tempe. Focus groups representing Arizona's East, West, and Central Valleys, as well as a Spanish-speaking group were used to design a survey. Researchers compared the results of 1,400 telephone surveys of single-family homes and responses from focus groups with actual water use behavior. (BBC 2007)

The study was designed to "gauge current awareness" of the *Water – Use It Wisely* campaign (and other programs) and to "explore the relationship between such awareness… and conservation attitudes," as well as look at the relationship between "conservation attitudes" and actual water use patterns. Findings from the studies are summarized below (BBC 2007):

- Most households in the study cities perceived their water use as less than it actually was.
- Households that claimed to reduce their use did not use less than those who claimed not to have reduced use.
- There was no statistically significant correlation between awareness of *Water – Use It Wisely* and related conservation strategies and the amount of water that households actually used.
- Households "have not made a strong cognitive connection between general water conservation and the more specific *Water – Use It Wisely* program."
- Some households expressed altruistic reasoning to explain their "motives for conserving water."

This study provides insights into the impacts of a large, well-crafted, and carefully implemented social marketing water conservation program. The study provides information on customer awareness, attitudes toward social marketing, and expected water use behaviors.

CBSM Programmatic Example: Region of Durham

The regional municipality of Durham, Ontario, Canada, implemented CBSM programs starting in 1997 to reduce high irrigation demands during the summer and to achieve other conservation goals. High irrigation demands, often 150–200% of average winter day demands, often occurred on consecutive days, several times during the year. As is the case with many water utilities, infrastructure elements in the region of Durham (i.e., treatment plants, mains, reservoirs, valves, etc.) were specifically designed and built to handle peak demands that are typically fueled by high irrigation demands (Veritec 2000, 2001, 2003), (Pleasance 2002).

"Study areas" and a "control area" were established, and various CBSM programs were implemented to impact the residents of the study areas from 2000 to 2003. Findings from the studies were reported as follows (Veritec 2003):

- The data collected during the summer of 2002 indicates that the control area continued to use more water for irrigation than either the 2000 or the 2002 study areas.
- The irrigation savings achieved in 2000 fell slightly over time but were generally maintained (87% of savings originally achieved in 2000) even though there were no subsequent interventions in the area.
- The irrigation savings achieved in 2002 were comparable to the original savings achieved in the 2000 study even though implementing the CBSM program required contacting a significantly greater number of households.
- Both the 2000 and the 2002 CBSM programs are more cost effective at meeting growing peak day water demands than the construction of new infrastructure.

CBSM Programmatic Example: City of Calgary, Alberta, Canada

The city of Calgary's Waterworks 2005 Draft Water Efficiency Plan developed strategies and action areas to enhance the efficiency of its customers' water use. The strategies may be defined as best practices for achieving (among other objectives) "behavioral and attitudinal change." One core strategy, fostering a conservation ethic, combines communication and social marketing to "incrementally build awareness," make customers aware of their own "personally relevant" barriers and opportunities for behavioral change, and "ultimately persuade Calgarians to become stewards" of the city's water resources. (City of Calgary 2005) Action areas planned to carry out this strategy are as:

- Develop programs for all customers that promote both the benefits of and opportunities for water conservation.
- Provide opportunities for residential and commercial, institutional, and industrial (CII) customers to better understand their water use.
- Enhance education programs to ensure that they identify and address potential customer concerns or barriers to adopting water-wise behaviors and technologies (e.g., cost, inconvenience, false perceptions).
- Develop campaigns that encourage Calgarians to adopt sustainable water use practices for irrigation, gardening, and other outdoor applications.
- Implement communication strategies that focus on ways Calgarians can reduce water use inside their homes.
- Measure the effects of education and marketing programs on Calgarians' water use behaviors and attitudes toward water conservation.
- Support water education opportunities for youth, who can act as change catalysts in their homes and communities.

Calgary's 2006 annual survey on water conservation demonstrates the impacts of its social marketing (and other) programs. According to its survey, 65% of water customers claim to have participated in a conservation program or used water-saving tips. One interesting finding is that although 75% of survey respondents agreed on the importance of promoting conservation, only 64% perceived that conservation was important in their respective homes. (City of Calgary 2006)

CBSM Research Example (Non-Water Related): Pilot to Increase Do-It-Yourself Oil Recycling Rates

California State University, San Marcos conducted CBSM test pilots in three California counties: Los Angeles, Madera, and Napa. The study revealed that grant funding spent promoting used oil recycling through mass media did not increase public adoption of those behaviors. That is, although campaigns do raise public awareness, awareness is not sufficient to alter behavior. According to this study, however, CBSM successfully increased public participation in oil recycling. Pilot studies were tailored to address the four counties' respective recycling barriers. (California State University Foundation 2006) Below are some key findings from the test pilots:

- Los Angeles County
  - Barrier: Recyclers were turned away from centers because they lacked appropriate collection containers.
  - Intervention Strategy: Distribute free collection containers affixed with motivational prompts.
  - Result: Centers that distributed free collection containers with motivational prompts experienced a 22% increase in the volume of oil collected.
- Madera County
  - Barriers: Lack of oil recycling commitment and no oil collection centers in unincorporated region.
  - Intervention Strategies: Distribute free oil funnels affixed with commitment pledge stickers. Giving customers exiting NAPA Auto Parts stores one of three incentive packets:
    - » Packet 1: A $5 gift certificate and used oil recycling brochure (the control group)
    - » Packet 2: A $5 gift certificate, the brochure, and an oil funnel
    - » Packet 3: A $5 gift certificate, the brochure, and an oil funnel affixed with an oil recycling pledge sticker
  - Results:
    - » Packet 1: 6% reported improper disposal, and 22% reported oil recycling.
    - » Packet 2: 0% reported improper disposal, and 40% reported oil recycling.
    - » Packet 3: 0% reported improper disposal, and 37% reported oil recycling.
    - » Free funnels increased intent to recycle, but the pledge sticker did not.
- Napa County
  - Barriers: Majority of respondents did not know enough about the county's curbside oil recycling program or were not motivated enough to use it. Many also believed that their fellow DIY residents infrequently recycled their used oil.
  - Intervention Strategy: Send residents informational curbside program enrollment/commitment mailers containing testimonials from community role models about the value of the program.
  - Results: A 22% increase in curbside oil enrollment in one area and a 45% increase in another. A 248% increase in the number of curbside oil pickups followed a month after the intervention.

Case Study – Seattle 1% Program

The Seattle Regional 1% Water Conservation Program (*1% Program*) is a broad efficiency campaign sponsored by the Saving Water Partnership (SWP). This Partnership includes the City of Seattle and a group of 17 utilities purchasing wholesale water from the City of Seattle. Seattle Public Utilities administers the *1% Program* in collaboration with participating wholesale utility customers, under terms of long-term water supply contracts.

The long-term goal of the *1% Program* is to keep water demand at the end of 2010 the same level as it was in 2000, despite growth in population and economic activity. To achieve this goal based on the forecasted growth rates at the time of program initiation, three specific target objectives were developed to track program achievements:

- Reduce peak season per capita average consumption 1% per year from 2000 to 2010.
- Achieve total programmatic conservation savings (as adjusted following the departure of CWA utilities) of 14.5 million gallons per day (MGD) peak season savings (11.0 MGD annual average) in the 10 years from 2000 through 2010.
- Achieve annual programmatic conservation savings targets. The target for 2005 was 1.2 MGD peak season savings (0.9 MGD annual average).

The 1% target was selected to achieve a number of objectives, including:

- Keeping up with demand
- Resource stewardship and endangered species protection
- Cost-effective extension of existing supplies
- Customer service
- Reliability

Program Measures

The *1% Program* is an integrated conservation effort that includes some social marketing components, but which focuses on specific measures and strategies that have been proven to affect water savings. The program is targeted at the residential and the commercial sector and includes an information/education/marketing component that is designed to support the savings from the identified measures. This program does not anticipate that information or marketing alone will achieve the desired results.

Table 2.1 provides a list of the measures and strategies implemented by participating agencies in the *1% Program* (not all of these measures are implemented by all participants). Different strategies may be employed to target the same measure such as toilet retrofits.

Table 2.1
Measures and Strategies for *Seattle 1% Program*

Types of Measures	Types of Strategies
Residential Indoor	
• Replace washing machines • Replace toilets and faucets (single family and multifamily) • Fix leaks • Change behaviors (flushes, faucet use, shower time, full loads)	• WashWise rebates • Multifamily toilet rebates • Building owner and operator targeting • Behavior messaging • Collaboration with energy utilities • Program recruiting through media, mailing • Promotion of Flush Star toilet performance
Residential Landscape	
• Improve watering efficiency - Irrigation system performance - Landscape watering behaviors - Practices that affect watering (e.g., mulch and soil prep)	• Irrigation system efficiency rebates • Aesthetic-oriented media campaign • Regional sales events • Retailer partnerships (nurseries and home and garden centers) • Technical materials • High peak users targeting
Commercial Process/Domestic	
• Upgrade toilets and other domestic water use fixtures • Upgrade efficiency of equipment for cooling, process other industrial uses • Improve cooling performance • Upgrade efficiency of specific water consuming medical and lab equipment • Replace pre-rinse spray heads	• Small and large business targeting • Restaurant targeting and other users of inefficient pre-rinse spray heads • Project recognition through BEST awards program • Outreach to chambers of commerce and other business groups through Resource Venture • Technical assistance, assessments, workshops • Financial incentives (custom projects and standard rebates) • Bonus incentives to increase specific measure participation • Targeted promotion through vendors, trade groups, agencies • End-use metering wherever possible to build cost-effective conservation recommendations
Commercial Landscape	
• Upgrade irrigation equipment (controls, rain sensors, drip) • Improve scheduling and maintenance	• Assessments, workshops, and technical assistance • Financial incentives (custom projects and set rebates) • Targeted recruiting and promotion • Market transformation by establishing and building vendor and contractor relationships
Youth Education (Supports savings in other sectors)	
• Build conservation awareness and residential measures	• Educator training and resources • Classroom and take-home materials • Educational TV PSA for kids • Interactive activities
Overall Messaging (Supports savings in other sectors)	
• Conservation awareness supporting recruitment of residential and commercial customers	• Targeted marketing • Collaboration with Puget Sound regional water utilities • Festivals

Results

The *1% Program* has yielded impressive results since it began in 2000. The cumulative long-term water savings are on track to reach the long-term goal stated in the initial plan. According to the Program's 2005 report, savings of 0.94 MGD were achieved in 2005, slightly above the annual target of 0.9 MGD. Total long-term customer savings for 2005 were 2.4 MGD. This consists of the savings from the *1% Program*, as well as price, code, and Seattle-only conservation.

Social Marketing Research Example–Using Mass Media to Influence Energy Consumption Behavior: California's 2001 Flex Your Power Campaign as a Case Study

(Bender, Moezzi, Gossard, Lutzenhiser, 2002)

In 2001, California was at the height of an energy crisis. Record demands on California's energy supply resulted in energy alerts, predictions of blackouts, and intense media coverage. To address this crisis, Governor Gray Davis signed legislation implementing a large and aggressive energy conservation effort targeting the summers of 2001 and 2002. Governor Davis set an aggressive goal for 2001–reduce summer peak energy demand by 5,000 megawatts. The Flex Your Power campaign was developed in response to the Governor's legislation.

Using mass marketing to reduce residential energy consumption emerged as a popular strategy in the energy sector in the 1990s. Flex Your Power provides an example of how mass marketing campaigns can be effective in achieving long and short-term conservation goals. The success of Flex Your Power cannot be attributed solely to mass media. Rather, the combination of mass media along with outreach to businesses and community groups contributes to the program's success. However, Flex Your Power's mass media campaign can be credited with helping to achieve dramatic results in a very short time period. By October 2001, just eight months after campaign launch, Californians had reduced peak electricity demand by 6,369 megawatts; 3,743 megawatts (59%) were credited to a demand responsive and rebate/incentive programs, and 2,616 megawatts (41%) were credited to voluntary conservation savings. (California Energy Commission, 2002)

California used mass marketing as the primary communication tactic to launch Flex Your Power. This study evaluates the effectiveness of Flex Your Power's mass media campaign using four key factors:

1. Targeting the right audience;
2. Delivering a credible, understandable message;
3. Delivering a message that influences audience beliefs; and
4. Creating a social context that leads to the desired outcome.

While California's energy crisis set a unique context for the development and promotion and success of the social marketing effort, Bender et al. maintain that the atypical context of the energy crisis cannot be the only reason for the linking of individual action with collective benefits. Using results from telephone survey cross-matched with billing data, interviews, behavioral research, and media tracking, the analysis provides relevant insights into how research, understanding the target audience, developing and delivering clear, vivid, doable conservation messages, and repetition are critical for campaign success and behavior change.

A National Example: ENERGY STAR®

ENERGY STAR's success as a well-known and credible label is the result of marketing and outreach conducted at the national level to manufacturers, retailers, and homebuilders as well as locally and regionally by program sponsors such as utilities and other entities. Some ENERGY STAR marketing programs were developed by the regional sponsors and therefore the tactics used were specific to accomplish the goals and objectives set forth by the sponsors. The summary presented here provides a general overview of ENERGY STAR.

The success of ENERGY STAR is a testament to the dedication and determination of EPA, U.S. Department of Energy and the many different retailers and local and regional programs that support ENERGY STAR through incentive programs, retailer promotions, and homebuilder marketing. The development of ENERGY STAR began in the 1990s when EPA started looking at sources of greenhouse gas emissions and means to reduce these emissions. In 1992, EPA introduced ENERGY STAR as a voluntary labeling program designed to identify and promote energy-efficient products whose use in the workplace and at home would reduce greenhouse gas emissions. Computers and monitors were the first labeled products.

As a product label, ENERGY STAR motivates businesses, public organizations, and individuals to take action to help protect the global environment, while saving money on energy bills and maintaining their quality of life. ENERGY STAR is designed so that ENERGY STAR qualified products, homes, buildings, and services are more energy-efficient than conventional products and therefore help reduce greenhouse gas emissions.

But developing a label alone was not enough. All market actors (e.g., manufacturers, retailers, consumers) must understand the value of the label, choose to promote it, and subsequently make it the preferred choice among consumers. Marketing to all actors was critical to ENERGY STAR's success. In other words, the product must be accessible, but demand must also be high for manufacturers to develop product. The "push-pull" of the market needed to be activated to advance the awareness and adoption of ENERGY STAR.

Today ENERGY STAR is promoted year-round via three major marketing campaigns implemented by program partners. Each campaign consists of a set of promotional materials (e.g., signage, print PSAs, press releases, radio and TV PSAs, Web tools), and messages that program sponsors can use to promote the campaign to their customers. Using a franchise approach, ENERGY STAR allows sponsors to take credit for their actions by customizing the marketing pieces and provides value because the creative pieces are pre-developed. Primary ENERGY STAR campaigns include:

- *Heat Your Home Smartly*: A winter campaign that offers advice to help Americans to heat their homes smartly and stay comfortable, while also saving energy and helping the environment;
- *Cool Your World*: A summer effort, the ENERGY STAR Cool Your World campaign encourages Americans to cool their homes smartly with ENERGY STAR products, use less energy, and protect our environment by preventing greenhouse gas emissions; and
- *Change a Light, Change the World*: Perhaps ENERGY STAR's most successful campaign, the ENERGY STAR Change a Light, Change the World campaign is a national challenge to encourage every American to help change the world, one light-one step-at a time. The campaign culminates around ENERGY STAR Change a Light Day. EPA and DOE, along with organizations around the country, encourage

> Americans to take the ENERGY STAR Change a Light Pledge. This campaign is a great example of CBSM as it encourages individuals and communities to commit to a cause and take an easy first step at fulfilling their promise.

To date, ENERGY STAR has achieved over 68% brand awareness. (EPA 2007) Sixty-two percent of consumers understand ENERGY STAR to mean energy efficiency and cost savings. (EPA 2007) Water providers can capitalize on the success and learning from ENERGY STAR in two significant ways; first, water providers can capitalize on ENERGY STAR label recognition to promote the water saving features of appliances such as washers and dishwashers. Potential marketing opportunities include cross-promotion with DIY and appliance retailers year-round or seasonally; second, water utilities can learn from the various strategies and tactics implemented by electric and gas utilities–from public relations to mass media radio and TV advertisements to in-store retail promotions. Market research and a clear understanding of the key market actors in the water utility field, is the critical first step to developing a social marketing campaign that will accomplish the goals set forth by each water provider.

RESIDENTIAL WATER USE AND FACTORS INFLUENCING CONSUMPTION

Residential demand often represents the greatest portion of water use for an urban provider. There are almost always more residential customers than any other customer class for any given utility. Given these facts, it is not surprising that many urban water conservation programs target the residential sector, which has the most customers and often the highest demand.

The 1999 AWWARF *Residential End Uses of Water* study (REUWS) offers a snapshot of demand in a sample of nearly 1,200 single-family residential customers spread across 14 cities in the United States and Canada. (Mayer et al. 1999) The REUWS reported that the average single-family indoor water use was 69.3 gallons per capita per day (gpcd). Figure 2.1, reprinted from the REUWS, shows the mean per capita water use measured for each end use category. Water used from toilets, clothes washers, showers, and faucets accounted for more than 80% of all indoor demand.

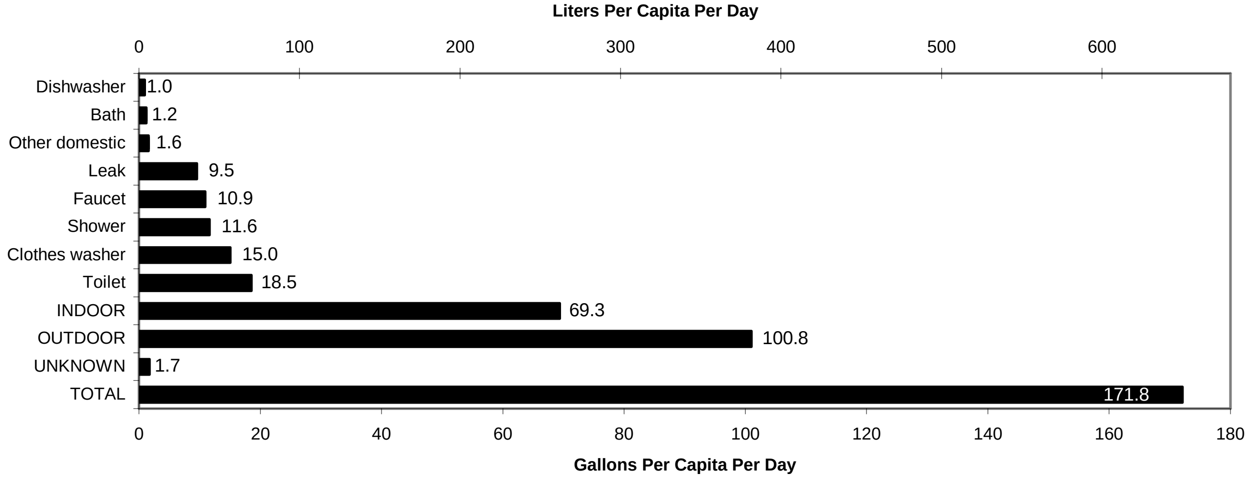

Figure 2.1 Mean daily per capita water use, 12 study sites (from REUWS 1999)

Another component of the REUWS was to examine the factors that influence residential water use. This was accomplished using survey responses matched with data on water consumption and local weather. These data were developed into an ordinary least squares (OLS) multiple regression model that estimated the coefficient value for each potential factor that influenced water use in the study group. The result was an elaborate model with an R-squared value (measure of the goodness of fit of the model) of 0.479. This indicates the model is capable of explaining about 48% of the variability in water use found in the data. While the fit of the model is adequate, it also serves to illuminate the set of factors (available in this study) that appear to have the biggest impact on residential water used. Table 2.1 presents a list of these factors sorted by their relative impact on water use (i.e., regression coefficient) so that factors with a bigger impact on demand are listed first. A negative number indicates the factor contributed to a decrease in use.

A total of 20,551 observations on monthly average water use, survey, price, and weather data were used in the estimation process. As shown in Table 2.2, the model contains a group of binary variables indicating the month of the billing period. The coefficients show the common distinct seasonal trend in average single-family water use. Among the sample, the month of July was on average the month of highest average use, while February was generally the month of lowest average daily use. As expected, water use is shown to increase with temperature and decrease with precipitation, which, similar to the seasonal component, is related to the outdoor component of total use–a component of use that cannot be precisely differentiated from total use without the aid of data logging.

Average daily use increases with the number of persons in a household, which is certainly related to the indoor/domestic component of total use. Generally, however, the model indicates that children and teenagers add incrementally less to average daily use than adults. Further, the greater the number of persons employed outside the home, the less water use that occurs.

Household water use increases with the number of toilets and showers in the home, but decreases with the number of toilets that have been retrofitted with the conserving/ultra-conserving variety. The indicator variable for the presence of a dishwasher shows little significance and retains a negative sign, which is contrary to expectations. The clothes washer indicator suggests that households with clothes washers use about 10% more water, on average, than their counterparts. Similarly, households that have evaporative coolers, pools, and/or irrigation systems use substantially more, on average, than households that do not have these end uses.

As expected, households that have access to other non-utility sources of water (such as a well, ditch, or harvested rainwater for irrigation) display lower billed water use than those that rely solely on utility-supplied water, everything else held constant.

Table 2.2
OLS model of household billing data water use

Variable Definition	Coefficient	Std. Error	T Statistic	P-Value
Intercept	0.267	0.226	1.18	0.24
Log_{10}(average maximum temperature)	0.568	0.045	12.76	0.00
Log_{10}(household size)	0.465	0.015	31.17	0.00
Indicator that billing period is July (0/1)	0.387	0.03	12.97	0.00
Indicator that billing period is June (0/1)	0.325	0.028	11.42	0.00
Indicator that billing period is August (0/1)	0.324	0.029	11.33	0.00
Indicator of swimming pool (0/1)	0.257	0.013	19.64	0.00
Indicator of additional water sources for outdoor use (example–well) (0/1)	-0.243	0.019	-13.06	0.00
Indicator that billing period is May (0/1)	0.201	0.027	7.52	0.00
Indicator that billing period is September (0/1)	0.17	0.027	6.24	0.00
Indicator of automatic timer sprinkler (0/1)	0.168	0.013	12.52	0.00
Indicator that the household irrigates (0/1)	0.159	0.027	5.96	0.00
Log_{10}(total precipitation(in.)+1)	-0.159	0.009	-18.5	0.00
Log_{10}(home living space (sf)), midpoints of intervals	0.158	0.017	9.22	0.00
Indicator of in-ground sprinkler system (0/1)	0.147	0.013	11.41	0.00
Indicator house retrofitted all usable toilets (0/1)	-0.147	0.033	-4.4	0.00
Log_{10}(number of children+1, ages 0-12)	-0.136	0.013	-10.54	0.00
Indicator that billing period is February (0/1)	-0.134	0.02	-6.57	0.00
Indicator that household wasn't responsible for paying water bill (0/1)	-0.125	0.047	-2.68	0.01
Indicator of evaporative/swamp cooler (0/1)	0.111	0.016	7.02	0.00
Indicator of flower and/or vegetable garden (0/1)	0.104	0.01	10.83	0.00
Log_{10}(water marginal price[2nd block]+1)	-0.102	0.047	-2.18	0.03
Indicator of clothes washer (0/1)	0.09	0.019	4.63	0.00
Indicator that billing period is March (0/1)	-0.09	0.021	-4.26	0.00
Indicator that billing period is October (0/1)	0.086	0.022	3.82	0.00
Indicator that billing period is April (0/1)	0.082	0.024	3.48	0.00
Indicator house was built between 1990–present (0/1)	-0.072	0.017	-4.21	0.00
Log_{10}(lotsize(sf)), midpoints of intervals	0.065	0.006	11.15	0.00
Indicator that billing period is January (0/1)	-0.063	0.02	-3.09	0.00
Indicator of whirlpool bathtub (0/1)	0.062	0.015	4.02	0.00
Indicator house was built before 1960 (0/1)	-0.05	0.014	-3.57	0.00
Indicator of garden hose w/ attached sprinkler (0/1)	0.044	0.011	4.2	0.00
Number of showers	0.043	0.008	5.53	0.00
Indicator of home water treatment system (0/1)	0.038	0.011	3.35	0.00
Indicator that billing period is November (0/1)	-0.037	0.021	-1.81	0.07
Log_{10}(household income, midpoints of intervals)	0.035	0.008	4.25	0.00
Household ultra-low-flush toilet ratio	-0.034	0.011	-3.13	0.00
Log_{10}(number of teenagers+1, ages 13-17)	-0.025	0.015	-1.63	0.10
Indicator of hot-tub (0/1)	0.024	0.014	1.74	0.08
Indicator house was built between 1960–1969 (0/1)	0.019	0.014	1.42	0.16
Indicator house was built between 1970–1979 (0/1)	0.018	0.013	1.37	0.17
Indicator of drip irrigation system (0/1)	0.017	0.012	1.4	0.16
Indicator of dishwasher (0/1)	-0.011	0.014	-0.78	0.44
Indicator of rented house (0/1)	0.009	0.019	0.49	0.62
Number of toilets	0.005	0.01	0.54	0.59
Number of sinks(bathroom, kitchen, indoor utility)	0.005	0.005	0.95	0.34

(continued)

Table 2.2 (Continued)
OLS model of household billing data water use

Variable Definition	Coefficient	Std. Error	T Statistic	P-Value
Indicator of garbage disposals (0/1)	-0.003	0.013	-0.22	0.82
Percentage of lawn among landscape	0.002	0.00	9.83	0.00
Dependent variable:	Ln(Logged Total Daily Use in GPD)			
Observations:	20551			
Root Mean Square Error(RMSE):	0.589			
Mean Square Error:	0.347			
R-Square:	0.479			

Key Factors in Residential Demand

The research team reviewed models prepared for two previous projects: the REUWS (Mayer et al. 1999) and the EPA-sponsored Combined Retrofit Studies (Aquacraft, Inc. 2005), conducted in Seattle, WA; Oakland, CA; and Tampa, FL, to determine which factors were found to be the most relevant for explaining water use in those studies.

The following were determined to be the most important factors, which are readily available to water utilities and researchers. It is important to keep in mind that these factors were chosen from a much larger survey that often included more detailed questions. For example, the survey asked not just about the household size but also about the number of adults, teens, and children living in the home. These more detailed parameters were either found not to increase the predictive ability of the model at all or were not predictive enough to warrant the extra effort required to obtain them.

Marginal Price of Water (MPW)

This was found to be important for predicting toilet use, shower/bath use, dishwasher use, leaks, and outdoor use. The best sources for these data are the water and wastewater utility serving the customer.

Household Size (HS)

The number of residents in the home was found to be significant to explaining toilet use, shower/bath use, faucet use, dishwasher use, clothes washer use, leaks, and other domestic uses. The best source for these data is from the occupants through either a survey or a telephone call.

House Area (HSQFT)

The area of the finished living space in the home was found to be significant to explaining toilet use, faucet use, and leakage. Possible sources of these data include occupant-supplied information, tax assessor records, or Internet data sources such as www.zillow.com.

Year House Built (HSYR)

This can be used to calculate a range of time parameters. In the REUWS, the values Pre60s and Post80s were used (meaning the percent of houses in the population built prior to 1960 or after 1980, respectively). These variables were found to be significant for only toilet use and were meant to capture the impacts of plumbing code changes that mandated toilets that use 3.5 gallons per flush (gpf). At present it would make more sense to use a date relative to the 1992 Energy Policy Act (EPAct). The date most often used to capture this is 1995, which allows time for implementation to take effect. If the year the house was built is known, then a variety of cut-off dates can be used for time parameters. The best sources of these data include user-supplied information, assessor data, utility data (when the meter was first installed), or Internet data.

Presence of ULF Toilets (ULFT)

This covers whether the house is partially or fully equipped with 1.6 gpf ultra-low flow (ULF) toilets. This parameter also could cover whether the toilets are 1.6 gpf or 1.1 gpf high-efficiency models (WaterSense specification). The best source for this information is from recorded flow trace data or in-home audits. Customer surveys are a notoriously unreliable source for this information.

Presence of High-Efficiency Clothes Washer (HECW)

Models that use 25 gallons per load (gpl) or less classify as high-efficiency models. The best source of this information is from flow trace analysis or user surveys. Flow trace analysis provides information on the average gpl of the machine. As an alternative, the residents can provide the make and model of the washer, and the water use can be determined by referencing ENERGY STAR databases.

Household Income (INC)

This is the average household income for the group. The best source is through surveys or proxy factors such as census data or house value.

Rental Status (RENT)

Another parameter is whether the home is rented or owned. The researchers found this parameter significant for predicting leakage. The best source for this information would be from a survey.

Presence of Low-Flow Showers (ULS)

The presence of 2.5 or 1.7 gallons per minute (gpm) showerheads also is important. The best source of this information is from flow traces or household audits.

Presence of Home Water Treatment (TREAT)

A fraction of residential customers have home water treatment systems that use water for regeneration. These devices are commonly found in areas with hard water that requires softening. The best source of information is from surveys, flow traces, or local knowledge (i.e., “everyone in our city has one”).

Presence of Swimming Pools (POOL)

Pools were significant for predicting leakage and outdoor use. The best sources of this information are surveys, audits, or aerial photographs.

Size of Lot (LOTSIZE)

The size of the lot (square footage) is a useful factor for predicting outdoor water use. The best data sources include assessor databases, plat maps, utility GIS, Google Earth, or other Internet resources. These data can be used in conjunction with the house size to estimate irrigated area. An alternate approach is to use aerial photo analysis to determine irrigated areas directly.

Presence of an In-Ground Sprinkler System (SPRINK

This factor is used for predicting outdoor use. The best sources are flow traces, home audits, or surveys.

Presence of a Hot Tub (Spa) or Evaporative Cooler (HOTTUB) or (COOLER)

These factors were useful for predicting “other domestic uses” of water. Evaporative coolers may be an important factor in seasonal demand. The best sources of these data are surveys or in-home audits.

Researchers can construct end use models that use these parameters to predict household water use in populations. These models also can be used to project the impacts of conservation programs.

Impacts of Conservation Programs

Conservation programs are as diverse and unique as the water utilities that implement them. The impacts of these programs range tremendously depending upon the program size, scope, budget, targeting method, conservation potential, customer acceptance, and a number of other factors. Some of the education and communication programs described earlier in this chapter were not able to show statistically reliable water savings as a result of the campaigns. Different programs that focus on technological changes such a toilet rebates, turf replacement, clothes washer rebates, etc., have been able to demonstrate statistically reliable water savings.

Indoor Water Savings from Technological Changes

How much can water use be reduced indoors in a single-family home through technological changes? A series of retrofit end use studies sponsored by the EPA determined the approximate current limit of indoor water savings available from standard technological changes such as replacing toilets, clothes washers, showerheads, and faucets (Aquacraft, Inc. 2005), (Mayer 2007). This study examined indoor water use in 96 single-family homes in Seattle, Oakland, and Tampa before and after installing water-conserving toilets, clothes washers, showerheads, and faucet aerators. The participating homes had water use patterns that were statistically similar to those of single-family customers in each of the participating water utilities' territories. (Mayer 2007)

The study found that installation of water-efficient fixtures reduced indoor use by 29.7 kgal per household per year–a savings of 39%. (Aquacraft, Inc. 2005) Most of the water savings were accomplished through the toilet retrofit, which also resulted in reduced leakage since older toilet fixtures are prone to serious leaks. The toilet retrofit saved 21.1 kgal per household per year, the clothes washer retrofit saved 5.6 kgal per year, showerheads saved 1.6 kgal per year, and the faucet aerators saved 1.4 kgal per year. (Aquacraft, Inc. 2005)

Additional indoor technological savings beyond the 39% reduction measured in this study are possible. High-efficiency toilets that use 1.3 gallons per flush or less were only used in about one-third of the homes in the EPA study. Higher-efficiency clothes washers are available. Additional devices such as hot water recirculation systems, small-scale gray water reuse systems (where reused water is used to flush toilets), water smart readers for consumption monitoring, and other devices may further reduce indoor demand. In general it is reasonable to assume that a 40 to 45% reduction in indoor water use for a single-family home is possible through technological changes alone and without any alteration in water-using behavior (i.e., shorter showers). A 40 to 45% reduction represents a maximum target for indoor conservation programs that go after the "low-hanging fruit" of toilet, clothes washers, showerheads, and faucets.

Outdoor Water Savings from Technological Changes

For many water utilities, outdoor use for landscape irrigation represents the largest end use of water in their systems. Irrigation drives peak demands and is typically the end use that new water treatment plants are sized to meet. Substantial reductions in outdoor water use are possible through a variety of measures that range from improving the efficiency of irrigation systems and their operation to replacement of turf grass with landscape materials that require little or no supplemental irrigation beyond natural precipitation. Unlike indoor savings potential, which is relatively similar across water utilities with housing stock of a similar age, outdoor savings potential is dependent upon regionally specific conditions such as climate, local landscape choices, and precipitation.

Automatic irrigation systems have been shown to result in substantially higher water use than manual irrigation (even when landscape size and climate are controlled for). (Mayer et al. 1999) However, automatic irrigation is a convenience that many homeowners want; hence, many water utilities are seeking technological methods for improving automatic irrigation efficiency. Technologies such as soil moisture sensors, rain shutoff devices, and water-smart irrigation controllers that adjust applications to meet local climate conditions are being considered for inclusion in the EPA WaterSense labeling program, and water utilities are offering incentives for their use. The potential water savings from these devices is not fully known. Preliminary studies suggested that weather-based (smart) irrigation controllers can reduce demand anywhere from 10 to 25% (Aquacraft, Inc. 2002), (Santa Barbara County Water Agency 2003), (D&R International 2005). A large-scale field study of water-smart irrigation controllers was completed in June 2009 and is available for free download from the California Urban Water Conservation Council (www.cuwcc.org).

Aside from irrigation controllers, there are a number of irrigation and landscape practices and technologies that can promote water efficiency for the residential and small commercial sectors. These can be divided into two broad categories:

- Landscape plan, design, installation, and maintenance
- Irrigation system design, construction, and maintenance

Turf replacement programs such as the Las Vegas Xeriscape program have measured sizeable outdoor water use reductions through the removal of turf grass landscapes. The best documented Xeriscape study to date is the 2006 research conducted by Sovocool, et al., in Las Vegas. This carefully controlled study found homes that converted from turf grass to Xeriscape achieved a 30% decrease in yearly total household water use. (Sovocool et al. 2006) This amounts to a 50% to 60% reduction in outdoor water use.

A 50% reduction in outdoor use represents a lofty but proven achievable target for consideration. Local conditions must be considered, and a 50% reduction in outdoor demand is not a reasonable target for all utilities. Even a 25% reduction in outdoor use across a utility would represent a tremendous achievement.

Utility Conservation Program Savings

The indoor (40% to 45%) and outdoor (25% to 60%) savings described above represent the outer limits of technologically achievable residential water savings. Further reductions are possible but require behavioral changes and often personal sacrifice, and these are usually only sought during a water supply emergency such as a drought. Utility programs tend to have more modest savings goals such as the *Seattle 1% Program*, which aims to reduce demand by 1% per year. It is common to find utility water conservation savings goals in the range of 5% to 20% to be achieved over a 10- to 20-year implementation period.

RANGE OF COMMUNICATION STRATEGIES AND TACTICS USED BY WATER UTILITIES

For this review, conservation collateral materials were requested of water utilities as were overviews of communication strategies and approaches. In general, unless a utility is implementing a specific campaign (e.g., *Water – Use It Wisely*), communication materials often serve as stand-alone educational materials aimed at guiding end users to more desirable behaviors. We examined sample materials such as general audience brochures, annual reports, and guides to water use. Materials focused solely on select solutions to saving water, but none attempted to convince the audience that 1) a problem existed; 2) solutions offered were effective in addressing the problem; and 3) that not implementing the solutions defined could create negative consequences. Further investigation needs to occur in order to better evaluate the value and content of such collateral materials–in particular information should be collected and evaluated on how each piece was distributed, to whom it was targeted, or to what level of success the material had been used. See Appendix F for a table that summarizes the range of strategies and tactics.

McKenzie-Mohr says brochures are a waste of resources without all the additional CBSM steps being implemented.

CONCLUSION

This comprehensive literature review allows for a number of observations. One is that social marketing research and theory is abundant, and its application and approaches are relevant to water conservation. Numerous titles presented in the master reference list focus on approaches, theories, and research into the topic of social marketing. Many of those titles focus on social marketing's application in the areas of health and wellness, including drinking and driving, HIV/AIDS, and smoking. Fewer titles focus on environmental issues. Literature that examines its application and efficacy in the area of water conservation is markedly absent.

A second observation points to the fact that the definition and approaches of social marketing have and continue to evolve. Alan Andreasen underscores this in his book titled *Social Marketing in the 21st Century*, when he addresses the need for social marketing to more directly apply *upstream* approaches. He writes, "Most observers and many practitioners see social marketing as an approach to influencing people with 'bad behaviors'. However, this narrow view hugely underestimates social marketing's real potential. Social marketing is simply about influencing the behavior of target audiences. There are many more target audiences who need to act besides 'problem people' if we are to solve major social problems." (Andreasen, 2005). Those projects examined in this literature review with the greatest impact were those that included a mixed approach of policy changes (such as rate structure), communications, and incentives.

A number of studies have sought to quantify the impacts of water efficiency outreach campaigns that provide information and education to consumers. The results are mixed, but it is common to find that an education and information campaign for water conservation heightens awareness and increases knowledge but often does not impact behavior.

This literature review suggests some existing studies offer significant promise with regard to providing additional insight into how communication can most effectively influence water conservation behaviors. And finally, the REUWS offers valuable data to marketers with regard to determining what types of households targeted can make the greatest impact on water savings.

CHAPTER 3
OVERALL RESEARCH APPROACH AND METHODOLOGIES USED

The research reported here employed a multiple method approach to address the research questions. By obtaining data from a variety of methods, researchers are able to assess the extent to which the data converge toward similar findings. The value and validity of the findings are strengthened in those instances where such convergence occurs.

Methods included interviews with the partner utility officials, capturing billing data for residential customers in the areas serviced by the utility partners, and a survey distributed to approximately 6,000 residential customers. The remainder of this section describes the methods used in more detail and provides a summary of the statistical analytical techniques employed, as follows:

- Literature review
- Utility interviews and case study development
- Sampling the residential customers and obtaining water billing data
- Questionnaire development
- Survey administration
- Survey responses and billing data linkage
- Data analysis and analytic methods

LITERATURE REVIEW

The literature review for this study served as an important foundation for all other tasks. The information collected and synthesized in review influenced the direction and scope for subsequent components of the project. The subtasks for the literature review included the following:

- An examination of the state of knowledge regarding residential water use and the impact of conservation programs
- A review of the range of water conservation communication strategies and tools put into practice

The ICF/Aquacraft Team conducted an in-depth literature review examining reports provided by our partner water utilities, scholarly journals, publicly available project reports, and available bibliographies, and synthesized the current knowledge concerning awareness and behavior. This review was “source agnostic”, emphasizing the quality and utility of the reported research. Additionally, we examined the literature in other environmental issues and efforts (e.g., recycling, energy efficiency) to lend additional insights to our efforts in this project.

The literature review provides a comprehensive compilation of water conservation campaigns.

Recruitment of Utility Partners

To conduct a survey on messaging that resonates with customers and to evaluate water use, the ICF/Aquacraft Team recruited a small number of water utility companies as partners. For the purposes of research, the Team sought water utility companies that already had conducted large focused social marketing programs to reinforce water conservation behavior on the part of their residential customers.

The ICF/Aquacraft Team recruited a total of seven utility partners. These partners were selected to gain access to their residential customers, as well as to present a variety of climatological environments with different water availability and water use profiles. The seven original partners were:

1. ***Calgary, Alberta, Canada – (City of Calgary Water Services):*** This utility services 930,000 customers, 80% of whom are on water meters, and 20% are on fixed rate plans. It’s budget for water conservation with residential customers is CAD 800,000 per year, with another CAD 1,300,000 for commercial sector. With goals and measurable objectives defined, Calgary’s water conservation efforts evolved into an integrated conservation program with a diverse set of voluntary programs, pilot projects, financial incentives, and policies. In the summer of 2007, The City piloted a community based social marketing program in two Calgary neighborhoods. The “Water Wise Team” went door to door asking homeowners to participate in a summer program educating them about how to water wisely outdoors and providing them with individual guidance and tools to help them become water wise. Three hundred and sixty-four residents participated in the pilot. The program was successful and resulted in average 40% increase in homeowners who commit to new water wise behaviors. For this project, this utility provided sample questions, and the results of several of their own internal evaluation projects.
2. ***Durham, North Carolina – (City of Durham Department of Water Management):*** This utility serves approximately 70,000 customers. It promotes wise water use through a mix of mass media advertising, direct outreach and education, and City ordinances. Through these vehicles, the water conservation team helps residents understand the benefits of water conservation and provides them with the necessary knowledge and tools to reduce water consumption. The City of Durham also participates in North Carolina WaterWise Partners – a group of seven water providers formed to share the cost of participating in the *Water – Use It Wisely* social marketing campaign. At the time of this study, Durham had experienced drought conditions for several years. The drought ended in the fall of 2008.
3. ***Jacksonville, Florida – (JEA Electric Water Sewer, Greater Jacksonville, Florida metropolitan area):*** JEA serves about 360,000 customers. Its budget for conservation efforts is about $2 million, including rebate programs. Although Florida is surrounded on three sides by water, and the natural resource is seemingly abundant with regular rainfall throughout the year, much of the rain water is lost due to evaporation, and the climate is subject to drought. This climate condition coupled with a growing population and increasing demands on the water supply necessitates that the state, utilities, and residents carefully manage their water consumption. JEA implements a multi-faceted water conservation program comprised of a variety of community

outreach and mass media efforts, as well as financial incentives to raise awareness for water conservation, encourage residents to change their attitudes about water use, and to motivate residents to adopt water wise behaviors.

4. ***Orange County, Florida – (Orange County Utilities, Water Division):*** This utility services approximately 136,000 customers in Orange County, including the city of Orlando. It has a budget of $800,000 for water conservation efforts. Orange County utilizes a variety of vehicles to market their water conservation programs. These vehicles include advertising, direct mail, outreach and education, and rebate programs. Central Florida exhibits a relatively consistent climate throughout the year reducing the need for significant seasonal messaging or differences in resource allocation. Because outdoor water use is the largest end use of water in the county, many of the utility's programs focus on becoming more water efficient outdoors. Through their customer profile study, the utility determined that water usage in their service area varies by socio-economic level with the highest water users in the upper income brackets. These groups also tend to live in specific areas enabling Orange County to target programs by message and geography.
5. ***Phoenix, Arizona – (City of Phoenix Water Services Department):*** This utility provides water service to an estimated 1.6 million residents in the Phoenix area. For more than 23 years, the City of Phoenix has been implementing water conservation programs. Phoenix was among the earliest Cities to establish local efficiency standards for plumbing fixtures. In recent years the budget for water conservation has been near $1.9 million annually, with $500,000 allocated to communications and educational outreach, and $150,000 allocated to the *Water – Use It Wisely* media campaign. An additional $40,000 worth of printed materials is provided through an association membership. Phoenix’s water conservation program consists largely of community outreach and education to promote water conservation awareness and maintain the water conservation ethic among residents. The program also provides large volumes of educational materials and training for classroom teachers to incorporate water into their lessons and activities. Throughout the department’s history, the conservation program has found that conducting research and piloting programs is fundamental in developing programs that will be effective in reaching their goal to raise the efficiency of new development and reduce the community’s vulnerability to drought. The City of Phoenix works closely with Arizona Municipal Water Users Association (AMWUA) and other water utility partners in the areas to coordinate conservation efforts throughout the region. Objectives of the conservation program include raising awareness for water conservation (particularly outdoor water use) among residents, advancing the level of efficiency among new development, assisting customers with achieving a low-water use lifestyle while maintaining their preferred quality of life, and preparing customers to adapt their water use in the event of severe water supply shortages resulting from long-term drought.
6. ***Seattle, Washington – (Seattle Public Utilities - SPU):*** This utility services 1.3 million customers in the King County area, which includes the city of Seattle. It has a total operating budget for conservation efforts about approximately $1 million. Water in the Northwest is seemingly abundant, but in actuality, the region receives less average rainfall than other areas of the United States. Out of 100 U.S. cities, Seattle area ranks 56th in average rainfall at 38.6 inches behind Atlanta, Baltimore, New York and

Miami. The increased demand on water supply due to Seattle's population growth coupled with changing climate conditions has resulted in an intensified need to reduce water consumption. SPU’s water conservation programs represent an integrated approach to communications. Through their programs, SPU strives to establish a water conservation ethic among Seattle residents. SPU believes that residents must recognize and understand the need for conserving all natural resources and they must want to conserve resources before they will be receptive to messages prompting them to take actions. Both components are critical to any marketing communications effort and are necessary to change residential water use behavior.

7. ***Tempe, Arizona – (City of Tempe Water Utilities):*** This utility serves about 165,000 residents in the greater Tempe area. It has an annual budget of $300,000 for water conservation activities. Tempe’s service area consists of mainly business, industry (including Arizona State University), and multifamily residences. Therefore, the majority of water use is attributed to non-residential use. To accommodate the unique nature of Tempe’s service territory, the state of Arizona modified the Groundwater Management Code to allow the City of Tempe to measure conservation based on best conservation practices rather than a gallon per capita basis. Similarly, the number of jobs in Tempe outnumbers the residential population, posing a unique challenge to residential water conservation efforts. The keystones of Tempe’s water conservation initiative are the toilet rebate, the landscaping, and the elementary school programs. Most of the real estate in Tempe’s service territory is already developed and existing homes still have the typical 1970’s landscaping consisting of turf and high water-use trees. Therefore, Tempe focuses water conservation efforts on upgrading technology in existing homes, converting lawns to water wise landscapes, educating Tempe’s young people about being water wise, and implementing local ordinances.

Of the seven partners, Calgary played a more limited role because the utility already has an evaluation program in place, and was slated to collect data during the period of the research reported here. The results described in this report are from the six remaining utility partners.

UTILITY INTERVIEWS AND CASE STUDY DEVELOPMENT

Each of the utility partners participating in the study has a different set of geo-environmental factors that affect water use. Each utility partner has its own political setting, and each has a different history of employing various water conservation programs to reduce overall water use. To gain a better understanding of those factors, as well as to inform the development of questionnaire for the residential survey, the ICF/Aquacraft Team developed case studies of all utilities by conducting interviews with utility staff. An interview protocol was developed that contained the following sections:

- Past experience and current responsibilities
- Information about current programs
- Characteristics of program communications
- Impact of program communications
- Program metrics

- Program outcome
- Lessons learned

The protocol contained 43 questions. The protocol also contained a matrix completed by the interviewer summarizing the salient characteristics of the water conservation programs carried out by the utility. The characteristics in the matrix included:

- Geopolitical factors
- Demographics
- Housing Factors
- Target Audience
- Size of Target Audience
- Family Factors
- Message(s)
- Media Channel
- Type of Outreach Materials
- Financial Incentives
- Outcome
- Estimated Cost

A copy of the complete protocol for the partner interviews can be found in Appendix B.

The interviews were summarized as notes taken during the interview. The notes became the basis for the development of the case history for each utility partner. These case studies can be found in Chapter 4: Results. The interviews were augmented by various publications and materials related to the water conservation campaigns supplied by the utilities.

Calculating the Size of the Sample for the Residential Survey

The requisite sample sizes are determined in Equation 3.1, the desired size of the confidence interval, and Equation 3.2 the Standard Error (SE). The formula for calculating the sample size is:

$$n = \frac{P(y)P(1-y) + SE^2}{SE^2 + \frac{P(y)P(1-y)}{N}} \tag{3.1}$$

Where:

N is the population size n is the sample size
$P(y)$ is the probability of a dichotomous variable
$P(1-y)$ is the complementary probability such that
$P(y) + P(1-y) = 1.00$ (We used $y = .50$)
SE^2 is the Standard Error squared

For the purposes of calculating sample size, we use 0.50 for *P(y)* and *P(1-y)*, a very conservative estimate.

The formula for the standard error squared is:

$$\text{Standard Error}^2 = \left(\frac{\text{Acceptable Level of Error}}{\text{Z or t distribution coefficient}}\right)^2 \tag{3.2}$$

We are choosing a 95% Confidence Interval, a customary band in applied survey research. The Z or t distribution for a 95% confidence level is 1.96, and the acceptable level of error is plus or minus 5 percentage points. Therefore, the standard error is calculated as:

$$\text{Standard Error}^2 = \left(\frac{.05}{1.96}\right)^2 = .0006507 \tag{3.3}$$

Once the sample size needed to reach the required confidence level is computed, the number of surveys to be distributed is calculated by dividing the sample size by the estimated percentage of surveys that would be returned, or the effective response rate. The formula is:

$$\text{Number of Surveys Distributed} = \left(\frac{\text{Sample Size}}{\text{Estimated Response Rate}}\right) \tag{3.4}$$

Equation 3.5 presents an example of sample size calculation for the city of Phoenix with 1.7 million customers. Applying the formula for the calculation of sample size, we get:

$$n = \left(\frac{\text{P(y)P(n)} + \text{Standard Error}^2}{\text{Standard Error}^2 + \left(\frac{\text{P(y)P(n)}}{\text{N}}\right)}\right) = \frac{(.50)(.50) + .0006507}{.0006507 + \frac{(.50)(.50)}{1{,}700{,}000}} = 385 \tag{3.5}$$

Apply the formula to calculate the number of surveys to be distributed:

$$\text{Number of Surveys Distributed} = \left(\frac{385}{.40}\right) = 963 \tag{3.6}$$

We are estimated a response rate of 40%, a figure slightly lower than that experienced in the Residential End Uses of Water Study. We lowered the estimate because of the historical trend in response rates continuing to drop over the past 10 to 15 years.[15]

We asked the utility partners to provide the contact information for an even 1,000 residential customers, using the process described in the next section.

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[15] See, for example, Cull, W., O'Connor, K., Sharp, S. & Tang, S.S. Response Rates and Response Bias for 50 Surveys of Pediatricians, *Health Services Research*, 40(1), 213-226.

SAMPLING THE RESIDENTIAL CUSTOMERS AND OBTAINING BILLING DATA

Questionnaires such as the ones used in this study rely on self-reported attitudes and behavior. Validating self-reported responses with actual behavioral metrics increases the meaningfulness of the results. The ICF/Aquacraft Team was able to obtain billing data for the residential customers who were surveyed by working closely with the utility partners.

Each utility partner was asked to supply contact information for approximately 1,000 of its residential customers using systematic sampling. This procedure has the advantage of selecting a random sample that is representative of the residential customers serviced by the utility partners. Systematic sampling as applied in this context comprised the following steps:

Divide the total number of residential customers by the size of the total sample desired; 1,000 in this study. This number is called the *sampling interval*, represented by the letter “*k*.” If there are 250,000 residential customers and the desired sample is 1,000 customers, the sampling interval would 250.

Order all of the residential customers alphabetically by last name (or by account number). This is called the *ordered sampling frame*. The type of ordering should be selected so that the customers are more or less randomly distributed in that order. For example, although last names may not be distributed equally among the alphabet, there will be no particular pattern that could introduce bias affecting the results in such an ordering.

Start from the beginning of the ordered sampling frame, selecting every k^{th} customer for inclusion in the sample. In the example here, one would select customer numbered 250 in the ordered list, then number 500, and so on.

The contact information was transmitted electronically to the Study Team in the form of Microsoft Excel files. Each customer was then assigned a sequence number. The first digit, from 1 to 6, represented the utility partner. The remaining digits constituted a sequence from 1 through *n* for each sample from each partner.

The utilities also supplied water-billing data for each of the customers selected to be in the sample, in the form of Microsoft Excel files. Each billing data record was matched with the corresponding customer, and assigned the same sequence number. In this way, the ICF/Aquacraft Team would be able to match billing data with questionnaire responses. A total of 4,807 billing records of the residential customers in the sample were obtained for periods ranging from two to five years. The billing data was summary in nature and included:

- total annual water usage,
- seasonal annual water usage, and
- non-season water usage.

The water billing measurement unit was thousands of gallons per household.

Analysis was conducted with files that had the questionnaire data merged with the billing data. No customer identifying information known by the utilities was placed in the analytical data files to maintain customer confidentiality.

QUESTIONNAIRE DEVELOPMENT

Each utility's customers received questionnaires customized for that utility. Development of the questionnaire was an iterative collaborative process involving the study team, the utility partners, and the AWWARF Project Advisory Committee (PAC). A copy of each questionnaire can be found in Appendix C.

The questionnaire was developed using a structured process:

- ICF/Aquacraft developed an initial set of research or knowledge domains.
- The study team created a "pool" of potential questionnaire items during the literature review phase of the project. The items placed into this pool came from research articles and reports that published the instrument used. This resulted in a list 170 pages long comprising about 5,000 items. The Team then categorized the items into the much smaller set of domains.
- A list of the messages was obtained from each of the utility partners urging water conservation. These messages were required to have been used in the recent past.
- The team also asked each utility for list of questions to which this study could supply some data for possible including in the questionnaire.
- The study team reduced the list of potential questions down to a manageable number, eliminating duplications and similar questions from the question pool.
- The questionnaire was circulated to the AWWARF PAC and the utility partners in draft form. The instruments were modified and circulated again. This process continued until no additional changes were desired. There were eight such iterations.
- Finally, each questionnaire was customized with questions specific to the messages associated with each utility. In addition, the utility's logo was placed on the various printed materials for the survey as well as the questionnaire itself.

The final questionnaire contained 25 numbered questions, with many having more than one response item, in the following categories:

- ***Water utility messages.*** This section contained eight questions concerning the water conservation messages communicated by each utility to its residential customers. The number of items for the first three questions could vary, depending on the number of messages supplied by the utility partner.
- ***Attitudes towards water conservation.*** This section contained two questions on water conservation attitudes.
- ***Preferred method of getting information.*** This section contained one question with multiple response items.
- ***General concerns.*** This section contained three questions on general attitudes toward environmentalism, customer water use versus their neighbor's, and the credibility of various potential sources of water conservation information.
- ***About you and your household.*** This section contained nine questions on demographics of the customers.
- ***Additional comments.*** Here, respondents could write in comments.

Because of the customization for each utility, the total number of items differed slightly, depending on the number of messages from each utility[16]. Table 3.1 shows the total number of items contained in the questionnaire for each utility in the final order in which the sections were printed.

Table 3.1
Number of items by questionnaire section for each utility partner

Section	Durham	JEA	Orange County	Phoenix	Seattle	Tempe
General concerns	26	26	26	26	26	26
Messages about water use	524	760	379	575	371	575
Attitudes on water conservation	25	25	25	25	25	25
Preferred ways of getting information	27	27	27	27	27	27
You and Your Household	9	9	9	9	9	9
Additional comments	1	1	1	1	1	1
Totals	612	848	467	663	459	663

SURVEY ADMINISTRATION

The ICF/Aquacraft Team employed a five-step survey administration process patterned after Dillman (1999).[17] The steps included:

1. A letter of introduction was mailed on utility stationary alerting the customers that they had been randomly selected to participate in a survey, and that a questionnaire would be mailed to them shortly. A toll-free number was given to answer any questions.
2. Within one week, a complete survey packet was mailed to the residential customers. The survey packet contained another letter, the questionnaire, and a business reply envelope in which to return the questionnaire.
3. Two weeks after the initial mailing, a reminder postcard (See Figure 3.1) was mailed to the customers asking them to respond to the survey if they had not done so already.
4. Four weeks after the initial mailing, a complete survey packet was mailed to all sampled residential customers, asking customers to complete the questionnaire using the supplied materials.
5. Two weeks after the second survey packet was mailed, another reminder postcard was mailed asking customers to respond if they had not yet done so.

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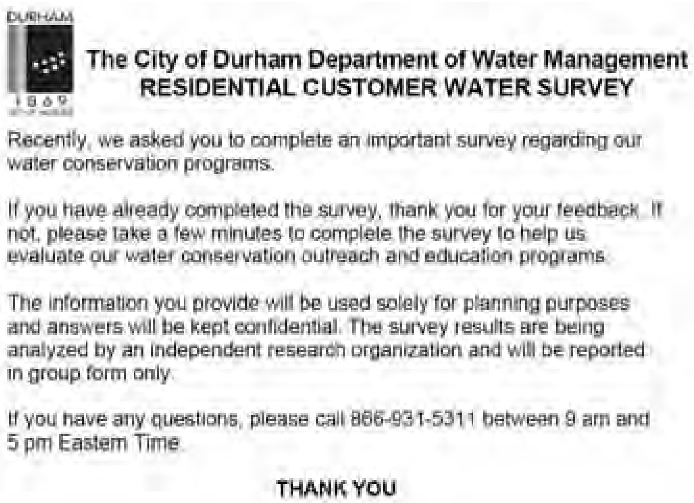
[16] If a question allowed only one response, the question had one item. A single numbered question could have many items, each of which the respondent was asked to rate, or a question may allow more than one response to be selected. Thus all of the surveys had exactly 25 numbered questions, but the number of items ranged from 459 to 848. The number of items is a better indicator of overall questionnaire length.

[17] Dillman, Don. (1999). *Mail and Internet Surveys: The Tailored Design Method*, John Wiley & Sons, New York.

Copies of all the letters and postcards can be found in Appendix D.

Data collection was closed three weeks after Step 5 above. The complete data collection period lasted a total of ten weeks, from the initial letter of introduction until the close of data collection. All questionnaires and postcards were mailed at the same time for all utilities with the exception of Seattle. Seattle's materials followed the same five steps but began one week later in order to gain the City Council approval of the questionnaire.



The City of Durham Department of Water Management
RESIDENTIAL CUSTOMER WATER SURVEY

Recently, we asked you to complete an important survey regarding our water conservation programs.

If you have already completed the survey, thank you for your feedback. If not, please take a few minutes to complete the survey to help us evaluate our water conservation outreach and education programs.

The information you provide will be used solely for planning purposes and answers will be kept confidential. The survey results are being analyzed by an independent research organization and will be reported in group form only.

If you have any questions, please call 866-931-5311 between 9 am and 5 pm Eastern Time.

THANK YOU

Figure 3.1 Example of Reminder Postcard

The responses from all surveys were key-punched and SPSS files created and verified for accuracy. Each comment and the survey tracking number for each respondent was entered into Excel spreadsheets. The SPSS files were then analyzed using the procedures described in the next section.

The demographic characteristics of the respondents who completed the surveys were compared with the demographics of the residential customer base for each utility partner to identify whether differences exist that would attenuate the extent to which the results presented here could be applied to the population. The demographic characteristics were also compared to the demographics of the samples used in the REUWS study. No meaningful differences were found.

DATA ANALYSIS AND ANALYTIC METHODS

The ICF/Aquacraft Team used a number of statistical procedures in analyzing the data. Some analyses used data from all the respondents from all the utilities, while others examined the customers of each utility separately. The specific data used is detailed in the Results section of this report. Table 3.2 below presents an overview of the statistical techniques employed.

Table 3.2
Statistical procedures employed in the data analysis

Statistical Procedure	Description
Measures of central tendency (mean, median, mode)	Indicators of the central tendency of a distribution. The mean is the arithmetic average; the median is the 50th percentile value, and the mode is the most frequent value. The median and the mode are used if the underlying data are skewed or have extremely large or extremely small outlying values. Such values distort the meaning of the mean.
z test	The z test is used to test whether a sample mean is significantly different from the population mean.
χ^2	Pronounced "chi-squared," is used to measure the extent to which the relationship between two categorical variables differs from one that is expected from pure chance.

(continued)

Table 3.2 (Continued)
Statistical procedures employed in the data analysis

Statistical Procedure	Description
Fisher’s exact test	This is used to test whether there is a non-random relationship between two categorical variables. It used in place of the χ^2 in those instances where the total n in the categorical contingency table less than the minimum required for that test.
Analysis of variance (ANOVA)	The analysis of variance is a procedure that tests for differences in the mean of the dependent variable, as a function of the independent categorical variables, called factors. When there is only one independent variable with two values defining two groups, the results from the analysis of variance and the t-test are equivalent. The advantage of ANOVA is that it allows the testing of the effects of multiple factors individually (called main effects), as well as simultaneously as interaction terms. When some of the independent variables are continuous rather than categorical in nature, the Analysis of Covariance (ANCOVA) is used.
Multiple regression	This procedure calculates the effects of one or more independent variables on the dependent variable. It is used in those instances when many of the independent variables are continuous in measurement scale. The results include coefficients for each independent variable that can be stated in standardized or raw form. Raw form shows the coefficients in terms of the original units of the independent variable. For example, a multiple regression relating height in inches (the independent variable) to weight in pounds (the dependent variable) would show coefficients in terms of inches. Standardized coefficients are scaled to reflect a unit normal distribution having a mean of zero and a standard deviation of one. Both standardized and raw coefficients are useful. Standardized coefficients will show the relative contribution of each independent variable to variations in the dependent variable. Raw coefficients are useful for calculating the actual values in the dependent variable modeled by the regression equation.
R^2	Pronounced “R-Squared,” this measures the total variance in the dependent variable accounted for by the independent variables. It is frequently used to check the adequacy of various multiple regression models, the model with a greater R^2 being preferred over one with a smaller R^2.
Partial η^2	The partial eta-squared is analogous to R^2 in multiple regression, and is a measure of effect size. The partial eta-squared has the advantage, when compared to eta-squared, of not being affected by the total number of factors in the analysis of variance design.

Some of the statistical procedures necessitated transformations of the data in various ways either because of the underlying data distribution, or in order to clarify the effects of the independent variable on the dependent variable. These transformations are noted in the Results section where they were completed.

Data Limitations

Every effort was made to ensure that the data set developed for this study was as accurate as possible. However, data from customer surveys can be incomplete and/or inaccurate, and water agency customer information systems may contain errors or have missing data points.

Researchers must strive to obtain accurate data, but ultimately must work within the limitations of the data set available.

In this study a number of data limitations emerged through the analysis process that should be acknowledged at the outset. These include:

- ***Non-response bias.*** The overall response rate to the customer survey was 35.3%. This is acceptable but indicates that 64.7% of those surveyed did not respond. Although water use of respondents was compared against the survey sample to check for non-response bias on water use, a different level of non-response bias on income or education level could affect the results.
- ***Incomplete survey responses*** were not an issue in this study as only surveys that contained complete responses to key questions were included.
- ***Inaccuracies in customer information data.*** Utilities were asked to provide billing data from single-family homes only, but completed survey responses indicated that a small percentage of respondents lived in duplexes, triplexes, or other multi-family housing.
- ***Inaccuracies in water billing data.*** Billing data errors are a part of any utility billing system. In this study there was no way to determine if the billed consumption for each participant was accurate or not. Fortunately, utilities have developed procedures to ensure the accuracy of customer consumption data. The researchers relied upon the water utilities to provide accurate data to the research team.

Although the final data set for this study undoubtedly contains errors of the nature discussed above, these limitations did not prevent the research team from carrying out the analysis proposed for this study. The researchers strove to ensure the results presented are as accurate as possible given these acknowledged issues and limitations.

CHAPTER 4
RESULTS

Results obtained from the mail surveys, billing data, and combined billing data and survey data are presented below. Results from the mail surveys are presented first, followed by a comparison of residential water use at the six study sites. The combined billing and survey data sets are then used to examine the factors that significantly influence residential water use. Finally, the data sets are used to evaluate communication strategies and to determine whether the conservation communication strategies implemented by the six participating agencies have influenced demand.

The results obtained in this research are often compared against results from the *Residential End Uses of Water* study (Mayer, et. al., 1999) as this provides a solid benchmark for evaluating difference in attitudes and water use patterns. In many instances, results from the data set developed for this behavior change study align closely with the results from the *Residential End Uses of Water* study (REUWS). The consistency of the findings suggests that the samples utilized in this study are reasonable and representative of single-family demand across the continent. The consistency also suggests that average water use patterns have not changed substantially over the past 10 years – an important finding in itself.

SURVEY RESULTS

A detailed mail survey was sent to a representative, random sampling of single-family residential customers in each of the six participating study sites. A detailed explanation of the mail survey implementation process is provided in Chapter 3: Overall Research and Methodologies Used. Copies of the six survey instruments and the fully enumerated survey responses for all six study sites are presented in Appendix C.

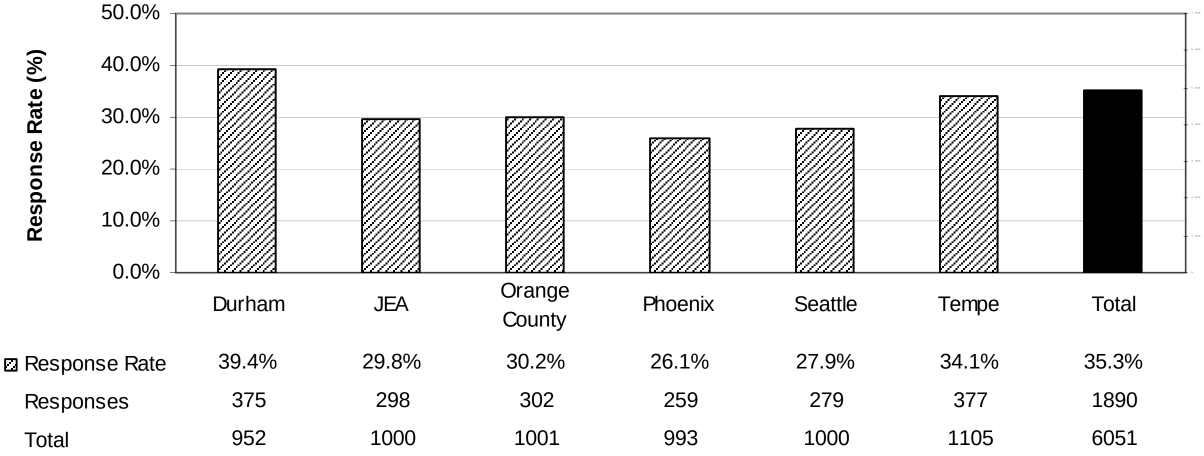
A total of 18 questions were common to the surveys at all six study sites. The remaining questions were tailored for the specific situation at each site. Of the 18 questions held in common, nine were demographic questions and nine related to conservation messages, programs, and behavior. Detailed response results from these common questions are presented below.

Survey Response Rates

A total of 6,051 surveys were sent out in the six study sites, from which 1,890 useable responses (35.3%) were returned and coded for analysis. The response rate for each study site is presented in Figure 4.1. The implementation methodology for Seattle differed from other sites, but for the other five sites with similar implementation methods, the response rate varied from a low of 26.1% in Phoenix to a high of 39.4% in Durham. The total of 1,890 completed surveys represents a reasonable sample of respondents providing adequate statistical power for the analysis.

The experience of the research team and the survey contractor, the National Research Center, is that survey response rates (both mail and telephone implementation) have been declining over the past 10 years. In the *Residential End Uses of Water* study, which used a similar survey implementation methodology, the overall response rate (from 12 study sites) was 46.2%. The 35.3% response rate in this study, was 11.9% less than the rate for the REUWS.

However, the 35.3% response rate provided sufficient statistical power for thoroughly conducting the analysis for this study.



	Durham	JEA	Orange County	Phoenix	Seattle	Tempe	Total
▨ Response Rate	39.4%	29.8%	30.2%	26.1%	27.9%	34.1%	35.3%
Responses	375	298	302	259	279	377	1890
Total	952	1000	1001	993	1000	1105	6051

Figure 4.1 Survey response rates in six study sites

Survey Results – Demographic Questions

Nine of the 18 questions common across all six surveys were basic demographic questions that provide fundamental information about the population surveyed. Results from these questions are presented below.

The intent of this study was to survey detached single-family residential properties exclusively. The sample of customers to be surveyed, provided by the participating utilities, was screened to include only these customers. However, database records are imperfect as the results in Table 4.1 show. While 93% of the respondents lived in a single-family home (as intended for this study) the remaining 7% live in a townhouse, multi-family apartment, mobile home, duplex, or other type of dwelling. Respondents who reported living in something besides a single-family home were *not* excluded from subsequent analysis.

Table 4.1
Survey results – type of housing

Question 17: Which statement describes your home?	Percent	Count
Single family	93%	N=1738
Townhouse	4%	N=70
Multi-family home	2%	N=37
Mobile home	1%	N=13
Other	0%	N=9
Duplex	0%	N=7

Most of the survey respondents (95%) own the home they live in, as shown in Table 4.2. Only 5% of respondents indicated they rent their home and less than 1% did not know. The predominance of owner-occupied respondents is typical for this type of survey. Water customers who rent their home appear far less likely to respond to a mail survey like the one implemented here.

Survey respondents were generally well established in their respective communities as shown in Table 4.3. Nearly three-quarters of the survey respondents (72%) reported living at the current address for seven or more years, and another 19% reported living at the current address for 3 to 7 years. About 6% reported living at this address for 1 to 3 years while only 2% had been at the current address less than one year.

The homes of the survey respondents were largely built prior to 1994 when the Federal plumbing code changed requiring more water efficient toilets, showerheads, and faucets to be installed (Energy Policy Act of 1992). The average home in this study was built in 1974 (using midpoints from question 19), and more than 25% of the homes were built prior to 1960 as is shown in Table 4.4.

Table 4.2
Survey results – home ownership

Question 18: Do you own or rent your home?	Percent	Count
Own	95%	N=1761
Rent	5%	N=100
Do not know	0%	N=2

Table 4.3
Survey results – length of time at current address

Question 16: How long have your lived at this current address?	Percent	Count
Seven or more years	72%	N=1352
Three to less than seven years	19%	N=361
One to less than three years	6%	N=118
Less than one year	2%	N=41

Table 4.4
Survey Results – what year was home built

Question 19: In what year was your home built?	Percent	Count
Before 1950	15%	N=281
1951 to 1960	11%	N=206
1961 to 1970	10%	N=180
1971 to 1980	16%	N=303
1981 to 1994	26%	N=492
1995 to 2000	10%	N=190
2001 to present	7%	N=137
Do not know	4%	N=74

The average home in this study had 2.20 bathrooms, as shown in Table 4.5. In the REUWS, the question was asked slightly differently and it was found that homes in that study had an average of 2.27 toilets per house. Assuming that each bathroom in Table 4.5 includes one toilet, then the average number of toilets per home would be 2.29 – almost identical to the REUWS. Nearly half of the homes surveyed in the six study sites had two bathrooms.

The survey respondents had an average of 2.4 people per household on a year-round basis. This result, shown in Table 4.6, uses the midpoint from each range in question 21. The household size was somewhat smaller than the 2.71 people per household found in the REUWS.

More than 60% of the homes in the six study sites had 1 or 2 people in residence year round. Only 7% of respondents reported having five or more people per household.

Survey respondents reported a high education level as shown in Table 4.7. Fifty-nine percent of survey respondents were college graduates and of that, more than half had a graduate degree or some graduate school. Ninety-seven percent of survey respondents completed high school.

Table 4.5
Survey results – number of bathrooms

Question 20: How many bathrooms does your house have?	Percent	Count
One	11%	N=210
One and one-half	8%	N=156
Two	46%	N=859
Two and one-half	14%	N=271
Three	13%	N=236
More than three	8%	N=141
Average number of bathrooms per home		2.20

Table 4.6
Survey results – number of people per household

Question 21: How many people reside at this address year-round?	Percent	Count
1 – 2	63%	N=1177
3 – 4	30%	N=566
5 – 6	6%	N=107
6 or more	1%	N=16
Average number of people per home		2.4

Table 4.7
Survey results – educational attainment

Question 22: Which of the following describes your educational background?	Percent	Count
Some high school	3%	N=61
High school graduate, G.E.D., or tech school	13%	N=231
Some college	18%	N=325
Two year associates degree	7%	N=136
College graduate	25%	N=468
Some graduate school	6%	N=117
Graduate degree	28%	N=510

Household income averaged $84,562 among survey respondents as shown in Table 4.8, which uses the mid-point of the intervals in question 23 and $200K as the value for the highest category. The median U.S. household income in 2006 was $48,000 according to the United States Census bureau. The median is of course different from the average; therefore, it is not possible to compute a precise median value from the survey data obtained in this study. However, the median would land at the upper end of the $50,000 to $74,999 category, a little below to the average. The income data collected here proved a useful explanatory variable for water use as discussed later in this report.

Table 4.8
Survey results – household income

Question 23: Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	9%	N=159
$25,000 – $49,999 per year	22%	N=364
$50,000 – $74,999 per year	20%	N=343
$75,000 – $99,999 per year	14%	N=238
$100,000 – $124,999 per year	12%	N=198
$125,000 – $149,999 per year	8%	N=127
$150,000 or more per year	12%	N=201
Blank	3%	N=49
Average household income		$84,562

Survey Results – Water, Conservation, and Environmental Questions

The primary purpose of the residential customer water survey was to determine attitudes and opinions about water, water use, water conservation messaging efforts, and general environmental concerns. A total of nine such questions were common across all six surveys. The results from this category of questions are presented below. In many cases, the survey responses have been sorted by response rate to highlight items respondents found most (and least) important. Full survey response results from each participating water agency are presented in Appendix E.

Question 1 sought to identify general environmental concerns. Respondents were asked if they agree or disagree with a number of statements about environmental issues. Results are presented in Table 4.9 and responses are sorted by level of agreement from highest to lowest. Overall, the respondents to this survey expressed substantial agreement that the issues listed are environmental concerns.

Table 4.9
Survey results – general environmental concerns

Question 1: For each statement below, how strongly do you believe this it IS or IS NOT an environmental concern in your community?	Strongly Agree	Agree	Neither Agreee nor Disagree	Disagree	Strongly Disagree
Water is precious and in great demand for many uses.	65%	23%	7%	2%2	2%
Air pollution is a problem.	50%	36%	9%	4%	2%
Residential growth is impacting the water supply.	48%	37%	11%	3%	2%
Industrial pollution is a major problem.	45%	36%	13%	4%	2%
People do not recycle enough.	45%	35%	14%	5%	2%
Commercial/ Industrial growth is impacting the water supply.	42%	36%	16%	4%	2%
We are losing habitats for fish and aquatic animals.	45%	31%	17%	4%	2%
Global climate change is occurring.	45%	31%	14%	5%	5%
Urban development is damaging our environment.	43%	33%	16%	6%	2%
Fossil fuels are being used up.	41%	33%	19%	5%	3%
The ozone layer is being depleted.	37%	33%	20%	5%	4%
The quality of water is getting worse.	17%	28%	34%	17%	5%

Water supply and demand stood alone at the top as the biggest concern. Eighty-eight percent of respondents agreed or strongly agreed with the statement, “Water is precious and in great demand for many uses.” Only 4% disagreed or strongly disagreed.

Air pollution and residential growth impacting water supplies were the second and third biggest concerns of survey respondents, with more than 80% agreeing with the statements. Other areas of high concern to respondents were industrial pollution, lack of recycling, loss of fish and aquatic habitat, commercial growth, urban development, depletion of fossil fuels, climate change, and destruction of the ozone layer. More than 70% of respondents agreed or strongly agreed with the statements of these issues.

The lowest-ranked environmental issue stated, “the quality of water is getting worse.” Only 45% of respondents agreed with this statement, 34% had no opinion, and 22% disagreed.

Question 3 asked respondents which sources they found “credible” for information on water conservation. The results are shown in Table 4.10 and are sorted from highest to lowest, with the “most credible” sources listed at the top and the “least credible” sources at the bottom.

Water supply managers were cited as the most credible source for water conservation information, with 90% of respondents calling them at least “somewhat credible.” In contrast, sales associates at home improvement stores were cited as the least credible source with only 55% finding them at least “somewhat credible.”

Water supply managers were cited as the most credible source for water conservation information with 90% of respondents calling them at least “somewhat credible”.

In contrast, sales associates at home improvement stores were cited as the least credible source with only 55% finding them at least “somewhat credible”.

College professors ranked second in credibility after water supply managers, followed by local landscapers or nurseries, radio stations, TV shows, family, and friends. Plumbers ranked below friends in credibility on water conservation, followed by appliance manufacturers, irrigation contractors, reporters, and elected officials. In general, respondents found those with a financial interest in a conservation product or service (plumbers, manufacturers, contractors, sales associates) to be less credible than sources such as water supply managers, professors, and family. The exception was landscapers or nurseries, which were ranked more highly on water conservation credibility.

Table 4.10
Survey results – credible sources of information on water conservation

Question 3: Which sources do you find credible for information about water conservation?	Always Credible	Frequently Credible	Somewhat Credible	Rarely Credible	Not Credible
Water supply managers	13%	45%	32%	6%	4%
College professors	9%	37%	34%	10%	10%
Local landscapers or nurseries	8%	36%	42%	10%	5%
Radio shows on gardening or the home	7%	30%	46%	11%	5%
Television stations such as HGTV	6%	26%	45%	14%	9%
Family	8%	24%	46%	16%	7%
Friends	5%	23%	48%	16%	8%
Plumbers	5%	23%	45%	18%	9%
Water conservation information provided by appliance manufacturers	4%	23%	45%	19%	9%
Newspaper or television reporters	5%	21%	44%	18%	12%
Irrigation contractors	3%	22%	47%	19%	8%
Elected officials	3%	13%	45%	21%	19%
Sales associates at hardware stores and do-it-yourself stores	2%	12%	41%	28%	16%

Which water conservation behaviors are practiced most frequently? Question 7 presented respondents with an extensive list of water conservation behaviors and asked them how often they put these measures into practice. The results, presented in Table 4.11, are ranked from most frequently practiced to least frequently practiced. In general, respondents reported practicing all of the conservation measures at least some of the time. A maximum of only 14% of respondents said they rarely or never practice any of the specific measures. If accurate, the results suggest that most people believe they regularly practice water efficiency measures. Whether true or not, it does suggest a high level of awareness about conservation practices and a concerted attempt to integrate conservation practices into everyday life.

Using a garbage can rather than the toilet to dispose of trash was the most frequently practiced water conservation behavior practiced "most" or "all of the time" by 94% of respondents. Ninety percent of respondents reported avoiding the heat of the day for watering most or all of the time, while 88% said they don't irrigate when it is raining. Running the dishwasher and clothes washer only when full ranked high as well.

> Results suggest that most people believe they regularly practice water efficiency measures.
>
> Whether true or not, it does suggest a high level of awareness about conservation practices.

The three conservation activities that respondents practiced least often were: water-wise landscaping techniques (50% – most or all the time, which is still quite high); a jug of water in the fridge (63% – most or all of the time); and track usage with monthly water bill (64% – most or all of the time).

Which water conservation actions have been most frequently taken during the past year? Question 9 on the customer survey asks respondents to identify all of the conservation actions they had recently taken. The results are presented in Table 4.12.

Repairing leaking faucets and/or toilets was the most frequently taken action, with 58% of respondents indicating that they had done this over the past year. The next most popular action taken was changing the "lawn watering schedule," but only 37% of the respondents indicated doing this during the past year. Thirty percent responded that they installed a "water-saving" shower head in the past year, and that same amount also reported stopping water some or all of an existing lawn, possibly due to drought conditions.

Table 4.11
Survey results – conservation activity frequency

Question 7: How often do you perform any of these activities?	All of the time	Most of the time	Some of the time	Rarely	Never
Use a garbage can, not the toilet, to dispose of trash	82%	12%	3%	1%	2%
Water lawn or garden during hours that avoid the heat of the day	69%	21%	4%	2%	3%
Do not water if it has rained	72%	16%	6%	2%	4%
Use clothes washer only with full load	51%	38%	8%	1%	1%
Use dishwasher less, or run only with full load	64%	23%	4%	2%	7%
Use broom to clean sidewalk or driveway rather than using the water hose	56%	25%	10%	4%	5%
Turn off water while brushing teeth or shaving	53%	25%	13%	5%	3%
Scrape food from dishes into garbage instead of rinsing down the drain with water	52%	26%	13%	5%	3%
Monitor outdoor water use	52%	27%	11%	5%	5%
Check water hoses and outdoor water fixtures for leaks	50%	26%	13%	5%	5%
Make sure irrigation water does not run off my landscape into gutters and storm drains	54%	24%	8%	4%	10%

Table 4.11 (Continued)
Survey results – conservation activity frequency

Question 7: How often do you perform any of these activities?	All of the time	Most of the time	Some of the time	Rarely	Never
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	54%	23%	9%	3%	11%
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	49%	26%	12%	5%	8%
Conserve water while cooking	41%	34%	15%	6%	4%
Target watering the lawn with no more than one inch of water over a period of a week	46%	24%	13%	5%	12%
Take a shorter shower or time my shower	34%	33%	19%	9%	5%
Check toilet for leaks	43%	21%	16%	13%	7%
Track water usage monthly using my water bill	41%	23%	16%	9%	10%
Keep a jug of water in the refrigerator instead of using the tap to get cold water	49%	14%	9%	10%	17%
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	28%	22%	21%	13%	16%

Table 4.12
Survey results – conservation actions performed during the past year

Question 9: Which actions have you performed during the past year?	Yes		No	
Repaired leaking faucets and/ or toilets	58%	N=1106	42%	N=798
Changed lawn watering schedule	37%	N=707	63%	N=1197
Stopped watering some or all of an existing lawn	30%	N=573	70%	N=1331
Installed water-saving shower heads	30%	N=567	70%	N=1337
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	25%	N=473	75%	N=1431
Installed water-efficient clothes washer	20%	N=372	80%	N=1532
Installed water-saving faucets or water-saving aerators on existing faucets	19%	N=370	81%	N=1534
Planted alternative ground covers/trees/shrubs to replace grass	16%	N=313	84%	N=1591
Installed water-efficient dishwasher	15%	N=282	85%	N=1622
Planted more trees to shade the landscape and reduce evaporation	15%	N=282	85%	N=1622
Purchased water-saving hose nozzles	14%	N=270	86%	N=1634
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	12%	N=212	88%	N=1502
Purchased soaker hoses for outside watering	10%	N=175	90%	N=1539
None of the above	10%	N=167	90%	N=1547
Insulated hot water pipes	9%	N=147	91%	N=1567
Installed irrigation controller with a rain sensor	5%	N=78	95%	N=1636
Checked humidifier for leaks	3%	N=47	97%	N=1667
Replaced irrigation controller with one that contains a rain sensor	2%	N=28	98%	N=1686

Most frequently reported water efficient behavior was repairing leaking faucets or toilets; changed lawn watering schedule, or installed water-saving shower head.

Respondents appear to be installing new clothes washers at more than double the expected rate, perhaps due to incentive programs or to the anticipated water and energy savings associated with installing a new washing machine.

Installing an irrigation controller with a rain sensor was an action taken by only 2% of respondents during the past year, while 3% checked their humidifier for leaks. Most of these homes are not equipped with a humidifier. Only 5% of respondents reported installing a rain sensor on their irrigation system during the past year.

One in five respondents (20%) reported installing an efficient clothes washer during the past year. Clothes washers have an expected useful life of 14 years, so it is anticipated that a little over 7% of the public will replace their clothes washer per year. This is much lower than the 20% replacement rate found in survey group. The respondents appear to be installing new clothes washers at more than double the expected rate, perhaps due to incentive programs or to the anticipated water and energy savings associated with installing a new washing machine.

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One in four respondents (25%) reported replacing a toilet or installing a toilet displacement device during the past year. Nearly one in five respondents (19%) reported installing water efficient faucet aerators during the past year. Both of these reported installation rates exceed the expected natural replacement rate for these fixtures.

As shown in Table 4.14, 9% of respondents have ever participated in a utility rebate program. Therefore, the increased installation rate of clothes washers, dishwashers, and toilet devices presented in Table 4.14 is not likely due to utility sponsored rebate programs, although 12% of respondents said their utility offered a program but they didn’t participate. A full 62% said they would have participated in a rebate program if one had been available. These results suggest that rebate programs are useful but not always necessary to achieve a higher than expected installation rate of efficient fixtures. Many customers are installing efficient fixtures without a rebate incentive and furthermore, if a rebate had been available, these customers might well have taken advantage of the offering to get money back for an action they would have taken any way. This is commonly referred to as “free-ridership,” and has been shown to be a real issue for many utility rebate programs (Whitcomb 2003).

Overall, 86% of respondents reported taking at least one of the actions listed in Question 9 during the past year while 14% took none of the actions listed. These results are shown in Table 4.13. Seventy-three percent of respondents took more than one water conservation action over the past year and 55% took more than two actions during the past year. This result indicates that people are just as likely to take several water conservation actions in a year as they are to take one or none.

Nearly 10% of respondents reported participating in a utility sponsored rebate program as shown in Table 4.14. Question 11 sought to identify how many respondents have *ever* participated in a utility rebate program. Thirteen percent of respondents said their utility offered a rebate program but did not participate; while 62% said their utility did not offer a rebate, but if they had they would have participated. Since most of the participating agencies in this study do offer rebates, this response suggests many customers are not getting the message. Combined with the 9% that did participate in utility rebate programs, this suggests that 71% of the respondents have participated or are interested in participating in a utility rebate program. This is a very high level of interest and utilities seeking to increase the number of efficient fixtures in their service area should take note.

Table 4.13
Survey results – count of conservation actions taken in past year

Count of Conservation Actions Taken in Question 9	Frequency	Percent	Cumulative Percent
0	246	14%	14%
1	216	13%	27%
2	309	18%	45%
3	293	17%	62%
4	209	12%	74%
5	151	9%	83%
6	107	6%	89%
7	73	4%	94%
8	37	2%	96%
9	31	2%	98%
10	21	1%	99%
11	7	0%	99%
12	4	0%	99%
13	3	0%	100%
14	2	0%	100%
17	5	0%	100%

Table 4.14
Survey results – rebate program participation rate

Question 11: Have you ever participated in a utility sponsored rebate program?	Percent	Count
Yes, I have.	9%	N=142
The utility offered it, but I did not participate.	12%	N=190
The utility never offered one, but I would have participated if it did.	62%	N=971
The utility never offered one, but I would not have participated anyway.	17%	N=270

Why do people take action to conserve water? Question 12 on the survey asked customer to select reasons why they took deliberate steps to conserve water sometimes or all the time. These results are presented in Table 4.15. Three reasons stood out above the rest as the most important in influencing conservation steps: (1) saving money – 78%; (2) it is the right thing to do – 76%; (3) concern about water availability – 75%.

About half of the respondents' conservation actions were supported by drought (57%), climate change (53%), environmental impacts (50%), and drought restrictions (44%).

Peer pressure (2%), utility workshops (1%), TV shows (13%), and water bill inserts (18%) were at the bottom of the list for respondents in terms of supporting conservation steps. The rating of peer pressure as a motivating factor is interesting because other studies have found that peer pressure "...works better than trying to appeal to people's sense of social responsibility, desire to save money or even their hope of safeguarding the earth for the future generations."[18]

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[18] Quoted in Classen, Neal (2007). Peer Pressure: Conserving Water Because Everyone is Doing It, *Watermark Magazine*, Winter.

In contrast to Question 12 on the customer survey, Question 13 asked respondents about the reasons that might support a decision to rarely or never take conservation steps. This question attempted to identify barriers to water conservation and results are presented in Table 4.16. Overall, only a small percentage of respondents indicated that there was any reason that they don't take conservation steps. Nearly one third (29%) of respondents reported that they are "already conserving" as much as they can. The cost of purchasing and installing efficient fixtures and appliances was a factor for 6% of respondents. All other responses were below 5% as shown in Table 4.16. With 86% of respondents indicating that they have taken at least one water conservation step in the past year (indicated in Table 4.13), the results on barriers to implementation are perhaps not surprising.

Table 4.15
Reasons that support water conservation steps taken

Question 12: Which reasons support the conservation steps you take sometimes or all of the time?	Yes		No	
I save money on my water bill.	78%	N=1488	22%	N=416
It is the right thing to do.	76%	N=1450	24%	N=454
I am concerned about water availability.	75%	N=1437	25%	N=467
I am concerned about a drought.	57%	N=1093	43%	N=811
I am concerned about global climate change and how it may affect water supplies.	53%	N=1013	47%	N=891
I am concerned about the impact of water withdrawals on the environment.	50%	N=958	50%	N=946
I am concerned about water restrictions.	44%	N=832	56%	N=1072
I am concerned about my family's health.	29%	N=546	71%	N=1358
I changed my behavior after reading a brochure insert with my water bill.	18%	N=340	82%	N=1564
I changed my water usage after seeing a television show about water conservation.	13%	N=239	87%	N=1665
Other.	5%	N=88	95%	N=1816
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water.	2%	N=34	98%	N=1870
I changed my water usage after attending a workshop given by the water utility.	1%	N=25	99%	N=1879
I do not know.	1%	N=16	99%	N=1888
I do not conserve water.	0%	N=9	100%	N=1895

Drought can be a powerful motivator for water conservation activities. Question 14 on the customer mail survey asked respondents whether, when drought is experienced, is their water use behavior changed and why. Results from this question are presented in Table 4.17. Most respondents (45%) reported changing their behavior, "because it is the right thing to do." Another 31% reported changing their behavior during drought because of governmental mandate (e.g., water use restrictions). Another 11% reported conserving water above and beyond locally mandated drought restrictions, while 8% responded that their region does not experience droughts. Only 3% of respondents indicated that "do not think about it."

Table 4.16
Survey results – reasons that support rarely or never taking conservation steps

Question 13: Which reasons support your decision to rarely or never take conservation steps?	Yes		No	
I am already conserving as much as I am able.	29%	N=558	71%	N=1346
I cannot afford to purchase and install water-saving fixtures.	6%	N=115	94%	N=1789
I do not think about it.	3%	N=50	97%	N=1854
I can afford to pay for as much water as I want or need.	2%	N=42	98%	N=1862
I do not know.	2%	N=37	98%	N=1867
Other.	2%	N=34	98%	N=1870
I do not think there is a water supply problem.	1%	N=26	99%	N=1878
I do not have time.	1%	N=17	99%	N=1887
I do not have to pay for water.	0%	N=4	100%	N=1900

Table 4.17
Survey results – drought response behavior

Question 14: If you experience drought sometimes, do you change your water use behavior and why?	Percent	Count
Yes, I change behavior because it is the right thing to do.	45%	N=725
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation).	31%	N=512
Yes, I change behavior and go beyond any locally mandated conservation rules.	11%	N=174
My region does not experience droughts.	8%	N=136
No, I do not think about it.	3%	N=47
Other	2%	N=32
Total	100%	N=1626

What do customers believe is the best way to reach them with information about water conservation? Question 15 asked, “What would be the most effective way to reach you with information about water conservation that you will use?” Results from this question are presented in Table 4.18 and are sorted by response rate.

Approximately 71% of respondents reported that they are not conserving as much as they can and indicated limited barriers to implementation.

Utility bill inserts about water conservation (68%) and TV ads demonstrating water conservation tips (55%) were the two most frequently chosen information delivery methods, followed by newspaper ads (35%), radio ads (26%), TV demos (25%) magazine articles (24%), the Weather Channel (23%), demonstrations (21%) and billboards (21%).

The lowest-rated methods for delivering conservation information were irrigation contractors (4%), university extension services (4%), utility sponsored classes and workshops (4%), public meetings (5%), and plumbers (6%). Personal contact with a utility representative was selected by only 7%.

Table 4.18
Survey results – most effective way to deliver water conservation information

Question 15: What would be the most effective way to reach you with information about water conservation?	Yes		No	
Utility bill inserts about water conservation	68%	N=1294	32%	N=610
TV ads demonstrating water conservation tips	55%	N=1040	45%	N=864
Newspapers ads about water conservation techniques	35%	N=658	65%	N=1246
Radio ads discussing water conservation techniques	26%	N=495	74%	N=1409
Demonstration of eco-friendly gardening and landscaping on television	25%	N=474	75%	N=1430
Magazine articles discussing the value of water conservation with tips for residential consumers	24%	N=456	76%	N=1448
The Weather Channel	23%	N=446	77%	N=1458
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	21%	N=406	79%	N=1498
Billboards encouraging consumers to conserve water	21%	N=399	79%	N=1505
Home improvement store	19%	N=368	81%	N=1536
Free home water audits	19%	N=356	81%	N=1548
Demonstrations of water-efficient products in hardware or home improvement stores	18%	N=340	82%	N=1564
Internet search	18%	N=337	82%	N=1567
Nursery or landscape company	14%	N=262	86%	N=1642
Utility web site	13%	N=243	87%	N=1661
Emailed information	12%	N=233	88%	N=1671
School or classroom discussions	12%	N=230	88%	N=1674
Information fairs at malls or parks	11%	N=214	89%	N=1690
Personal contact with water utility representative	7%	N=129	93%	N=1775
Plumber	6%	N=119	94%	N=1785
Public meetings or forums	5%	N=104	95%	N=1800
Local university extension services	4%	N=82	96%	N=1822
Utility-sponsored class or conference	4%	N=78	96%	N=1826
Irrigation contractor	4%	N=77	96%	N=1827
Other	3%	N=57	97%	N=1847
Do not want any conservation information	3%	N=49	97%	N=1855
Don’t know	2%	N=44	98%	N=1860

Utility web sites (13%) are frequently used to provide conservation information, but apparently customers do not view this as a particularly effective communication method. E-mailed information also received only a 13% response. These results should be of interest to utilities that strive to communicate conservation messages regularly to customers. Bill inserts are often criticized as an ineffective way to reach people, yet in this survey they were by far the most-preferred method for receiving water conservation information.

WATER USE COMPARISON

Periodic billing data were obtained from each of the six participating water agencies as part of the initial survey group selection process. Billing data from a total of 4,807 customers across six study sites were obtained. These data, when coupled with the survey response data, comprise a useful tool for examining water use trends, the factors that influence water use, and for evaluating agency conservation program measures. The analysis of billing data is also a convenient way to compare and contrast water use between study sites and examine differences in consumption.

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Agencies were able to provide two complete years of billing data (and in some cases five years of data) for their sample of customers. As soon as the data from each agency was received, the water use characteristics of the survey sample were tested to ensure statistical representation of the population of (all) single-family detached water use accounts in the service area. The mean water use for the sample was compared to that of the originating population by calculating z-tests to determine whether the water use of the sample was significantly different from that of the population. If the mean water use of the sample was statistically different from the mean water use of the population at the 95% confidence level, the participating agency was asked to select a new sample of customers. This only occurred once in this study, and each of the six survey samples used in this study was found to have no statistically significant differences in annual water use from the population from which it was drawn.

Average Annual Water Use

The six participating study sites represent a diverse collection of single-family water use patterns. Table 4.19 is a statistical summary of the annual water use at each site. The most recent complete year of billing data (typically 2006 or 2008) from each site was used to develop this table.

Table 4.19
Average annual water use and sample size – six study sites

		Total annual water use from billing records (kgal)		
Site Location	Sample Size*	Mean**	Median	Std. Dev.
All Sites	5,223	135.5	99.0	149.3
Tempe	1,082	190.8	155.2	231.2
Durham	952	53.2	47.9	29.5
Phoenix	966	159.4	125.7	139.7
JEA	969	148.8	114.4	122.0
Orange County	969	141.8	111.5	109.6
Seattle	282	52.9	43.4	39.2

*Samples drawn from the population of single-family accounts in each study. The sample size presented is smaller than the original sample because of missing data.
**Based on most recent available complete year of historic billing data (2006 for all sites except Seattle – 2008)

The average annual single-family water use across all six study sites was 135.5 kgal per year and the median was 99.0 kgal per year. The standard deviation was 149.3 kgal. For comparison, the average annual single-family water use (from billing data) from 12,055 homes in the Residential End Uses of Water study (REUWS) was 146.1 kgal per year and the median was 123.3 kgal per year.

The consistency of results from this study and the REUWS indicates that about 135 to 145 kgal per year is a reasonable estimate of the average annual water use for residential properties. When considering “typical” single-family residential water use, the median is probably a better measure than the mean, which is strongly influenced by a few high water users. The median water use across all six study sites was 99.0 kgal per year, which is about 27% less than the mean.

Significant differences in demand between cities and regions exist. As shown in Table 4.20 the average annual use in Seattle was 52.9 kgal and in Durham it was 53.2 kgal. The average annual use in Phoenix was three times higher at 159.5 kgal, and in Tempe it was four times higher at 190.8 kgal. Water use in the two Florida study sites (Orange County and Jacksonville – JEA) was 141.8 kgal and 148.8 kgal per year respectively.

The distribution of annual water use across all six study sites is shown in Figure 4.2, which depicts the variability in water use consumption among the 5,223 homes for which billing data were available. Note that the bins in this graph are unequal. From 0 to 400 kgal per year, the bins increase in increments of 20 kgal. The rise in the 500 kgal bin is caused by the shift in bin increments from 20 to 100 kgal at that point. This apparently lognormal[19] distribution includes the billed annual water consumption from all 5,223 homes for which billing data were available.

A comparison of basic demographic and climate data in the six study sites is presented in Table 4.20. Average persons per household ranged from 2.08 in Seattle to 2.79 in Phoenix. Median household income ranged from $40,316 in Jacksonville to $50,988 in Orange County, Fla. Average annual temperature ranged from 52.9 degrees F in Seattle to 74.2 degrees F in Phoenix. Average annual precipitation ranged from 8.29 inches per year in Phoenix/Tempe to 48.35 inches per year in Orange County, Fla.

Table 4.20
Basic demographic and climate data from six study sites

	Household Size and Income		Climate Data*		
Study Site	Persons Per Household	Median Household Income	Data Source	Avg. Annual Temp. (F)	Avg. Annual Precip. (in.)
Seattle, Wash.	2.08	$45,736	US Census (1999,2000)	52.9	38.25
Orange County, Fla.	2.61	$50,988	US Census (2000,2007)	72.8	48.35
Jacksonville, Fla.	2.53	$40,316	U.S. Census (2000,1999)	68.0	52.34
Durham, N.C.	2.37	$41,160	U.S. Census (2000,1999)	59.6	43.05
Phoenix, Ariz.	2.79	$41,207	U.S. Census (2000,1999)	74.2	8.29
Tempe, Ariz.	2.41	$42,361	U.S. Census (2000,1999)	74.2	8.29

*From National Climate Data Center (NCDC) web site.

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[19] A "lognormal" distribution is one where the logarithms of numeric values have a normal distribution (i.e., the classic "bell-shaped" curve) rather than the values themselves. A number of real-world variables tend to be lognormally distributed, including: the size of silver particles in a photographic emulsion, the survival time of bacteria in disinfectants, the weight and blood pressure of humans, and the number of words written in sentences by George Bernard Shaw (Wolfram Research Mathworld, http://mathworld.wolfram.com/LogNormalDistribution.html, accessed on February 22, 2009).

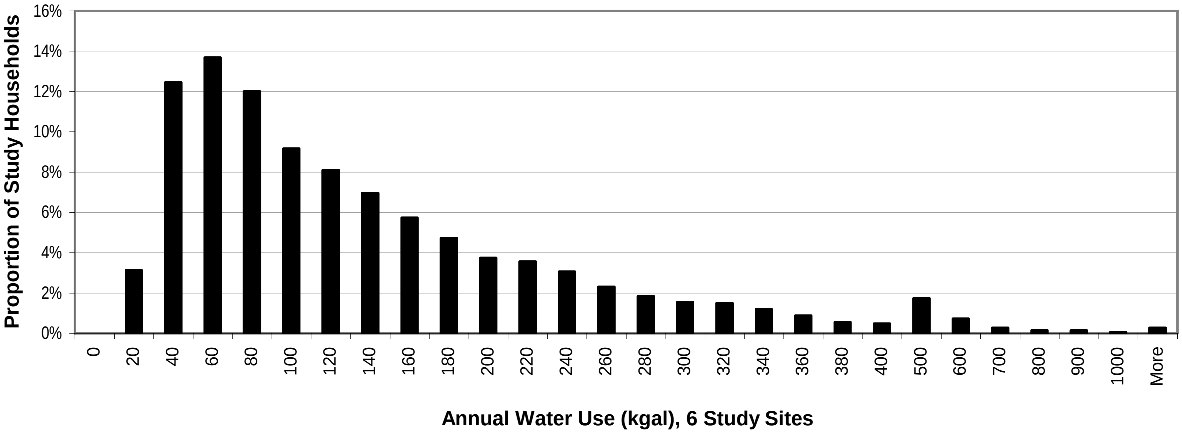

Figure 4.2 Annual water use distribution, 6 study sites, 5,223 homes Seasonal and Non-Seasonal Water Use

Outdoor water use (referred to as seasonal use) was much more variable from city to city than indoor water use, due largely to profound differences in climate among study sites such as Phoenix (hot and dry) and Seattle (cool and wet). Table 4.21 shows the average annual seasonal (outdoor) and non-seasonal (indoor) water use for the survey sample in each study group. Figure 4.3 presents the frequency distribution of seasonal and non-seasonal water use for all six study sites.

Table 4.21
Average annual non-seasonal and seasonal water use – six study sites

Site Location	Sample Size*	Non-Seasonal annual water use from billing records (kgal)		Seasonal annual water use from billing records (kgal)	
		Mean**	Std. Dev.	Mean**	Std. Dev.
All Sites	5223	66.1 (48.8%)	79.5	69.4 (51.2%)	92.3
Tempe	1082	85.8 (45.0%)	114.6	105.0 (55.0%)	130.5
Durham	952	37.5 (70.5%)	22.0	15.7 (29.5%)	16.2
Phoenix	967	83.0 (52.1%)	84.1	76.2 (47.9%)	74.3
JEA	969	64.3 (43.2%)	59.7	84.5 (56.8%)	94.9
Orange County	970	74.9 (52.8%)	63.4	66.8 (47.2%)	65.3
Seattle	283	33.8 (62.8%)	21.7	19.2 (36.3%)	28.8

*Samples drawn from the population of single-family accounts in each study.
**Based on most recent available complete year of historic billing data (year varies by site).

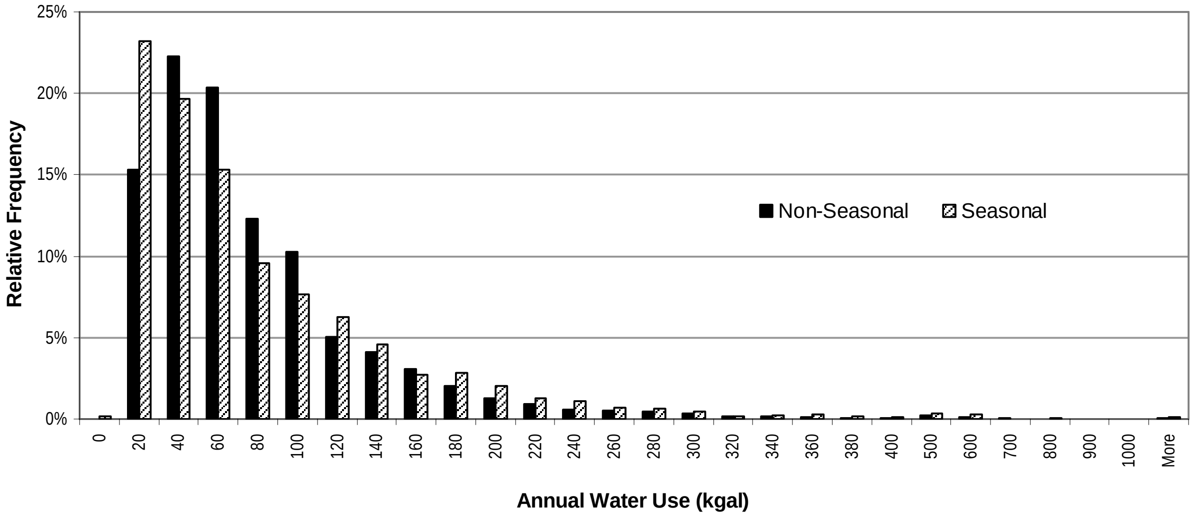

Figure 4.3 Annual seasonal and non-seasonal water use distribution – six study sites

The seasonal or outdoor water use component for each site was calculated from the most recent year of periodic billing data using Equation 4.1. This method assumes the minimum month usage contains no outdoor component. This assumption, while frequently relied upon to estimate outdoor use, can lead to inaccurate estimates, particularly in hot, dry climates where irrigation can occur in all months of the year.

$$S = \frac{\left[Q_{annual} - (Q_{\min\ month} \times 12)\right]}{Q_{annual}} \tag{4.1}$$

Where:

S = percent seasonal use
Q_{annual} = mean annual per household water use
$Q_{min\ month}$ = mean minimum monthly per household water use

The variability in the calculation of non-seasonal use in particular is evident in Table 4.21, and the similarity in overall seasonal and non-seasonal averages can be seen in Figure 4.3. Indoor and outdoor use was divided roughly 50-50 in this analysis. In the Residential End Uses of Water study, annual indoor use ranged from 54.1 kgal/year to 76.3 kgal/year, but indoor use was measured using more accurate flow trace recording techniques (Mayer, et. al., 1999). In this study, average annual indoor use ranged from 33.8 kgal/year up to 85.8 kgal/year, a somewhat broader range.

In sites such as Phoenix and Tempe where irrigation can (and likely does) occur year round, non-seasonal use is likely over estimated by the analytic methods used here, while seasonal use is underestimated. In this study, the accuracy of this method has no bearing on the final results because analysis of changes in water use was conducted using total annual use rather than seasonal or non-seasonal use. Most of the conservation program messaging implemented by the participating providers was aimed at both indoor and outdoor use, so evaluating overall changes is a sensible approach.

FACTORS THAT INFLUENCE WATER USE

Introduction

The contemporary approach to forecasting water demand and evaluating water conservation programs often involves formation of water use models that use a variety of factors to explain the variation in total household water use (Mayer, et. al., 1999). The analytic database of survey response data and historic billing data developed for this study allows for the fundamental factors that influence household demand to be explored, and for the impact of conservation communication strategies to be examined. While the annual use data available for this study was too coarse to allow for an examination of specific end uses of water (other recent studies have addressed this topic), it was still possible to evaluate the influential factors impacting annual household demand. The methodology employed is discussed here.

Multiple regression analysis was used to estimate the water use relationships in this study as discussed below. Multiple regression techniques are commonly used to estimate a direct and quantifiable numeric relationship between variables of interest (the dependent variable) and a set of independent variables that are hypothesized to affect or explain the variable of interest – in this case annual household water use. The general linear regression model may be expressed as shown in Equation 4.2:

$$Y = \beta_0 + \sum_m \beta_m X_m + \varepsilon \tag{4.2}$$

Where

Y = the dependent variable of interest (e.g., annual water use)
X_m = the *m*th explanatory or independent variable (e.g., household size, income)
β_0 = an estimated model intercept term
β_m = estimated model parameter that measure the relationship between Y and a the *m*th explanatory variable, X_m
ε = a random error term that denotes the difference between actual Y, and Y as estimated from the model

To improve the overall fit and explanatory power, the natural or base 10 logarithmic transformations of data are used for the regression relationships such that equation 2 can be re-written as shown in Equation 4.3. In this example the common or base 10 log equation is presented.

$$\log Y = \beta_0 + \sum_m \beta_m \log X_m + \varepsilon \tag{4.3}$$

Where the term log denotes the base-10 logarithmic transformation. Upon estimating this type of transformed equation, the relationship would retain the mathematical form shown in Equation 4.4 after it is back-transformed from the logarithmic to original data:

$$Y = 10^{\beta_0} \prod_m X_m^{\beta_m} \tag{4.4}$$

Basic Multiple Regression Model

What are the significant factors that influence differences in water use? Using the dataset developed for this study and the logarithmic transformation multiple regression techniques described above, the factors that influence water use across all six study sites were examined.

The four basic factors found to influence water use at a 95% confidence level (in order of magnitude) were:

1. ***Type of residence (single-family or other)***[20] – Single family residence used 35% more water annually than duplexes, apartments and other multi-family types of residence.
2. ***Number of bathrooms in the home*** – Each bathroom added about 29% more water use annually. This factor is often considered a surrogate for size and value of the home.
3. ***Number of people in the home (capita)*** – Each additional person added about 11% more water use annually.
4. ***Household income*** – Each additional $1,000 of annual income added 0.3% more water use annually.

The other factor included in this basic model was the water agency that supplied the data. As shown in the analysis above, water use varied tremendously between different agencies due to differences in climate, demography, water rates, and a myriad of other factors. Including the water agency as a factor corrects for these and other systematic differences between providers. Ideally, a model should include all of these different factors like rates and climate explicitly, but obtaining all of the data necessary for that level of analysis was beyond the scope of this study.

The model specification is provided below in Table 4.22 and Table 4.23. The adjusted coefficient of determination (R^2) for the model is 0.494. This value indicates that this model explains 50% of the variability in the data. The P-value for the model is less than 0.0001 indicating that the fit is statistically significant at the 95% confidence level. As an example of how the model could be applied, equation 5 presents the mathematical expression described by this model.

Table 4.22
Basic multiple regression model summary statistics, coefficient of determination, and significance

R	R Squared	Adjusted R Square	Std. Error of the Estimate	Degrees of Freedom	F	P-value
.705	.496	.494	.26473	1601	197.092	.000

The B coefficients (un-standardized) presented in Table 4.23 show the effect of the independent variables on the dependent variable (e.g., water use in kilo-gallons) in metrics reflecting the units of those independent variables. The range of values provided for water

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[20] Although the intention was to study only detached single-family residences, 6% of the survey responses came from duplexes and multi-family properties that were mistakenly included in the sampling process. Since water use and survey data were available for these customers, it was decided to include these properties in the analysis.

agency is an indication of the variability in annual use patterns as discussed earlier. The effect on water use of variables such as income, number of bathrooms, and number of residents can be seen.

The "useable model coefficients" column in Table 4.23 presents the relative impact of the independent variables on non-seasonal use. For example, adding a bathroom adds 25.5% to non-seasonal water use while adding an additional resident adds 10.9% to non-seasonal use. An additional $25,000 in household income adds 7.8% to non-seasonal use. The water agency variables adjust for differences in non-seasonal water use found in these study sites.

Equation 4.5 is the mathematical representation of this regression analysis shown in Table 4.23. By substituting values for the variables shown in the equation it is possible to obtain an estimate of the annual water use (in kgal) for a site.

Table 4.23
Basic multiple regression model coefficients and significance of independent variables

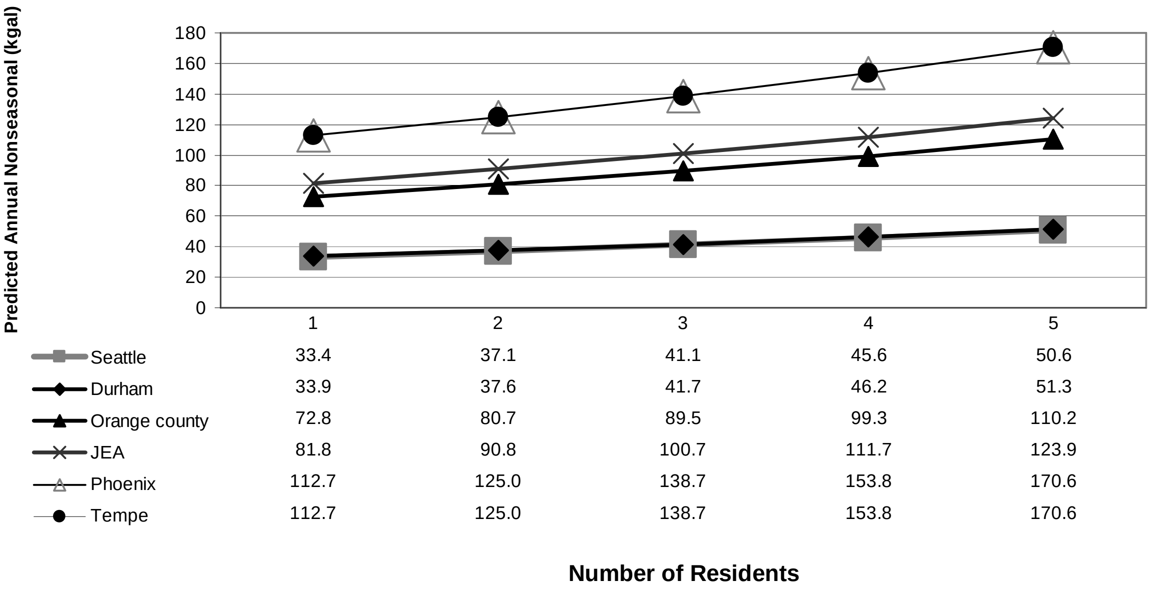
Independent Variable	B*	95% Lower Confidence Bound	95% Upper Confidence Bound	t	P-value	Useable Model Coefficients
(Constant)	1.651	1.585	1.717	49.050	.000	44.72
# of Bathrooms	.099	.077	.120	9.014	.000	125.5%
# of Residents	.045	.034	.055	8.229	.000	110.9%
Annual income ($1000)	.001	.001	.002	7.484	.000	100.3%
Single-family residence?	.108	.061	.155	4.546	.000	128.2%
Water Agency – Durham	-.522	-.559	-.485	-27.770	.000	30.0%
Water Agency – Seattle	-.528	-.568	-.487	-25.551	.000	29.7%
Water Agency – Orange County	-.190	-.229	.150	-9.393	.000	203.0%
Water Agency – JEA	-.139	-.178	-.099	-6.869	.000	146.0%

Dependent Variable: log of Annual household water use (most recent year available)
*Un-standardized coefficients. Represents the impact of each independent variable in kgal per year per household

$$\boxed{\text{Annual kgal} = 44.72 \cdot \mathit{Agency\ coeff} \cdot \#\ \mathit{of\ bathrooms}^{(1.255)} \cdot \#\ \mathit{of\ residents}^{(1.109)} \cdot \mathit{Income}^{(1.003)} \cdot \mathit{SFR}^{(1.282)}} \qquad (4.5)$$

This non-linear model is more accurate at predicting mean values rather than extreme values.

Figure 4.4 presents a set of predicted values for each agency based on a set of similar assumptions – a 2-bedroom house and an annual household income of $50,000. The number of residents was varied from one to five. The predicted values for Phoenix and Tempe are identical because the best fit model did not include a separate utility factor for those agencies.



	1	2	3	4	5
Seattle	33.4	37.1	41.1	45.6	50.6
Durham	33.9	37.6	41.7	46.2	51.3
Orange county	72.8	80.7	89.5	99.3	110.2
JEA	81.8	90.8	100.7	111.7	123.9
Phoenix	112.7	125.0	138.7	153.8	170.6
Tempe	112.7	125.0	138.7	153.8	170.6

Figure 4.4 Predicted non-seasonal water use assuming 2 bathrooms and $50K household income

The factors identified here have been found to explain differences in water use in many other research studies conducted in the United States, Canada, and other countries. The number of people per household, household income, and number of bathrooms are standard factors that are included wherever possible in forecasting models. There is nothing surprising or out of the ordinary about these findings.

What *is* perhaps surprising is that factors such as the age of the home, educational background, and ethnicity were found not to have a statistically significant influence on annual water use pattern in this study. Because significant changes to the federal plumbing codes that mandated more efficient toilets, faucets, and showerheads were enacted in the early 1990s[21] homes built before 1994 are more likely to be equipped with high volume and flow fixtures. In this model configuration, no statistically significant difference in water use could be detected based on age of the home.

Expanded Multiple Regression Models

To further investigate the factors that influence differences in water use, all survey questions common across the six participating water agencies were evaluated using analysis of variance (ANOVA) techniques. Only five questions were significant when considered in a model that includes factors discussed above and the agency. These factors were included in Expanded Model #1. Including nearly all of the survey questions resulted in the water agency factor dropping out of the model as well as some instability as many factors co-vary. However, this analysis is useful as well. Consequently, a model with many more factors, but a much lower coefficient of determination is presented below as Expanded Model #2.

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[21] 1992 Energy Policy Act (EPAct), which went into effect in 1994.

Expanded Model #1

Five survey questions were added to the basic model above to develop the “expanded” multiple regression model #1 specified in Table 4.24 and Table 4.25.

The adjusted coefficient of determination (R^2) for the model is 0.523, which is quite similar to the basic model, so incorporating the three questions did not improve the model fit. The R^2 value indicates that this model explains 52.3% of the variability in the data. The P-value for the model is 0.00 indicating that the fit is statistically significant at the 95% confidence level.

Table 4.24
Expanded multiple regression model #1 – summary statistics, coefficient of determination, and significance

R	R-Squared	Adjusted R Square	Std. Error of the Estimate	Degrees of Freedom	F	P-value
.728	.53	.523	.2569	923	85.9339	.000

Table 4.25
Expanded multiple regression model #1 – coefficients and significance of independent variables

Independent Variable	B*	95% Upper Confidence Bound	95% Lower Confidence Bound	t	P-value
(Constant)	1.613	1.520	1.706	34.013	.000
# of Bathrooms	.087	.063	.111	7.130	.000
# of Residents	.044	.032	.056	7.286	.000
Annual income ($1000)	.001	.001	.001	5.537	.000
Single-family residence?	.103	.051	.155	3.888	.000
Water Agency – Durham	-.447	-.496	-.398	-17.900	.000
Water Agency – Phoenix	.027	-.024	.077	1.027	.305
Water Agency – JEA	-.125	-.174	-.077	-5.033	.000
Water Agency – Orange County	-.173	-.222	-.123	-6.816	.000
Water Agency – Seattle	-.452	-.504	-.400	-17.140	.000
Stopped watering some or all of an existing lawn	-.093	-.126	-.059	-5.415	.000
Changed lawn watering schedule	.068	.036	.100	4.135	.000
Repaired leaking faucets and/ or toilets	.045	.015	.075	2.931	.003
Irrigation contractor	.111	.038	.185	2.973	.003
# of outdoor activities implemented	.015	.006	.023	3.438	.001
Use broom to clean sidewalk or driveway rather than using the water hose	-.080	-.141	-.018	-2.548	.011
We are losing habitats for fish and aquatic animals	-.035	-.066	-.005	-2.285	.022

Dependent Variable: log of Annual household water use (most recent year available).
*Un-standardized coefficients. Represents the impact of each independent variable in kgal per year per household
**Responses were assigned coefficient values (1 = always, 0.75 = most of the time, 0.5 = sometimes, 0.25 rarely, 0.0 = never). A respondent who answered “Sometimes” would only receive 50% of the B impact described by the model.

A discussion of the survey questions common to all six sites found to significantly impact differences in water use is presented below. Five of the seven questions relate to outdoor water use and could indicate homes that are equipped with an automatic irrigation system.

- Question 9 asked, “Please indicate whether you performed any of the following actions during the past year.” Respondents who indicated that they stopped watering some or all of their existing lawn during the past year used 19.2 *less* water on average.
- Respondents to Question 9 who indicated that they changed their watering schedule during the past year used 16.8% *more* water on average.
- Respondents to Question 9 who indicated that they repaired leaking faucets or toilets used 10.9% *more* water on average.
- Question 15 asked which information sources would be most effective reaching out about water conservation. Respondents who indicated that an irrigation contractor would be an effective source used 29.2% *more* water on average.
- Question 7 asked respondents to, “Please indicate how often you perform any of the activities” listed. Respondents who indicated that they water their garden during hours to avoid the heat of the day use 19.3% *more* water on average.
- A small number of respondents answered parts Question 7 relating to outdoor efficiency measures. For this small number of respondents, there is a 3.5% *increase* in water use on average for each measure implemented.
- Question 1(f)asked how strongly does the respondent believe that, “We are losing habitats for fish and aquatic animals”? Respondents who answered affirmatively used 7.8% *less* water on average.

It is expected that people who stopped watering some or all of their lawn would use less water than those who do not. The finding from Question 9(q) is a sensible and understandable finding, but why would people who changed their irrigation schedule (Question 9(l)) and who don’t water during the heat of the day (Question 7(n)) use more water?

One possible explanation is that these questions identify respondents who have automatic irrigation systems and those who don’t. Numerous studies have found that homes equipped with automatic in-ground irrigation systems use nearly twice as much water outdoors than homes that manually irrigate (Aquacraft, Inc. 2008), (Mayer, et. al., 1999), (Mayer 1995). To the extent that Question 9(l) and 15(x) identify automatic (vs. manual) irrigators, this could easily explain the difference in water use.

It is of interest that customers that repaired leaking faucets and toilets had statistically higher water use. The billing data used in this analysis covered calendar year 2006, but the customer survey was implemented in 2008. This suggests that any reported repairs to toilets and faucets noted on the survey might easily have been made *after* the billing data were obtained. If significant leaks were occurring, they would have been captured in the 2006 water use data utilized in this analysis, which could easily explain why this group of customers was found to use more water than those that did not repair a leak.

Expanded Model #2

Expanded Model #2 (specified in Table 4.26 and Table 4.27) includes as many factors as possible while still producing a reasonable R^2 value of 0.326. The model factors shown in Table 4.27 are divided into two categories:

1. Factors that decreased water use in the model
2. Factors that increased water use in the model

Numerous models were specified in the development process, and it should be understood that Expanded Model #2 is not a reliable predictor of water use. In fact, the researchers found that removing even one factor from the model would cause other factors to change in magnitude and even change in sign (e.g., switch from decreasing to increasing water use) in the model while remarkably still retaining statistical significance within the model. This indicates a high degree of instability in the model, which is caused by strong correlation among many of the factors.

Expanded Model #2 is presented for informational purposes rather than as a real predictive tool. It is interesting to see the impact of all of the various survey responses on water use in the sample, but only when some of these factors are examined on the individual utility level (later in this report) can the impact of various conservation behavioral change efforts be evaluated. Not all of the factors presented in Table 4.26 were statistically significant at the 95% confidence level. A P-value less than or equal to 0.05 is required for statistical significance at this level. The final column in Table 4.27 indicates whether or the factor was significant or if it nearly approached significance.

Table 4.26
Expanded multiple regression model #2 – summary statistics, coefficient of determination, and significance

R	R-Squared	Adjusted R Square	Std. Error of the Estimate	Degrees of Freedom	F	P-value
.580	.337	.326	.31382	1903	32.792	.000

Using Less Water. The two factors that most effectively explained lower water use patterns in Expanded Model #2 were:

- stopping watering some or all of an existing landscape, and
- using a broom rather than a hose to clean the sidewalk.

The halting of irrigation was likely the result of drought response efforts that occurred during the billing data time frame. Since outdoor irrigation is typically the largest single end-use of water in the residential sector, eliminating it results in significant savings. Temporary drought response, while of critical importance during periods of limited supply availability, is different from behavioral water conservation, which seeks to permanently reduce demands through changes in habits and installation of more efficient equipment.

Cleaning hardscapes with a broom rather than with water was the behavioral action with the largest measurable impact in this model. Scraping dishes rather than rinsing them, and implementing water wise gardening techniques, were the behaviors with the next-largest impacts.

Respondents who scrape food from dishes view friends as a credible source of conservation information, use water wise gardening techniques, view commercial and industrial growth impacting water supplies. In addition, people who try and limit irrigation applications used *less water* on average.

Customers who stopped irrigating after a rainstorm believe that climate change is occurring, and view media reports and college professors as credible sources of conservation information used *less water* on average. A strong educational background was also slightly associated with lower water use.

Table 4.27
Expanded multiple regression model #2 – coefficients and significance of independent variables

Independent Variable	B*	95% Upper Confidence Bound	95% Lower Confidence Bound	t	P-value	Statistically Sig. at 95% Conf. Int.?
(Constant)	1.369	1.234	1.504	19.882	.000	Yes
Factors That Decreased Water Use						
Stopped watering some or all of an existing lawn	-0.198	.230	.165	11.989	0.000	Yes
Use broom to clean sidewalk or driveway rather than using the water hose	-0.159	.220	.098	5.104	0.000	Yes
Scrape food from dishes into garbage instead of rinsing down the drain with water	-0.109	.169	.050	3.582	0.000	Yes
Friends – credible source	-0.076	.134	.017	2.538	0.011	Yes
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	-0.074	.121	.028	3.139	0.002	Yes
None of the above	-0.068	.122	.014	2.480	0.013	Yes
Commercial/ Industrial growth is impacting the water supply	-0.065	.109	.021	2.873	0.004	Yes
Target watering the lawn with no more than one inch of water over a period of a week	-0.065	.116	.013	2.456	0.014	Yes
Do not water if it has rained	-0.061	.125	.004	1.844	0.065	Nearly
Global climate change is occurring	-0.048	.084	.013	2.670	0.008	Yes
Newspaper or television reporters – credible source	-0.043	.081	.005	2.247	0.025	Yes
College professors – credible source	-0.035	.068	.003	2.133	0.033	Yes
We are losing habitats for fish and aquatic animals	-0.034	.074	.006	1.689	0.091	No
q22 Educational background	-0.025	.042	.009	2.978	0.003	Yes

(continued)

Table 4.27 (Continued)
Expanded multiple regression model #2 – coefficients and significance of independent variables

Independent Variable	B*	95% Upper Confidence Bound	95% Lower Confidence Bound	t	P-value	Statistically Sig. at 95% Conf. Int.?
(Constant)	1.369	1.234	1.504	19.882	.000	Yes
Factors that Increased Water Use						
Water lawn or garden during hours that avoid the heat of the day	.185	.112	.259	4.936	.000	Yes
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	.137	.084	.190	5.103	.000	Yes
Changed lawn watering schedule	.118	.087	.150	7.350	.000	Yes
Single-family residence?	.106	.055	.157	4.046	.000	Yes
Use clothes washer only with full load	.095	.016	.173	2.366	.018	Yes
Repaired leaking faucets and/or toilets	.088	.057	.119	5.531	.000	Yes
Air pollution is a problem	.085	.047	.124	4.309	.000	Yes
Television channels such as HGTV	.070	.031	.109	3.498	.000	Yes
Residential growth is impacting the water supply	.064	.018	.109	2.756	.006	Yes
# of residents	.049	.037	.061	8.050	.000	Yes
Family – credible source	.046	-.009	.101	1.626	.104	Yes
Irrigation contractors – credible source	.024	-.011	.059	1.368	.171	No
Length of time at current address	.023	.002	.044	2.139	.033	Yes
Annual income ($1000)	.001	.000	.001	3.023	.003	Yes

Dependent Variable: log of Annual household water use (most recent year available)
Independent Variable sorted by magnitude of regression coefficient, B.
*Un-standardized coefficients. Represents the impact of each independent variable in kgal per year per household

Using More Water. As discussed earlier, it is well established that homes equipped with automatic irrigation systems typically use more water than homes that manually irrigate. Many of the factors that most effectively explain higher water use in Table 4.27 are likely surrogates for identifying customers with automatic irrigation systems (as opposed to manual irrigators frequently referred to as "hose draggers"). Four of the top five factors associated with higher water use are related to automatic irrigation including*:*

- Avoiding watering during the heat of the day – a practice made easier by simply programming an automatic irrigation timer to start watering in the evening or night;
- Rapid repair of sprinkler heads – a clear indicator of automatic irrigation; and
- Changing the lawn water schedule – a direct reference to automatic irrigation.

These results bear out the findings from numerous studies (discussed above) that found that homes equipped with automatic irrigation systems frequently use twice as much water outdoors compared with homes without (Mayer, et. al., 1999).

Other factors found to increase water use in this analysis are discussed here. Some of the results make little sense in light of the prevailing understanding of water use patterns and conservation. For example, the following factors were found to increase water use on average:

- Using the clothes washer only with a full load, and
- Repairing leaking faucets or toilets.

Common sense indicates that running the clothes washer only when full should reduce not increase water use. The limitations of this data set and covariance of factors are on display with this result, which the research team does not deem reliable. It is also of interest that customers that repaired leaking faucets and toilets had statistically higher water use. The billing data used in this analysis covered calendar year 2006 (with the exception of Seattle, where data from 2008 was used), but the customer survey was implemented in 2008. This suggests that any reported repairs to toilets and faucets noted on the survey might easily have been made *after* the billing data were obtained. If significant leaks were occurring, they would have been captured in the 2006 water use data utilized in this analysis, which could easily explain why this group of customers was found to use more water than those that did not repair a leak.

Respondents who felt that air pollution is a problem and that residential growth was impacting water supply used more water in this analysis. Respondents who view TV shows such as HGTV, friends, family, and irrigation contractors[22] as credible sources for conservation information used more water.

Well-established physical and economic factors such as the number of residents, number of bathrooms, and household income discussed in detail earlier in this section were also found to be significant in this model. It is interesting to note that the length of time at the current address was also found to be a factor in water use. The greater the time at the current address the higher the water use on average – perhaps an indication of older housing and/or more elaborate landscaping and irrigation.

Other Factors That Influence Water Use

The preceding expanded regression model and analysis of three survey questions identifies the only common factors that *when considered together* have a statistically significant impact on differences in water use patterns. The researchers were able to identify other factors that *when considered by themselves* had a statistically significant influence on water use, but which did not improve the regression model by their inclusion. These factors may co-vary with other factors in the model or may have insufficient survey response data (sample size) to contribute to the model. These additional influential factors are explored below.

These results are presented in Table 4.28. Each factor was examined using an analysis of variance (ANOVA) procedure that corrected for the known factors that were shown to influence water use in this study – water agency, number of bathrooms, number of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided, the sign of

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[22] Another surrogate for customers who have automatic irrigation systems installed, but this factor was not statistically significant at the 95% confidence level.

the coefficient is actually of more significance than the magnitude as it indicates whether the factor increases (+) or decreases (-) annual water use.

Respondents who use a broom rather than a hose to clean pavements, stopped watering part of their landscape, change behavior under drought conditions, water no more than 1 inch per week, and who get pressure from neighbors to conserve used *less* water than those who did not. Respondents who avoid the heat of the day for irrigation, repair sprinkler heads, prefer to receive information from irrigation contractors or billboards, changed their watering schedule recently, repaired leaking fixtures, and don’t know why they conserve used *more* water.

Table 4.28
Individual factors found to influence water use*

Question	Question Specifics	Coefficient**	Std. Error	95% Upper Confidence Bound	95% Lower Confidence Bound	Stat. Test	P-value	Partial η2+	N
Factors that Decrease Water Use									
Q7,T	Use a broom to clean sidewalk rather than a hose	-74.89	15.77	-105.79	-43.99	t = -4.75	0.000	r2 = 0.116	All the time: 56%
Q9,Q	Stopped watering some of all of an existing lawn in the past year	-66.59	7.20	-80.70	-52.48	F = 85.60	0.000	0.051	30%
Q14	Yes, I change behavior under drought conditions	-61.335	20.807	-102.12	-20.55	F = 8.69	0.003	0.007	97% of 1439
Q7,S	Water to no more than 1 inch per week	-57.01	13.72	-83.91	-30.11	t = -4.15	0.000	r2 = 0.116	All the time: 46%
Q12,J	I get pressure from neighbors to conserve	-50.709	23.763	-97.28	-4.13	F = 4.55	0.033	0.003	2%
Q1,F	We are losing habitats for fish and aquatic animals	-29.91	7.79	-45.17	-14.64	t = 3.84	0.000	r2 = 0.069	At least agree: 77%
Q15,C	Prefer radio ads discussion conservation	-23.15	8.01	-38.85	-7.45	F = 8.35	0.004	0.005	26%
Q15,G	Prefer demonstrations in home improvement stores	-22.50	10.28	-42.64	-2.35	F = 4.79	0.029	0.003	18%
Q15,B	Prefer TV ads demonstrating conservation	-15.72	7.52	-30.45	-0.98	F = 4.37	0.037	0.003	54%
Factors that Increase Water Use									
Q7,N	Water the lawn during hours that avoid the heat of the day	75.24	20.14	35.76	114.71	t = 3.74	0.000	r2 = 0.116	All the time: 69%
Q7,P	Repair sprinkler heads	71.73	13.95	44.38	99.08	t = 5.14	0.000	r2 = 0.116	All the time: 54%
Q15,X	Prefer information from irrigation contractors	61.84	19.35	23.91	99.77	F = 10.21	0.001	0.006	4%
Q13,G	I do not know why I conserve	51.59	24.88	2.83	100.36	F = 4.30	0.038	0.003	2%
Q17	Single family home?	41.764	12.628	17.01	66.51	F = 10.94	0.001	0.007	
Q9,L	Changed watering schedule in the past year	39.38	7.02	25.62	53.13	F = 31.49	0.000	0.020	37%
Q1,C	Air pollution is a problem	26.16	8.36	9.77	42.55	t = 3.13	0.002	r2 = 0.069	Strongly Agree: 50%
Q15,F	Prefer billboards	24.98	8.90	7.54	42.43	F = 7.88	0.005	0.005	21%
Q9,F	Repaired leaking faucets or toilets	24.77	7.08	10.90	38.64	F = 12.25	0.000	0.008	58%
Q12,H	I changed my behavior after a water bill insert	23.35	9.033	5.65	41.05	F = 6.68	0.010	0.004	18%
Q9,J	Purchased soaker hoses in the past year	22.59	10.73	1.56	43.61	F = 4.43	0.035	0.003	10%

(continued)

Table 4.28 (Continued)
Individual factors found to influence water use[*]

Question	Question Specifics	Coefficient[**]	Std. Error	95% Upper Confidence Bound	95% Lower Confidence Bound	Stat. Test	P-value	Partial η2[+]	N
Q3,E	Home and gardening TV shows credible source	14.73	7.26	0.49	28.96	t = 2.03	0.043	r2 = 0.076	>=Somewhat credible: 45%
Q9 Indoor	Number of indoor conservation activities associated with higher use	5.20	2.03	1.22	9.17	t = 2.56	0.010	0.073	Mean: 1.78, Median 1
Q7 Outdoor	Number of outdoor conservation activities is associated with higher use	3.60	1.70	0.26	6.94	t = 2.11	0.035	r2 = 0.068	Mean: 7.21, Median 7.5

[*] Dependent variable = annual water use (untransformed). Each question evaluated in isolation, but water agency, income, # of bathrooms, # of residents, type of housing, and water agency from which data were obtained are controlled for.

[**] Sorted by magnitude of regression coefficient, B. The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] Partial η2 can be interpreted as similar to the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, number of residents, and water agency.

Some of the factors associated with decreased water use relate to irrigation changes and drought response such as stopping irrigation some or all of a lawn, changing behavior in response to drought, and watering no more than one inch per week. Many of the factors associated with increased water use can be interpreted as surrogates for the presence of an automatic irrigation system at the home such as watering at night, repairing sprinkler heads, preferring information from irrigation contractors, and changing the watering schedule in the past year.

Peer pressure from neighbors registered as the most effective informational tool for decreasing water use, followed by radio advertising, demonstrations in home improvement stores and TV advertising. Information sources that are associated with higher water use include: irrigation contractors, billboards, and home and gardening TV shows. Respondents who reported practicing multiple indoor and multiple outdoor conservation activities were associated with higher water use, a result contrary to what might be expected.

The analysis of individual factors analysis provided some interesting results, but it is does not appear that any of these responses are particularly useful or instructive to agencies seeking to develop or improve their water conservation program efforts. Conflicting results muddle the findings and the inability of any of these factors to reliably influence water use in combination with other statistically significant factors reduces the utility of these results.

EVALUATION OF COMMUNICATION STRATEGIES AND WATER USE

The survey response and historic consumption database was used to more closely evaluate the linkages and relationships between the water conservation behavior of residential customers and the effectiveness of communication approaches that seek to influence that behavior. In each survey, specific questions that pertained to communication and conservation approaches were examined and relationships were evaluated to determine whether water use was measurably impacted.

Using periodic billing data to try and measure potentially small and subtle differences in usage can be problematic, and the evaluation presented below should not be viewed as a critique of the communication campaigns implemented by the participating agencies. Rather, this analysis is intended to shed light on strategies that may be working so that they can be examined and possibly adopted by other water providers seeking to achieve water use reductions from their residential customers.

Communication strategies and water use at each of the six participating agencies are examined separately below. Five survey questions (Q4, Q5, Q6, Q8, and Q10) relate directly to unique conservation messaging campaigns at the participating agencies. The content of these questions was customized for each participating agency. These questions are discussed briefly below. Copies of the complete survey instrument implemented in each agency and fully enumerated survey responses for each agency are provided in Appendix E.

Question 4 asked, “For each of the messages below, please indicate where you saw or heard each message.” A list of messages unique to each agency was provided. Potential responses included: radio, network TV, cable/satellite TV, web site, home improvement store, outdoor ads, bill insert, direct mailing, educational event, newspaper/magazine, brochure, and “did not see or hear this message.” Respondents could select as many information sources as applied for each message.

Question 5 asked, “For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).” A list of messages unique to each agency was provided. Potential responses included: more than 10 times, 5 to 10 times, 2 to 4 times, once, or never. Only one response for each message was permitted.

Question 6 asked, “For each message below, please indicate whether hearing or seeing that message made you change your water use behavior.” A list of messages unique to each agency was provided. Potential responses included: “I was conserving prior to seeing or hearing message,” “Yes. I change my behavior or performed some action,” “I thought about it, but did not do anything,” “I did not think about it,” and I did not see or hear this message.” Only one response per message was permitted.

Question 8 asked, “For each behavior that you marked above as doing, please indicate what helped motivate that change (mark ALL that apply).” The same list of measures found in Question 6 and 7 is provided. Potential responses included: Radio, TV, web site, home improvement store, outdoor ad, bill insert, children, family member/friend, plumber or water professional, other, and did not perform activity.

Question 10 asked, “For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action (Mark ALL that apply)”. An extensive list of measures and actions is provided. Potential responses were the same as for Question 8.

These five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA process that corrected for the known factors that were shown to influence water use in this study – # of bathrooms, # of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (un-transformed). While the coefficient for each factor is provided, the sign of the coefficient is actually of more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Analysis from all six study sites is presented below. Detailed case studies were developed for Phoenix and Seattle. More limited analysis is presented from Tempe, Ariz.; JEA, Jacksonville, Fla.; Orange County, Fla.; and Durham, N.C.

Both Fisher and Pearson Chi-Square statistical tests were used to evaluate communication strategies and water use. These two methods were necessary because of key differences in survey questions and potential responses. No single statistical method was appropriate for the evaluation.

Statistical significance in the Fisher Text is calculated using the F statistic, which is related to the T statistic, but more general to groups defined by categorical variables. When testing the effect of a binary category, F=1 explains the condition of 50% of variance is explained and 50% is undetermined. The section (a region between -b and b) on the T distribution where the null hypothesis is accepted occurs at low F values. Significance (p) is calculated from the cumulative distribution function of F, which is also non-negative (Snedecor, 1989).

Tempe, Arizona (www.tempe.gov)

The City of Tempe (population of 165,000) has implemented water conservation programs to residential, multifamily, and industrial customers for more than fourteen years. Renewable surface water sources make up more than 95% of Tempe's annual water supply in an average year with the remaining 5% coming from safe-yield groundwater supplies plus surface water or reclaimed water that has been stored in groundwater aquifers.

The City of Tempe's Water Conservation Program began in the early 1990s in response to the 1980 Groundwater Management Code, a legislative order limiting the amount of ground water being pumped by Arizona cities.

In efforts to reduce water usage and comply with the 1980 Code, the City of Tempe created a Water Conservation team, which develops and administers water conservation efforts. Tempe also participates in the *Water – Use it Wisely* conservation social marketing program with other utilities and water authorities in the Valley.

Tempe has a $300,000 annual conservation program budget with $80,000 going for rebates and $10,000 going toward the aforementioned the marketing campaign.

The City of Tempe's residential water conservation program seeks to educate residents about water use and to provide information about how to conserve water in their home. In addition to Tempe-specific water conservation initiatives, Tempe contributes to the *Water – Use It Wisely* campaign along with 20 other water providers in the Valley. The campaign has enabled smaller water providers to leverage marketing dollars to reach more residents and ensures consistent messaging in the region. The broad reach of the general awareness campaign has contributed to establishing a water conservation ethic in the Valley, which allows the City of Tempe to focus on initiatives and messaging to educate residents about how to be water-wise.

The keystones of Tempe's water conservation initiative are the toilet rebate, the landscaping, and the elementary school programs. Most of the real estate in Tempe's service territory is already developed; existing homes still have the typical 1970's landscaping consisting of turf and high water-use trees. Therefore, Tempe focuses water conservation efforts on upgrading technology in existing homes, converting lawns to water wise landscapes, educating Tempe's young people about being water wise, and implementing local ordinances.

Tempe employs several outreach vehicles to market its water conservation program. These vehicles includes promoting programs and rebates on individual utility bills, a dedicated water conservation web page on the city's web site, direct outreach through community events and school assemblies, how-to workshops, the distribution of brochures and conservation how-to informational materials, press releases and media outreach, and occasional newspaper advertising to promote workshops. Because Tempe's programs have been implemented since 1993, many rebate programs are advertised by word-of-mouth through stakeholders such as plumbers, contractors, and other city departments.

In times of extreme water conditions, such as drought, the City of Tempe activates their media outreach strategies to help educate residents about the water conditions and steps they can take to reduce their water use. Pete Smith, Water Conservation Coordinator for the City of Tempe believes that "the media is our best avenue for getting information out to the public."

Evaluation of Communication Strategies and Water Use in Tempe

Survey respondents in Tempe had a high degree of familiarity with many of the conservation communication messages promoted by the City. The *Water – Use it Wisely* message, "There are a number of ways to save water, and the all start with you," was familiar to 75% of survey respondents. Many conservation messages were seen more than 10 times by respondents, indicating a good familiarity with Tempe conservation communication programs.

The evaluation of communication strategies and water use in Tempe turned up some similar findings, with the analysis covering all sites presented earlier in this report. Results on the individual factors found to influence water use in Tempe are shown in Table 4.29. Only a few conservation communications specific to Tempe emerged as statistically significant influences on water use. As discussed above, survey questions 4, 5, 6, 8, and 10 offered respondents the opportunity to react to unique conservation communication efforts implemented by each participating agency.

Those five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA procedure that corrected for the known factors that were shown to influence water use in this study: # of bathrooms, # of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided in Table 4.29, the sign of the coefficient is actually or more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Factors that Decrease Water Use in Tempe

Two factors unique to Tempe's conservation communication efforts were found to decrease water use at the 95% confidence level. These were: Question 10(i), choosing a low water use plants and Question 8(h), using drip irrigation[23]. Both of these questions are associated with efficient water wise, non-turf landscaping practices promoted by the City of Tempe. In addition, customers who reported that they monitor their outdoor water use used substantially less water. These results suggest that Tempe's outdoor conservation efforts promoting Xeriscape and alternatives to turf are having a measurable impact among residential customers.

Other conservation behaviors found associated with lower water use in Tempe were:

- using a broom rather than a hose to clean pavements,
- stopping irrigation of some or all of an existing lawn, and
- conservation actions taken in the past year: none of the above[24].

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[23] While drip irrigation was associated with lower water use on Question 8, it was associated with higher water use on Question 6.

[24] This response does not necessarily indicate that no conservation actions were taken in the past year (although it could). Rather it indicates that if any conservation actions were taken, they were not included on the list of actions provided in the survey for this study. Since the list of actions was extensive it could be an indication that no conservation action was taken over the past year.

Customers in Tempe that had lower water use also had the following characteristics and preferences:

- prefer demonstration in home improvement stores for conservation information,
- prefer the City of Tempe web site as a source of conservation information,
- prefer free home water audits,
- prefer TV ads for conservation communication,
- believe people do not recycle enough, and
- believe commercial/industrial grown is impacting local water supplies.

These results suggest that Tempe’s broad communication approach to conservation messaging and program delivery is reaching customers, particularly those with an environmental consciousness concerned about growth in the community. This may be the “low hanging fruit” for conservation in the Tempe area. As discussed below, the small number of customers who are not being reached by Tempe’s conservation communication and program efforts are associated with higher water use.

Factors that Increase Water Use in Tempe

Four variables (referred to as “factors”) unique to Tempe’s conservation communication efforts were found to increase water use at the 95% confidence level. These were:

- Question 10(e), minimize evaporation by water using during early morning hours (outdoor activities indicated, outdoor use increase)[25];
- Question 6(h), drip irrigation messaging made customer change behavior; and
- Question 8(i), “other message” (not specified in survey) motivated conservation behavior change (outdoor activities indicated, outdoor use increase).

One percent of survey respondents in Tempe responded that (1) they did not know why they conserve water, and (2) they did not know what source of information they preferred, and used substantially more water on average. The fact that a very small number of respondents who expressed apathy regarding water conservation were also associated with higher water use suggests that Tempe’s communication efforts are reaching the broad population and are having an impact on water use.

Two of the factors shown to increase water use in Tempe could be associated with presence of an automatic irrigation system at the home, including:

- repairing broken sprinkler heads (49% of respondents), and
- preferring irrigation contractors as a source of information (4% of respondents).

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[25] Multiple response question. Only outdoor conservation activities were indicated for these respondents and the increase in water use was only associated with seasonal (outdoor) use.

Customers in Tempe with higher water use also had the following characteristics and preferences:

- prefer outdoor conservation demonstrations on TV,
- believe fossil fuels are being used up,
- prefer e-mail as communication vehicle for conservation messaging, and
- view family as a credible source of conservation information.

Twenty-nine percent of the respondents in Tempe reported that the *Water – Use It Wisely* message (“There are a number of ways to save water and they all start with you”) encouraged them to take action outdoors (Q10) and were associated with higher outdoor water use.

Table 4.29
Tempe, Arizona – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Factors that Decrease Water Use									
Q7, k	Monitor outdoor water use	-93.225	29.681			t = -3.141	0.002		>= Most of the time: 72%
Q10,outdr.i	Choose a low water use plant	-62.872	17.832			t = -3.528	0.000		4%
Q7, t	Use a broom instead of hose	-61.046	26.533			t = -2.301	0.022		>= Most of the time: 71%
Q9, r	Conservation actions taken in past year: none of the above	-59.869	24.754	-108.575	-11.164	F = 5.849	0.016	0.018	8%
Q15, g	Demonstrations in hardware stores are preferred	-53.692	18.162	-89.361	-18.023	F = 8.774	0.003	0.028	19%
Q1,e	People do not recycle enough	-51.082	15.334			t = -3.331	0.001		Strongly agree: 47%
Q9, q	Stopped watering some or all of an existing lawn	-50.71	17.49	-85.123	-16.298	F = 8.407	0.004	0.026	17%
Q15, r	Utility web site is preferred	-39.972	18.48	-76.338	-3.606	F = 4.678	0.031	0.015	13%
Q15, p	Free home water audit is preferred	-34.728	16.235	-66.675	-2.781	F = 4.576	0.033	0.015	20%
Q1, k	Commercial/Industrial growth is impacting the water supply	-33.237	14.845			t = 2.239	0.026		At least agree: 78%
Q15, b	TV ads as preferred	-31.75	13.333	-57.986	-5.514	F = 5.671	0.018	0.018	51%
Q8 total. h	Drip irrigation	-9.967	4.22			t = -2.362	0.019		10%
Factors that Increase Water Use									
Q12, m	I do not know why I conserve	263.374	78.178	109.558	417.19	F = 1.349	0.001	0.035	1%
Q15, y	Don't know what source of info is preferred	205.002	73.867	59.647	350.357	F = 7.702	0.006	0.025	1%
Q17	Single-family home?	190.498				F = 5.938	0.001	0.054	93% single family
Q7, n	Water / avoid the heat of the day	106.56	42.342			t = 2.517	0.013		Always: 63%
Q10,outdr.e	Minimize evaporation	92.358	19.639			t = 4.703	0.000		6%
Q7, p	Repair sprinkler heads	84.822	29.887			t = 2.838	0.005		Always: 49%
Q15, x	Irrigation contractor is preferred	74.037	35.682	3.822	144.252	F = 4.305	0.039	0.014	4%
Q15, h	Demonstrations of outdoor watering on TV are preferred	59.209	18.566	22.676	95.743	F = 10.171	0.002	0.032	26%
Q1, h	Fossil fuels are being used up	49.652	14.07			t = 3.529	0.000		Strongly agree: 42%

Table 4.29
Tempe, Arizona – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Q15, o	Email is preferred	48.141	17.536	13.633	82.649	F = 7.536	0.006	0.024	15%
Q6, h	Drip irrigation	48.026				F = 3.254	0.026	0.111	Aware + Action: 27%
Q4, b	Water your plants deeply	36.989	17.408	2.742	71.236	F = 4.515	0.034	0.014	75%
Q3, m	Family as credible source of info	36.717	12.642			t = 2.904	0.004		Somewhat credible: 45%
Q8, outdr. j	Other message	18.538	5.967			t = 3.107	0.002		11%
Q10,outdr.a	There are a number of ways to save water, and they all start with you	5.79	2.744			t = 2.110	0.036		29%

[*] Dependent variable = annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] Sorted by magnitude of regression coefficient, B. he sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text).

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

JEA – Jacksonville, Florida (www.jea.com)

JEA provides electric, water, and sewer services to the greater Jacksonville, Florida metropolitan area. JEA is part of the St. Johns River Management District and services much of Duval County and portions of three neighboring North Florida counties.

JEA is the largest community-owned utility in Florida and the 8th-largest in the nation. JEA began as an electric utility in 1895, and in 1997, assumed water service responsibilities from the City of Jacksonville. Today, more than 80% of all residents and businesses in JEA's service territory receive water and sewer service from JEA.

JEA's Water System consists of 150 artesian wells tapping the Floridian Aquifer, which is one of the world's most productive aquifers. Water is distributed through 44 water treatment plants and 3,480 miles of water lines. More than 2,500 miles of collection lines and six regional sewer treatment plants comprise the JEA sewer system.

Water conservation is an important part of JEA's communication efforts, being integral to its mission of providing high-quality water service at the lowest possible price in an environmentally friendly manner. Florida draws its public water supply from underground aquifers. Although Florida is surrounded on three sides by water, and there is typically rainfall throughout the year, much of the rain water is lost due to evaporation, and the climate is subject to drought. This climate condition, coupled with a growing population and increasing demands on the water supply, necessitates that the state, utilities, and residents carefully manage consumption.

JEA's budget for combined energy and water conservation efforts is between $600,000-800,000 (including incentives). In addition, JEA allocates $1.4 million to advertising for conservation only. Included in this is a contribution to St. John's Water Management District's marketing efforts.

although not a formal goal, the utility wants to decrease water usage by 7 to 10% through water conservation efforts over the next five years. To reach this goal, JEA has outlined a singular objective: to educate its customers about water resource issues and to help them learn ways to conserve for the future.

When water conservation efforts began in 1997, JEA partnered with the University of Florida Policy Research Project to conduct a telephone survey. The survey assessed residents' knowledge of water resource issues and attitudes toward water conservation, specifically outdoor water use. Through the survey, JEA found that:

- more than 70% of Duval County homeowners do not know that lawn and landscape irrigation is the single biggest use of water in the home;
- less than half of the respondents were confident that there will be sufficient fresh water to meet the needs of Duval County in the next 20 years; and
- about 44% of homeowners report their irrigation systems do not operate properly.

JEA implements a water conservation program comprised of a variety of community outreach and mass media efforts, as well as financial incentives to raise awareness, encourage residents to change their attitudes about water use, and to motivate residents to adopt water wise behaviors.

JEA is a heavily residential utility with more than 50% of water consumption attributed to lawn irrigation. Many of JEA's water conservation programs and messages are directed to reducing residential outdoor demand. JEA also has implemented a conservation oriented rate structure to encourage water users to adopt water wise irrigation behaviors.

JEA strives to create water conservation awareness among its customers, to shape positive customer attitudes, and to change water-consuming behaviors to water-conserving behaviors through outreach initiatives. Bruce Doueck, Manager of Conservation Programs for JEA. believes that water conservation is most successful when outreach and education are coupled with the implementation of new technologies such as rain sensors or faucet aerators.

JEA recognizes the overlap between energy and water efficiency. Because JEA is both an electric and water utility, they are uniquely positioned to package both messages into one holistic resource conservation campaign. JEA's *Living Smart, Living Well and Living Green* outreach effort is an attempt to integrate water and energy conservation. This effort is further exemplified through their "Conservation Center" web site (www.jea.com) as well as through collateral material such as the JEA How to *Save Energy & Water at Home* pamphlet.

JEA implements an ongoing media campaign comprised of TV sponsorships, PSA messages, print and radio. These media vehicles provide customers with information about the benefits of conserving water and practical tips on how to conserve water. JEA recognizes that not all residents are motivated by the same messages. While they do not have the budget necessary to target specific homeowner demographics, JEA does focus the majority of its efforts on outdoor water use using a variety of "hot button" messages – from money-saving to green living. Also, JEA focuses its messaging during the peak water-use season (April to June) on how to be water-wise outdoors.

The utility offers many community outreach programs such as landscape demonstration projects, exhibits at local events, and presentations to community groups and schools. These programs support the media campaigns and create additional opportunities for JEA to educate residents directly about water conservation.

A successful JEA outreach effort is their free LawnSmart program. which began in 1997. This mobile irrigation lab provides residents with an outdoor irrigation check-up. JEA believes that the LawnSmart irrigation lab, as well as their indoor water audit program, are their most effective efforts because they address high water-use homeowners directly and provide residents with immediate and simple solutions to lower water consumption.

As part of the St. John's Water Management District (SJWMD), JEA participates in several District-sponsored initiatives. JEA contributes to SJWMD's "Think 2" campaign and is co-branded on many campaign materials. In addition, JEA participates in the SJWMD's Florida Water Star program, which provides incentives to homebuilders and homebuyers to build and purchase homes that are certified as water-efficient.

JEA has gained the following insights from its conservation program efforts:

- Customers are more likely to change their behavior if the requested change is small, convenient, and easy to implement.
- Utilities cannot implement a water savings measure such as a new technology or behavior change without an outreach component to communicate that change.
- It is critical that the technology/industry supply chain align with conservation efforts so that residents can easily obtain new water-saving technologies, native plants, etc.

- Engaging stakeholders, such as plumbing or lawn care professionals, and educating them about the water conservation will empower them to act as “voices” of the program, will aid in the creation of a water conservation ethic in the community, and extend the reach of limited water conservation dollars.
- Programs must be evaluated regularly to ensure they are efficient and effective and to determine whether modifications are required.

Evaluation of Communication Strategies and Water Use in Jacksonville

Survey respondents in the JEA service area had a high degree of familiarity with many of the conservation communication messages promoted by JEA. More than 80% of respondents were familiar with the message, “Water lawn or garden during hours that avoid the heat of the day.” In general, more than 50% of respondents indicated at least some familiarity with most of the conservation messages presented in the survey.

Although customers expressed familiarity with JEA water conservation messages, only one factor from the survey was associated with statistically significant differences in water use among respondents. As shown in Table 4.30, respondents that viewed plumbers as a credible source of conservation information were associated with higher water use compared with those that did not view plumbers as a credible source. This was the only survey factor found to have a statistically significant association with water use at the 95% confidence level. Except for this single survey question, water use between survey respondents was not significantly different at the 95% confidence level.

These results should not be viewed as any kind of failure on behalf of JEA or its conservation efforts. Rather, there were simply no distinct water use trends in this data set that enabled any meaningful analysis of differences in water use. This lack of trends could be the result of coarse billing data, survey response rates, and the general variability of demand among JEA customers. Future studies by JEA may wish to obtain more disaggregated water consumption data that allows for more detailed analysis of water use patterns of residential customers.

Table 4.30
JEA, Jacksonville, Florida – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Q3,H	Plumbers are a credible source of information	35.276	16.789			t = 2.101	0.037		>=Somewhat credible = 46%

[*] Dependent variable = annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text)

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

Orange County, Florida (www.orangecountyfl.net)

Central Florida's rapidly growing population is dependent upon rainfall for its freshwater supply. Orange County, Florida, which includes the cities of Orlando and Winter Park, typically receives 52 inches of rainfall per year. Most of the rainfall is not available for consumption because much of it is lost to evaporation. Water that does not evaporate percolates into the Floridian Aquifer and is used as Central Florida's primary supply of freshwater.

Because of stress on this aquifer, by year 2013 the State of Florida will require utilities to draw water from other sources. Orange County has committed to reducing its overall water consumption by 5% as required by the water management district's consumptive use permit. These water management policies coupled with significant population growth in the county (6% to 7% annually) has heightened the need for water conservation initiatives.

Orange County's largest water users are hotels and single-family homes belonging to affluent residents. Orange County has determined that at least 50% of water use is for outdoor irrigation. The Orange County water conservation team seeks to reduce per capita water consumption and has piloted conservation programs to determine the most cost-effective solutions to achieve stated goals.

Orange County utilizes a variety of vehicles to market their water conservation programs including mass media advertising, direct mail, community outreach, school education, and rebate programs. Jacqueline Torbert, Water Conservation Manager for Orange County's Water Utilities Division, believes that one of the keys to a successful water conservation program is having a complete understanding of utility customers. Only then can a utility develop efficient and effective water conservation programs. Because outdoor water use is the largest single end-use of water in the county, many of the utility's programs focus on outdoor efficiency.

The utility is part of the St. John's and South Florida Water Management Districts and contributes to St. John's Water Management District's conservation awareness campaign, *It's Worth Saving*. By pooling the financial resources of ten other utilities, Orange County has the ability to deliver broad conservation awareness messages through television ads and public service announcements. In 2006, Orange County's budget for water conservation was $1.3 million. In 2007 this was reduced to $800,000. Orange County contributes $75,000 annually to the St. John's Water management district for advertising and outreach

To raise awareness for upcoming activities, Orange County regularly issues news releases to local newspapers and radio and TV stations. Orange County staff provides interviews to local radio and TV programs on request. Once per quarter, utility customers receive a bill insert about general conservation that includes a schedule of upcoming water conservation activities. Other educational materials include Healthy Lawn guides, Water Management guides, and trade show exhibits.

Many of Orange County's programs are currently in pilot phase. Piloting programs is a key element in Orange County's approach to developing water conservation initiatives. Through pilot programs, the utility hopes to determine which programs reduce water consumption effectively and efficiently.

In April 2008, Orange County launched a pilot program to address outdoor water consumption: the Blue Ribbon Neighborhood Initiative. This program targeted entire neighborhoods throughout their service area to instill a water conservation ethic among homeowners and neighborhood groups. The utility partnered with the local Agricultural Extension Office to educate customers about native Florida plants and water-efficient irrigation methods. As part of the program, both sponsors provided direction and assistance for the re-landscape of individual properties and communal land.

Direct outreach has proven an effective communication tactic for Orange County. Throughout the year, the water conservation team offers free irrigation audits delivered by certified irrigation experts via the county's Mobile Irrigation Lab. High water users are eligible to apply for the program and participants receive assistance to help reset sprinkler timers, develop irrigation design schemes, and develop landscaping and irrigation plans. At the end of the audit, the irrigation expert provides the homeowner with a list of recommendations to improve the efficiency of their irrigation system.

Indoor water conservation is also important to Orange County, which provides rebates to residents for replacing old high volume toilet fixtures with low-flow models. The rebate program is marketed via direct mail campaign targeted to homes built around or before 1987. Customer feedback from the toilet rebate pilot program indicated that customers were willing to exchange their standard toilets but wanted in the ability to choose the toilet model and installer. As a result, Orange Country partnered with The Home Depot to offer customers more choice in toilet models. The rebate program has helped install more than 2,000 low-flow toilets in Orange County. The public-private partnership developed through this effort has expanded beyond the toilet retrofit program to include direct education and outreach to The Home Depot's customers via water-wise, how-to workshops.

Orange County's conservation efforts include youth education; each year, every school in the county receives water conservation posters and display materials. The utility also provides free curriculum for elementary and middle school students through two utility-sponsored programs: the Blue Thumb Program and the Water Facts Festival. The Blue Thumb Program was designed for elementary school students to educate about the importance of saving water. The program includes activity packets and giveaways such as low-flow shower heads. The Water Facts Festival was developed for middle school children and educates about the drinking water process from treatment to distribution to testing.

Tracking and measurement are included in conservation program efforts. Through research and surveys, the utility seeks to tailor programs, identify areas of weakness and improvement, and verify water savings. To enhance tracking efforts and ensure that conservation programs are properly targeted to achieve maximum effect, Orange County is developing a database that will allow better access to information about customer water use behaviors.

Orange County staff believes there are three keys to success for any conservation program:

- understanding the target audience and customer base to inform program and message development,
- strong water conservation codes and code enforcement, and
- identification of a publicly known and respected water conservation champion.

Evaluation of Communication Strategies and Water Use in Orange County

Survey respondents in Orange County had a varying degree of familiarity with the conservation communication messages promoted by the County. Results are shown below:

- The "Florida Water – It's Worth Saving" message was seen or heard by to 78% of survey respondents.

- The “Saving Water Starts with You” message was seen or heard by 54% of survey respondents.
- The “Free…Florida Friendly Landscape Workshops” message was seen or heard by 37% of survey respondents.
- The “If Water is Life, Then Water Conservation Is the Way of Life” message was seen or heard by 23% or respondents.
- The “Think Two – Water the Lawn Only 2 Days a Week” message was seen or heard by 89% of respondents.

The range of recognition rates could be indicative of the maturity of different conservation messaging or could indicate that different communication methods were used for each message. Network TV was the most frequently reported vehicle for receiving these messages in almost all cases and in particular for the “Florida Water – It’s Worth Saving” message and for the “Think Two” message. Fully enumerated survey results from Orange County and all other study sites are presented in Appendix E.

The evaluation of communication strategies and water use in Orange County provided several different findings with the analysis covering all sites presented earlier in this report. Results on the individual factors found to influence water use in Orange County are shown in Table 4.31. Six conservation communications specific to Orange County emerged as statistically significant influences on water use. As discussed above, survey questions 4, 5, 6, 8, and 10 offered respondents the opportunity to react to unique conservation communication efforts implemented by each participating agency.

Those five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA procedure that corrected for the known factors that were shown to influence water use in this study: # of bathrooms, # of people in the household, income, and type of residence In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided in Table 4.31, the sign of the coefficient is actually or more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Factors that Decrease Water Use in Orange County

Two factors unique to Orange County’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were Questions 4 and Question 10. In Question 4, customers classified as “aware.” meaning that they heard or saw at least one Orange County conservation message were associated with lower water use at the 95% confidence level. Ninety-four percent of the survey respondents were classified as “aware.” This result favorably indicates that Orange County’s messaging efforts may be having an impact on water use.

In Question 10, customers who were encouraged to take conservation action by the message, “Free… Florida-Friendly Landscaping Workshops,” were associated with lower outdoor water use. Only 1% of the respondents answered Question 10 in this manner; therefore the analysis sample is too small to determine whether the lower water use is a result of the messaging, but it is an encouraging finding.

Customers in Orange County that had lower water use also had the following characteristics and preferences:

- A small number (1%) do not want any conservation information.
- They prefer conservation information from a nursery or landscape company (8%).
- They believe residential growth is impacting water supply (58%).
- They prefer TV ads for conservation communication (67%).

The age of the home was also found to be associated with differences in water use. In this case, older homes were associated with lower use.

These results suggest that Orange County's communication messaging is effectively reaching customers. More than 90% of survey respondents had received at least one Orange County conservation communication, and this group of customers used less water than those that had not received any conservation communications.

Factors that Increase Water Use in Orange County

Four factors unique to Orange County's conservation communication efforts were found to be associated with increased water use at the 95% confidence level. These were:

- Question 5, "If Water Is Life, Then Water Conservation Is a Way of Life" (26% of respondents heard this message)
- Question 8, "Other message" (11% reported hearing a conservation message not included on the survey)
- Question 8, "Florida's Water – It's Worth Saving" (26% reported hearing this message)
- Question 8, "Saving Water Starts with You" (24% reported hearing this message)

While these specific messages were associated with higher water use, as discussed earlier, the magnitude of the coefficients for these factors were relatively small. As discussed earlier, awareness of any of the messages was associated with lower use, so it is likely that the increases discussed here are not meaningful.

Two of the factors shown to increase water use in Orange County could be associated with presence of an automatic irrigation system at the home including:

- prefer irrigation contractors as a source of information (5% of respondents), and
- believe irrigation contractors are at least a "somewhat credible" source of information (50% of respondents).

Customers in Orange County that had higher water use also had the following characteristics and preferences:

- Always check hoses for leaks (63% of respondents)
- Have replaced some grass with Xeriscape or hardscape (10% of respondents)
- Prefer free home water audits as a source of conservation information (19% of respondents)
- # of outdoor conservation activities performed (higher water use is associated with more activities performed)

It is unknown why these factors would be associated with higher water use. In general, checking for leaks, replacing turf, home water audits, and outdoor conservation activities have been shown to save water. Covariance with other factors could be an issue in this analysis. These findings could also be the result of coarse billing data, survey response rates, and the general variability of demand among Orange County customers. Future studies in Orange County may wish to obtain more disaggregated water consumption data that allows for more detailed analysis of water use patterns of residential customers.

Table 4.31
Orange County, Florida – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Factors that Decrease Water Use									
Q15,AA	Do not want any info	-103.33	46.49	-194.92	11.74	F = 4.94	0.027	0.021	1%
Q4 Aware	At least one message heard	-85.94	36.62	-158.06	-13.29	F = 5.51	0.021	0.021	94%
Q15,V	Nursery or landscape company preferred source	-56.82	28.53	-113.02	-0.62	F = 3.97	0.048	0.017	8%
Q10 Outdoor	Free…Florida-Friendly Landscaping Workshops	-41.24	20.68			t = -1.99	0.047		1%
Q1,L	Residential growth is impacting water supply	-29.79	13.73			t = -2.17	0.031		Strongly Agree: 58%
Q19	Age of home	-2.02	0.43			t = -4.75	0.000		
Factors that Increase Water Use									
Q15,X	Irrigation contractors preferred source	163.70	34.02	96.68	230.73	F = 23.15	0.000	0.089	5%
Q15,Z	“Other” preferred source	152.77	41.72	70.58	234.96	F = 13.41	0.000	0.054	2%
Q7,R	Check water hoses for leaks	103.71	26.43			t = 3.92	0.000		Always: 63%
Q9,O	Replaced some grass with xeri/ hardscape	68.22	21.64	25.59	110.84	F = 9.94	0.002	0.039	10%
Q15,P	Free home water audits as preferred source	35.00	14.69	6.06	63.95	F = 5.68	0.018	0.023	19%
Q3,i	Irrigation contractors are a credible source	29.57	13.79			t = 2.15	0.033		Somewhat credible: 50%
Q7 Outdoor	Outdoor activities performed	11.47	3.48			t = 3.30	0.001		Mean 7.93, Median 8.25
Q5	If Water Is Life, then Water Conservation Is the Way of Life	4.89	2.06			t = 2.38	0.018		26%
Q8	Other message	4.47	2.18			t = 2.05	0.050		11%
Q8	Florida’s Water – It’s Worth Saving	4.13	1.92			t = 2.15	0.033		26%
Q8	Saving Water Starts with You	3.53	1.79			t = 1.97	0.041		24%

[*] Dependent variable = annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] Sorted by magnitude of regression coefficient, B. The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text)

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

Durham, North Carolina (www.durhamnc.gov)

City of Durham Department of Water Management provides treated drinking water to more than 70,000 residential customers in North Carolina. In 1993, the City developed a water conservation team to help the growing population use water wisely and reduce the need for additional water and wastewater treatment facilities. The program has been active since that time. Until a recent drought, the marketing budget had been $26,000, of which $4,000 is dedicated to the *Water – Use It Wisely* social marketing campaign. In 2008, the budget was expanded significantly to improve messaging efforts related to conservation and mandatory water restrictions.

The City of Durham does not have any specific water reduction goals for the conservation program. Rather, the Department of Water Management's conservation and efficiency measures aim to reduce water usage, decrease the demand on the water treatment plants, and extend the life of the City's water supplies.

Durham's primary water supply comes from the Lake Michie and Little River reservoirs, which typically yield 37 million gallons per day (MGD). North Carolina is subject to periodic drought. In 2002 and 2007, North Carolina and surrounding states experienced a severe drought that drastically reduced the water supply and required statewide water restrictions. During drought periods, the Department's focus shifts from awareness and conservation to messages about water restrictions and informing residents about ways to reduce their water use. Billing data from Durham used in this study are from the 2006 calendar year.

Durham's Department of Water Management promotes wise water use through a mix of mass media advertising, direct outreach, education, and City ordinances. Through these vehicles, the Durham water conservation team promotes two key objectives:

- Raise awareness about the benefits of water conservation.
- Provide information, skills, and tools to reduce water consumption.

The City of Durham conservation program has a relatively small budget. This constraint requires outreach tactics to be highly effective in order to accomplish the key objectives. The Durham Department of Water Management implements an array of water conservation and education programs throughout the year. It relies heavily on mass media, media outreach, direct outreach, collateral materials, bill-inserts, and its web site to deliver information and conservation messaging to residents. The water conservation team also leverages City-sponsored outreach vehicles such as a newsletter and annual water quality report to bolster outreach efforts.

The City of Durham participates in North Carolina WaterWise Partners, a group of seven water providers formed to share the cost of participating in the *Water – Use It Wisely* social marketing campaign. Durham extends the value of their partnership by using existing campaign materials, along with developing their own materials using *Water – Use It Wisely* logos and messaging. This provides uniform messages to city residents and the greater population of North Carolina.

The majority of Durham's conservation program budget is allocated to outreach and educational speaking opportunities with civic organizations and schools. Durham's "Conservation Station" display travels to schools, community fairs, and festivals. The Department believes that maintaining a presence at community events encourages residents to become involved in water conservation. Outreach topics range from information about specific behaviors and tools to reduce water use to information on water-wise landscaping.

Durham views their showerhead exchange initiative and one the most successful programs implemented. Exchanges are generally held in conjunction with community events and provide a valuable opportunity for the water conservation team to inform residents about water-wise behaviors while providing them with the opportunity to test new water-efficient technologies free of charge.

Educating Durham's youth is important to establishing a water conservation ethic. The City does not have a formal agreement with the public school system; however, the water conservation team will conduct presentations at schools at a teacher's request. The school program includes hands-on activities designed to educate students about wise water use at home and the benefits of water-efficient fixtures, information about water sources, groundwater, wastewater treatment, and water quality issues. The City's youth education program also includes materials about the water cycle and water-use posters, conservation video tapes, and activity books. The Department hosts an annual water festival to educate 4th-grade students on the value of water and water conservation, and sponsors an annual water conservation poster contest, which is featured during Drinking Water Week each May.

Durham's Water Use Assessment program is another successful outreach tactic. These low cost (e.g., $10), one-on-one water audits educate residents about their water use patterns, and provides information about how to use water efficiently and save money. Through the water assessment, water experts identify leaks and "how-to" information on retrofitting old fixtures. The Durham water conservation team also offers telephone consultations. These programs are promoted via bill inserts and through the City's web site.

The City of Durham has identified key "lessons learned" from implementing their conservation program over the past 14 years:

- Education is essential. Durham promotes the benefits of saving water with a particular emphasis on the key message: Water conservation does not equate to water restrictions. They are different.
- Media coverage helps generate buzz about water conservation, but Durham gets the most traction when media is interested in the story and seeks information.
- Case studies are helpful for water conservation program implementers, particularly studies that provide information about how to maximize a small budget.
- Data is required. It is important to have data about community water consumption patterns to inform and direct water conservation programs.

Evaluation of Communication Strategies and Water Use in Durham

Survey respondents in Durham had a varying degree of familiarity with the key conservation communication messages promoted by the City. Results from a few messages are presented here:

- The "Water – Use it Wisely" message was seen or heard by to 82% of survey respondents.
- The "There Are a Number of Ways to Save Water and They All Start with You" message was seen or heard by 71% of survey respondents.

- The “Resourceful Landscapes: Choose Drought-Tolerant/Low-Water Use Plants for Landscaping” message was seen or heard by 67% of survey respondents.

Network TV, water bill inserts, radio, and newspapers/magazines were the most frequently reported vehicles for receiving these messages. Fully enumerated survey results from Durham and all other study sites are presented in Appendix E.

The evaluation of communication strategies and water use in Durham turned up some useful findings relating to specific messages implemented. Results on the individual factors found to influence water use in Durham are shown in Table 4.32. Four conservation communications specific to Durham emerged as statistically significant influences on water use. As discussed above, survey questions 4, 5, 6, 8, and 10 offered respondents the opportunity to react to unique conservation communication efforts implemented by each participating agency.

Those five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA procedure that corrected for the known factors that were shown to influence water use in this study: # of bathrooms, # of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided in Table 4.32, the sign of the coefficient is actually or more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Factors that Decrease Water Use in Durham

Four factors unique to Durham’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were elements of Questions 4, 5 and 10 on the customer survey.

In Question 4, customers that saw or heard any one (or more) of Durham’s water conservation messages via any medium were associated with statistically significant lower water use. Significantly, 94% of survey respondents saw or heard at least one of these messages indicating that Durham is doing an excellent job in reaching customers. The 6% of customers who had not heard or seen any water conservation message from the City use more water.

Also in Question 4, respondents who heard or saw the specific message, “There Are a Number of Ways to Save Water and They All Start with You,” via any delivery method, were associated with lower water use at the 95% confidence level. Seventy-one percent of the respondents had been exposed to this message.

In Question 5, lower water use at the 95% confidence level was associated with hearing or seeing Durham conservation messages more frequently. The more frequently a message was heard or seen, the lower the water use. Ninety-two percent of the survey respondents were classified as “aware,” indicating that they had heard or seen at least one Durham conservation message. This is a favorable indication that Durham’s messaging efforts are having an impact on water use, and that repeating the message in various places is likely to increase water savings. This analysis found that the more messages a customer was exposed to, the lower their water use was likely to be.

In Question 10, customers who were encouraged to take indoor conservation action(s) by the message, “There Are a Number of Ways to Save Water and They All Start with You,” were associated with lower indoor water use. The number of indoor behaviors motivated by the message, as reported on the survey, was associated with differences in water use. The more behaviors taken by respondents, the lower the use. Twenty-nine percent of the survey respondents identified at least one indoor behavior that was motivated by this message.

These were the only four factors found to be associated with decreased water use at the 95% confidence level in Durham. The results suggest that the *Water – Use It Wisely* campaign and other conservation communications are reaching a large number of customers in Durham and are likely having a real impact by stimulating actions that result in lower water use. More than 90% of the respondents had seen or heard conservation communications from the City of Durham. The primary *Water – Use It Wisely* message, “There Are a Number of Ways to Save Water and They All Start with You” in particular, was associated with lower water use by customers familiar with that communication.

Factors that Increase Water Use in Durham

Only three factors were associated with higher water use among survey respondents in Durham. These three factors were customers who:

- reported installing an irrigation controller with a rain sensor (1% of respondents),
- preferred personal contact from the utility as a source of conservation information (6% of respondents), and
- repaired leaking faucets/toilets in the past year (48% of respondents).

As discussed earlier in this report, installing an irrigation controller is essentially a surrogate for identifying customers whose homes are equipped with automatic irrigation. Numerous studies have found that customers with automatic irrigation systems use more water than comparable customers that manually irrigate. This likely explains the finding here.

It is unclear why a preference for direct contact from utility personnel would be associated with higher water use. Not all of the results from this type of analysis are easily interpreted or meaningful.

It is of interest that customers that repaired leaking faucets and toilets had statistically higher water use. The billing data used in this analysis covered calendar year 2006, but the customer survey was implemented in 2008. This suggests that any reported repairs to toilets and faucets noted on the survey might easily have been made *after* the billing data were obtained. If significant leaks were occurring, they would have been captured in the 2006 water use data utilized in this analysis, which could easily explain why this group of customers were found to use more water than those that did not repair a leak.

Table 4.32
Durham, North Carolina – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Factors that Decrease Water Use									
Q4 Aware	Saw/heard any message	-24.678	9.378	-43.130	-6.226	F = 6.925, t = 2.623	0.009	0.022	94%
Q5 Aware	Number of messages seen/heard	-15.546	5.611	-26.544	-4.548	t = -2.771	0.006	r2 = 0.267	92%
Q4 Message 2	There are a number of ways to save water and they all start with you.	-11.854	4.196	-20.111	-3.597	F = 7.979, t = 2.825	0.005	0.025	71%
Q8 Message 2 Indoor	There are a number of ways to save water and they all start with you (# of behaviors indicated)	-1.152	0.539	-2.208	-0.096	t = -2.138	0.033	r2 = 0.250	29%
Factors that Increase Water Use									
Q9,M	Installed irrigation controller with a rain sensor	31.094	13.781	3.975	58.213	F = 5.091, t = -2.256	0.025	0.017	1%
Q15,Q	Personal contact from utility preferred source of info	14.759	6.687	1.598	27.919	F = 4.871, t = -2.207	0.028	0.017	6%
Q9,F	Repaired leaking faucets/toilets in the past year	8.191	3.297	1.703	14.679	F = 6.173, t = -2.485	0.014	0.02	48%

[*] Dependent variable = annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] Sorted by magnitude of regression coefficient, B. The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text)

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

CASE STUDIES OF TWO LARGE COMMUNICATION CAMPAIGNS

Phoenix, Arizona (www.phoenix.gov/waterservices)

Since 1907, The City of Phoenix's Water Services Department has aimed to provide high-quality water and wastewater services to the area of Phoenix. The City serves 1.7 million residents with water drawn 90% from the Salt, Verde, and Colorado rivers, and the remaining 10% drawn from groundwater sources.

Many of the western United States have experienced moderate to severe drought conditions for the past ten years. This climate condition, coupled with the continued rise in the region's population, poses water availability challenges to Phoenix and surrounding municipalities. To address potential water shortages, the City of Phoenix implements a multi-pronged water conservation and awareness program to educate residents about the importance of being water wise and provide them with the skills to reduce their water consumption.

Water Conservation in Phoenix

Phoenix's water conservation program consists of mass media outreach, community outreach and education, and incentive programs to promote water conservation awareness and create a water conservation ethic among residents. The conservation program has an annual budget of $1.9 million with $500,000 allocated to communications and education outreach and $150,000 allocated to the *Water – Use It Wisely* social marketing campaign.

The City of Phoenix's water conservation team includes eight staff members focused on water conservation and education. For 12 years, the City of Phoenix has been implementing water conservation programs. Throughout this time, the team has found that piloting programs and research are critical to developing programs that are effective in reaching their goal to reduce per capital water use. The City of Phoenix works closely with Arizona Municipal Water Users Association (AMWUA) and other water utility partners in the area to coordinate conservation efforts throughout the Valley. The utility has two primary outreach objectives: to raise awareness for water conservation among residents, and to change customer attitudes about water conservation.

The City realizes that customers must be aware of and understand the importance of water conservation before they will act upon water conservation messages and ultimately change their water use behavior. The water conservation team believes that once customers understand the importance of reducing demand, they will be more inclined to adjust to any mandates the City of Phoenix may need to enforce during drought conditions. City staff believe they face a significant attitudinal barrier to wise water use because of its large hospitality industry comprised of hotels, resorts, and golf courses. Feedback from residential surveys indicates that residents have a negative attitude about water conservation, and less motivation to decrease their water because they believe that the City of Phoenix itself is not practicing what it preaches and is not using water efficiently.

Water – Use It Wisely

The keystone of Phoenix's water conservation program is the *Water – Use It Wisely* social marketing campaign sponsored by a group of 20 water utilities in the Valley. Phoenix Public Information Specialist, Mary Lu Nunley believes that this mass media advertising campaign is, “one of the most important aspects of their water conservation program.” The *Water – Use It Wisely* campaign began in 2001 and was designed to ensure that residents throughout the Valley received consistent water efficiency messaging.[26] Implementing the effort on a regional scale allowed smaller cities with limited budgets to capitalize on the pre-packaged conservation messages, leveraging the campaign throughout the Phoenix media-shed. The campaign uses radio and TV to communicate indoor and outdoor water conservation messages to residents.

Education and Outreach

Education and outreach is another key component of the City’s water conservation programs. In a 1999 survey, residents indicated a desire for increased education and outreach to school-aged children. To address this need, Phoenix partnered with the University of Arizona to create Project W.E.T. (Water Education for Teachers). This program is designed to train teachers how to teach water conservation in their classes (grades pre-kindergarten to 12), addressing residents’ request and the state of Arizona's curriculum requirements. In addition to Project W.E.T., Phoenix reaches school-aged children through free school assemblies, puppet shows, and other community events.

In 1995, Phoenix initiated a low-income retrofit program. The retrofit program was developed to help low-income homeowners with high unintentional water use to reduce their water consumption. Each year, the water conservation team and the City’s Neighborhood Services Department assists 400 low-income households repair leaks and replace toilets, faucets, and showerheads with water-efficient technology. The program is advertised through door hangers in targeted neighborhoods and is completely voluntary. In addition to replacing and repairing hardware, the water conservation team distributes educational materials. Through this program, the City of Phoenix has learned that many low-income households are headed by women who may not be informed about how to fix leaks. The City has developed a do-it-yourself educational DVDs to address this barrier.

The City of Phoenix recognizes the diversity of Phoenix’s population. Although programs have not been developed specifically targeted to Spanish-speaking residents, water conservation materials *are* available in Spanish. In 2006, Phoenix conducted a Spanish-language focus group, discussing awareness, attitudes, perceptions and behaviors concerning water use and conservation among Spanish-speaking residents. As a result of this focus group, Phoenix learned various ways to raise awareness among Spanish-speaking residents and to design educational materials that are more culturally appropriate and likely to be successful.

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[26] The *Water – Use It Wisely* social marketing campaign was developed by Park and Company Marketing Communications, a Phoenix-based branding and marketing agency. Originally implemented in the Phoenix area in 2001, this theme has been adopted by utilities around the country. In this study, three participating agencies – Phoenix, Tempe, and Durham – have used this campaign.

The City of Phoenix has a significant number of collateral materials that are available to the public free of charge. In addition to brochures and fact sheets, the City produced four, 15–20 minute videos on water conservation that run on the public access TV channel throughout the year. The videos are also available to the public by request.

Delivering information to residents using the most up-to-date technology and vehicles is increasingly important to the City's outreach efforts. The water conservation team has observed that educational workshop attendance tends to skew to the older generations, whereas younger residents prefer to receive information online or via other technologies such as pod casts. They are currently working closely with AMWUA to develop an interactive online tool that will help residents landscape with native plants. The water conservation team is also looking to engage industry stakeholders such as nurseries, landscapers, and real estate agents who can help disseminate water conservation information throughout the community.

When presenting a new program to senior managers, Phoenix recommends providing solid, quantitative results of similar program successes in the form of case studies to demonstrate success in other regions and gain management support.

Changes in Water Use, 1996–2007

The City of Phoenix Water Services Department was one of 14 agencies to participate in the Residential End Uses of Water Study (REUWS) conducted by Aquacraft, Inc., and published by the American Water Works Association (Mayer, et. al., 1999). As part of this study, water use in a representative sample of 1,000 single-family homes was closely examined. For a sub-set of 100 homes, the volume used for each of the major end uses (irrigation, toilets, showers, clothes washers, etc.) was measured.

For this study, consumption data for the same set of 1,000 homes was obtained, thereby enabling a comparison of water use patterns over a 10-year time span, during which Phoenix implemented the *Water – Use It Wisely* program and a number of other significant water conservation efforts. Average annual water use for this sample (which remains representative of the population in 2007) is shown in Figure 4.1. Non-seasonal (indoor) and seasonal (outdoor) water use are split out in Figure 4.6. Although indoor and outdoor use fluctuates over the 11 year time period, the general trend is a distinct reduction in water use. Average annual demand in 2007 was 18.8% lower than in 1996. Keep in mind that the *Water – Use It Wisely* program began in 2001.

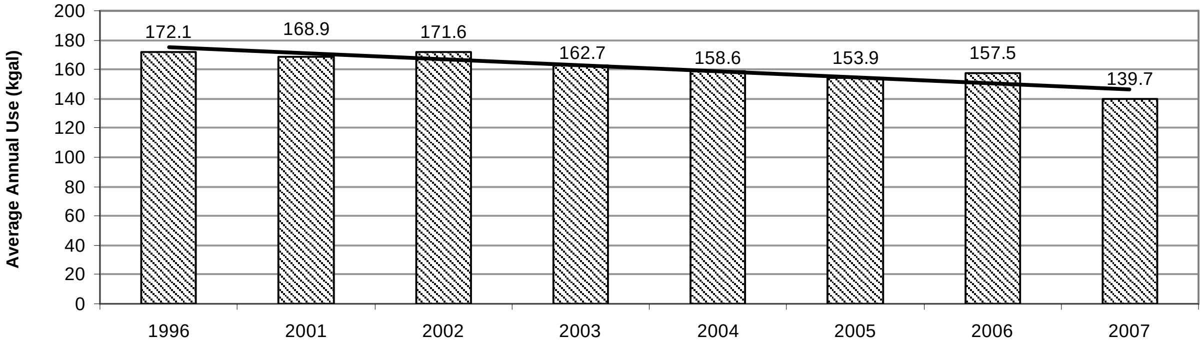

Figure 4.5 Single-Family Water Use in Phoenix with Regression Line, 1996–2007[27]

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[27] Phoenix imposed voluntary drought restrictions in 2007, which could have contributed to the reduced level of demand.

A linear regression, shown in Figure 4.5, indicates that demand reduced by an average of -2.6 kgal per household per year from 1996-2007. Of the 993 homes in the sample, 636 (64%) homes reduced water use and 357 (36%) homes increased water use from 1996–2007. A total of 426 (43%) homes reduced both indoor and outdoor water use while 151 (15%) increased both indoor and outdoor water use. The remaining homes had a mixed result of increase and decrease.

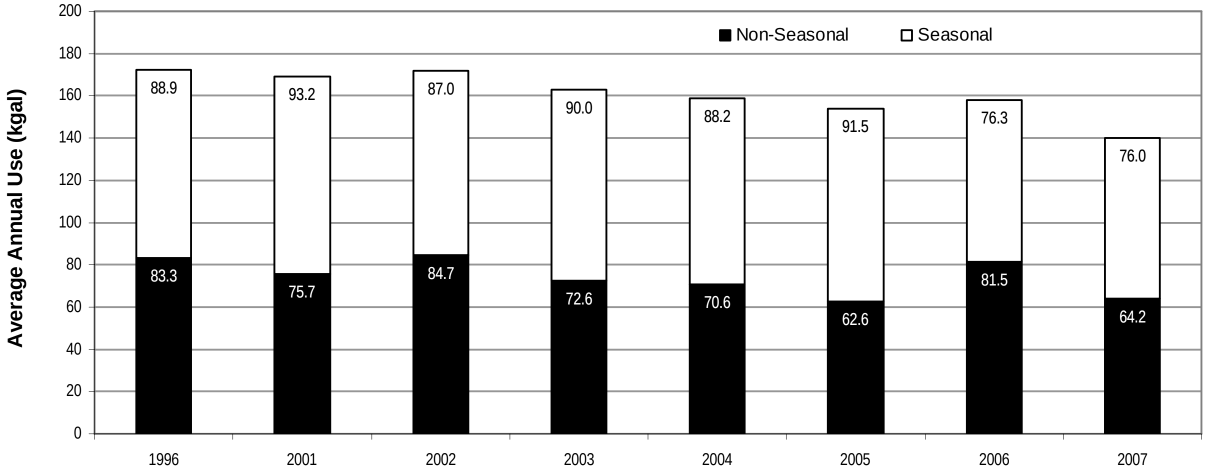

Figure 4.6 Seasonal and Non-Seasonal Single-Family Water Use in Phoenix, 1996–2007

This result shows a clear trend of decreasing single-family residential water use in Phoenix. What is not clear is what is causing this decrease in demand. From this analysis, it is not clear if these changes can be directly attributed to the City's water conservation messaging programs as many factors could be contributing to the change. The increased efficiency of the fixtures and appliances consumers are purchasing and installing, possibly motivated by the conservation messaging program, is but one of many factors to be considered.

Residential End Uses of Water Results

As part of the *Residential End Uses of Water* study, daily per capita water use in the 100-home Phoenix sample was measured over a period of four weeks (2 weeks in the summer and 2 weeks in the winter) (Mayer, et. al., 1999). The average daily per capita indoor use for each end use is shown in the pie chart in Figure 4.7. Toilets were the largest single indoor end use, accounting for 19.6 gpcd of indoor demand, followed by clothes washers (16.9 gpcd), leaks (14.8 gpcd), showers (12.5 gpcd), and faucets (9.6 gpcd).

The average toilet flush volume in Phoenix in 1999 was 3.63 gallons per flush (gpf), well above the current EPAct ceiling of 1.6 gpf or the current WaterSense specification of 1.28 gpf. The average shower flow rate in Phoenix in 1999 was 2.32 gallons per minute (gpm), which is below the EPAct ceiling of 2.5 gpm. However this average flow rate ranked in the top third of all study sites in the REUWS. This information is provided here as evidence that in 1999, prior to the implementation of the *Water – Use It Wisely* program, Phoenix had significant potential for indoor water savings through the installation of efficient fixtures and appliances such as toilets, showerheads, clothes washers, and faucets. Research sponsored by the EPA determined that retrofitting these four items in typical single-family homes could reduce average per capita demands below 40 gpcd, a little more than half of what residents in Phoenix were using in 1999 (DeOreo, et. al., 2001).

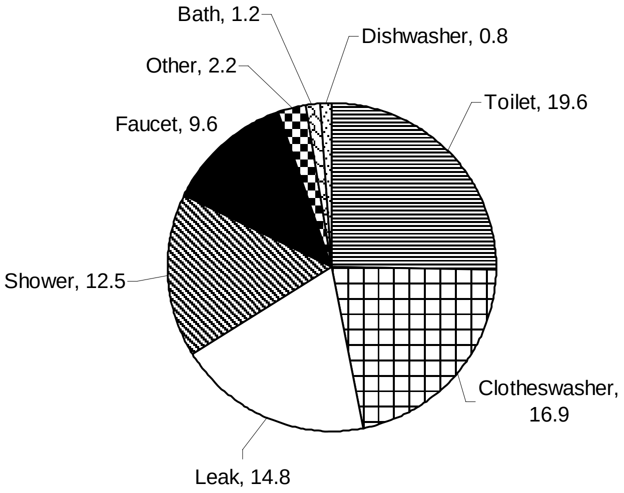

Figure 4.7 Average residential daily per capita indoor water use in Phoenix, (from *Residential End Uses of Water* study, (Mayer, et. al. 1999))

Evaluation of Communication Strategies and Water Use in Phoenix

Using the survey response data obtained through this study and the time series billing data provided by the City of Phoenix covering 1996–2007, it was possible to compare water use trends among customers. For the first analysis, Question 6 from the survey was used. Respondents who heard or saw at least one water conservation message from the City (N=193) were compared against respondents who heard none of the water conservation messages (N=43). Results are presented in Table 4.33. In 1996, customers that reported "no message heard" used 170.7 kgal per year on average, which was 9.3% less water than customers that reported "at least one message heard" who used 188.3 kgal per year on average. In 2007, the situation was reversed and customers that reported "at least one message heard" used 149.2 kgal per year on average, which was 7.3% less than customers that reported "no message heard" who used 161.1 kgal per year on average. This simplistic analysis does not take into consideration changes in occupancy and a myriad of other factors that could be involved, but it indicates that a real change in water use occurred for the customers that "heard at least one message." Between 1996 and 2007, their use declined by 20.7% on average.

Next, Question 6 was used to divide survey respondents into two categories:

1. customers who took "no action" on water conservation (N=63), and
2. customers who "took at least one action" on water conservation (N=173).

Comparisons of average annual water use in these two groups from 1996–2007 are shown in Table 4.33 and Table 4.34 and Figure 4.8. Customers in the "took at least one action" category, used 7.8% *more* water on average in 1996 than the customers who "took no action." In 2007, customers who "took at least one action" used 16.2% *less* water on average than customers who "took no action."

Table 4.33
Survey response and water use – Phoenix Q6 – Was a conservation message heard?

Question 6 indicates at least one message heard		1996 Total (kgal)	2001 Total (kgal)	2002 Total (kgal)	2003 Total (kgal)	2004 Total (kgal)	2005 Total (kgal)	2006 Total (kgal)	2007 Total (kgal)
No message heard	Mean	170.7	165.2	179.1	168.2	160.4	164.0	177.4	161.1
	N	43	43	43	43	43	43	43	43
	Std. Deviation	128.7	123.9	172.1	181.6	166.8	185.8	242.1	159.2
At least one message heard	Mean	188.3	177.2	181.4	165.3	162.0	154.5	164.9	149.2
	N	193	193	193	193	193	193	193	193
	Std. Deviation	138.6	137.3	144.2	111.2	117.6	119.3	151.8	129.4
Total	Mean	185.1	175.0	180.9	165.8	161.7	156.3	167.2	151.4
	N	236	236	236	236	236	236	236	236
	Std. Deviation	136.7	134.7	149.3	126.5	127.5	133.4	171.3	135.0

The trends in water use between these two groups are shown graphically in Figure 4.8. Regression trend lines show that water use in the “took no action” group stayed essentially the same over the 10-year period, while the “took at least one action” group showed a steady decline in demand. Overall, the “took at least one action” group reduced its average annual demand by 23.8% between 1996–2007. Additional analysis on this group of customers is presented below.

Table 4.34
Survey response and water use – Phoenix Q6 – Was a conservation action taken?

q6_action Action taken on at least one message		1996 Total (kgal)	2001 Total (kgal)	2002 Total (kgal)	2003 Total (kgal)	2004 Total (kgal)	2005 Total (kgal)	2006 Total (kgal)	2007 Total (kgal)
No action taken	Mean	174.2	168.9	182.5	170.8	163.7	167.8	185.1	171.8
	N	63	63	63	63	63	63	63	63
	Std. Deviation	119.8	113.1	160.5	162.2	155.9	183.6	247.2	184.2
Action taken on at least one message	Mean	189.0	177.2	180.4	164.0	161.0	152.0	160.7	144.0
	N	173	173	173	173	173	173	173	173
	Std. Deviation	142.6	142.0	145.5	111.2	116.0	110.0	133.7	111.7
Total	Mean	185.1	175.0	180.9	165.8	161.7	156.3	167.2	151.4
	N	236	236	236	236	236	236	236	236
	Std. Deviation	136.7	134.7	149.3	126.5	127.5	133.4	171.2	135.0

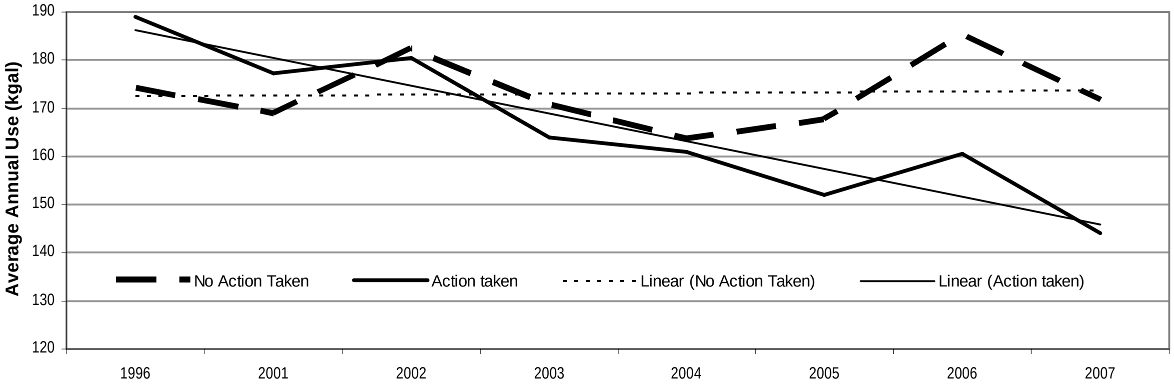

Figure 4.8 Annual water use Q6 survey respondents – Was conservation action taken?

Water use among respondents to Question 6 who "took at least one action" was examined over the time period from 1996–2007. Water use data from 1996 was used as a baseline since that was prior to the implementation of the *Water – Use It Wisely* social marketing campaign. Respondents that "took at least one action" as reported on Question 6 reduced their water use by -45 kgal (e.g., x – y) from 1996–2007 (not corrected for number of persons, income, bathrooms, etc.). This difference was found to be significant at the 95% confidence level. However, when this group of customers' demand patterns in 1996 were compared against the average water use over the 2001–2007 time period, no statistically significant change in use was identified.

This suggests that the water savings found in customers that "took at least one action" is sensitive to the end of the time span for which data were available. Reductions in water use that occurred in 2007 were enough to be statistically significant, but it appears to be recent changes in demand patterns that have had the most influence. In other words, if this time series ended in 2006 (rather than 2007), then no statistically significant difference in water use would have been observed. In 2007, water use in these two groups diverged resulting in the finding discussed above. It is not known whether any specific program or effort in Phoenix (such as voluntary drought restrictions) may have influenced the water use differences observed in 2007.

The specific conservation messages tested in Question 8 of the survey in Phoenix were also evaluated in a similar manner. Hearing one or more of the messages listed in Question 8 was found to be a signification contribution to the regression analysis (e.g., lower water use from 1996–2007) only if the income factor was removed from the regression. If a factor for income was included, then Question 8 not longer retained statistical significance. This suggests a correlation between income level and reception of the Phoenix conservation messages in Question 8. It appears that hearing or seeing a conservation message may impact water use, but the data from this study is not adequate to fully explain this relationship or measure the effect.

From the analysis discussed above, it is clear that taking conservation action reduces water use as shown in the Question 6 analysis. However it is not clear from this analysis to what extent Phoenix's conservation messaging campaign has stimulated these changes in water use or to what extent they are the result of other factors not considered in this study.

Regression Analysis of 2006 Consumption Data

Regression analysis, comparable to what was done for the other five study sites, was performed using the data set from Phoenix. Survey respondents in Phoenix had a high degree of familiarity with the key conservation communication messages promoted by the City. Results from a few messages are presented here:

- The "there are a number of ways to save water and they all start with you" message was seen or heard by 75% of survey respondents.
- The "water your plants deeply, but less frequently to create healthier and stronger landscapes" message was seen or heard by 69% of survey respondents.
- The "use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time" message was seen or heard by 61% of respondents.

Water bill inserts, television, and newspapers/magazines were the most frequently reported vehicles for receiving these messages. Fully enumerated survey results from Phoenix and all other study sites are presented in Appendix E.

The evaluation of communication strategies and 2006 water use in Phoenix turned up very limited findings. Results on the individual factors found to influence water use in Phoenix are shown in Table 4.35. Only one conservation communication specific to Phoenix emerged as a statistically significant influence on water use. As discussed above, survey questions 4, 5, 6, 8, and 10 offered respondents the opportunity to react to unique conservation communication efforts implemented by each participating agency.

Those five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA procedure that corrected for the known factors that were shown to influence water use in this study: # of bathrooms, # of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided in Table 4.35, the sign of the coefficient is actually or more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Factors that Decrease Water Use in Phoenix

Only three distinct survey questions were associated with lower water use at the 95% confidence level; they provide little insight into the impact of water conservation communications in Phoenix.

- Customers who reported “rarely” or “never” conserving and indicated that they “did not know” why (N=6) used less water. The sample is so small in this result as to have little or no meaning.
- Customers who reported that “air pollution” is an environmental concern in the community were associated with lower water use.
- Customers who found sales associates at hardware stores “rarely credible” or “not credible” were associated with lower water use.

These results point out the limitations of this analysis technique that relies on coarse billing data from a single year coupled with survey responses from a different year to try and detect changes in water use. Occasionally, as with the City of Durham, North Carolina, useful results are obtained, but frequently the results are ambiguous or even meaningless. In Phoenix, more useful results were obtained from examining water use over a longer period of time and focusing on Question 6 that indicated the frequency with which people were exposed to conservation messages.

Factors that Increase Water Use in Phoenix

Seven factors were associated with higher water use among survey respondents in Phoenix. These were:

- Customers who reported monitoring their outdoor water use “always” or “most of the time” (75% of respondents) used more water.
- Customers who purchased a soaker hose in the past year (10% of respondents) used more water.

- Customers who strongly agree that residential growth is impacting water supply (51% or respondents) had higher water use.
- Customers who saw the message, "next time you add or replace a flower or shrub, choose a low-water use plant for year-round landscape color and save up to 550 gallons each year" (59% of respondents), had higher water use.
- Customers who found elected officials "not credible" or "rarely" credible as a source of conservation information had higher water use.
- Customers who indicated that they conserve water because they are "concerned about my family's health" (29% of respondents) had higher water use.
- Older homes were associated with higher water use.

Unlike the findings from other agencies, in Phoenix none of the factors associated with higher water use could be viewed as a surrogate for the presence of automatic irrigation. As with the factors that decrease water use, the results in Phoenix are difficult to sensibly interpret and may have little if any bearing on conservation messaging efforts.

2007 AMWUA Water Conservation Awareness, Attitudes, and Behaviors Study

In 2007, the Arizona Municipal Water Users Association (AMWUA) released a report titled, "Water Conservation Awareness, Attitudes, and Behaviors" (BBC Research and Consulting, 2007). This regional study used focus groups, a survey of 1,400 customers across nine cities, and water use data to examine the impacts of water conservation programs including *Water – Use It Wisely*.

The report had the following findings about awareness of the program:

- "The 2007 survey results showed 84% aided awareness of *Water – Use It Wisely* as compared to 53% aided awareness of a test program, *Doing Our Part to Save Water*. The survey also showed 53% aided awareness of "Use Only What You Need," a Denver slogan associated with water conservation programming.
- "As an "umbrella" campaign, *Water – Use It Wisely* appears to maintain a high rate of aided recognition. There is a similarly high, if also general, recognition for its slate of conservation strategies. However, *Water – Use It Wisely* is not top-of-mind, even when residents are asked about conservation programs. Very few focus group or survey respondents were able to name *Water – Use It Wisely* when unaided. This may reflect the current level of investment in marketing the program among member cities" (page 9).

The report contained the following findings about water savings associated with the program:

- "Although *Water – Use It Wisely* may have had an effect on some Valley residents' attitudes toward water conservation, households who are aware of and knowledgeable about *Water – Use It Wisely* did not have lower water use than residents who did not report knowing about campaign. BBC's multivariate analysis of actual water use did not find a statistically significant relationship between awareness of *Water – Use It Wisely* and observed water use" (page 9).

These results bear out some of the findings in this study. As discussed earlier in this section, analysis of the data obtained in this study found that taking conservation action reduces water use (as shown in the Question 6 analysis). However it is not clear to what extent Phoenix's conservation messaging campaign has stimulated these changes in water use and to what extent they are the result of other factors beyond the scope of this study. A change in water use has occurred among those who have taken action to conserve. What remains unclear is the motivation for this change.

Table 4.35
Phoenix, Arizona – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Factors that Decrease Water Use									
Q13G	Rarely or never conserve: Don't know why	-94.96	85.803	-264.1	74.159	F = 7.055	0.008	0.032	5%
Q1C	Air pollution is a problem	-67.12	31.543			t = -2.128	0.035		Strongly agree: 68%
Q3J	Sales associates at hardware stores *NOT* credible source of info	-66.72	23.704			t = -2.815	0.005		<= rarely credible: 46%
Factors that Increase Water Use									
Q7K	Monitor outdoor water use	102.99	47.318			t = 2.176	0.031		>= most of the time: 75%
Q9J	Purchased soaker hose	92.023	36.173	20.711	163.34	F = 6.473	0.012	0.031	10%
Q1L	Residential growth is impacting the water supply	76.182	20.308			t = 3.751	0.000		Strongly agree: 51%
Q4 Message 9	Low water use plants	67.941	25.327	18.013	117.87	F = 7.195	0.008	0.033	59%
Q3A	Elected officials *NOT* credible source of info	67.618	24.25			t = 2.789	0.006		<= rarely credible: 43%
Q12B	I conserve because I am concerned about my family's health	66.744	25.058	17.343	116.14	F = 7.094	0.008	0.033	29%
Q19	Age of home	2.1333	0.763			t = 4.114	0.000		Mean: 34.6, Median: 33

[*] Dependent variable = 2006 annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text)

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

Seattle, Washington (www.seattle.gov/util)

For more than 100 years, Seattle has been a growing and vibrant city known for its environmental stewardship. Seattle Public Utilities (SPU) serves 1.4 million residential and business customers, mostly within King County, Washington. Service is divided between City of Seattle retail water customers, and water Seattle supplied to 18 wholesale water utilities outside the City. About half of all water supplied, and about half the service area population, resides in wholesale utility service areas. Recent projections indicate that the service area population will continue to increase at a rate of approximately 1% per year. This significant population increase puts tremendous pressure on the fresh water supply necessary for residents, economic growth, and maintaining environmental values. Water in the Northwest is seemingly abundant but in actuality, the region receives less average rainfall than other areas of the United States. Out of 100 U.S. cities, Seattle area ranks 56th in average rainfall at 38.6 inches behind Atlanta, Baltimore, New York, and Miami. The increased demand on water supply due to Seattle's population growth coupled with changing climate conditions has resulted in an intensified need to reduce water consumption.

Recognizing the limitations on the water supply, Seattle and its wholesale utility partners have implemented conservation measures. Under the regional banner of the Saving Water Partnership, the combined utility effort will help ensure the availability of and quality of drinking water for its residents while protecting the natural habitats of other species that are dependent upon the fresh water supply.

Sixty-five percent of the total annual regional water demand goes to residential customers. Seasonal water use (mostly lawn and landscape irrigation during May-September) results in peak monthly water demands 50% to 100% higher than winter month water demands. Households that regularly irrigate their landscapes frequently have double or triple the total water use in the month of August compared with the same household’s use in the month of January. The Saving Water Partnership is addressing this issue by implementing multiple water conservation initiatives focused on reducing residential peak season water consumption, commercial peak-season reduction, and developing a water conservation ethic among all regional residents and businesses.

Saving Water Partnership’s (SWP) Water Conservation Program

Since the 1980s, Seattle and participating local water utilities have engaged in water conservation efforts. Initial programs began with basic youth and adult “awareness” education, In the late 1980s a public awareness and marketing effort began; in the late 1990s it was joined with customer incentives (rebates), and after 2000 the program was augmented with public messages aimed at motivating behavior change and breaking down traditional barriers to conservation. The programs promote indoor and outdoor water conservation and include educational outreach, mass media messaging, and financial incentive components. The programs have specific target audiences and markets. However, they do support each other in terms of messaging, education and outreach. All of the programs are designed with the ultimate goal of developing a water conservation ethic and the necessary behavior changes to achieve water conservation goals. SPU’s water conservation initiatives can be divided into four categories.

National efforts that support federal initiatives such as the EPA's WaterSense program and national codes and standards, and applied research.

Local programs promoted through the Partnership for Water Conservation (not to be confused with the Saving Water Partnership) – a collaboration of more than 150 utilities over multiple counties in the greater western Washington area. This Partnership aims to create water conservation awareness through mass media in cooperation with environmental groups, local suppliers and vendors, and industry stakeholders, such as landscape and builder associations.

Local-Regional programs promoted through the Saving Water Partnership are comprised of 18 utilities in the Seattle region. This program provides rebates and incentives, creates water conservation awareness, and encourages behavior and attitude change. In 1999, the partner utilities (SWP) adopted a goal of reducing per capita water demand by 1% each year for ten years, or a total of 10%, by year 2010. This program thus became known as the 1% Water Conservation Program. In 2009, approximately 80% of the $3 million-a-year conservation for the *1% program* will be spent on capital projects, mostly as incentive cost-shares with customers to install more water efficient equipment. About 10% will go for behavior change efforts, with the remaining 10% for evaluation, national research, and other activities.

In addition to the 1% regional program, the City of Seattle itself offers a separate incentive program just for low-income retail customers in the city. This program provides upgraded plumbing products to qualified low-income customers and housing providers and in 2009 has an annual budget of $650,000. Special efforts are made to reach out to diverse customers who are unlikely to participate in many of the incentive based regional programs, due to language or economic barriers.

Communicating Conservation

SWP's water conservation programs represent an integrated approach to communications. Through their programs, the SWP strives to establish a water conservation ethic among regional residents. Al Dietemann, at Seattle Public Utilities, who leads the SWP's 1% Conservation Program, believes that residents must recognize and understand the need for conserving all natural resources and they must want to conserve resources before they will be receptive to messages prompting them to take actions. Both components are critical to any marketing communications effort and are necessary to change residential water use behavior.

When the SWP began developing water efficiency marketing and conservation programs, they borrowed programs from other water utilities across the country. However, the SWP soon found that their programs had a greater impact when they were designed specifically for their customers. An example of this is the SWP's efforts to connect water conservation with broader environmental concerns such as the health of the local salmon population. A customized approach afforded the utility the opportunity to develop program messages and materials that addressed the barriers encountered by their diverse customer base and local environment.

The SWP conducts regular residential surveys, focus groups, and other feedback techniques to measure the impact of current programs, to guide the development of new initiatives, and to ensure that messages are reaching all segments of their customer base. Developing specific programs to reach target audiences is important to the SWP because market segmentation ensures the most effective and efficient use of marketing resources. In addition, reaching specific audiences ensures that all customers have access to the conservation knowledge and tools for their benefit and that of their community. Dietemann acknowledges that "investing resources to target audiences can be resource intensive but is important and can be achieved."

The SWP's conservation programs have specific goals; some include metrics that track actual water reductions while other goals measure behavior change less directly. For example, the Partnership for Water Conservation's umbrella awareness campaign focuses on creating broad awareness for water efficiency and conservation using mass media vehicles. This type of mass media program cannot provide quantifiable water reduction metrics, but is a critical component to their communications effort because it educates residents about "why" water efficiency is important.

SPU leverages the knowledge building communicated in the Partnership for Water Conservation's mass media campaign by taking the awareness message a step further with skill-building and incentive programs. This layering effect creates an integrated communications effort that has proven successful. Generally speaking, the SWP allocates approximately 10% of behavior change resources to general water awareness campaigns and the balance is directed to specific targeted efforts, such as skill-building programs (e.g., landscaping workshops) and other tactics.

Regional 1% Program

The Saving Water Partnership's Regional *1% Program* produces an annual accomplishment report to better quantify program activities and success. The program goal is to obtain a cumulative annual savings of 11 million gallons of drinking water per day by the end of year 2010. Since the program's inception in 2000 up through 2008, it has already saved 8.4 MGD, and is on track to reach the 11 MGD goal by 2010. The *1% Program* has helped improve customer water-use efficiency through education and outreach, rebate and toilet replacement programs, and regulation compliance efforts. These initiatives include direct mailings, collateral materials, web and hotline resources, workshops, stakeholder partnerships and a host of targeted promotions.

The SWP has found great success through partnerships with stakeholders such as landscapers. nurseries, and equipment suppliers. These partners have great influence over customers and are viewed as credible sources of information.[28] SPU has piloted community-based social marketing programs focused on water-efficient landscaping and lawn care and has documented impressive results.

Assess for Success

The SWP actively assess the types of water-saving messages that will resonate with their customers and modifies conservation campaigns accordingly. Recently, the SWP wrapped its messages around the climate change platform and worked collaboratively with energy utilities to deliver a combined water and energy efficiency message.

The SWP water conservation team is held accountable for the success of all program activities, and they are constantly shifting focus to maximize water savings and cost efficiencies throughout their program portfolio. Since 1990, Seattle system water consumption has declined by 26% (44 million gallons per day) while population has increased 16% during those same

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[28] Survey results bear this out. 91% of respondents in Seattle rated local landscapers as "always credible," "frequently credible," or "somewhat credible."

years. On a per-person basis water consumption has shrunk more than one-third from150 gallons per day in 1990 to just 90 gallons per capital per day in 2008.

The SWP uses several tools to influence program design and capture metrics. These tools include a self-reported survey conducted every two years which helps assess long-term trends, a cost-benefit model to look at individual project cost and benefits, and a conservation potential assessment model (CPA) to look at regional benefits. The CPA model allows SPU to enter information about savings potential, customer participation estimates, and participation in the absence of a any utility efforts (education, incentives, requirements, etc). Output from the model helps identify measures or packages of measures providing the greatest and most cost-efficient water savings from three perspectives: the individual customer, the utility partners, and the general society.

Recommendations for Program Design

The SWP offers other utilities several suggestions as they develop and grow their water efficiency initiatives:

- Pay close attention to long-term demographic changes in your service area when creating a communications strategy. Accurately segmenting customers will help customize messages according to each socio-demographic segment and increase customer receptivity, better address barriers, and promote behavior change.
- Designing programs to achieve water savings from a diverse customer base is important in developing a conservation ethic among all residents.
- Collaborating with energy utilities to develop programs that promote water and energy-saving behaviors can be cost-effective and can show a rapid return on investment for the customer which increases customer confidence in the utility and programs.
- Price structures (tiers), more than just the actual rates themselves, can be a strong conservation tool. Sound program design coupled with specific info on dollar savings and other benefits can lead the customer to the best choice.
- Although customers consistently respond to surveys that bill stuffers are their preferred way of learning about water efficiency, actual recall and action taken after receiving them was much lower than other communication tools. Utilities should carefully review the cost and desired impact of bill stuffers relative to other options.

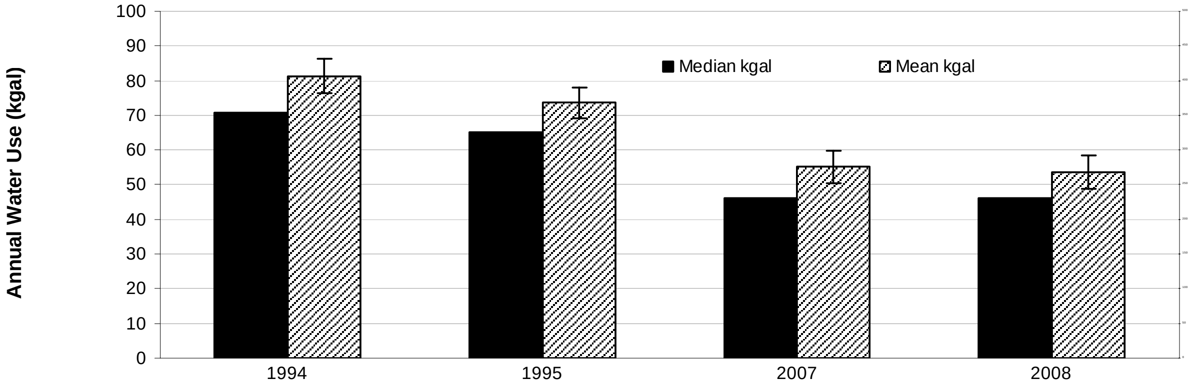
Changes in Water Use 1994–2008

Seattle Public Utilities (then called Seattle Water) was one of 14 agencies to participate in the Residential End Uses of Water Study (REUWS) conducted by Aquacraft, Inc. and published by the American Water Works Association (Mayer et. al. 1999). As part of this study, water use in a representative sample of 463 single-family homes in the City of Seattle was closely examined. Consumption data from these homes from 1994 and 1995 were provided. For a sub-set of 100 homes, the volume used for each of the major end uses (irrigation, toilets, showers, clothes washers, etc.) was measured.

For this study, consumption data for a different, but still statistically representative, set of 258 single-family homes in Seattle was obtained enabling a comparison of water use patterns over a 15-year time span, during which Seattle implemented a number of other significant water conservation efforts including the Regional 1% Water Conservation Program. Average and median water use from these two representative samples of single-family homes are presented in Figure 4.9. The 95% confidence bounds around the mean water use in each year are also provided.

Residential water use in Seattle has declined significantly over the past 15 years. In 1994, the average single-family home in Seattle used approximately 81.3 kgal of water both indoors and out (Mayer, et. al., 1999). In 2008, the average single-family home in Seattle used 53.7 kgal of water, a difference of 27.6 kgal and a 33.9% reduction in average demand. This difference is statistically significant at the 95% confidence level as none of the confidence boundaries shown in Figure 4.9 overlap. The number of people per household during 1994–95 was compared with the number of people per household found in the 2007 survey, and the values were found to be within 3% of each other, thereby suggesting that this significant demographic has not changed over this period of time.

This result shows a clear trend of decreasing single-family residential water use in Seattle. What is not as clear is what is causing this decrease in demand. Which changes are the result of SPU's water conservation messaging programs? Which changes are the result of the increased efficiency of the fixtures and appliances consumers are purchasing and installing? To what extent are Seattle residents motivated to take action by SPU's conservation messaging programs? These questions are examined using the data set developed for this study of behavior changes.



	1994	1995	2007	2008
■ Median kgal	70.7	65.1	46.0	46.0
▨ Mean kgal	81.3	73.6	55.2	53.7
N	463	466	258	258

Figure 4.9 Residential water use in Seattle, 1994–2008

Residential End Uses of Water Results

As part of the *Residential End Uses of Water* study, daily per capita water use in the 100-home Seattle sample was measured over a period of four weeks (2 weeks in the summer and 2 weeks in the winter) (Mayer, et. al., 1999). The average daily per capita indoor use for each end use is shown in the pie chart in Figure 4.10. Toilets were the largest single indoor end use, accounting for 17.1 gallons per capita per day (gpcd), followed by clothes washers (12.0 gpcd), showers (11.4 gpcd), and faucets (8.7 gpcd).

The average toilet flush volume in Seattle in 1999 was 3.69 gallons per flush (gpf), well above the current EPAct ceiling of 1.6 gpf or the current WaterSense specification of 1.28 gpf. The average shower flow rate in Seattle in 1999 was 2.21 gallons per minute (gpm), which is below the EPAct ceiling of 2.5 gpm. his information is provided here as evidence that in 1999, Seattle had significant potential for indoor water savings through the installation of efficient fixtures and appliances such as toilets, showerheads, clothes washers, and faucets. Research sponsored by the EPA and SPU conducted in Seattle in 2000–01 determined that retrofitting these four items in typical single-family homes could reduce average per capita demands below 40 gpcd, a 30% reduction from what residents in Seattle were using in 1999 (DeOreo, et. al., 2001).

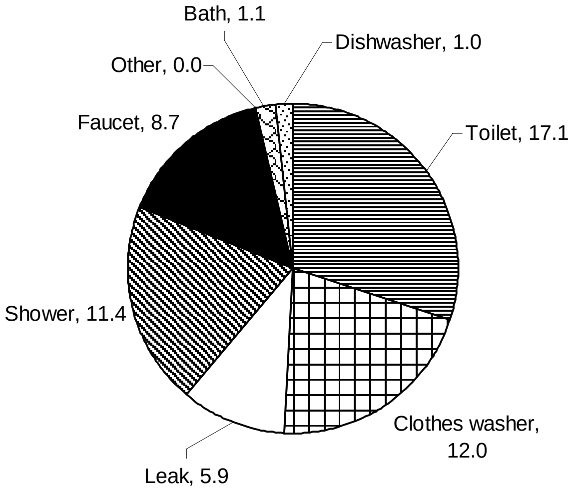


Figure 4.10 Average residential daily per capita indoor water use in Seattle, (from *Residential End Uses of Water* study, (Mayer, et. al., 1999))

Regression Analysis of 2008 Consumption Data

Regression analysis, comparable to what was done for the other five study sites, was performed using the data set from Seattle. Survey respondents in Seattle had a mixed degree of familiarity with the recent conservation communication messages promoted by the City. Results from a few messages are presented here:

- The “Free Showerheads: Return the postage paid mailer card sent to you and you’ll be mailed a free showerhead” message was seen or heard by 75% of survey respondents.
- The “Water Busters: Go to www.savingwater.org to play the Water Busters water conservation online game” message was seen or heard by only 9% of survey respondents.
- The “Low-Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information” message was seen or heard by 40% of respondents.
- The “Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline” message was seen or heard by 49% of respondents.

Direct mailings from the water utility, water bill inserts, network TV, and newspapers/magazines were the most frequently cited communication vehicles where respondents received information about SPU's conservation programs. Fully enumerated survey results from Seattle and all other study sites are presented in Appendix E.

The evaluation of communication strategies and water use in Seattle turned up some useful findings relating to specific messages implemented. Results on the individual factors found to influence water use in Seattle are shown in Table 4.36. Two conservation communications specific to Seattle emerged as statistically significant influences on water use. As discussed above, survey questions 4, 5, 6, 8, and 10 offered respondents the opportunity to react to unique conservation communication efforts implemented by each participating agency.

Those five questions were examined in concert with the other questions discussed above, but in this analysis each water agency was considered on its own since the messaging campaigns at each provider were unique. Each factor (survey question) was examined using an ANOVA procedure that corrected for the known factors that were shown to influence water use in this study: # of bathrooms, # of people in the household, income, and type of residence. In this analysis, the dependent variable was annual water use (untransformed). While the coefficient for each factor is provided in Table 4.36, the sign of the coefficient is actually or more significance than the magnitude as it indicates if the factor increases (+) or decreases (-) annual water use.

Factors that Decrease Water Use in Seattle

Only one factor unique to Seattle's conservation communication efforts was found to decrease water use at the 95% confidence level using this data set.

In Question 8, customers that were motivated to take indoor conservation actions motivated by the low-income toilet program implemented in Seattle (2% of respondents) had lower water use.

Customers in Seattle that had lower water use also had the following characteristics and preferences as determined through the statistical analysis of water use and survey responses:

- installed a water efficiency clothes washer (21% of respondents);
- believe global climate change is an environmental concern (the 61% of respondents that "strongly agree" had lower water use);
- reason for conserving: I am concerned about global climate change and how it may affect water supplies (68% of respondents); and
- stopped watering all or some of an existing lawn (41% of respondents).

These results suggest that Seattle's communication messaging about the climate change issue as it relates to water supply availability are effectively reaching customers. Nearly 70% of respondents cited climate change as a motivating factor for conserving and those customers used less water on average than respondents who are not as concerned about climate change. Relevant factors such as installing an efficient clothes washer and making landscape changes were also found to have a influence resulting in lower water use. While it was not possible to tie these actions to any specific conservation messaging effort, these results suggest that SPU's communications are having a real and measurable impact on customers and their water use. The decrease in demand documented in Figure 4.9 is likely the result of Seattle's ongoing conservation program efforts.

Factors that Increase Water Use in Seattle

Two factors unique to Seattle's conservation communication efforts were found to be associated with higher water use at the 95% confidence level using this data set.

In Question 8, customers who were motivated to take indoor conservation actions motivated by the Water Busters program implemented in Seattle (3% of respondents) had higher water use.

In Question 8, customers who were motivated to take outdoor conservation actions motivated by the Water Busters program implemented in Seattle (1% of respondents) had higher water use.

Customers in Seattle who had higher water use also had the following characteristics and preferences:

- prefer irrigation contractor as source for conservation information (3% of respondents),
- prefer the Weather Channel as source for conservation information (10% of respondents),
- changed the lawn watering schedule over the past year (16% of respondents),
- believe radio shows on gardening are a "somewhat credible" source of information on conservation (52% of respondents), and
- believe older homes use more water than newer homes.

Two of the factors associated with higher water use (prefer irrigation contractors, and changed lawn watering schedule) are likely associated with presence of an automatic irrigation system, which is associated with higher water use.

2006 Residential Water Conservation Benchmarking Survey and Attribution/Consumption Analysis

In 2006, Seattle Public Utilities and the Saving Water Partnership released the "Residential Water Conservation Benchmarking Survey and Attribution/Consumption Analysis" (Dethman, L. et. al. 2007). This study reported on results from a survey of 896 residential customers in Seattle that sought information about water conservation attitudes and behaviors. Where possible, survey response data was linked to water consumption data provided by SPU and comparisons were made between customers who were "aware" of water conservation programs and those who were "unaware".

The report had the following findings related to water use patterns and customer awareness of conservation programs.

"The consumption analysis suggests that households aware of utility conservation programs, on average, may use less water than households who are not aware of the programs; these findings are consistent with aware households reporting they are taking more actions. The largest difference, although not at a statistically significant level, emerges for peak use. The analysis shows that aware households use between 7 and 12 gallons of water less per person per day, or 3–6 CCF less per person per year. On a per-person basis, average consumption during the peak summer season is 11% less for aware versus unaware households." (Dethman, L., et. al., 2006).

Further analysis on this data set was published in 2008 (Dethman, et. al., 2008). This analysis concluded that overall awareness of Seattle water conservation programs has declined since 2001, but it was also concluded that customer awareness of conservation programs lead to more actions being taken and less water used, an important finding. Per-person, peak-day consumption was 10% less in households that were "aware" of conservation programs compared with "unaware" households (Dethman, et. al., 2008).

The results from the 2006 Seattle survey confirm many of the findings in this WRF study including the high level of concern with environmental issues such as global climate change and its potential impact on water supplies. The study found that customers who are aware of conservation programs report taking significantly more indoor and outdoor conservation actions. Many reported that utility efforts influenced them to take water-saving actions.

Table 4.36
Seattle, Washington – individual factors found to influence water use[*]

Question	Subject	Coefficient[**]	Std. Error	95% Upper Confidence Bound[+]	95% Lower Confidence Bound[+]	Statistical Test	P-value	Partial η2[++]	N
Factors that Decrease Water Use									
Q8 Indoor Message 3	Low-Income Toilets	-39.022	18.653			t = 2.092	0.037		2%
Q9B	Installed water efficient clothes washer	-20.602	7.439	-35.259	-5.944	F = 7.669	0.006	0.032	21%
Q1i	Environmental concern: Global climate change is occurring	-14.805	5.204			t = -2.845	0.005		Strongly Agree: 61%
Q12C	Reason for conserving: I am concerned about global climate change	-14.494	6.374	-27.052	-1.937	F = 5.172	0.024	0.022	68%
Q9Q	Stopped watering some or all of existing lawn	-11.114	5.538	-22.026	-0.203	F = 4.028	0.046	0.017	41%
Factors that Increase Water Use									
Q15X	Irrigation contractor is preferred source of info	55.826	18.096	20.162	91.489	F = 9.517	0.002	0.041	3%
Q8 Indoor Message 2	Water Busters	32.075	7.54			t = 4.254	0.000		3%
Q10 Outdoor Message 2	Water Busters	31.265	13.773			t = 2.270	0.024		1%
Q15M	The Weather Channel is preferred source of info	21.122	9.283	2.827	39.418	F = 5.177	0.024	0.023	10%
Q9L	Changed lawn watering schedule	15.065	6.904	1.463	28.667	F = 4.762	0.030	0.020	16%
Q3F	Radio shows on gardening a "somewhat credible" source	14.25	6.496			t = 2.194	0.029		Somewhat credible: 52%
Q19	Age of home	0.492	0.165			F = 2.975	0.003		Mean: 49.12, Median 58

[*] Dependent variable = 2006 annual water use (untransformed). Each question evaluated in isolation, but income, # of bathrooms, # of residents, type of housing, and water agency factors are controlled for when significant.

[**] Sorted by magnitude of regression coefficient, B. The sign of the coefficient is more important than the magnitude. Negative coefficient indicates that respondents used less water than the out-group.

[+] It was not possible to construct sensible confidence bounds for the Pearson Chi-Square test in this analysis (please see explanation in text)

[++] Partial η2 can be interpreted like the coefficient of determinations (R^2). If η2 = 0.004, the question/factor explains 0.4% of variation in water use compared to other answers after correcting for bathrooms, income, type of house, and number of residents – where significant at the 95% confidence level.

CHAPTER 5
IMPLICATIONS FOR WATER CONSERVATION COMMUNICATIONS

The goal of this study was to evaluate the linkages and relationships between the water conservation behavior of residential customers and the effectiveness of communication approaches that seek to influence that behavior. The research team implemented this evaluation through a multi-method approach including: telephone interviews with water agency personnel, surveys of residential water customers, analyses of current and past billing records supplied by our agency partners, in-depth case studies of water agencies and their water conservation communication campaigns, and an evaluation of communication implemented by the six participating utilities. This study leveraged previous research, in particular AWWARF's Residential End Uses of Water Study (Mayer, et. al., 1999) as well as the knowledge gained from existing social marketing programs implemented in Durham, N.C.; Phoenix, Ariz.; Tempe, Ariz.; Jacksonville and Orange County, Fla.; and Seattle, Wash.

The findings presented in the results section offer water professionals responsible for conservation communications a number of useful insights for planning conservation communication efforts. The purpose of this section is to highlight findings that can immediately influence conservation communication planning for water utilities. We do this in two parts: the first presents implications for planning efforts; the second provides recommendations for evaluating the effectiveness of conservation communications efforts.

PLANNING CONSERVATION COMMUNICATION EFFORTS

Given the paucity of communication studies specific to water conservation and behavior change, some of the research findings can be immediately considered for current and future utility program efforts. Below are some of the findings the authors believe to be noteworthy with regard to planning conservation communications efforts.

Conservation or Efficiency Behavior

Recommendation: Focus on cost-effective water efficiency measures that are under-utilized, such as fixture replacement.

The study produced a number of findings related to self-reported conservation or water-efficiency behavior. Repairing leaking faucets and/or toilets was the most frequently reported action with 58% of respondents indicating that they had done this over the past year. The next most-popular action taken was changing the "lawn watering schedule," and just under 40% of the respondents indicated doing this during the past year. In this study, 30% responded that they installed a "water-saving" showerhead in the past year, and 30% reported stopping water some or all of an existing lawn, possibly due to drought conditions. This finding may help water agencies focus on other water saving measures not often reported or poorly adopted but would still garner significant savings. At the same time, water agencies could use this finding to support the approach of reinforcing and rewarding existing, well-adopted positive behavior.

Some measures to be considered could include:

- Highlighting associated water and energy savings for measures such as installing an irrigation controller with a rain sensor.
- Educating consumers about water-wise landscaping techniques, or how to track usage through monthly water bills.
- Emphasizing the financial advantages of utility rebate programs, by providing specific examples to increase the number of efficient fixtures in a high water usage service area (e.g., upgrade to a high-efficiency toilet (HET) and receive up to a $100 credit rebate on the water bill).

Recommendation: Clothes washer rebate programs appear to be accelerating the adoption of water and energy efficient products. Target rebate messaging at customers with high indoor water demands and provide rebates only for the most efficient products.

One in five respondents (20%) reported installing an efficient clothes washer during the past year. Clothes washers have an expected useful life of 14 years, so it is anticipated that a little over 7% of the public will replace their clothes washer per year. This is much lower than the 20% replacement rate found in the survey group. The respondents appear to be installing new clothes washers at more than double the expected rate, perhaps due to incentive programs or to the anticipated water and energy savings associated with installing a new washing machine. This finding may help water agencies prioritize rebate programs and fine tune outreach regarding the combined water and energy savings attained by clothes washers because receptivity for this activity is seemingly favorable.

Recommendation: Many people believe they are conserving already, even if their water use suggests otherwise. Conservation communication efforts must effectively educate customers about what constitutes efficient use and where each customer’s demand fits on a general efficiency scale.

Only 14% of survey respondents reported that they rarely or never practice any specific conservation measures. If accurate, this finding suggests that most people regularly practice conservation or efficiency measures. Furthermore, nearly one-third of respondents reported that they are “already conserving” as much as they are able. This finding underscores the need for communications to do a better job of identifying the many ways in which people can conserve. To address this, effective communications should identify a conservation behavior “path” that water users can take. Communicating options to them will identify numerous ways to expand conservation.

Recommendation: Research customer water billing records to identify good candidates for water conservation program efforts.

Furthermore, the study’s findings show an interesting relationship between conservation behavior and actual water use

- Respondents who indicated that they stopped watering some or all of their existing lawn during the past year used 17.5% *less* water on average.
- Respondents who indicated that they changed their watering schedule during the past year used 14.6% *more* water on average.

- Respondents who indicated that they water their garden during hours to avoid the heat of the day use 19.3% *more* water on average. Note: The presence of an automatic irrigation system has been shown to increase water use substantially (Mayer, et. al., 1995, 1999).

These findings could help water agencies better focus their efforts by further examining their customer account records and target marketing individuals who are high-use customers but have shown receptivity or adoption to a conservation or efficiency measure.

Recommendation: Use multiple communications channels to effectively deliver the right message to the right audience at the right time.

High Levels of Awareness

A number of study findings support the notion that water users recognize the importance of water conservation and water efficiency. The aforementioned finding helps underscore this notion. With this finding, those responsible for conservation outreach should carefully consider their goals in terms of awareness building versus skills building or behavior-modification goals. Given such seemingly high awareness, most water agencies could consider shifting outreach to focus on adopting a conservation behavior.

Credible "Influencers"

Effective communications efforts rely in part on the endorsement or influence of credible sources of information. In this study, more than 90% of survey respondents cited water supply managers as the most credible sources for water conservation information. In contrast, sales associate at home improvement stores were cited as the lease credible sources with only 55% of respondents finding them at least somewhat credible. This finding is not unexpected. Water agencies can confirm who and how customers perceive credible sources through research.

Communication Channels

The study findings related to communication channels are important to the communications planning process. Below are the top-ranked communication communications channels.

- Utility bill inserts about water conservation (68%)
- TV ads demonstrating water conservation tips (55%)
- Newspaper ads (35%)
- Radio ads (26%)
- TV demos (25%)
- Magazine articles (24%)
- Weather Channel (23%)
- Demonstrations (21%)
- Billboards (21%)

The experience of utilities including Seattle suggests that utility bill inserts are relatively ineffective at stimulating conservation behaviors, yet ironically in this survey it was by far the most preferred method for receiving water conservation information. This may be in part because bill inserts are easy to manage and ignore.

The lowest rated methods for delivering conservation information included the following.

- Irrigation contractors (4%)
- University extension services (4%)
- Utility-sponsored classes and workshops (4%)
- Public meetings (5%)
- Plumbers (6%)

Interestingly, respondents who indicated that an irrigation contractor would be an effective source used 23.9% *more* water on average, suggesting this question may be a surrogate for identifying properties equipped with automatic irrigation systems which have been shown to be associated with higher water use in numerous studies. Despite the identified credibility of water supply managers, personal contact with a utility representative was selected by only 7% of respondents.

Utility web sites (13%) are commonly used as a call to action ("visit our web site at …") for conservation information, but seemingly customers do not view this as a particularly effective communication method. E-mailed information also received only a 13% response.

These findings provide excellent insight into channel selection. However, such selections should be further researched or tested in specific markets.

Messaging and Motivation

Creating messages for target audiences requires an understanding of what motivates and influences consumer decisions. This study found that water supply and demand is a top concern. In fact, 88% of respondents agreed or strongly agreed with the statement, "water is precious and in great demand for many uses." While many utility water customers likely will agree with this type of statement, understanding whether the customer will modify or change a behavior that aligns with the statement often requires further investigation.

The survey asked respondents that take deliberate steps to conserve water sometimes or all the time to note the reasons why. Three reasons stood out above the rest as the most important in influencing conservation steps: (1) saving money – 78%; (2) it is the right thing to do – 76%; (3) concern about water availability – 75%. These findings should be considered during any communications planning, specifically during audience or market research and message develop/testing. These three reasons may be the most powerful motivators for stimulating conservation behavior.

Rebate/Incentive Communications

Many demand-side management programs rely upon awareness and education that is supplemented with incentives to help overcome first-cost barriers that inhibit efficiency purchase behavior. Incentive programs often produce favorable results that achieve immediate savings and can be easily tracked. This study found that only 10% of respondents reported to have ever participated in a utility rebate program. A total of 61% of respondents reported that they would have participated in a rebate program if one had been available. This suggests that rebate programs are useful but not always necessary to achieve a higher than expected installation rate of efficient fixtures. Many customers are purchasing efficient fixtures without a rebate incentive and furthermore, if a rebate were available, these customers might have become program "free-riders," taking advantage of the offering to get money back for an action they would have taken any way. Because most of the participating agencies in this study offer rebates, this response suggests many customers are not aware of agency rebate/incentive programs. Combined with the 9% who did participate in utility rebate programs, this suggests that 71% of the respondents have participated or are interested in participating in a utility rebate program. This is a very high level of interest and utilities seeking to increase the number of efficient fixtures in their service area should consider such rebate/incentive programs and/or fine-tune their communications about such programs.

While it may be difficult to associate changes in water use to social marketing efforts, lessons learned from the research results can be used to guide water utilities in designing a social marketing campaign around the four principles (4P's). The "4P's" are best used as part of an overarching social marketing process.

FINDINGS IN RELATION TO THE 4P'S OF SOCIAL MARKETING

While it may be difficult to associate changes in water use to social marketing efforts, lessons learned from the research results can be used to guide water utilities in designing a social marketing campaign around the four principles (4P's). The 4P's are best used as part of an overarching social marketing process. Social marketing is about being strategic in selling a behavior change to a targeted group of individuals to:

- *Accept a New Behavior*: Using monthly water bills to track usage.
- *Reject a Potential Behavior:* Don't let faucets leak for a long period of time without fixing it.
- *Modify a Current Behavior*: Taking shorter showers.
- *Abandon an Old Behavior:* Stop watering some or all of the existing lawn.

Product

In this context, the "product" is the programs and services offered by the utility to reach water conservations goals. This is where the message to the customer is determined, that is defining the behavior or set of behaviors you want your audience(s) to adopt and sustain. Ideally, messaging should move consumers to action. The results indicate that water conservation messages have worked over time. Consumers already have a high level of awareness about water conservation practices, and they make a concerted attempt to integrate water conservation practices into everyday life.

Recommendation: The overarching water conservation message should address water supply and demand, which stood alone at the top as the biggest concern for consumers.

Price

In the context of social marketing, “price” is the perceived costs of adopting the desired behavior. For example, the cost of buying low-flow faucets. However, “price” does not solely rely on dollars, it should be looked at from monetary, time, effort, and psychological perspectives.

Recommendation: Educate consumers about the availability and financial advantages of utility rebate programs, since saving money is becoming a higher priority in households across the nation.

Place

Place refers to the channels through which the products or programs are available, or the places where the behavior change can occur. The greater access people have to the new behavior and the easier it is to do, the more chance there is of persuading people to change. In order to be effective, education and outreach messages must reach the consumer at the point of decision-making, so that it is convenient for the customer to get the message.

Recommendation: Disseminate messages to consumers where they live, work, and play. Non-traditional venues should be considered, such as movie theaters, supermarkets, shopping malls, and retail and fast food outlets. Further, ensure that offered services and incentives are convenient and accessible for audiences.

Promotion

Promotion is how and where you communicate to your audience about the behavior, price, and place. It is using the most appropriate mix of media vehicles to best reach the target audience. Promotional channels can range from face-to-face contact to big-budget advertising. The case studies presented, illustrated a portfolio approach of mixed media can be effective in reaching consumers. A media mix can include advertising (print, broadcast, Web), direct mail (utility bill inserts), outdoor, mass transit, or editorial outreach (article placement) to name a few.

Recommendation: Use multiple communications channels to effectively disseminate information about water conservation to consumers. The more times consumers receive the message, the more it sticks and influences their behavior.

CHECKLIST FOR DEVELOPING A WATER CONSERVATION OUTREACH CAMPAIGN

☑ Use a Strategic Communications Approach

Many challenges arise when there is an effort to overcome information or attitudinal barriers and influence behavioral changes in people. The key to success is a sound approach based on disciplined (e.g., clear, consistent, timely) and strategic communications with social marketing techniques to deliver the *right* message to the *right* audience through the *right* channels at the right time. A strategic communication approach requires a solid understanding of the current situation. What are the barriers that prevent the target audience from acting upon a specific behavior? How are audiences receiving information and which messages might most compel them to action?

☑ Define Campaign Objectives

Before embarking on any social marketing campaign, it is essential to set objectives and define the target audience. Without a clear understanding of what is to be achieved and who needs to be reached, the campaign will not be focused and the results may be fragmented and weak. This is not just plotting objectives for the sake of being organized; the objectives directly determine the best strategy to take and the audience to target.

Having distinctive objectives allows the development of activities, which target specific audiences to fulfill individual goals. For instance, some campaign activities may need to be tailored for different audiences. To use the 4 P's as an example, the "place" where messages and activities are delivered will be different for homeowners than for business owners. Defined objectives will facilitate an easier examination of the general ROI (return on investment) for each audience. Monitoring and evaluating achievements over time will inform which media channel best fulfilled the goals. This results in greater informed planning for future social marketing initiatives.

☑ Know Your Audience

In the context of social media marketing, the chosen objectives will partially determine the target audience as well. To successfully engage in social marketing, you have to know your audience:

- What do they know?
- What stage of change are they in?
- What do they like? What interests them?
- What motivates them?
- What are their barriers to change?

Plan with the 4 P's. The planning process takes the target audience into account by addressing the elements of the "marketing mix" – product, price, place, and promotion. An understanding of the 4 P's allows the development of the appropriate product, at the right price, easily available through strategic placement, and known about through promotion that also aims to enhance desire. Only after acquiring an understanding of your audience (through survey research or focus groups, for example) will you be able to develop messages aimed at overcoming informational or attitudinal barriers

Messaging should move consumers to action. Saving money is becoming a higher priority in households across the nation, so messages should address this issue as appropriate and necessary. Utilities need to exercise caution when using a message related to saving money. For example, buy a low-flow shower head will lower water use only if all other factors (such as length of shower remain the same). Message may require a specific caveat that explains how actual dollar savings can be achieved.

Water conservation messages have worked over time. Consumers already have a high level of awareness about water conservation practices, and they make a concerted attempt to integrate water conservation practices into everyday life.

☑ Understand Current Perceptions

Many consumers believe they are already conserving as much water as they can. However, drought can be a powerful motivator for water conservation activities.

Take into account conservation activities that consumers practice least often (e.g., water-wise landscaping techniques, or tracking usage through monthly water bills). With respect to the installation rate of efficient fixtures, there is high interest in rebate programs but customers are not using them, which may indicate that more education needs to be done in this area. It should be noted that rebate programs are not always necessary to achieve a higher than expected installation rate of efficient fixtures.

☑ Carefully Consider Communications Channels

Using multiple communications channels can be effective in disseminating information about water conservation to consumers (e.g., utility bill inserts, advertising, and magazine articles). Consider how to engage water supply managers, since they are the most credible source for water conservation information.

☑ Evaluate Performance

The true test of the effectiveness of the campaign is not the number of PSAs that were aired, but whether they contributed to improving water conservation. The levels of evaluation se can be divided into three basic types: process, outcome and impact evaluation.

Evaluation Methods

Outcome: Focuses on the measures acted upon by the target audience that are attributed to the outreach activities. For example, did individuals use less water?

Output: Focus on the activities themselves. For example, did the advertising effectively reach the intended audience members?

RECOMMENDATIONS FOR EVALUATING EFFECTIVE CONSERVATION COMMUNICATION EFFORTS

A water utility can define a social marketing campaign as successful, if it can be determined that activated have effected some change in the target audience's attitudes and behaviors. While it is difficult to directly attribute changes in behavior to social marketing, various studies on communications outreach have identified ways in which to monitor and evaluate efforts. The true test of the effectiveness of the program is not the number of PSAs that were aired, but whether it contributed to improved water conservation. However, there are distinct methods to evaluate campaign activities, and each is important for different reasons. These can be divided into two basic types: outcome and output. Outcome focuses on the measures acted upon by the target audience that are attributed to the outreach or program (rebates/incentives) activities. Output focuses on the campaign activities themselves. A key lesson learned is that multiple evaluation methods should be used in a comprehensive social marketing program. Most organizations do not have the resources and expertise to measure impact, but with outcome, and output measurements, one can make a major step in evaluating programs, either the effectiveness of parts of the program, or the effectiveness of the total program.

Kotler, Roberto, and Lee (*Social Marketing: Improving the Quality of Life*) offer seven potential indicators for measuring outcomes and seven potential indicators for measuring outputs. The researchers have used these indicators in Table 5.1 shown below, and believe they are well suited for water agencies whose focus is behavior change. (adapted from Kotler et al. 2002)

Measuring outcomes and outputs is considered a best practice among social marketing professionals. Program budgets for some water agencies may prohibit measuring all 14 measures. However, focusing on some combination of measures will help ensure timely feedback that will allow for campaign adjustments, as well as demonstrate the effectiveness of efforts over time. Water agencies' access to customer data provides an advantage in measuring behavior change relative to water use. An agency's ability to measure water use changes over time, especially during pre and post campaign activities, also in an advantage.

Quick References on Social Marketing

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- Weinrich, N.K. 1999. *Hands-on Social Marketing*. Sage Publications, Inc.
- The Cause Marketing Forum–www.causemarketingforum.com
- Community-Based Social Marketing–www.cbsm.com
- Social Marketing Institute–http://www.social-marketing.org

Table 5.1
Measuring Outcomes and Outputs

Outcome	Indicator Example
Change in Behavior	Change in percentage, percentage increase or decrease, change in numbers
Change in Behavior Intent	Reported change in intention to adopt a desired behavior
Change in Knowledge	Change in awareness of facts, information, and recommendations
Changes in Belief	Attitude changes, opinion changes, and value changes
Responses to Campaign Elements	Calls to call center, visits to Web sites, applications for rebates/incentives, purchases of objects promoted
Awareness of Campaign	Levels of unaided and aided awareness, proven awareness
Customer Satisfaction Levels	Satisfaction with service components of the campaign
Output	Indicator Example
Changes in Policy and Infrastructure	Policy or infrastructure changes that encourage or support behavior change
Reach and Frequency	Estimated number people exposed to a campaign element as well as the number of times they were exposed
Media Coverage	Column inches in a newspaper, minutes on radio news, number people in audience
Total Impressions/Cost per Impressions	Total of people in the target audience exposed to campaign elements calculated with the total reach, frequency, attendance, media exposure, and material distribution
Dissemination of Materials	Numbers of materials distributed such as brochures
Participation and Contributions from Outside Sources	Number of volunteers and volunteer time, partners added
Assessment of Implementation of Campaign Programs	Audit of major activities in terms of planned versus activities, timeline and budget compliance

Adapted with permission from Kotler, P., E. Roberto, and N. Lee. 2002. *Social Marketing: Improving the Quality of Life*. Thousand Oaks, Calif.: Sage Publications, Inc.

To determine how the campaign will be measured, methodologies and techniques need to be identified to actually measure the above-mentioned indicators. Techniques can be quantitative or qualitative in nature. Quantitative techniques use data and are most commonly conducted using telephone surveys, mailed questionnaires, or in-person interviews. Qualitative techniques are less stringent or more subjective, such as the use of focus groups, informal interviews, and capturing anecdotal comments. For example, informal interviews might be used to understand why consumers walked away from a low-flow toilet display, even after reading informational materials and hearing testimonials from volunteers. Timing evaluation efforts should also be addressed and can happen at various periods. Some proven timeframes are:

- Prior to campaign launch: Referred to as pre-campaign or baseline measures.
- During campaign implementation: Tracking either one time or over a period of years.
- Post-campaign activities: Evaluation takes place when all campaign activities are completed.

Discussions should also take place regarding how the information will be used, who will be using it, and for what purpose. Considering additional advice from social marketing experts can be helpful during the social marketing process.

What Works: Findings from Research Partners

Durham, North Carolina

In Durham, North Carolina, the conservation program operates on a relatively small budget, but leverages their investment through participation in North Carolina WaterWiser Partners. This group of seven water providers formed to share the cost of participating in the *Water – Use It Wisely* social marketing campaign.

The City of Durham has identified key “lessons learned” from implementing their conservation program over the past fourteen years:

- Education is essential. Durham promotes the benefits of saving water with a particular emphasis on the key message: Water conservation does not equate to water restrictions. They are different.
- Media coverage helps generate buzz about water conservation, but Durham gets the most traction when media is interested in the story and seeks information.
- Case studies are helpful for water conservation program implementers – particularly studies that provide information about how to maximize a small budget.
- Data is required. It is important to have data about community water consumption patterns to inform and direct water conservation programs.

Residents in Durham had a high degree of familiarity with the *Water – Use It Wisely* program. The basic message was seen or heard by 82% or survey respondents and 71% reported familiarity with the message, “There are a number of ways to save water and they all start with you.”

Four conservation communications specific to Durham emerged as statistically significant influences on water use. Customers that saw or heard any one (or more) of Durham’s water conservation messages via any medium were associated with statistically significant lower water use. Significantly, 94% of survey respondents saw or heard at least one of these messages indicating that Durham is doing an excellent job in reaching customers. The 6% of customers that had not heard or seen any water conservation message from the City use more water.

Respondents who heard or saw the specific message, “There are a number of ways to save water and they all start with you,” via any delivery method were associated with lower water use at the 95% confidence level. Seventy-one percent of the respondents had been exposed to this message.

Lower water use at the 95% confidence level was associated with hearing or seeing Durham conservation messages more frequently. The more frequently a message was heard or seen, the lower the water use. Ninety-two percent of the survey respondents were classified as “aware”, indicating that they had heard or seen at least one Durham conservation message. This is a good indication that Durham’s messaging efforts are having an impact on water use and that repeating the message in various places is likely to increase water savings. This analysis found that the more messages a customer was exposed to, the lower their water use was likely to be.

Customers that were encouraged to take indoor conservation action(s) by the message, “There are a number of ways to save water and they all start with you” were associated with lower indoor water use. The number of indoor behaviors motivated by the message, as reported on the survey, was associated with differences in water use. The more behaviors taken by respondents, the lower the use. Twenty-nine percent of the survey respondents identified at least one indoor behavior that was motivated by this message.

The results from Durham suggest that even on a limited budget, a carefully designed and implemented social marketing campaign can have a measurable impact on water use. Getting conservation messages in front of customers repeatedly through a variety of media outlets is having an impact in Durham. Small-to-medium sized water providers seeking to maximize their conservation communication dollars should look closely at the Durham program.

Phoenix, Arizona

In Phoenix, Arizona – a large water agency with a $1.9 million annual conservation budget – $500,000 is allocated annually to communication and education. The *Water – Use It Wisely* social marketing campaign is the cornerstone of this effort. The results from this research study show a clear trend of decreasing single-family residential water use in Phoenix; however, it is not clear what exactly is causing this decrease in demand. From this analysis conducted by the researchers, it is not clear whether these changes can be directly attributed to the City’s water conservation messaging programs. Many factors could be contributing to the change. The increased efficiency of the fixtures and appliances consumers are purchasing and installing, possibly motivated by the conservation messaging program, is but one of many factors to be considered.

Survey respondents in Phoenix had a high degree of familiarity with the key conservation communication messages promoted by the City. Results from a few messages are presented here:

- The “There are a number of ways to save water and they all start with you” message was seen or heard by 75% of survey respondents.
- The “Water your plants deeply, but less frequently to create healthier and stronger landscapes” message was seen or heard by 69% of survey respondents.

- The "Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time" message was seen or heard by 61% of respondents.

Water bill inserts, television, and newspapers/magazines were the most frequently reported vehicles for receiving these messages.

Customer action to conserve water in Phoenix is having a measurable impact on demand. Regression trend lines (from Figure 4.8) show that water use among the group of customers that "took no action" has stayed essentially the same over a 10-year period from 1996–2007. Customers who "took at least one action" showed a steady decline in demand over that time period. Overall, the customers who "took at least one action" to conserve water reduced their average annual demand by 23.8% from 1996–2007.

While the statistical analysis of the survey results was not able to directly associate the *Water – Use It Wisely* program with these water use reductions, this easily could be due to survey response levels and the lack of precision provided by monthly billing data. The declining trend in water use among customers who took conservation action is a good indication the program efforts in Phoenix are impacting behavior and water use. What remains unclear is the motivation for this change in use. Phoenix has studied this question but has yet to obtain results that directly connect the *Water – Use It Wisely* program with measurable water savings.

Seattle, Washington

Seattle, Washington, is a large, rapidly growing metropolitan community with unique water supply challenges. Since the 1980s, Seattle Public Utilities and its wholesale water utility partners have engaged in water conservation efforts. Today, the Saving Water Partnership (SWP) participates in a variety of water efficiency programs, funded at a level of approximately $3 million per year. All programs promote indoor and outdoor water conservation and include educational outreach, mass media messaging, and financial incentive components. The programs are branded separately and have specific target audiences and markets. However, they do support each other in terms of messaging, education and outreach. All of the programs are designed with the ultimate goal of developing a water conservation ethic and the necessary behavior changes to achieve water conservation goals.

Residential water use in Seattle has declined significantly over the past 15 years. In 1994, the average single-family home in Seattle used approximately 81.3 kgal of water both indoors and out (Mayer, et. al., 1999). In 2008, the average single-family home in Seattle used 53.7 kgal of water, a difference of 27.6 kgal and a 33.9% reduction in average demand.

Environmental concerns, installing efficient clothes washers, and changes in irrigation watering patterns were found to be statistically significant influences on customers that used less water in Seattle. While it was not possible to tie actions to any specific conservation messaging effort, results suggest that the SWP's communications are having a real and measurable impact on customers and their water use. This is confirmed by the results from a 2006 study in Seattle that found households aware of utility conservation programs, on average, use 10% to 11% less water than households who are not aware of the programs (Dethman, et. al, 2007, 2008). This analysis found that the SWP's conservation programs lead to more actions being taken and less water used in "aware" households.

The SWP offers other utilities several suggestions as they develop and grow their water efficiency initiatives:

- Pay close attention to long-term demographic changes in your service area when creating a communications strategy. Accurately segmenting customers will help customize messages according to each socio-demographic segment and increase customer receptivity, better address barriers, and promote behavior change.
- Designing programs to achieve water savings from a diverse customer base is important in developing a conservation ethic among residents.
- Collaborating with energy utilities to develop programs that promote water and energy-saving behaviors can be cost-effective and can show a rapid return on investment for the customer which increases customer confidence in the utility and programs.
- Price structures (tiers) more than just the actual rates themselves, can be a strong conservation tool. Sound program design coupled with proper pricing and metering can lead to water and energy savings.
- Although customers consistently respond to surveys that bill stuffers are their preferred way of learning about water efficiency, actual recall and action taken after receiving them was much lower that other communication tools. Utilities should carefully review the cost and desired impact of bill stuffers relative to other options.

JEA – Jacksonville, Florida

JEA provides electric, water, and sewer services to the greater Jacksonville, Florida metropolitan area. JEA is part of the St. Johns River Management District and services much of Duval County and portions of three neighboring North Florida counties.

Water conservation is an important part of JEA’s communication efforts. JEA’s budget for combined energy and water conservation efforts is between $600,000 and $800,000 (including incentives). In addition, JEA allocates $1.4 million to advertising for conservation only. Included in this is a contribution to St. John's Water Management District’s marketing efforts.

Although not a formal goal, the utility wants to decrease water usage by 7% to 10% through water conservation efforts over the next five years. To reach this goal, JEA has outlined a singular objective: to educate its customers about water resource issues and to help them learn ways to conserve for the future.

JEA has gained the following insights from their conservation program efforts:

- Customers are more likely to change their behavior if the requested change is small, convenient, and easy to implement.
- Utilities cannot implement a water-savings measure such as a new technology or behavior change without an outreach component to communicate that change.
- It is critical that the technology/industry supply chain align with conservation efforts so that residents can easily obtain new water-saving technologies, native plants, etc.
- Engaging stakeholders, such as plumbing or lawn care professionals, and educating them about the water conservation will empower them to act as “voices” of the program, will aid in the creation of a water conservation ethic in the community, and extend the reach of limited water conservation dollars.

- Programs must be evaluated regularly to ensure they are efficient and effective and to determine if modifications are required.

In this WRF study, survey respondents in the JEA service area had a high degree of familiarity with many of the conservation communication messages promoted by JEA. More than 80% of respondents were familiar with the message, “Water lawn or garden during hours that avoid the heat of the day,” and in general more than 50% of respondents indicated at least some familiarity with most of the conservation messages presented in the survey.

Although customers expressed familiarity with JEA water conservation messages only one factor from the survey was associated with statistically significant differences in water use among respondents. Respondents that viewed plumbers as a credible source of conservation information were associated with higher water use compared with those that did not view plumbers as a credible source.

These results should not be viewed as any kind of failure on behalf of JEA or their conservation efforts. Rather, there were simply no distinct water use trends in this data set that enabled any meaningful analysis of differences in water use.

Orange County, Florida

Central Florida’s rapidly growing population is dependent upon rainfall for its freshwater supply. Orange County Florida, which includes the cities of Orlando and Winter Park, typically receives 52 inches of rainfall per year. The Orange County water conservation team seeks to reduce per capita water consumption and has piloted conservation programs to determine the most cost-effective solutions to achieve stated goals.

Orange County staff believe that there are three keys to success for any conservation program:

- understanding the target audience and customer base to inform program and message development,
- strong water conservation codes and code enforcement, and
- identification of a publicly known and respected water conservation champion.

Survey respondents in Orange County had a varying degree of familiarity with the conservation communication messages promoted by the County. Results are shown below:

- The “Florida Water – It’s Worth Saving” message, was seen or heard by to 78% of survey respondents.
- The “Saving Water Starts with You” message was seen or heard by 54% of survey respondents.
- The “Free… Florida-Friendly Landscape Workshops” message was seen or heard by 37% of survey respondents.
- The “If Water Is Life then Water Conservation Is the Way of Life” message was seen or heard by 23% or respondents.
- The “Think Two – Water the Lawn Only 2 Days a Week” message was seen or heard by 89% of respondents.

The range of recognition rates could be indicative of the maturity of different conservation messaging or could indicate that different communication methods were used for each message. Network TV was the most frequently reported vehicle for receiving these messages in almost all cases and in particular for the “Florida Water – It’s Worth Saving” message and for the “Think Two” message.

Two factors unique to Orange County’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were: Question 4 and Question 10. In Question 4, customers classified as “aware”, meaning that they heard or saw at least one Orange County conservation message were associated with lower water use at the 95% confidence level. Ninety-four percent of the survey respondents were classified as “aware.” This result is a good indication that Orange County’s messaging efforts may be having an impact on water use. In Question 10, customers who were encouraged to take conservation action by the message, “Free… Florida-Friendly Landscaping Workshops,” were associated with lower outdoor water use. Only 1% of the respondents answered Question 10 in this manner, so the analysis sample is too small to determine whether the lower water use is a result of the messaging, but it is an encouraging finding.

Customers in Orange County that had lower water use also had the following characteristics and preferences:

- A small number (1%) do not want any conservation information.
- They prefer conservation information from a nursery or landscape company (8%).
- They believe residential growth is impacting water supply (58%).
- They prefer TV ads for conservation communication.

The age of the home was also found to be associated with differences in water use. In this case, older homes were associated with lower use.

These results suggest that Orange County’s communication messaging is effectively reaching customers. More than 90% of survey respondents had received at least one Orange County conservation communication and this group of customers used less water than those who had not received any conservation communications.

Tempe, Arizona

The City of Tempe (population of 165,000) has been implementing water conservation programs to residential, multifamily, and industrial customers for over fourteen years. Tempe has a $300,000 annual conservation program budget with $80,000 going for rebates and $10,000 going to the *Water – Use It Wisely* marketing campaign.

The keystones of Tempe’s water conservation initiative are the toilet rebate, the landscaping, and the elementary school programs. Most of the real estate in Tempe’s service territory is already developed, and existing homes still have the typical 1970’s landscaping consisting of turf and high water-use trees. Therefore, Tempe focuses water conservation efforts on upgrading technology in existing homes, converting lawns to water-wise landscapes, educating Tempe’s young people about being water wise, and implementing local ordinances.

Tempe employs several outreach vehicles to market its water conservation program. These vehicles includes promoting programs and rebates on individual utility bills, a dedicated water conservation web page on the city’s web site, direct outreach through community events and school assemblies, how-to workshops, the distribution of brochures and conservation how-to informational materials, press releases and media outreach, and occasional newspaper advertising to promote workshops.

Survey respondents in Tempe had a high degree of familiarity with many of the conservation communication messages promoted by the City. The *Water – Use It Wisely* message, “There are a number of ways to save water, and the all start with you,” was familiar to 75% of survey respondents. Many conservation messages were seen more than 10 times by respondents, indicating a positive familiarity with Tempe conservation communication programs.

Two factors unique to Tempe’s conservation communication efforts were found to decrease water use at the 95% confidence level. These were: Question 10(i), choosing a low- water use plants, and Question 8(h), using drip irrigation[29]. Both of these questions are associated with efficient water-wise, non-turf landscaping practices promoted by the City of Tempe. Further, customers who reported that they monitor their outdoor water use used substantially less water. These results suggest that Tempe’s outdoor conservation efforts promoting Xeriscape and alternatives to turf are having a measurable impact among residential customers.

Other conservation behaviors found associated with lower water use in Tempe were:

- Using a broom rather than a hose to clean pavements
- Stopping irrigation of some or all of an existing lawn
- Conservation actions taken in the past year: none of the above[30]

Customers in Tempe that had lower water use also had the following characteristics and preferences:

- Prefer demonstration in home improvement stores for conservation information
- Prefer the City of Tempe web site as a source of conservation information
- Prefer free home water audits
- Prefer TV ads for conservation communication
- Believe people do not recycle enough
- Believe commercial/industrial grown is impacting local water supplies

These results suggest that Tempe’s broad communication approach to conservation messaging and program delivery is reaching customers – particularly those with an environmental consciousness concerned about growth in the community. This may be the “low hanging fruit” for conservation in the Tempe area. The small number of customers not being reached by Tempe’s conservation communication and program efforts are associated with higher water use.

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[29] While drip irrigation was associated with lower water use on Question 8, it was associated with higher water use on Question 6.

[30] This response does not necessarily indicate that no conservation actions were taken in the past year (although it could). Rather, it indicates that if any conservation actions were taken, they were not included on the list of actions provided in the survey for this study. Since the list of actions was extensive, it could be an indication that no conservation action was taken over the past year.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The findings − both from the survey and the literature review − presented in this report highlight the linkages between communication approaches and water use behavior among residential customers. The findings also highlight the challenges inherent in any study that focuses on behavior change, decision-making, and behavior motivation. Before discussing the topics that may profit from further study, we will review what we definitely know, as confirmed in the research reported here, and what we do not.

WHAT THIS STUDY TELLS US AND WHAT WE NOW KNOW

- Most people believe that they regularly practice water efficiency measures.
- There is a high level of awareness about conservation practices and a concerted attempt to integrate conservation practices into everyday life.
- “Saving money” is the most frequently cited motivating factor for conservation behavior.
- Most frequently taken actions are: repair (leaking plumbing), followed by increased purchasing of major appliances that use less water.
- The least practiced measures include water-wise landscaping and tracking usage with the water bill.
- Awareness of utility rebate programs is low, and the effectiveness of rebate programs seems muted, although the consumer desire for such programs is high.
- Almost 9 in 10 respondents say that they took at least one conservation step during the past year, and 1 in 3 believes they are doing all they can to conserve water.
- External pressure such as local government mandates coupled with fines or other means of enforcement reduce water use.
- Even when they have taken steps to reduce water consumption, residents with automatic sprinkler systems use significantly more water than those without.
- Residential water customers view those persons or organizations with a financial interest in either water equipment or plumbing or commerce as being less credible on matters of water conservation than those who do not have such an interest.
- Increase in the message “dosage” (frequency of being heard or read – different than frequency of being said or shown) is inversely proportional to water use: the more the dosage, the less the water use.
- A broad multi-modal communication approach to conservation messaging may be more effective in the long run than short sharply focused messages.
- Conservation is less a series of behaviors and more a lifestyle perspective: a “conservation ethic” if you will. Inducing or influencing behavior then will come from reinforcing a conservation way-of-living.
- Conservation messages that clearly articulate the end-goal (such as the *1% Program* in Seattle) seem more effective in the long run than those that are general and vague.

WHAT WE DO NOT KNOW

- We do not know the effect (or the power) of any one message. It is difficult to directly link the messaging with specific induced or influenced behaviors. However, it seems that persistent messaging (of almost any kind) having to do with water conservation will have an effect **in the long run** on attitudes and behavior.
- While a number of authorities in the field, and some of the utility partners, advocate directing the messages to specific market segments, we do not know which market segments are the ones that will work.
- We still do not know which media constitute the best channel for social marketing messages. Respondents to the survey reported here said they prefer water bill inserts as the source for water conservation messages, but some of the literature points to other media (e.g., television) as being more effective. Perhaps respondents prefer water bill inserts because they are easier to ignore? Media preferences and channels will be driven largely by the needs and barriers faced by the target audience. Therefore, channels will vary by community.
- Because we cannot directly measure the effectiveness of any one message on water conservation behavior, we do not know which, of all the possible social marketing messages that can be constructed, would be the most effective ones.
- Almost un-tested is the power of “the norm” message for water conservation. Regardless of the social issue, people are strongly motivated by their perception of what most other people are doing. They want to be in the middle of the herd. Unfortunately most utility programs lack good customer benchmarking to convey what the “average” customer is doing and the scale of improvement needed by “water hogs.” Few have in place effective reward mechanisms for “good achievers”. Instead, some utilities adopt regulatory approaches, to whip the slow members of the herd. This places them in the back of the herd instead of out in front of the herd, in more of a leadership role. Customer respect in utility leadership is often lost.

AREAS FOR FURTHER RESEARCH

Using the results reported here as a foundation, additional research can broaden our understanding as follows:

The data referenced in this report from the Residential End Uses of Water Study (REUWS) are in danger of become stale and dated. The REUWS was conducted almost 10 years ago, and great progress has been made in water conservation behavior, in technological advances that addressed increasingly wise water use, and in the evolution of standards governing appliances related to water usage in the home and in commercial environments. A more comprehensive and detailed REUWS should be mounted to update these important benchmark data.

That social marketing is an effective perspective and methodology for influencing behavior change is no longer a question. Identifying the most persuasive powerful social marketing techniques from the palette of those available is the next logical phase of research. As discussed in the introduction to this report, *commitment*, *norms*, and *prompts* are specific approaches that show promise for effecting long-lasting changes and can be made part of on-going research efforts as water utilities craft new campaigns to increase water conservation.

One of the most significant changes in the last 15 years has been the increased understanding of new and different market segments as compared with the past. Formerly, market segments were identified by various demographic categories such as socio-economic status, age, education, and race/ethnicity. In short, past market segments were defined by who you are. Today, more meaningful market segments are defined by what you do and how you do it. For example, does someone use the Internet extensively, regularly visit Facebook on the Internet, and engage in extensive text-messaging? Or does someone get her news from the newspaper, and from television? Does someone pay her bills with checks and stamps and envelopes, or does she pay her bills via electronic banking that precludes the use of "bill inserts"? Water utilities are moving towards online billing and automatic bill payment. While this offers greater convenience for the customer and can be beneficial for the utility as well, it does eliminate the communication element of the water bill. The water bill presents an important and significant opportunity for regular customer communication. The impact of the move toward on-line and automatic billing on customer communication should be evaluated. Agencies that no longer send paper bills to their customers may be interested in alternative communication avenues for reaching customers.

Water utilities need to research the relevant market segments among their customers (both residential and commercial), update this research every three to five years, and identify the most relevant media channels to use in reaching those segments. Possible new market segments include:

- ***Primary and secondary school students.*** Parents influence children, but children also influence their parents. There is some evidence from social marketing programs in other areas (e.g., emergency preparedness) supporting the idea that children can influence the behavior of their parents a great deal.
- ***Young home buyers who purchase older homes.*** People buying older homes may also be purchasing additional appliances and services (e.g., landscaping) that have implications for water use. They may be prime targets for social marketing efforts to ensure that water conservation is among the criteria they use to make such purchase decisions.

Water utilities need to adopt a more information-driven orientation toward marketing campaigns, including customer-oriented and social data as appropriate. Research should become as natural as breathing for the water utilities, and the acquisition and use of data for informing such campaigns should be a top priority for the utilities. Some data can come from focus groups, which have the advantage of relative quick acquisition of information rich data. Other data can come from periodic surveys of customers.

Free riders are consumers who are replacing a water efficient product due to remodeling efforts or product failure; however, they are able to take advantage of a rebate. Free riders reduce the cost effectiveness of water conservation programs as the water utility is expending resources on a consumer that would have taken the action at their own expense. Our study found that consumers purchase products without the use of available rebates. Research on reasons for this behavior would be insightful for communication strategies to minimize free riders.

Our study identified water supply managers as credible source of information on water conservation. Our survey respondents reside in areas with water conservation programs. In water rich areas that lack water conservation programs, the perception may be different, and, hence, future research is needed on credible sources in areas that face different water supply issues.

Regional economic growth results in increased water demand. Regional water conservation practices can be used to offset this increased demand. Research on consumers' attitudes toward water conservation practices to support economic growth would assist water utilities in developing their communication campaigns.

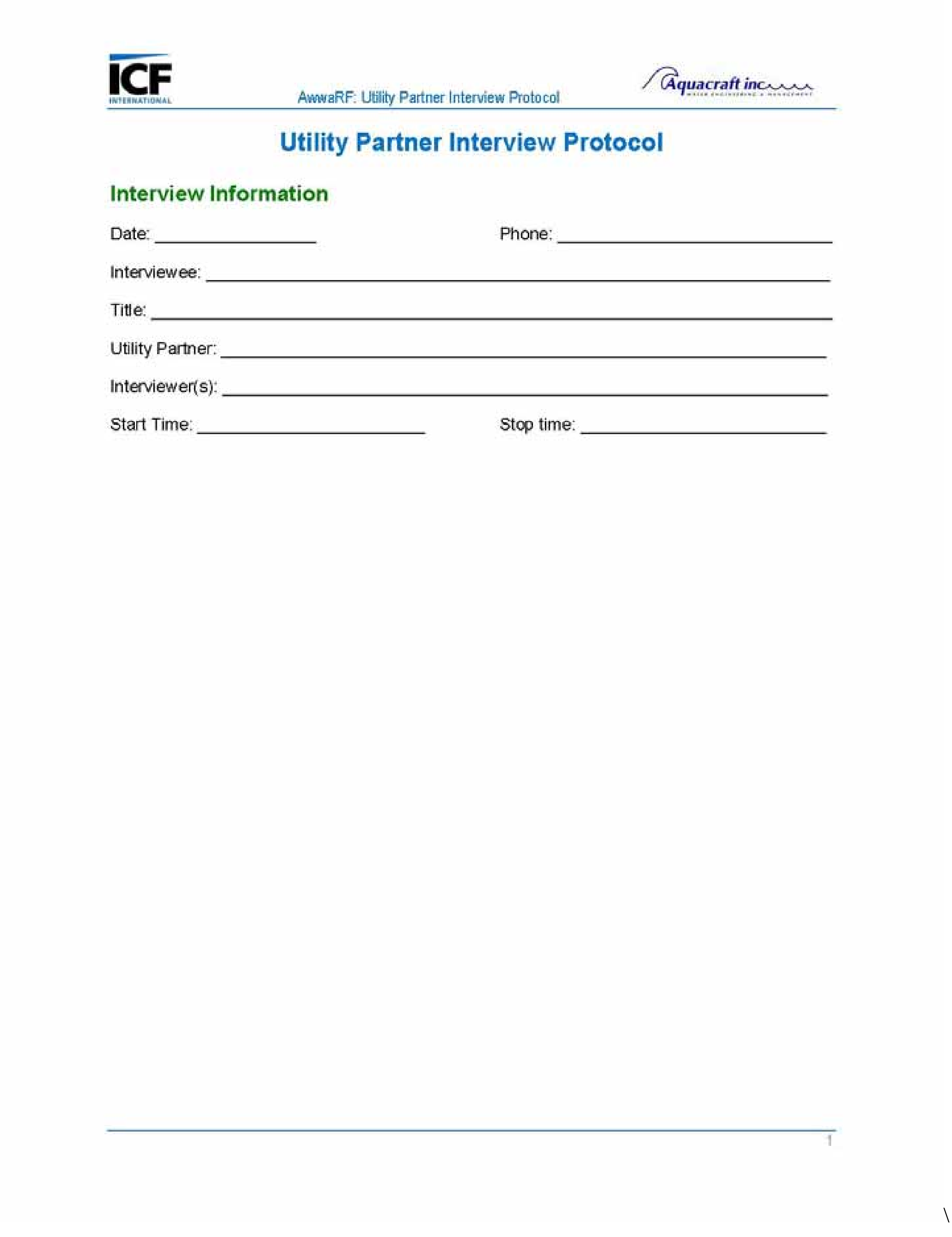
Water conservation practices improve regional water quality and, hence, provide environmental benefits and reduce water treatment costs. Research on consumers' attitudes toward water conservation practices to support improved water quality would assist water utilities in developing their communication campaigns.

Some water utilities change water rates to encourage water conservation. Research on consumers' perception of their water rates and the relative impact of water rates on their household budget, would assist water utilities in developing messages on the monetary benefits of water conservation.

Research on the impacts of drought response to changing long term behavior and options for leveraging the short term responses to changes in long term behavior would assist water utilities in expanding their drought response campaign (i.e., to address changes in long term behavior), in particular during times in which water utilities have a captive audience.

In this digital information age, the adage that "you cannot manage what you cannot measure" has increasing relevance for the ways in which water utilities approach their customers and manage their primary resources. The suggestions listed above will help the water utilities carry out their mission in an increasingly informed manner.

APPENDIX A:
UTILITY PARTNER INTERVIEW PROTOCOL



Utility Partner Interview Protocol

Interview Information

Date: ________________ Phone: ____________________________

Interviewee: ____

Title: ____

Utility Partner: ____

Interviewer(s): ____

Start Time: ______________________ Stop time: ________________________

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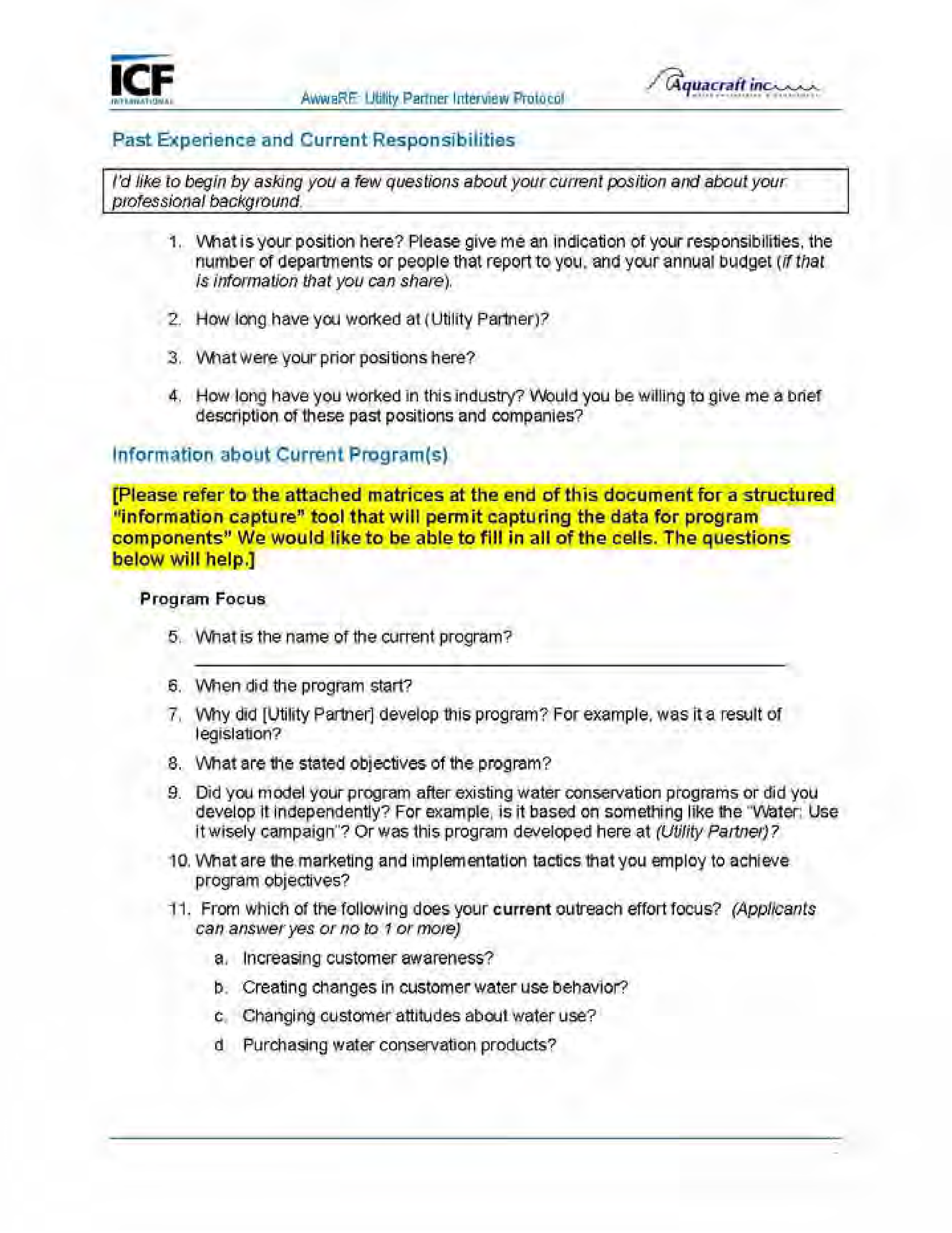


AwwaRF Utility Partner Interview Protocol

Past Experience and Current Responsibilities

I'd like to begin by asking you a few questions about your current position and about your professional background.

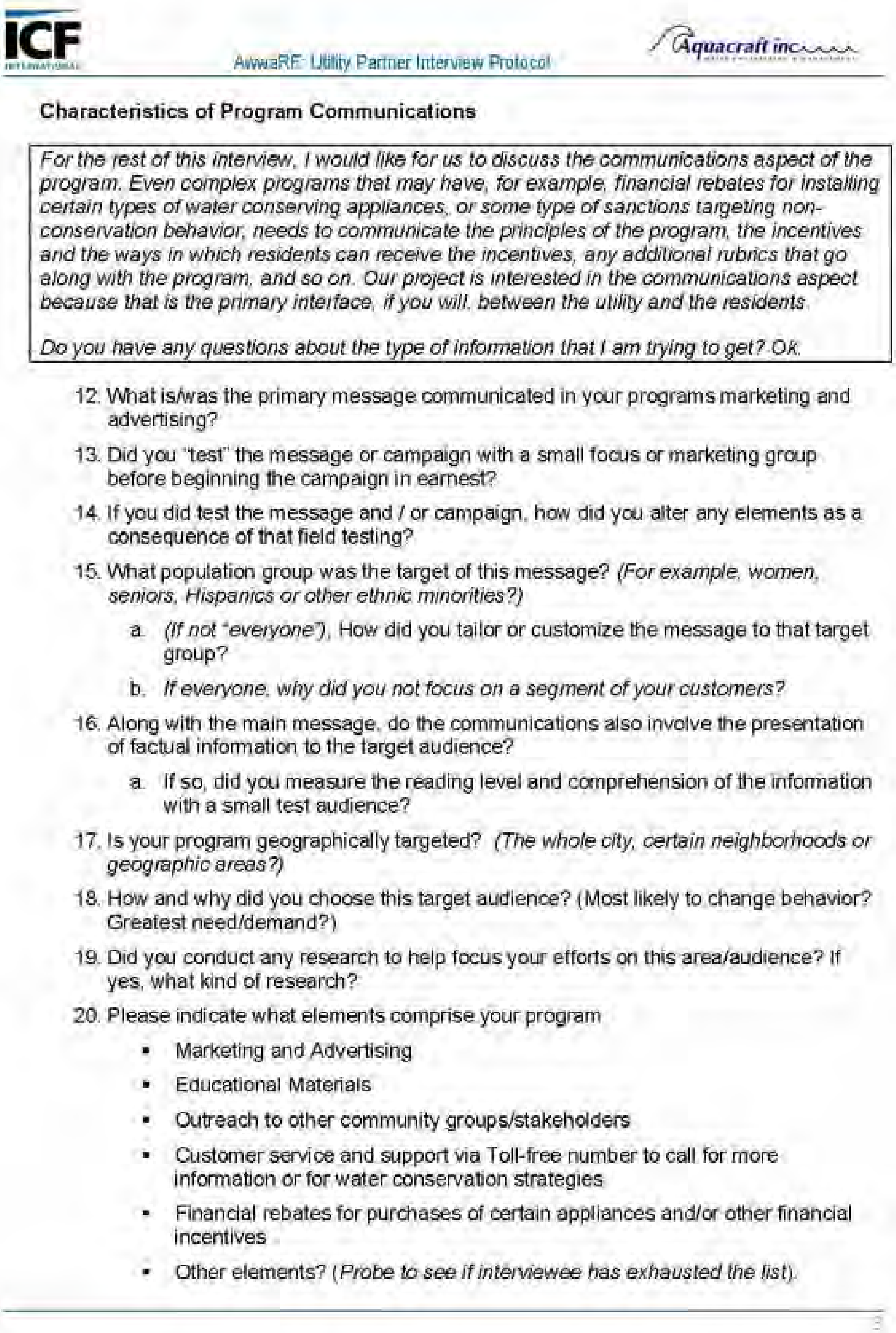
1. What is your position here? Please give me an indication of your responsibilities, the number of departments or people that report to you, and your annual budget (*if that is information that you can share*).
2. How long have you worked at (Utility Partner)?
3. What were your prior positions here?
4. How long have you worked in this industry? Would you be willing to give me a brief description of these past positions and companies?

Information about Current Program(s)

[Please refer to the attached matrices at the end of this document for a structured "information capture" tool that will permit capturing the data for program components" We would like to be able to fill in all of the cells. The questions below will help.]

Program Focus

5. What is the name of the current program?
6. When did the program start?
7. Why did [Utility Partner] develop this program? For example, was it a result of legislation?
8. What are the stated objectives of the program?
9. Did you model your program after existing water conservation programs or did you develop it independently? For example, is it based on something like the "Water: Use it wisely campaign"? Or was this program developed here at *(Utility Partner)?*
10. What are the marketing and implementation tactics that you employ to achieve program objectives?
11. From which of the following does your **current** outreach effort focus? *(Applicants can answer yes or no to 1 or more)*
    a. Increasing customer awareness?
    b. Creating changes in customer water use behavior?
    c. Changing customer attitudes about water use?
    d. Purchasing water conservation products?

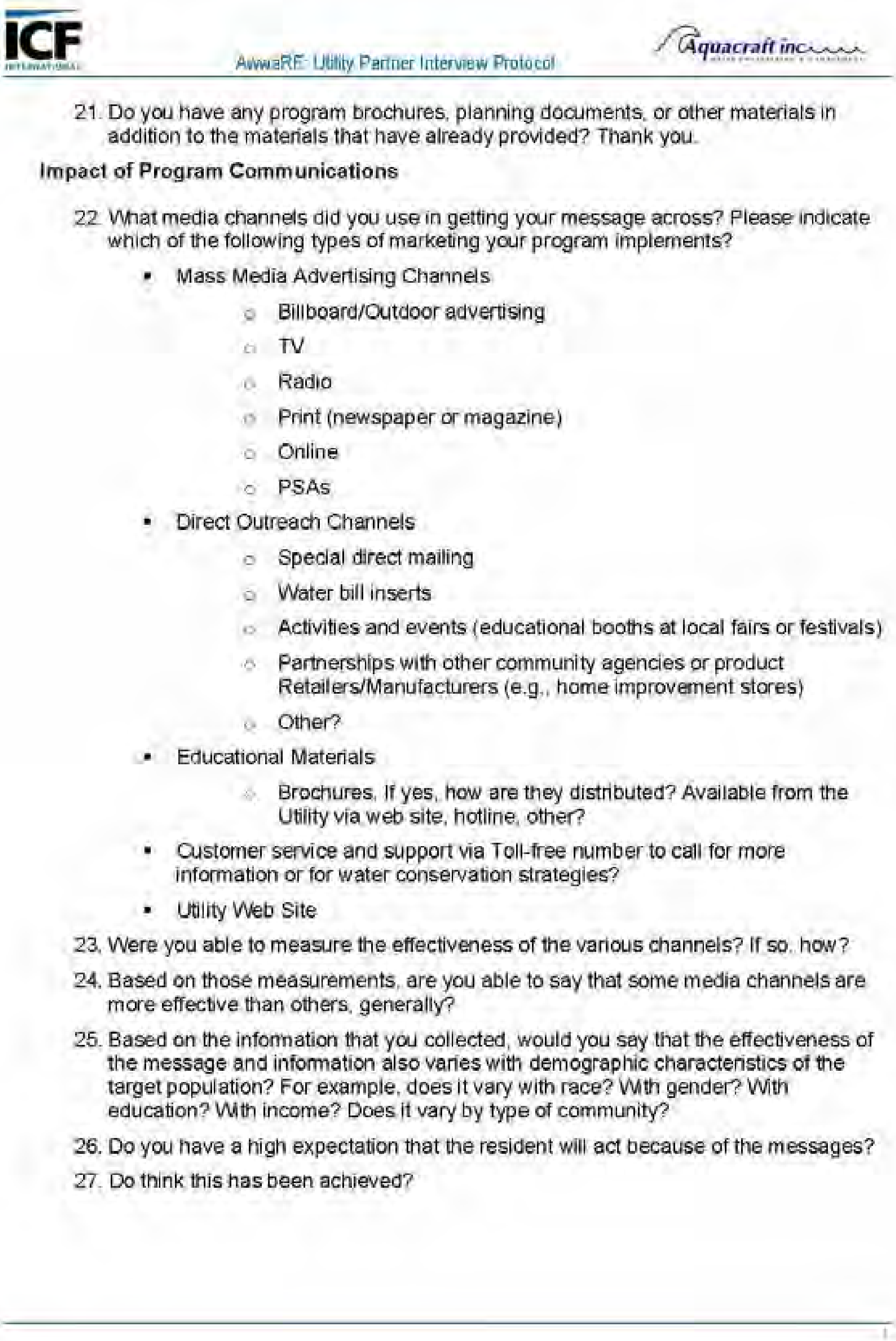


Characteristics of Program Communications

For the rest of this interview, I would like for us to discuss the communications aspect of the program. Even complex programs that may have, for example, financial rebates for installing certain types of water conserving appliances, or some type of sanctions targeting non-conservation behavior, needs to communicate the principles of the program, the incentives and the ways in which residents can receive the incentives, any additional rubrics that go along with the program, and so on. Our project is interested in the communications aspect because that is the primary interface, if you will, between the utility and the residents.

Do you have any questions about the type of information that I am trying to get? Ok.

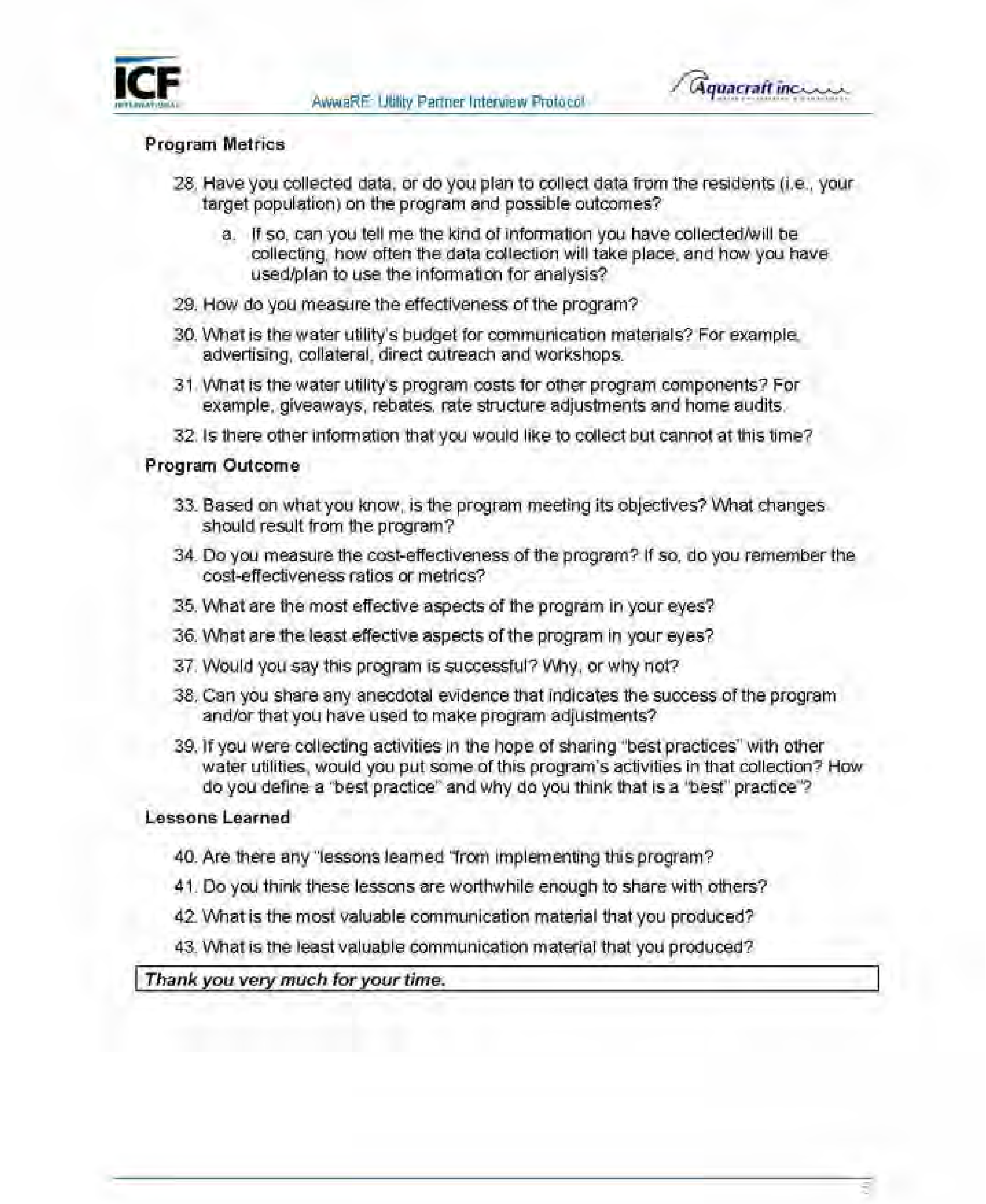
12. What is/was the primary message communicated in your programs marketing and advertising?
13. Did you "test" the message or campaign with a small focus or marketing group before beginning the campaign in earnest?
14. If you did test the message and / or campaign, how did you alter any elements as a consequence of that field testing?
15. What population group was the target of this message? *(For example, women, seniors, Hispanics or other ethnic minorities?)*
    a. *(If not "everyone")*, How did you tailor or customize the message to that target group?
    b. *If everyone, why did you not focus on a segment of your customers?*
16. Along with the main message, do the communications also involve the presentation of factual information to the target audience?
    a. If so, did you measure the reading level and comprehension of the information with a small test audience?
17. Is your program geographically targeted? *(The whole city, certain neighborhoods or geographic areas?)*
18. How and why did you choose this target audience? (Most likely to change behavior? Greatest need/demand?)
19. Did you conduct any research to help focus your efforts on this area/audience? If yes, what kind of research?
20. Please indicate what elements comprise your program
    - Marketing and Advertising
    - Educational Materials
    - Outreach to other community groups/stakeholders
    - Customer service and support via Toll-free number to call for more information or for water conservation strategies
    - Financial rebates for purchases of certain appliances and/or other financial incentives
    - Other elements? (*Probe to see if interviewee has exhausted the list*).



21. Do you have any program brochures, planning documents, or other materials in addition to the materials that have already provided? Thank you.

Impact of Program Communications

22. What media channels did you use in getting your message across? Please indicate which of the following types of marketing your program implements?
    - Mass Media Advertising Channels
        - Billboard/Outdoor advertising
        - TV
        - Radio
        - Print (newspaper or magazine)
        - Online
        - PSAs
    - Direct Outreach Channels
        - Special direct mailing
        - Water bill inserts
        - Activities and events (educational booths at local fairs or festivals)
        - Partnerships with other community agencies or product Retailers/Manufacturers (e.g., home improvement stores)
        - Other?
    - Educational Materials
        - Brochures. If yes, how are they distributed? Available from the Utility via web site, hotline, other?
    - Customer service and support via Toll-free number to call for more information or for water conservation strategies?
    - Utility Web Site
23. Were you able to measure the effectiveness of the various channels? If so, how?
24. Based on those measurements, are you able to say that some media channels are more effective than others, generally?
25. Based on the information that you collected, would you say that the effectiveness of the message and information also varies with demographic characteristics of the target population? For example, does it vary with race? With gender? With education? With income? Does it vary by type of community?
26. Do you have a high expectation that the resident will act because of the messages?
27. Do think this has been achieved?



Program Metrics

28. Have you collected data, or do you plan to collect data from the residents (i.e., your target population) on the program and possible outcomes?
    a. If so, can you tell me the kind of information you have collected/will be collecting, how often the data collection will take place, and how you have used/plan to use the information for analysis?
29. How do you measure the effectiveness of the program?
30. What is the water utility's budget for communication materials? For example, advertising, collateral, direct outreach and workshops.
31. What is the water utility's program costs for other program components? For example, giveaways, rebates, rate structure adjustments and home audits.
32. Is there other information that you would like to collect but cannot at this time?

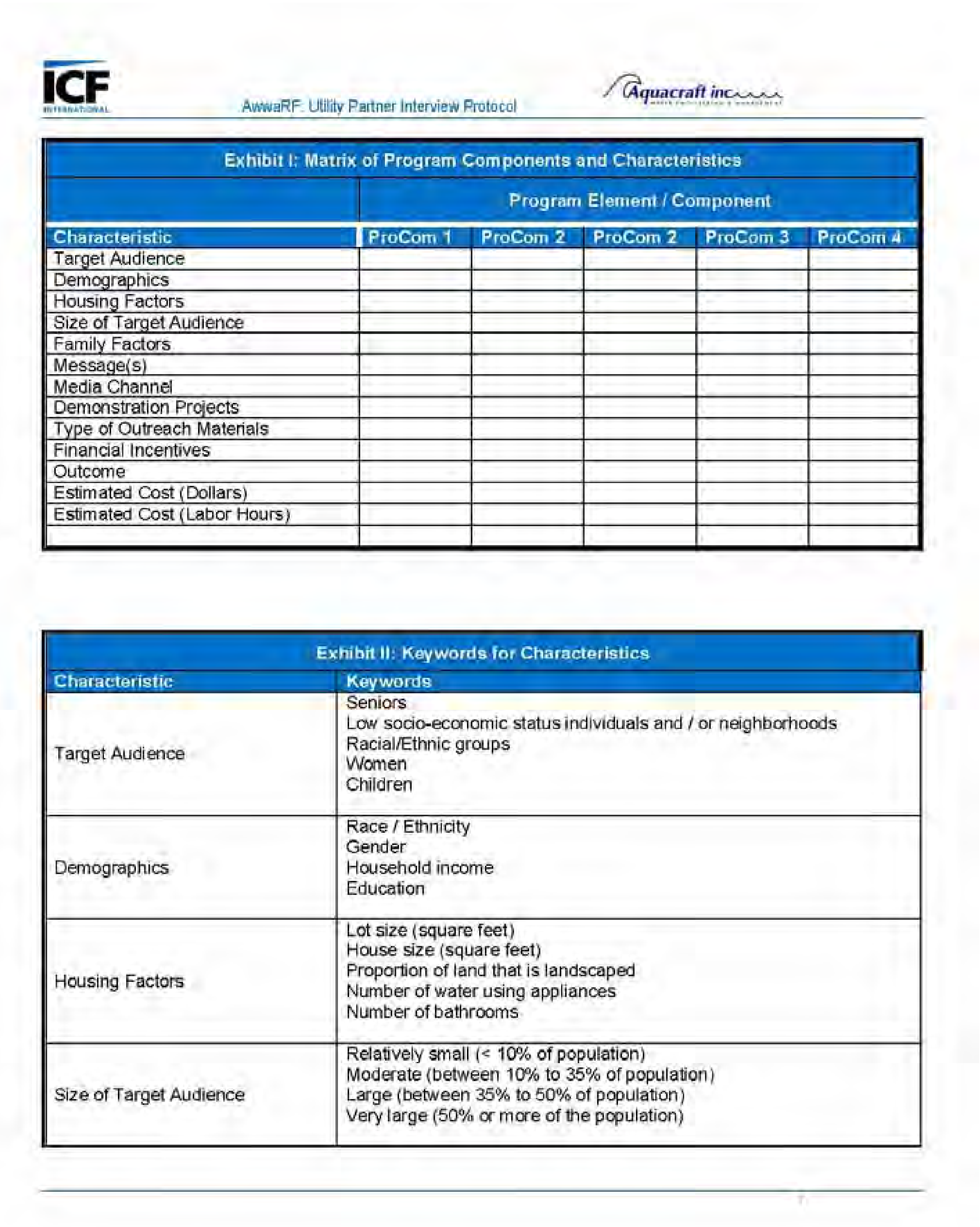
Program Outcome

33. Based on what you know, is the program meeting its objectives? What changes should result from the program?
34. Do you measure the cost-effectiveness of the program? If so, do you remember the cost-effectiveness ratios or metrics?
35. What are the most effective aspects of the program in your eyes?
36. What are the least effective aspects of the program in your eyes?
37. Would you say this program is successful? Why, or why not?
38. Can you share any anecdotal evidence that indicates the success of the program and/or that you have used to make program adjustments?
39. If you were collecting activities in the hope of sharing "best practices" with other water utilities, would you put some of this program's activities in that collection? How do you define a "best practice" and why do you think that is a "best" practice"?

Lessons Learned

40. Are there any "lessons learned "from implementing this program?
41. Do you think these lessons are worthwhile enough to share with others?
42. What is the most valuable communication material that you produced?
43. What is the least valuable communication material that you produced?

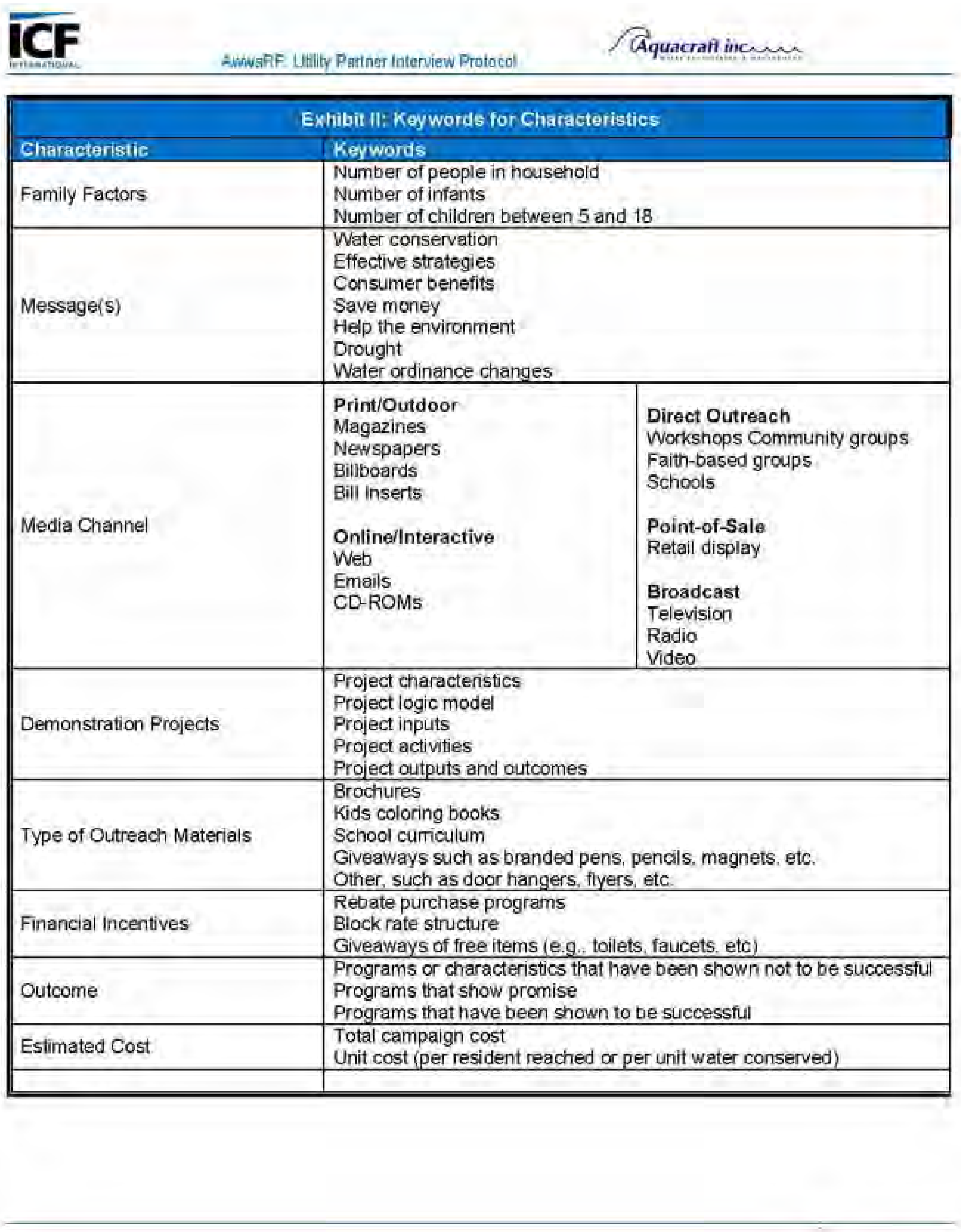
Thank you very much for your time.



ICF INTERNATIONAL AwwaRF: Utility Partner Interview Protocol Aquacraft inc

Exhibit I: Matrix of Program Components and Characteristics					
	Program Element / Component				
Characteristic	ProCom 1	ProCom 2	ProCom 2	ProCom 3	ProCom 4
Target Audience					
Demographics					
Housing Factors					
Size of Target Audience					
Family Factors					
Message(s)					
Media Channel					
Demonstration Projects					
Type of Outreach Materials					
Financial Incentives					
Outcome					
Estimated Cost (Dollars)					
Estimated Cost (Labor Hours)					

Exhibit II: Keywords for Characteristics	
Characteristic	Keywords
Target Audience	Seniors Low socio-economic status individuals and / or neighborhoods Racial/Ethnic groups Women Children
Demographics	Race / Ethnicity Gender Household income Education
Housing Factors	Lot size (square feet) House size (square feet) Proportion of land that is landscaped Number of water using appliances Number of bathrooms
Size of Target Audience	Relatively small (< 10% of population) Moderate (between 10% to 35% of population) Large (between 35% to 50% of population) Very large (50% or more of the population)



AwwaRF Utility Partner Interview Protocol

Exhibit II: Keywords for Characteristics

Characteristic	Keywords	
Family Factors	Number of people in household Number of infants Number of children between 5 and 18	
Message(s)	Water conservation Effective strategies Consumer benefits Save money Help the environment Drought Water ordinance changes	
Media Channel	**Print/Outdoor** Magazines Newspapers Billboards Bill Inserts **Online/Interactive** Web Emails CD-ROMs	**Direct Outreach** Workshops Community groups Faith-based groups Schools **Point-of-Sale** Retail display **Broadcast** Television Radio Video
Demonstration Projects	Project characteristics Project logic model Project inputs Project activities Project outputs and outcomes	
Type of Outreach Materials	Brochures Kids coloring books School curriculum Giveaways such as branded pens, pencils, magnets, etc. Other, such as door hangers, flyers, etc.	
Financial Incentives	Rebate purchase programs Block rate structure Giveaways of free items (e.g., toilets, faucets, etc)	
Outcome	Programs or characteristics that have been shown not to be successful Programs that show promise Programs that have been shown to be successful	
Estimated Cost	Total campaign cost Unit cost (per resident reached or per unit water conserved)	

APPENDIX B:
SURVEY INSTRUMENTS

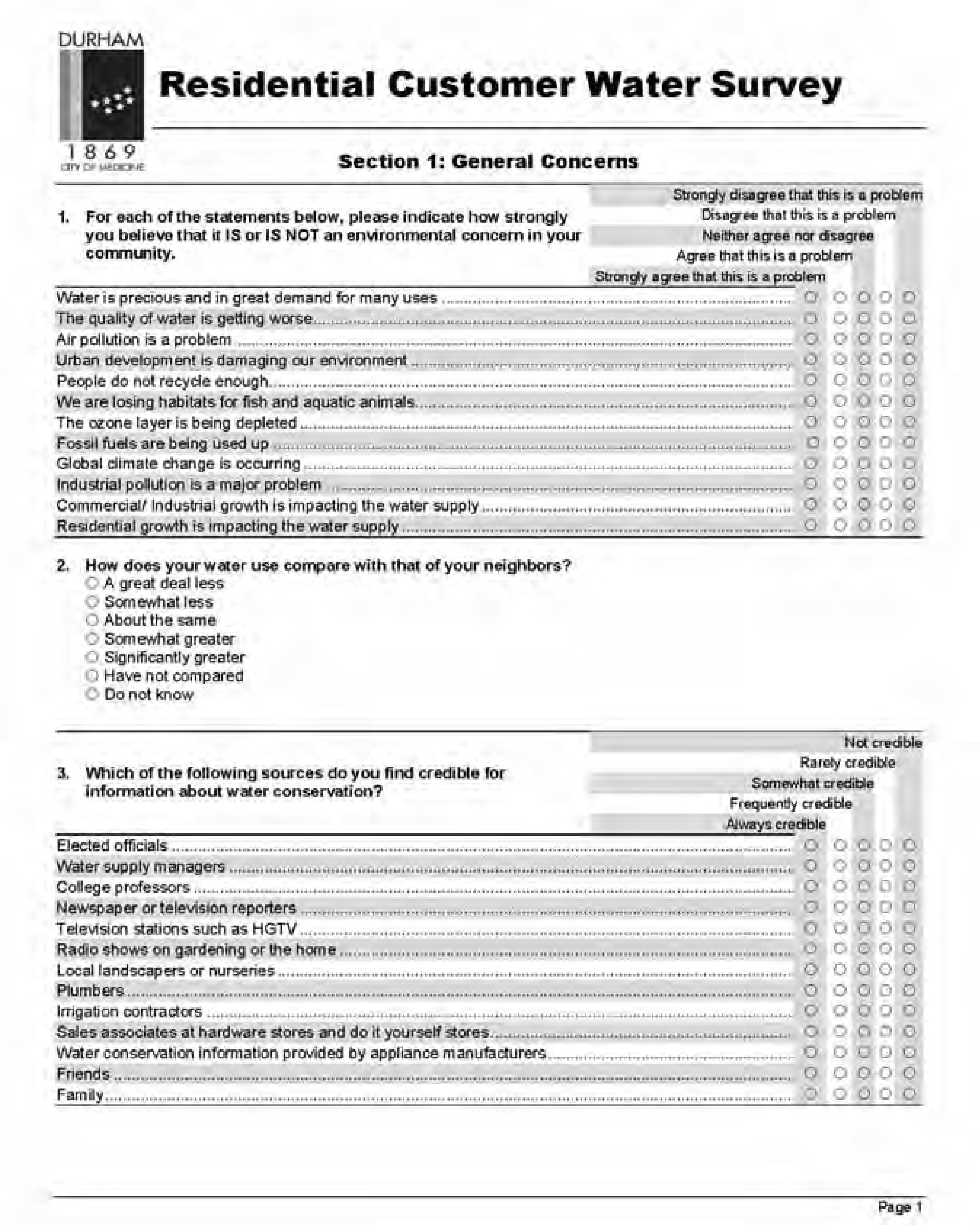
This appendix presents the survey instruments that we used for each water utility. The survey instrument was designed to be consistent with the water utilities current communications campaign. However, the Section 2 is specific to the messages within each water utility. The survey instrument consists of six sections:

- Section 1: General Concerns – seeks to understand the respondent's priority for water conservation compared with other environmental issues.
- Section 2: Water Utility Messages – addresses how respondents received (e.g., via network TV, web site, water bill insert) information about water conservation.
- Section 3: Your Attitudes on Water Conservation - assesses respondents' attitudes concerning water conservation in their communities.
- Section 4: Your Preferred Method of Getting Information – addresses from whom respondents prefer to receive information about water conservation.
- Section 5: About You and Your Household - gathers demographic data that may correlate to water use behavior and attitudes.
- Section 6: Your Additional Comments - provides an opportunity for respondents to add comments.

The following sections present the survey instruments for our water utility partners:

- City of Durham Department of Water Management
- City of Phoenix Water Services Department
- City of Tempe Water Utilities Department
- JEA – Jacksonville, FL
- Orange County Utilities Water Division
- Seattle Public Utilities

CITY OF DURHAM DEPARTMENT OF WATER MANAGEMENT



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Residential Customer Water Survey

Section 1: General Concerns

1. For each of the statements below, please indicate how strongly you believe that it IS or IS NOT an environmental concern in your community.

	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem
Water is precious and in great demand for many uses	○	○	○	○	○
The quality of water is getting worse	○	○	○	○	○
Air pollution is a problem	○	○	○	○	○
Urban development is damaging our environment	○	○	○	○	○
People do not recycle enough	○	○	○	○	○
We are losing habitats for fish and aquatic animals	○	○	○	○	○
The ozone layer is being depleted	○	○	○	○	○
Fossil fuels are being used up	○	○	○	○	○
Global climate change is occurring	○	○	○	○	○
Industrial pollution is a major problem	○	○	○	○	○
Commercial/ Industrial growth is impacting the water supply	○	○	○	○	○
Residential growth is impacting the water supply	○	○	○	○	○

2. How does your water use compare with that of your neighbors?

○ A great deal less
○ Somewhat less
○ About the same
○ Somewhat greater
○ Significantly greater
○ Have not compared
○ Do not know

3. Which of the following sources do you find credible for information about water conservation?

	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible
Elected officials	○	○	○	○	○
Water supply managers	○	○	○	○	○
College professors	○	○	○	○	○
Newspaper or television reporters	○	○	○	○	○
Television stations such as HGTV	○	○	○	○	○
Radio shows on gardening or the home	○	○	○	○	○
Local landscapers or nurseries	○	○	○	○	○
Plumbers	○	○	○	○	○
Irrigation contractors	○	○	○	○	○
Sales associates at hardware stores and do it yourself stores	○	○	○	○	○
Water conservation information provided by appliance manufacturers	○	○	○	○	○
Friends	○	○	○	○	○
Family	○	○	○	○	○

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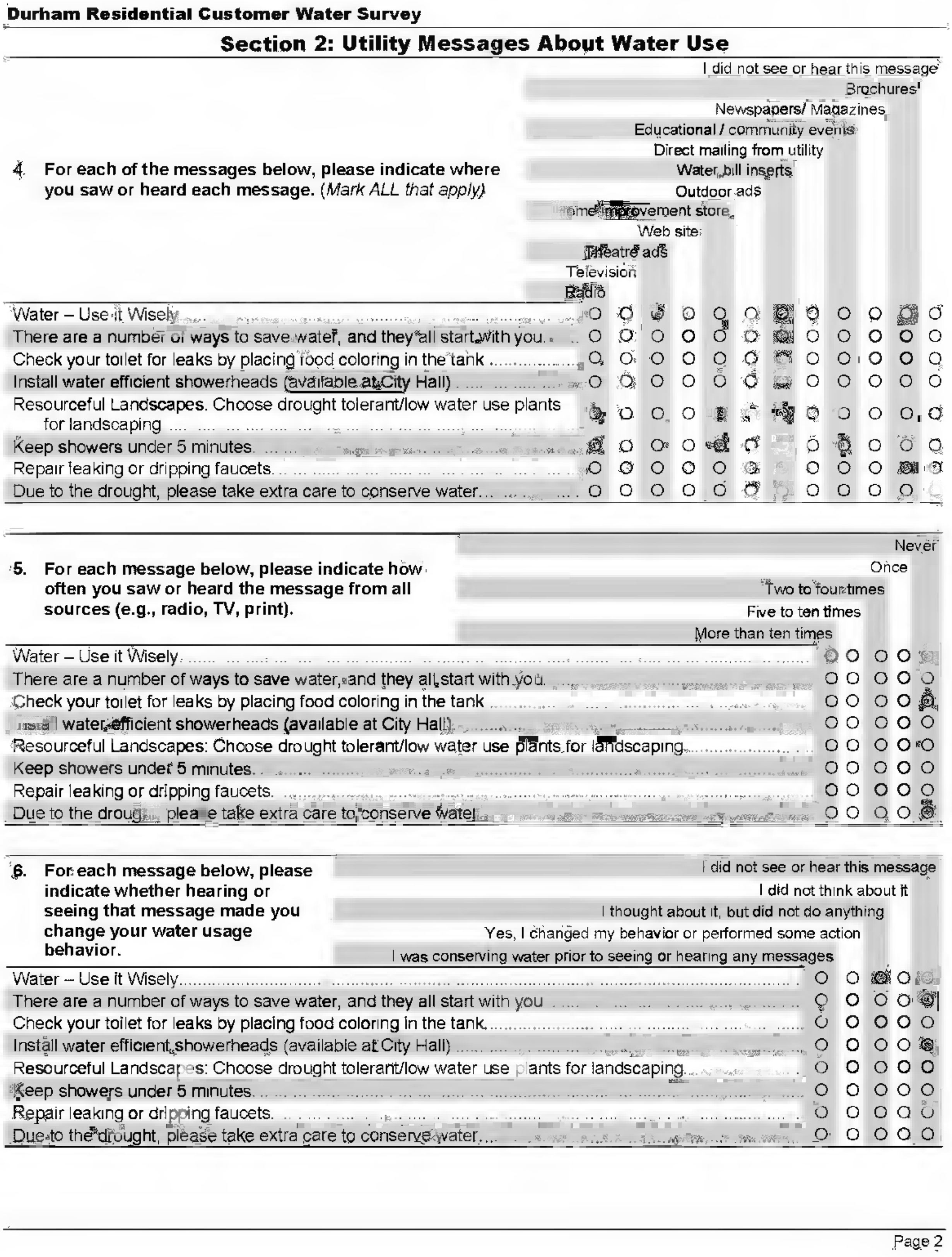

Durham Residential Customer Water Survey

Section 2: Utility Messages About Water Use

4. **For each of the messages below, please indicate where you saw or heard each message.** (*Mark ALL that apply*)

	Radio	Television	Theatre ads	Web site	Home improvement store	Outdoor ads	Water bill inserts	Direct mailing from utility	Educational / community events	Newspapers/ Magazines	Brochures	I did not see or hear this message
Water – Use it Wisely	○	○	○	○	○	○	○	○	○	○	○	○
There are a number of ways to save water, and they all start with you.	○	○	○	○	○	○	○	○	○	○	○	○
Check your toilet for leaks by placing food coloring in the tank	○	○	○	○	○	○	○	○	○	○	○	○
Install water efficient showerheads (available at City Hall)	○	○	○	○	○	○	○	○	○	○	○	○
Resourceful Landscapes. Choose drought tolerant/low water use plants for landscaping	○	○	○	○	○	○	○	○	○	○	○	○
Keep showers under 5 minutes.	○	○	○	○	○	○	○	○	○	○	○	○
Repair leaking or dripping faucets.	○	○	○	○	○	○	○	○	○	○	○	○
Due to the drought, please take extra care to conserve water	○	○	○	○	○	○	○	○	○	○	○	○

5. **For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).**

	More than ten times	Five to ten times	Two to four times	Once	Never
Water – Use it Wisely	○	○	○	○	○
There are a number of ways to save water, and they all start with you.	○	○	○	○	○
Check your toilet for leaks by placing food coloring in the tank	○	○	○	○	○
Install water efficient showerheads (available at City Hall)	○	○	○	○	○
Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping	○	○	○	○	○
Keep showers under 5 minutes.	○	○	○	○	○
Repair leaking or dripping faucets.	○	○	○	○	○
Due to the drought, please take extra care to conserve water	○	○	○	○	○

6. **For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.**

	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message
Water – Use it Wisely	○	○	○	○	○
There are a number of ways to save water, and they all start with you	○	○	○	○	○
Check your toilet for leaks by placing food coloring in the tank	○	○	○	○	○
Install water efficient showerheads (available at City Hall)	○	○	○	○	○
Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping	○	○	○	○	○
Keep showers under 5 minutes.	○	○	○	○	○
Repair leaking or dripping faucets.	○	○	○	○	○
Due to the drought, please take extra care to conserve water	○	○	○	○	○

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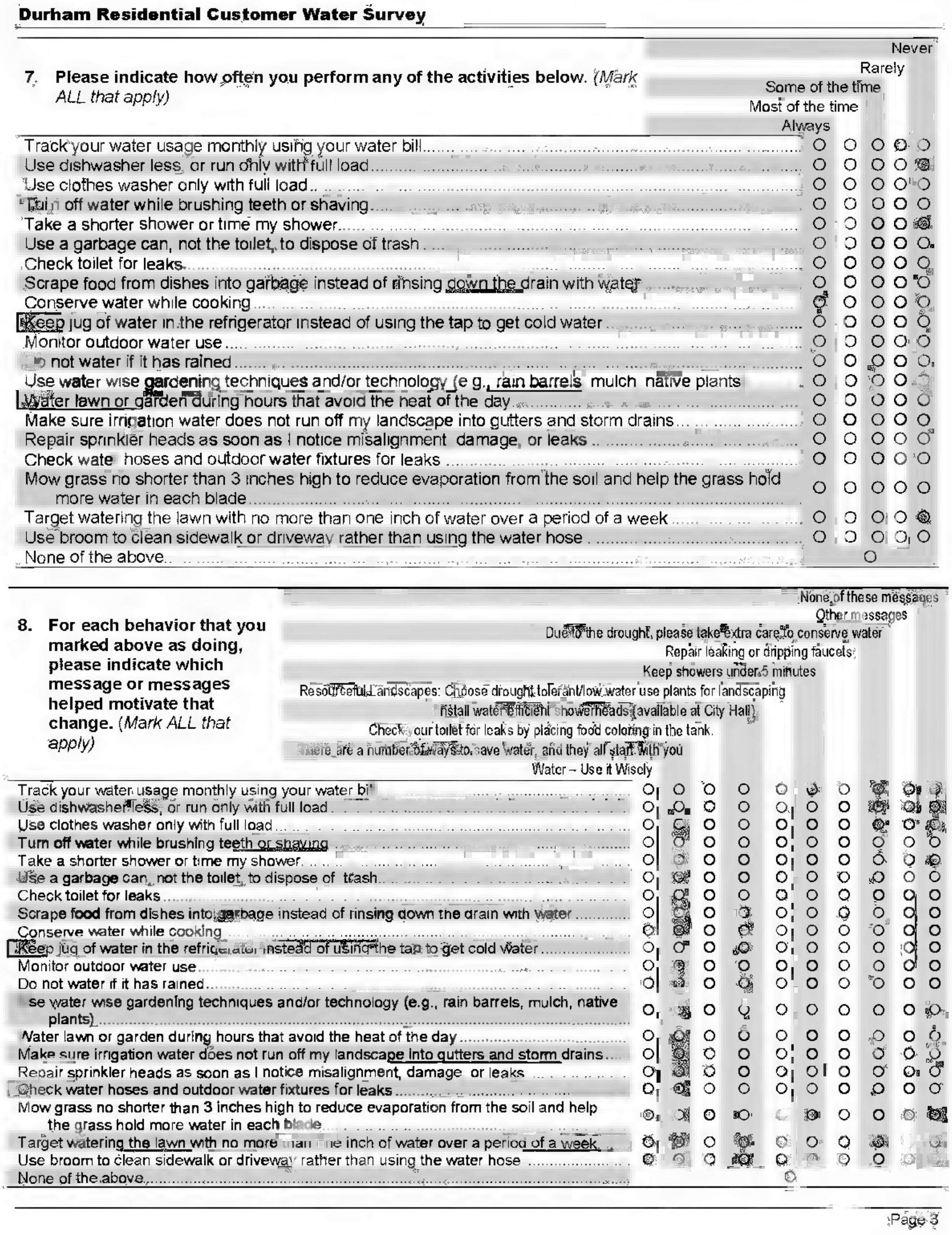

Durham Residential Customer Water Survey

7. Please indicate how often you perform any of the activities below. *(Mark ALL that apply)*

	Always	Most of the time	Some of the time	Rarely	Never
Track your water usage monthly using your water bill	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○
None of the above			○		

8. For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change. (*Mark ALL that apply)*

	Water – Use it Wisely	There are a number of ways to save water, and they all start with you	Check your toilet for leaks by placing food coloring in the tank.	Install water efficient showerheads (available at City Hall)	Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping	Keep showers under 5 minutes	Repair leaking or dripping faucets	Due to the drought, please take extra care to conserve water	Other messages	None of these messages
Track your water usage monthly using your water bill	○	○	○	○	○	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○	○	○	○	○	○
None of the above					○					

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Durham Residential Customer Water Survey

9. Please indicate whether you performed any of the following actions during the past year. *(Mark ALL that apply)*

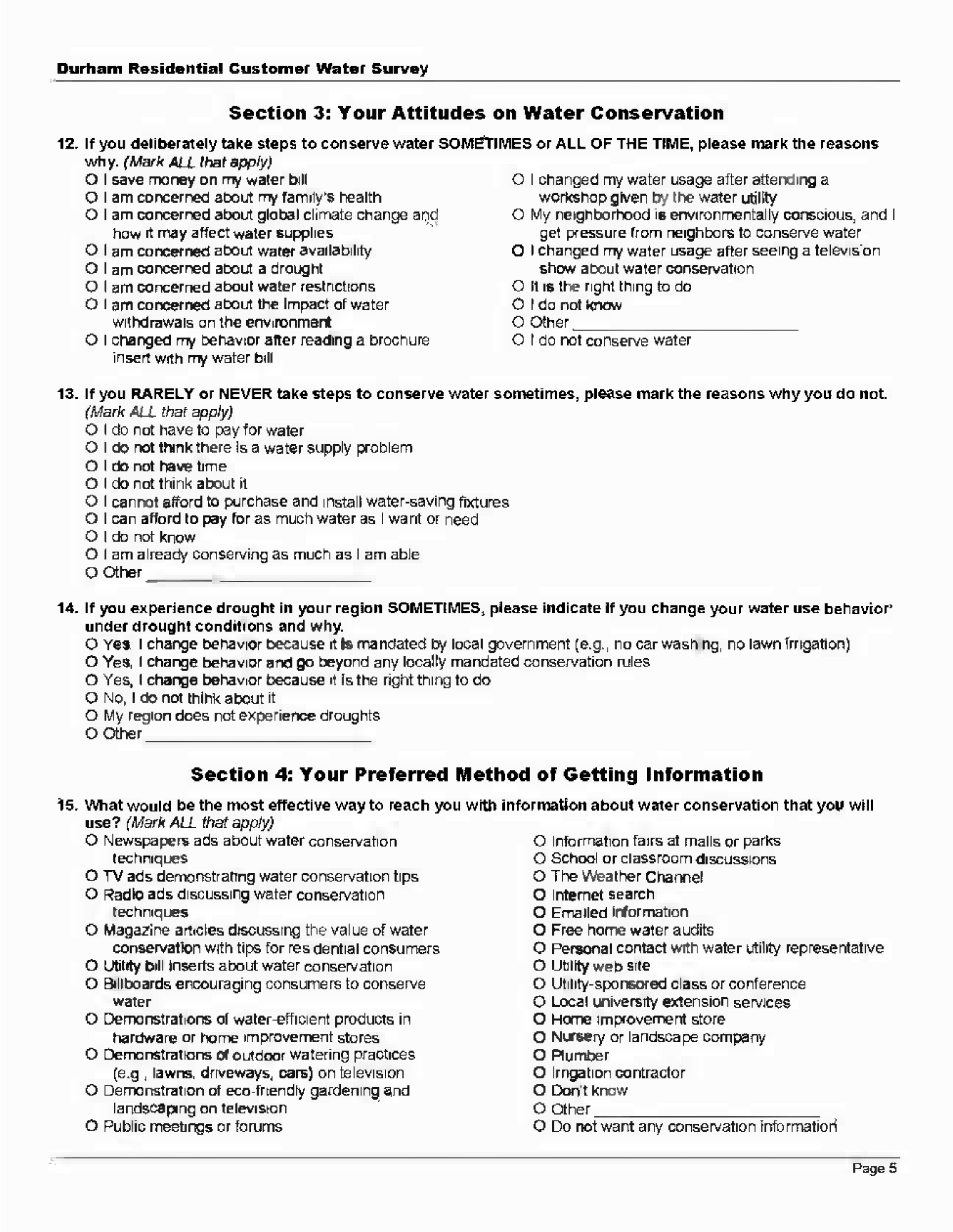
○ Installed water-efficient dishwasher
○ Installed water-efficient clothes washer
○ Installed water-saving faucets or water-saving aerators on existing faucets
○ Installed water-saving shower heads
○ Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters
○ Repaired leaking faucets and/ or toilets
○ Insulated hot water pipes
○ Checked humidifier for leaks
○ Planted alternative ground covers/trees/shrubs to replace grass
○ Purchased soaker hoses for outside watering
○ Purchased water-saving hose nozzles
○ Changed lawn watering schedule
○ Installed irrigation controller with a rain sensor
○ Replaced irrigation controller with one that contains a rain sensor
○ Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.
○ Planted more trees to shade the landscape and reduce evaporation
○ Stopped watering some or all of an existing lawn
○ None of the above

10. For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action. (*Mark ALL that apply*)

	Water – Use it Wisely	There are a number of ways to save water, and they all start with You	Check your toilet for leaks by placing food coloring in the tank.	Install water efficient showerheads (available at City Hall)	Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping	Keep showers under 5 minutes	Repair leaking or dripping faucets	Due to the drought, please take extra care to conserve water	Other messages	None of these messages
Installed water-efficient dishwasher	○	○	○	○	○	○	○	○	○	○
Installed water-efficient clothes washer	○	○	○	○	○	○	○	○	○	○
Installed water-saving faucets or water-saving aerators on existing faucets	○	○	○	○	○	○	○	○	○	○
Installed water-saving shower heads	○	○	○	○	○	○	○	○	○	○
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	○	○	○	○	○	○	○	○	○	○
Repaired leaking faucets and/or toilets	○	○	○	○	○	○	○	○	○	○
Insulated hot water pipes	○	○	○	○	○	○	○	○	○	○
Checked humidifier for leaks	○	○	○	○	○	○	○	○	○	○
Planted alternative ground covers/trees/shrubs to replace grass	○	○	○	○	○	○	○	○	○	○
Purchased soaker hoses for outside watering	○	○	○	○	○	○	○	○	○	○
Purchased water-saving hose nozzles	○	○	○	○	○	○	○	○	○	○
Changed lawn watering schedule	○	○	○	○	○	○	○	○	○	○
Installed irrigation controller with a rain sensor										
Replaced irrigation controller with one that contains a rain sensor	○	○	○	○	○	○	○	○	○	○
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	○	○	○	○	○	○	○	○	○	○
Planted more trees to shade the landscape and reduce evaporation	○	○	○	○	○	○	○	○	○	○
Stopped watering some or all of an existing lawn	○	○	○	○	○	○	○	○	○	○
None of the above						○				

11. Have you ever participated in a utility-sponsored rebate program promoting efficient water use?

○ Yes, I have
○ The utility offered it, but I did not participate
○ The utility never offered one, but I would have participated if it did
○ The utility never offered one, but I would not have participated anyway



Section 3: Your Attitudes on Water Conservation

12. If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why. *(Mark ALL that apply)*

○ I save money on my water bill
○ I am concerned about my family's health
○ I am concerned about global climate change and how it may affect water supplies
○ I am concerned about water availability
○ I am concerned about a drought
○ I am concerned about water restrictions
○ I am concerned about the Impact of water withdrawals on the environment
○ I changed my behavior after reading a brochure insert with my water bill
○ I changed my water usage after attending a workshop given by the water utility
○ My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water
○ I changed my water usage after seeing a television show about water conservation
○ It is the right thing to do
○ I do not know
○ Other ________________________
○ I do not conserve water

13. If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not. *(Mark ALL that apply)*

○ I do not have to pay for water
○ I do not think there is a water supply problem
○ I do not have time
○ I do not think about it
○ I cannot afford to purchase and install water-saving fixtures
○ I can afford to pay for as much water as I want or need
○ I do not know
○ I am already conserving as much as I am able
○ Other ________________________

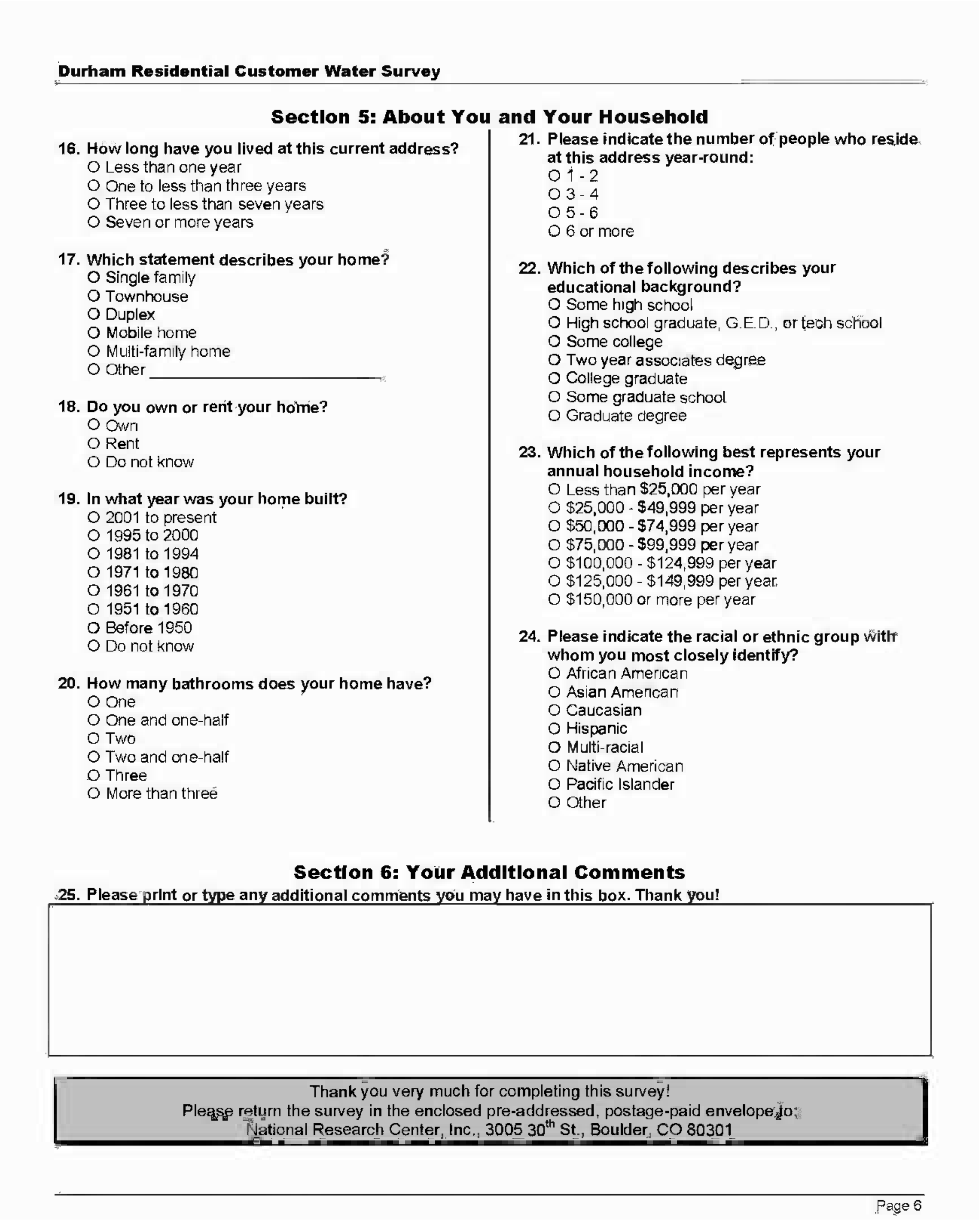
14. If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.

○ Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)
○ Yes, I change behavior and go beyond any locally mandated conservation rules
○ Yes, I change behavior because it is the right thing to do
○ No, I do not think about it
○ My region does not experience droughts
○ Other ________________________

Section 4: Your Preferred Method of Getting Information

15. What would be the most effective way to reach you with information about water conservation that you will use? *(Mark ALL that apply)*

○ Newspapers ads about water conservation techniques
○ TV ads demonstrating water conservation tips
○ Radio ads discussing water conservation techniques
○ Magazine articles discussing the value of water conservation with tips for residential consumers
○ Utility bill inserts about water conservation
○ Billboards encouraging consumers to conserve water
○ Demonstrations of water-efficient products in hardware or home improvement stores
○ Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television
○ Demonstration of eco-friendly gardening and landscaping on television
○ Public meetings or forums
○ Information fairs at malls or parks
○ School or classroom discussions
○ The Weather Channel
○ Internet search
○ Emailed information
○ Free home water audits
○ Personal contact with water utility representative
○ Utility web site
○ Utility-sponsored class or conference
○ Local university extension services
○ Home improvement store
○ Nursery or landscape company
○ Plumber
○ Irrigation contractor
○ Don't know
○ Other ________________________
○ Do not want any conservation information



Section 5: About You and Your Household

16. How long have you lived at this current address?
- ○ Less than one year
- ○ One to less than three years
- ○ Three to less than seven years
- ○ Seven or more years

17. Which statement describes your home?
- ○ Single family
- ○ Townhouse
- ○ Duplex
- ○ Mobile home
- ○ Multi-family home
- ○ Other ______________________

18. Do you own or rent your home?
- ○ Own
- ○ Rent
- ○ Do not know

19. In what year was your home built?
- ○ 2001 to present
- ○ 1995 to 2000
- ○ 1981 to 1994
- ○ 1971 to 1980
- ○ 1961 to 1970
- ○ 1951 to 1960
- ○ Before 1950
- ○ Do not know

20. How many bathrooms does your home have?
- ○ One
- ○ One and one-half
- ○ Two
- ○ Two and one-half
- ○ Three
- ○ More than three

21. Please indicate the number of people who reside at this address year-round:
- ○ 1 - 2
- ○ 3 - 4
- ○ 5 - 6
- ○ 6 or more

22. Which of the following describes your educational background?
- ○ Some high school
- ○ High school graduate, G.E.D., or tech school
- ○ Some college
- ○ Two year associates degree
- ○ College graduate
- ○ Some graduate school
- ○ Graduate degree

23. Which of the following best represents your annual household income?
- ○ Less than $25,000 per year
- ○ $25,000 - $49,999 per year
- ○ $50,000 - $74,999 per year
- ○ $75,000 - $99,999 per year
- ○ $100,000 - $124,999 per year
- ○ $125,000 - $149,999 per year
- ○ $150,000 or more per year

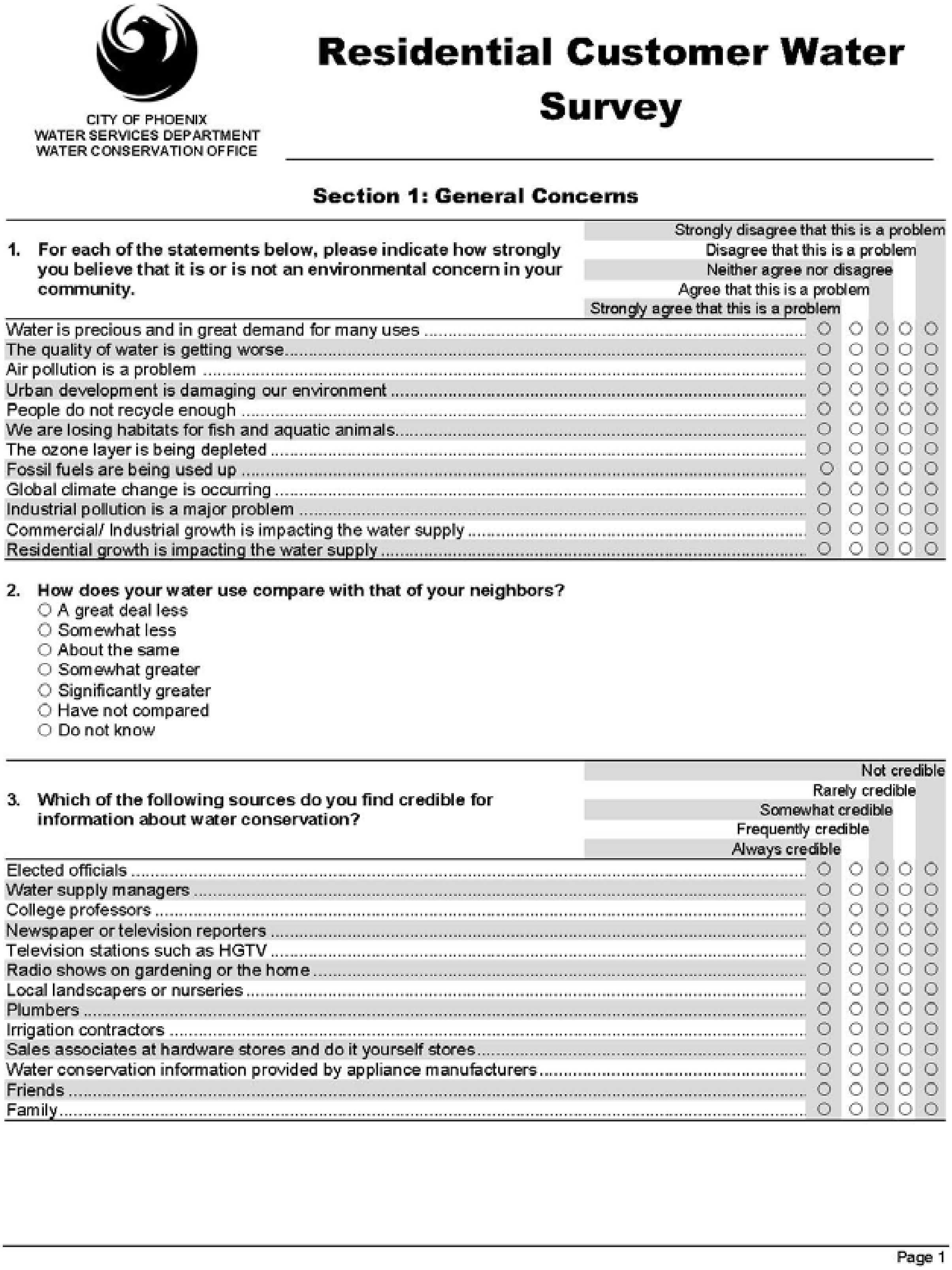
24. Please indicate the racial or ethnic group with whom you most closely identify?
- ○ African American
- ○ Asian American
- ○ Caucasian
- ○ Hispanic
- ○ Multi-racial
- ○ Native American
- ○ Pacific Islander
- ○ Other

Section 6: Your Additional Comments

25. Please print or type any additional comments you may have in this box. Thank you!

Thank you very much for completing this survey!
Please return the survey in the enclosed pre-addressed, postage-paid envelope to:
National Research Center, Inc., 3005 30th St., Boulder, CO 80301

CITY OF PHOENIX WATER SERVICE DEPARTMENT



CITY OF PHOENIX
WATER SERVICES DEPARTMENT
WATER CONSERVATION OFFICE

Residential Customer Water Survey

Section 1: General Concerns

1. For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.

	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem
Water is precious and in great demand for many uses	○	○	○	○	○
The quality of water is getting worse	○	○	○	○	○
Air pollution is a problem	○	○	○	○	○
Urban development is damaging our environment	○	○	○	○	○
People do not recycle enough	○	○	○	○	○
We are losing habitats for fish and aquatic animals	○	○	○	○	○
The ozone layer is being depleted	○	○	○	○	○
Fossil fuels are being used up	○	○	○	○	○
Global climate change is occurring	○	○	○	○	○
Industrial pollution is a major problem	○	○	○	○	○
Commercial/ Industrial growth is impacting the water supply	○	○	○	○	○
Residential growth is impacting the water supply	○	○	○	○	○

2. How does your water use compare with that of your neighbors?

○ A great deal less
○ Somewhat less
○ About the same
○ Somewhat greater
○ Significantly greater
○ Have not compared
○ Do not know

3. Which of the following sources do you find credible for information about water conservation?

	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible
Elected officials	○	○	○	○	○
Water supply managers	○	○	○	○	○
College professors	○	○	○	○	○
Newspaper or television reporters	○	○	○	○	○
Television stations such as HGTV	○	○	○	○	○
Radio shows on gardening or the home	○	○	○	○	○
Local landscapers or nurseries	○	○	○	○	○
Plumbers	○	○	○	○	○
Irrigation contractors	○	○	○	○	○
Sales associates at hardware stores and do it yourself stores	○	○	○	○	○
Water conservation information provided by appliance manufacturers	○	○	○	○	○
Friends	○	○	○	○	○
Family	○	○	○	○	○

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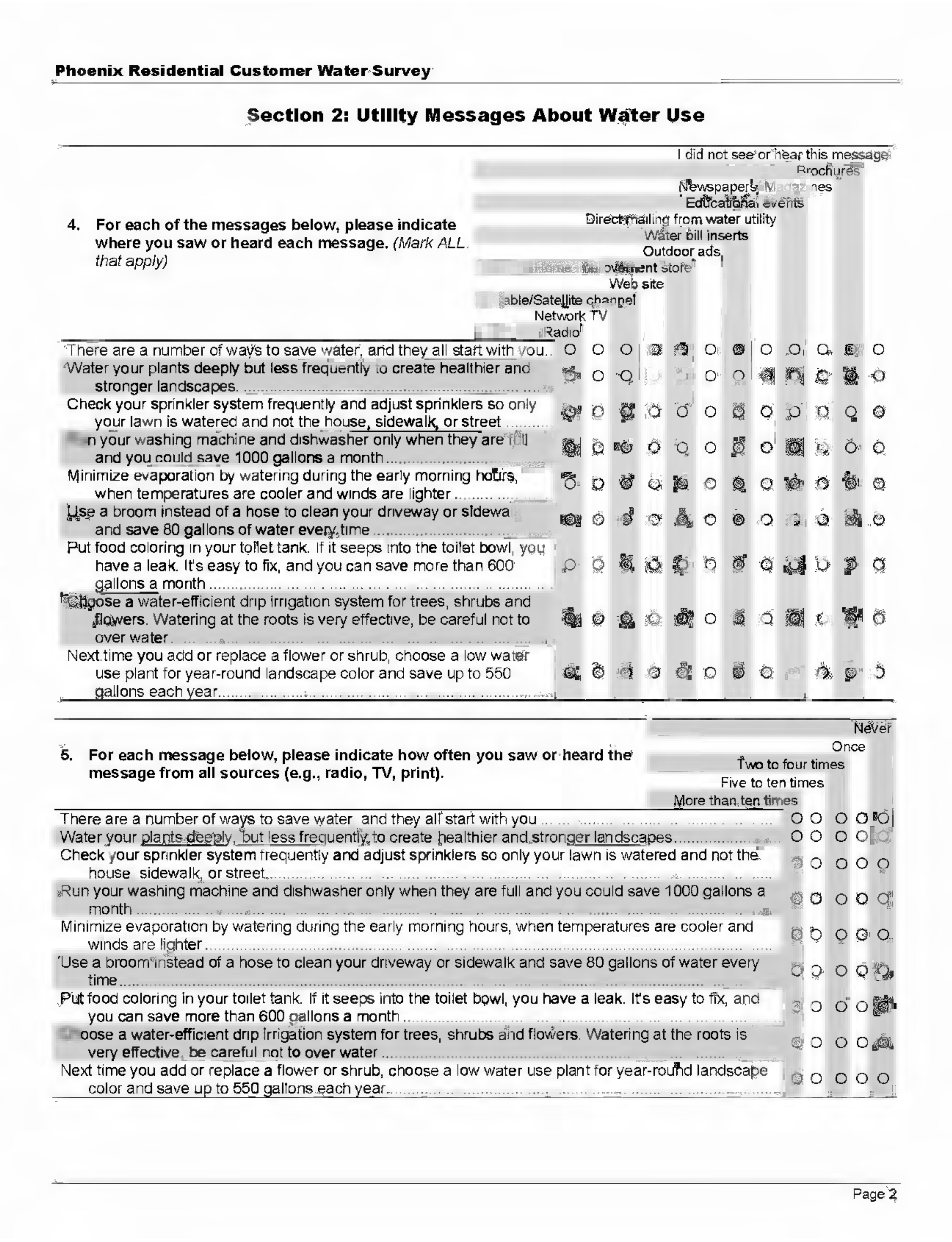

Phoenix Residential Customer Water Survey

Section 2: Utility Messages About Water Use

4. For each of the messages below, please indicate where you saw or heard each message. *(Mark ALL that apply)*

	Radio	Network TV	Cable/Satellite channel	Web site	Home improvement store	Outdoor ads	Water bill inserts	Direct mailing from water utility	Educational events	Newspapers/Magazines	Brochures	I did not see or hear this message
There are a number of ways to save water, and they all start with you	○	○	○	○	○	○	○	○	○	○	○	○
Water your plants deeply but less frequently to create healthier and stronger landscapes	○	○	○	○	○	○	○	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	○	○	○	○	○	○	○	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	○	○	○	○	○	○	○	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	○	○	○	○	○	○	○	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	○	○	○	○	○	○	○	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	○	○	○	○	○	○	○	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	○	○	○	○	○	○	○	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	○	○	○	○	○	○	○	○	○	○	○	○

5. For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).

	More than ten times	Five to ten times	Two to four times	Once	Never
There are a number of ways to save water and they all start with you	○	○	○	○	○
Water your plants deeply, but less frequently to create healthier and stronger landscapes	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house sidewalk, or street	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	○	○	○	○	○

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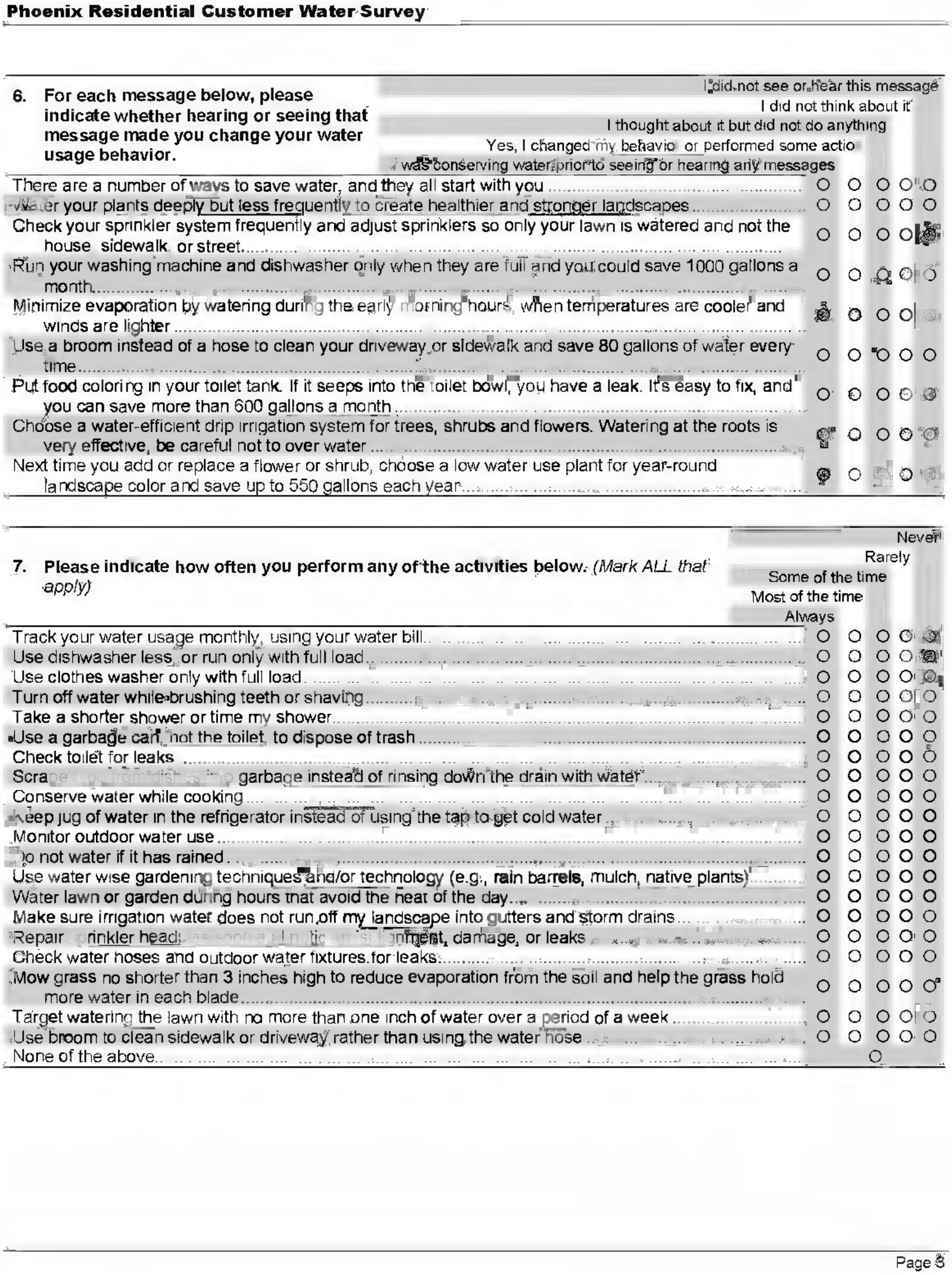

Phoenix Residential Customer Water Survey

6. For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.

	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it but did not do anything	I did not think about it	I did not see or hear this message
There are a number of ways to save water, and they all start with you	○	○	○	○	○
Water your plants deeply but less frequently to create healthier and stronger landscapes	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	○	○	○	○	○

7. Please indicate how often you perform any of the activities below. *(Mark ALL that apply)*

	Always	Most of the time	Some of the time	Rarely	Never
Track your water usage monthly, using your water bill	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○
None of the above			○		

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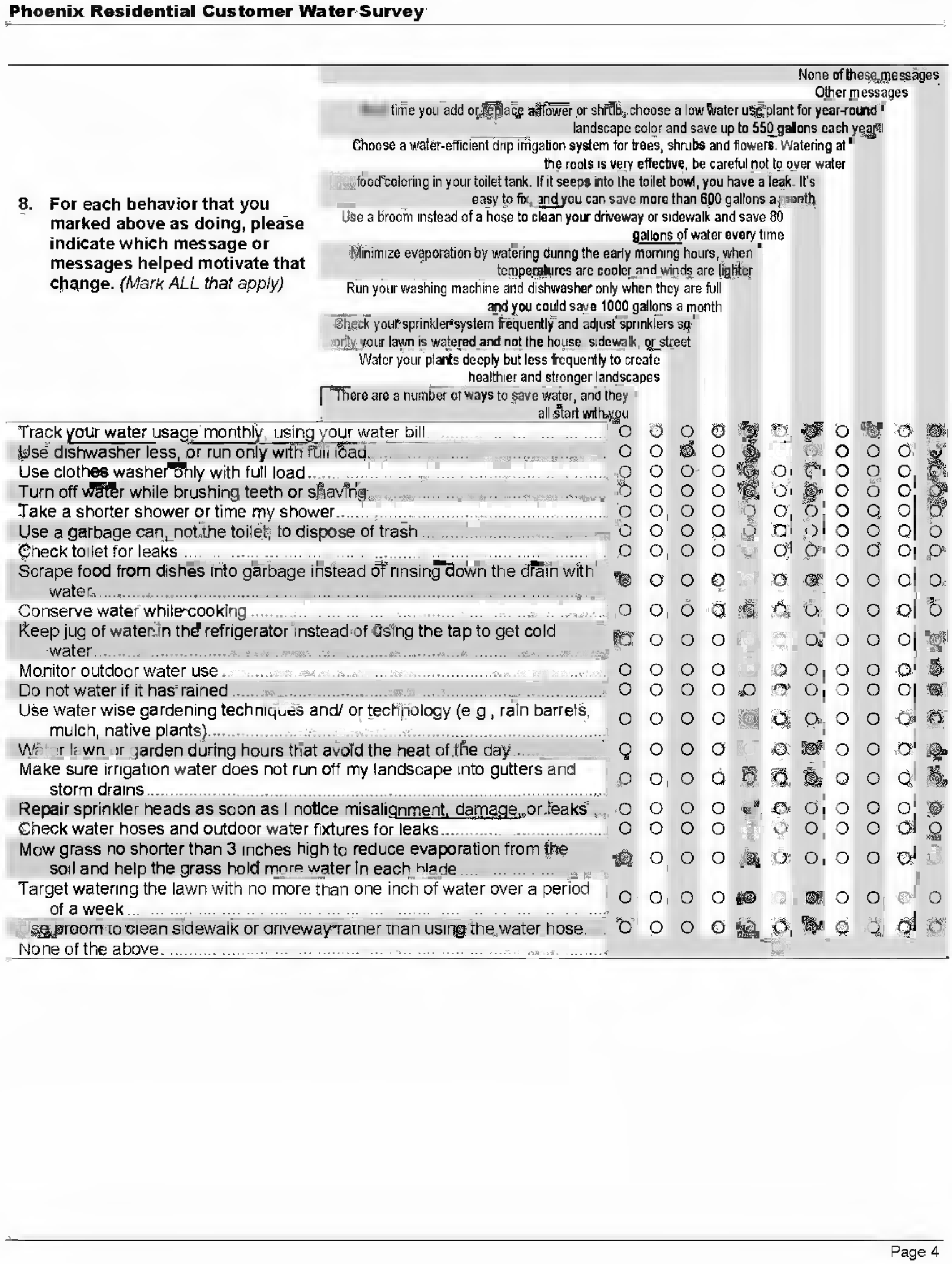

Phoenix Residential Customer Water Survey

8. **For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change.** *(Mark ALL that apply)*

	There are a number of ways to save water, and they all start with you	Water your plants deeply but less frequently to create healthier and stronger landscapes	Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	Other messages	None of these messages
Track your water usage monthly, using your water bill	○	○	○	○	○	○	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○	○	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○	○	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○	○	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○	○	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○	○	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○	○	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○	○	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○	○	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○	○	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○	○	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○	○	○	○	○	○	○
Use water wise gardening techniques and/ or technology (e g , rain barrels, mulch, native plants)	○	○	○	○	○	○	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○	○	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○	○	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○	○	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○	○	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○	○	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○	○	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○	○	○	○	○	○	○
None of the above											

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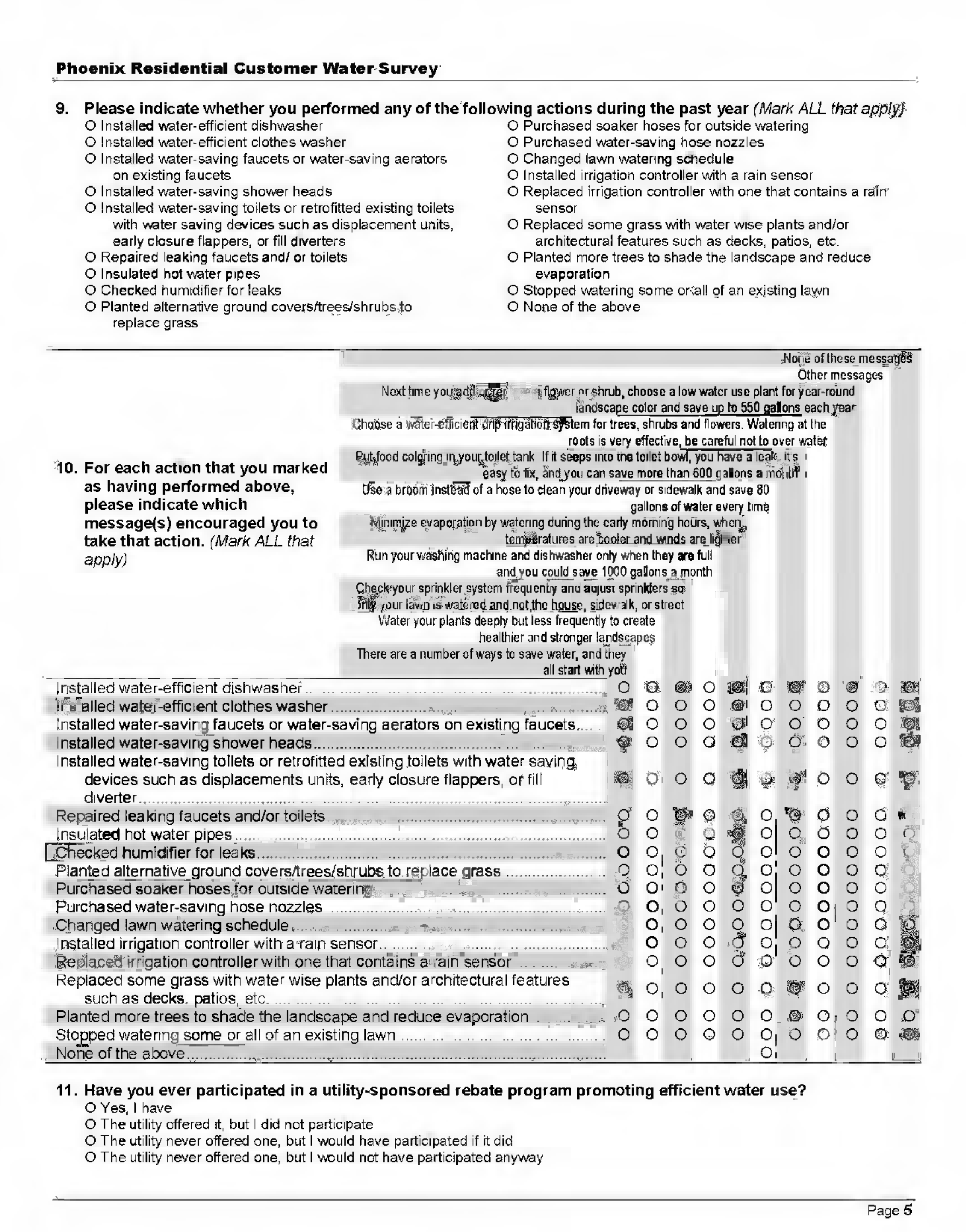

Phoenix Residential Customer Water Survey

9. Please indicate whether you performed any of the following actions during the past year *(Mark ALL that apply)*

○ Installed water-efficient dishwasher
○ Installed water-efficient clothes washer
○ Installed water-saving faucets or water-saving aerators on existing faucets
○ Installed water-saving shower heads
○ Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters
○ Repaired leaking faucets and/ or toilets
○ Insulated hot water pipes
○ Checked humidifier for leaks
○ Planted alternative ground covers/trees/shrubs to replace grass
○ Purchased soaker hoses for outside watering
○ Purchased water-saving hose nozzles
○ Changed lawn watering schedule
○ Installed irrigation controller with a rain sensor
○ Replaced irrigation controller with one that contains a rain sensor
○ Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.
○ Planted more trees to shade the landscape and reduce evaporation
○ Stopped watering some or all of an existing lawn
○ None of the above

10. For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action. *(Mark ALL that apply)*

	There are a number of ways to save water, and they all start with you	Water your plants deeply but less frequently to create healthier and stronger landscapes	Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	Next time you add a [illegible] flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	Other messages	None of these messages
Installed water-efficient dishwasher	○	○	○	○	○	○	○	○	○	○	○
Installed water-efficient clothes washer	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving faucets or water-saving aerators on existing faucets	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving shower heads	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	○	○	○	○	○	○	○	○	○	○	○
Repaired leaking faucets and/or toilets	○	○	○	○	○	○	○	○	○	○	○
Insulated hot water pipes	○	○	○	○	○	○	○	○	○	○	○
Checked humidifier for leaks	○	○	○	○	○	○	○	○	○	○	○
Planted alternative ground covers/trees/shrubs to replace grass	○	○	○	○	○	○	○	○	○	○	○
Purchased soaker hoses for outside watering	○	○	○	○	○	○	○	○	○	○	○
Purchased water-saving hose nozzles	○	○	○	○	○	○	○	○	○	○	○
Changed lawn watering schedule	○	○	○	○	○	○	○	○	○	○	○
Installed irrigation controller with a rain sensor	○	○	○	○	○	○	○	○	○	○	○
Replaced irrigation controller with one that contains a rain sensor	○	○	○	○	○	○	○	○	○	○	○
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	○	○	○	○	○	○	○	○	○	○	○
Planted more trees to shade the landscape and reduce evaporation	○	○	○	○	○	○	○	○	○	○	○
Stopped watering some or all of an existing lawn	○	○	○	○	○	○	○	○	○	○	○
None of the above						○					

11. Have you ever participated in a utility-sponsored rebate program promoting efficient water use?

○ Yes, I have
○ The utility offered it, but I did not participate
○ The utility never offered one, but I would have participated if it did
○ The utility never offered one, but I would not have participated anyway

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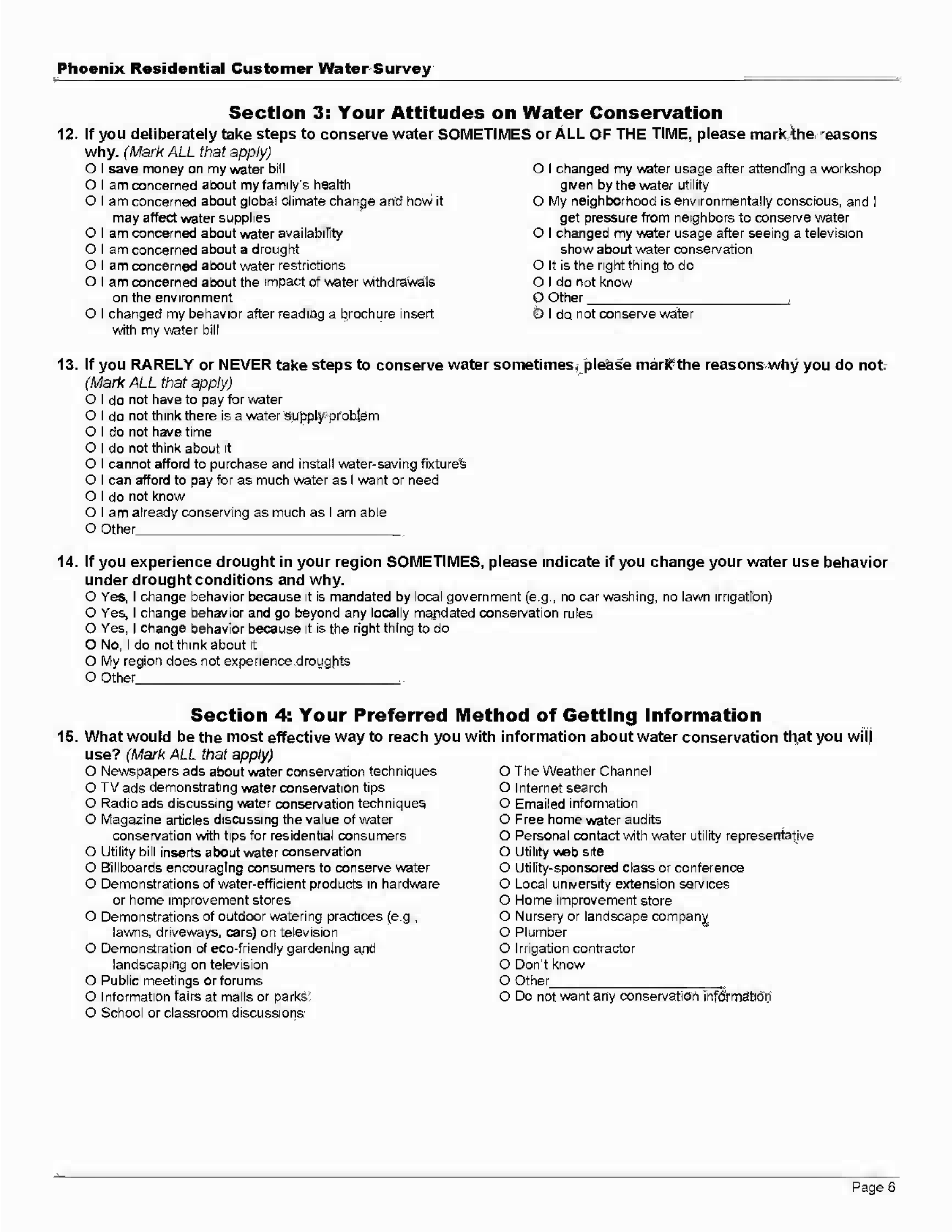

Phoenix Residential Customer Water Survey

Section 3: Your Attitudes on Water Conservation

12. If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why. *(Mark ALL that apply)*

- ○ I save money on my water bill
- ○ I am concerned about my family's health
- ○ I am concerned about global climate change and how it may affect water supplies
- ○ I am concerned about water availability
- ○ I am concerned about a drought
- ○ I am concerned about water restrictions
- ○ I am concerned about the impact of water withdrawals on the environment
- ○ I changed my behavior after reading a brochure insert with my water bill
- ○ I changed my water usage after attending a workshop given by the water utility
- ○ My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water
- ○ I changed my water usage after seeing a television show about water conservation
- ○ It is the right thing to do
- ○ I do not know
- ○ Other ____________________
- ○ I do not conserve water

13. If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not. *(Mark ALL that apply)*

- ○ I do not have to pay for water
- ○ I do not think there is a water supply problem
- ○ I do not have time
- ○ I do not think about it
- ○ I cannot afford to purchase and install water-saving fixtures
- ○ I can afford to pay for as much water as I want or need
- ○ I do not know
- ○ I am already conserving as much as I am able
- ○ Other ______________________________

14. If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.

- ○ Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)
- ○ Yes, I change behavior and go beyond any locally mandated conservation rules
- ○ Yes, I change behavior because it is the right thing to do
- ○ No, I do not think about it
- ○ My region does not experience droughts
- ○ Other ______________________________

Section 4: Your Preferred Method of Getting Information

15. What would be the most effective way to reach you with information about water conservation that you will use? *(Mark ALL that apply)*

- ○ Newspapers ads about water conservation techniques
- ○ TV ads demonstrating water conservation tips
- ○ Radio ads discussing water conservation techniques
- ○ Magazine articles discussing the value of water conservation with tips for residential consumers
- ○ Utility bill inserts about water conservation
- ○ Billboards encouraging consumers to conserve water
- ○ Demonstrations of water-efficient products in hardware or home improvement stores
- ○ Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television
- ○ Demonstration of eco-friendly gardening and landscaping on television
- ○ Public meetings or forums
- ○ Information fairs at malls or parks
- ○ School or classroom discussions
- ○ The Weather Channel
- ○ Internet search
- ○ Emailed information
- ○ Free home water audits
- ○ Personal contact with water utility representative
- ○ Utility web site
- ○ Utility-sponsored class or conference
- ○ Local university extension services
- ○ Home improvement store
- ○ Nursery or landscape company
- ○ Plumber
- ○ Irrigation contractor
- ○ Don't know
- ○ Other ____________________
- ○ Do not want any conservation information

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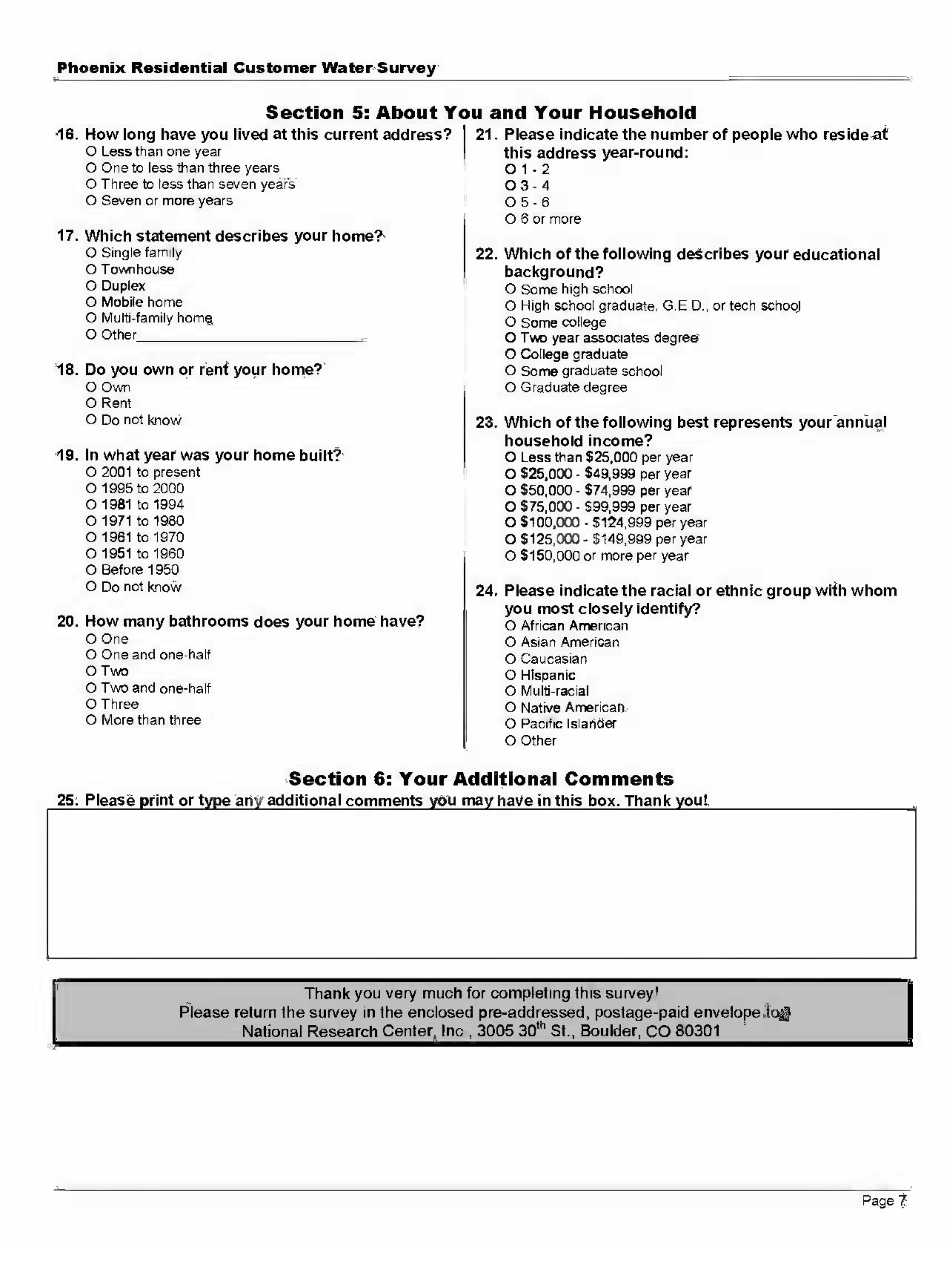


Phoenix Residential Customer Water Survey

Section 5: About You and Your Household

16. How long have you lived at this current address?
- ○ Less than one year
- ○ One to less than three years
- ○ Three to less than seven years
- ○ Seven or more years

17. Which statement describes your home?
- ○ Single family
- ○ Townhouse
- ○ Duplex
- ○ Mobile home
- ○ Multi-family home
- ○ Other________________________

18. Do you own or rent your home?
- ○ Own
- ○ Rent
- ○ Do not know

19. In what year was your home built?
- ○ 2001 to present
- ○ 1995 to 2000
- ○ 1981 to 1994
- ○ 1971 to 1980
- ○ 1961 to 1970
- ○ 1951 to 1960
- ○ Before 1950
- ○ Do not know

20. How many bathrooms does your home have?
- ○ One
- ○ One and one-half
- ○ Two
- ○ Two and one-half
- ○ Three
- ○ More than three

21. Please indicate the number of people who reside at this address year-round:
- ○ 1 - 2
- ○ 3 - 4
- ○ 5 - 6
- ○ 6 or more

22. Which of the following describes your educational background?
- ○ Some high school
- ○ High school graduate, G.E.D., or tech school
- ○ Some college
- ○ Two year associates degree
- ○ College graduate
- ○ Some graduate school
- ○ Graduate degree

23. Which of the following best represents your annual household income?
- ○ Less than $25,000 per year
- ○ $25,000 - $49,999 per year
- ○ $50,000 - $74,999 per year
- ○ $75,000 - $99,999 per year
- ○ $100,000 - $124,999 per year
- ○ $125,000 - $149,999 per year
- ○ $150,000 or more per year

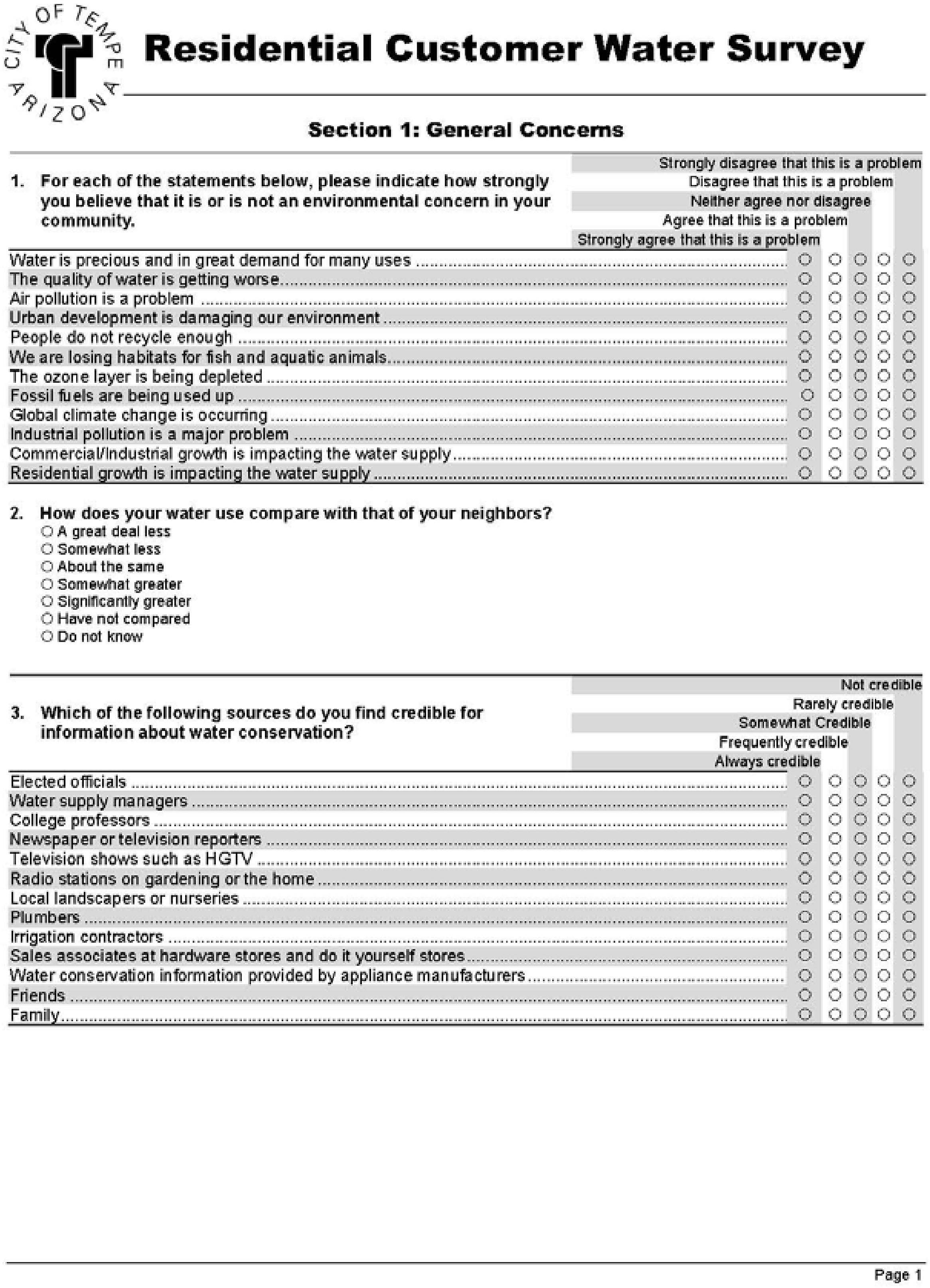
24. Please indicate the racial or ethnic group with whom you most closely identify?
- ○ African American
- ○ Asian American
- ○ Caucasian
- ○ Hispanic
- ○ Multi-racial
- ○ Native American
- ○ Pacific Islander
- ○ Other

Section 6: Your Additional Comments

25. Please print or type any additional comments you may have in this box. Thank you!

Thank you very much for completing this survey!
Please return the survey in the enclosed pre-addressed, postage-paid envelope to:
National Research Center, Inc., 3005 30th St., Boulder, CO 80301

CITY OF TEMPE WATER UTILITIES DEPARTMENT



CITY OF TEMPE ARIZONA

Residential Customer Water Survey

Section 1: General Concerns

1. **For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.**

	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem
Water is precious and in great demand for many uses	○	○	○	○	○
The quality of water is getting worse	○	○	○	○	○
Air pollution is a problem	○	○	○	○	○
Urban development is damaging our environment	○	○	○	○	○
People do not recycle enough	○	○	○	○	○
We are losing habitats for fish and aquatic animals	○	○	○	○	○
The ozone layer is being depleted	○	○	○	○	○
Fossil fuels are being used up	○	○	○	○	○
Global climate change is occurring	○	○	○	○	○
Industrial pollution is a major problem	○	○	○	○	○
Commercial/Industrial growth is impacting the water supply	○	○	○	○	○
Residential growth is impacting the water supply	○	○	○	○	○

2. **How does your water use compare with that of your neighbors?**
   - ○ A great deal less
   - ○ Somewhat less
   - ○ About the same
   - ○ Somewhat greater
   - ○ Significantly greater
   - ○ Have not compared
   - ○ Do not know

3. **Which of the following sources do you find credible for information about water conservation?**

	Always credible	Frequently credible	Somewhat Credible	Rarely credible	Not credible
Elected officials	○	○	○	○	○
Water supply managers	○	○	○	○	○
College professors	○	○	○	○	○
Newspaper or television reporters	○	○	○	○	○
Television shows such as HGTV	○	○	○	○	○
Radio stations on gardening or the home	○	○	○	○	○
Local landscapers or nurseries	○	○	○	○	○
Plumbers	○	○	○	○	○
Irrigation contractors	○	○	○	○	○
Sales associates at hardware stores and do it yourself stores	○	○	○	○	○
Water conservation information provided by appliance manufacturers	○	○	○	○	○
Friends	○	○	○	○	○
Family	○	○	○	○	○

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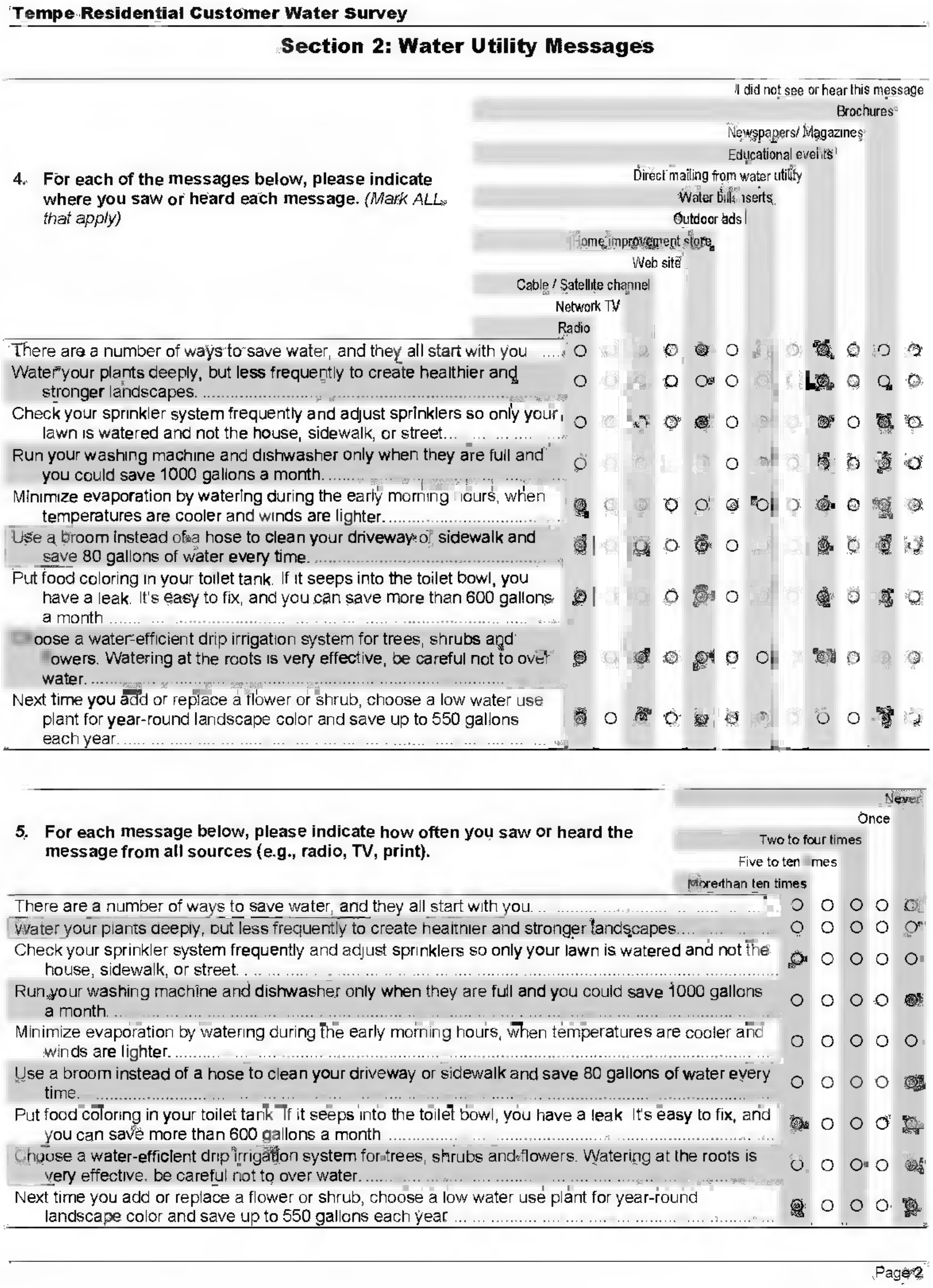

Tempe Residential Customer Water Survey

Section 2: Water Utility Messages

4. For each of the messages below, please indicate where you saw or heard each message. *(Mark ALL that apply)*

	Radio	Network TV	Cable / Satellite channel	Web site	Home improvement store	Outdoor ads	Water bill inserts	Direct mailing from water utility	Educational events	Newspapers/ Magazines	Brochures	I did not see or hear this message
There are a number of ways to save water, and they all start with you	○	○	○	○	○	○	○	○	○	○	○	○
Water your plants deeply, but less frequently to create healthier and stronger landscapes.	○	○	○	○	○	○	○	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	○	○	○	○	○	○	○	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.	○	○	○	○	○	○	○	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.	○	○	○	○	○	○	○	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.	○	○	○	○	○	○	○	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	○	○	○	○	○	○	○	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	○	○	○	○	○	○	○	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	○	○	○	○	○	○	○	○	○	○	○	○

5. For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).

	More than ten times	Five to ten times	Two to four times	Once	Never
There are a number of ways to save water, and they all start with you.	○	○	○	○	○
Water your plants deeply, but less frequently to create healthier and stronger landscapes	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	○	○	○	○	○

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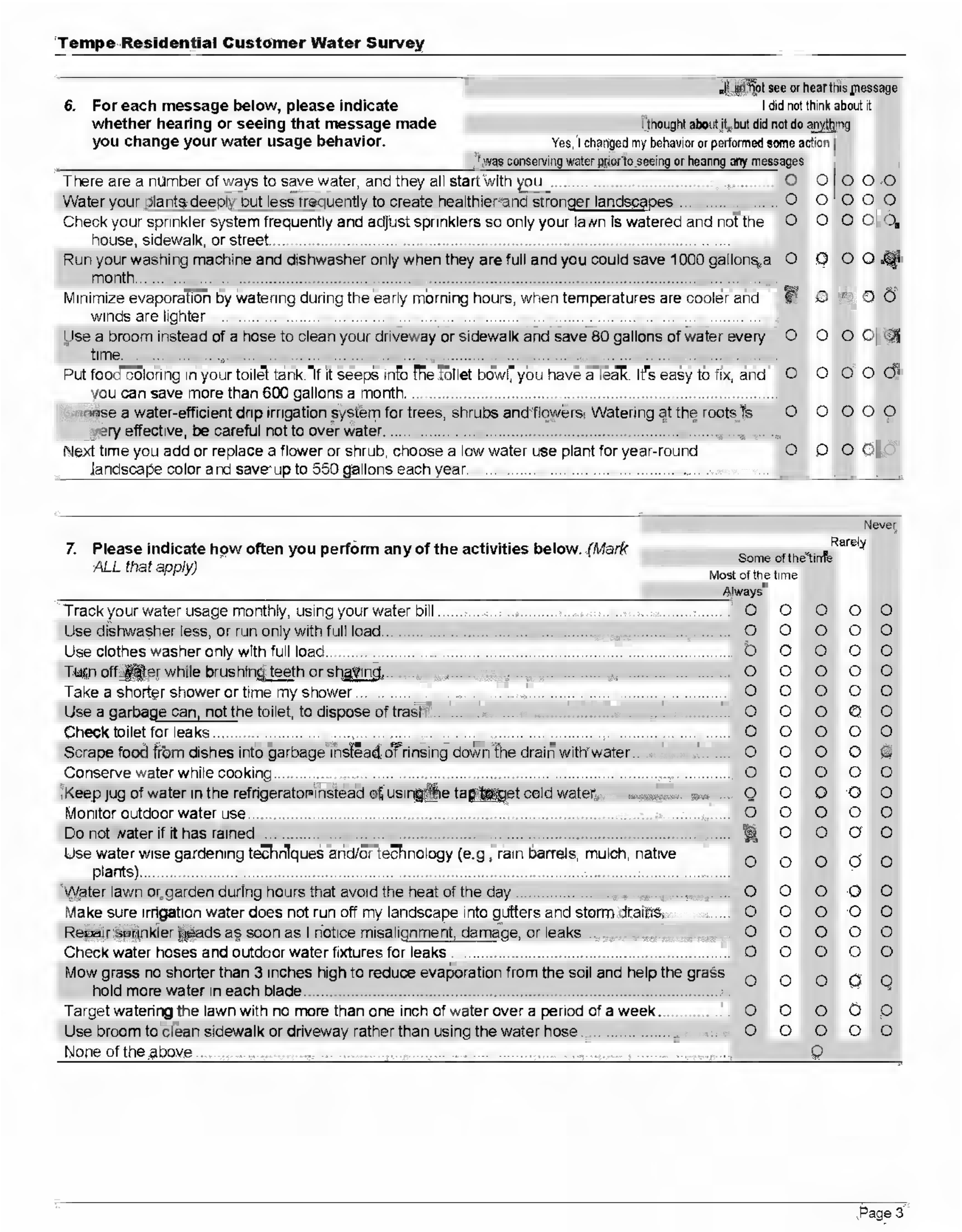

Tempe Residential Customer Water Survey

6. For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.

	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message
There are a number of ways to save water, and they all start with you	○	○	○	○	○
Water your plants deeply but less frequently to create healthier and stronger landscapes	○	○	○	○	○
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	○	○	○	○	○
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	○	○	○	○	○
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	○	○	○	○	○
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.	○	○	○	○	○
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month.	○	○	○	○	○
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	○	○	○	○	○
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	○	○	○	○	○

7. Please indicate how often you perform any of the activities below. *(Mark ALL that apply)*

	Always	Most of the time	Some of the time	Rarely	Never
Track your water usage monthly, using your water bill	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○
None of the above			○		

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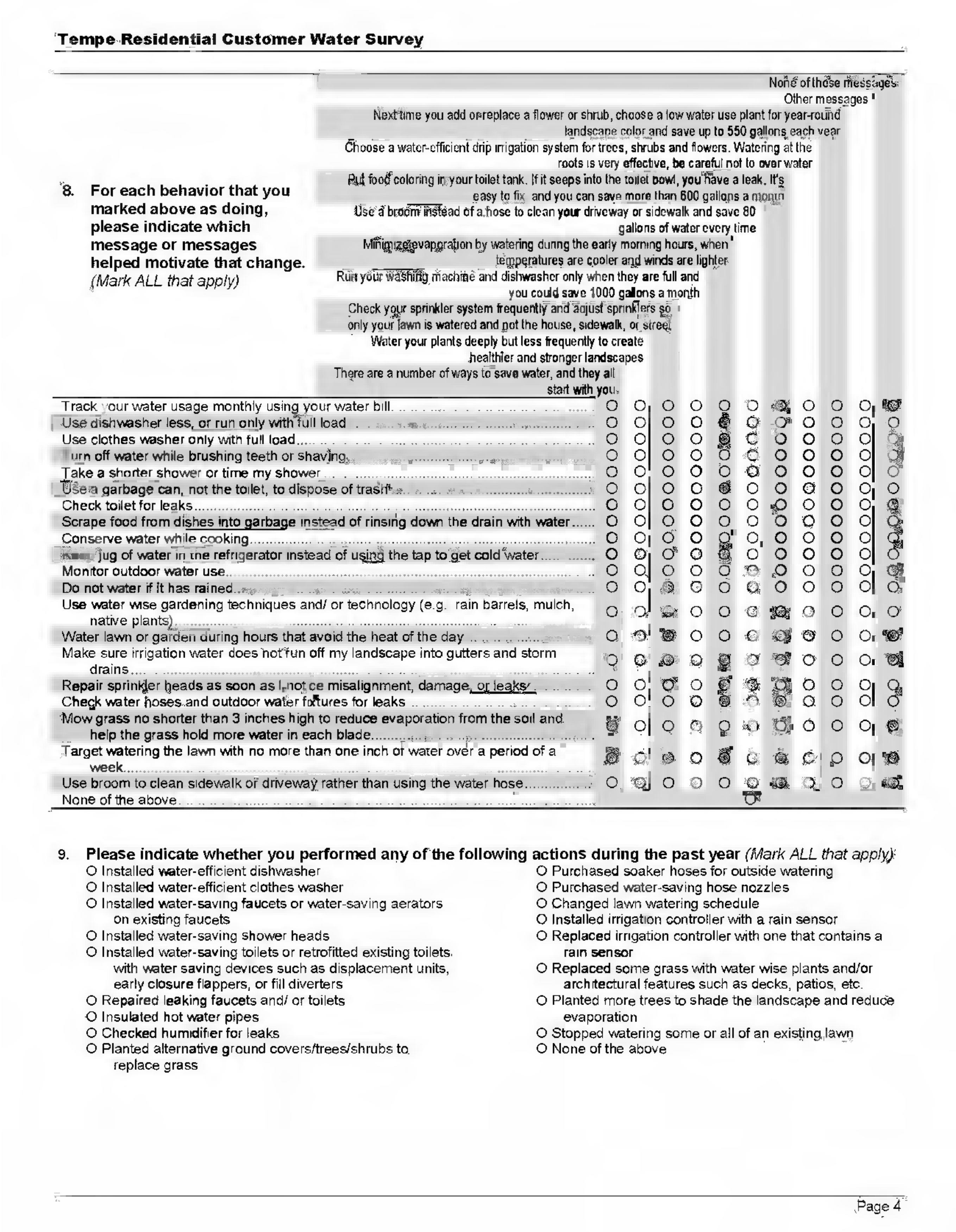

Tempe Residential Customer Water Survey

8. For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change. *(Mark ALL that apply)*

	There are a number of ways to save water, and they all start with you.	Water your plants deeply but less frequently to create healthier and stronger landscapes	Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix and you can save more than 600 gallons a month	Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	Other messages	None of these messages
Track your water usage monthly using your water bill	○	○	○	○	○	○	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○	○	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○	○	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○	○	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○	○	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○	○	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○	○	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○	○	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○	○	○	○	○	○	○
[illegible] jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○	○	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○	○	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○	○	○	○	○	○	○
Use water wise gardening techniques and/ or technology (e.g. rain barrels, mulch, native plants)	○	○	○	○	○	○	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○	○	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○	○	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○	○	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○	○	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○	○	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○	○	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○	○	○	○	○	○	○
None of the above						○					

9. Please indicate whether you performed any of the following actions during the past year *(Mark ALL that apply)*

○ Installed water-efficient dishwasher
○ Installed water-efficient clothes washer
○ Installed water-saving faucets or water-saving aerators on existing faucets
○ Installed water-saving shower heads
○ Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters
○ Repaired leaking faucets and/ or toilets
○ Insulated hot water pipes
○ Checked humidifier for leaks
○ Planted alternative ground covers/trees/shrubs to replace grass
○ Purchased soaker hoses for outside watering
○ Purchased water-saving hose nozzles
○ Changed lawn watering schedule
○ Installed irrigation controller with a rain sensor
○ Replaced irrigation controller with one that contains a rain sensor
○ Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.
○ Planted more trees to shade the landscape and reduce evaporation
○ Stopped watering some or all of an existing lawn
○ None of the above

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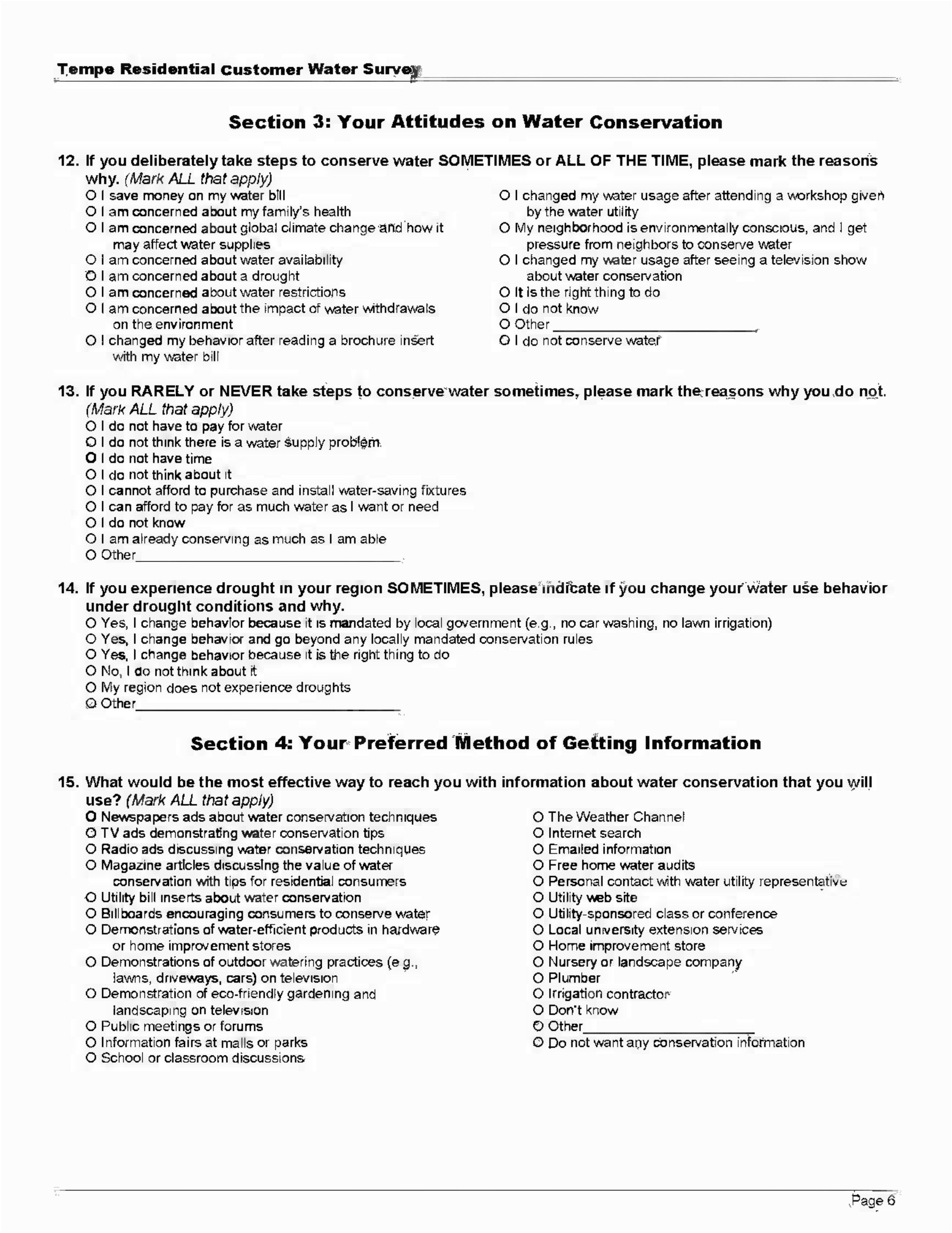
Tempe Residential Customer Water Survey

10. For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action.
(Mark ALL that apply)

	There are a number of ways to save water, and they all start with you	Water your plants deeply but less frequently to create healthier and stronger landscapes	Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	Other Messages	None of these messages
Installed water-efficient dishwasher	○	○	○	○	○	○	○	○	○	○	○
Installed water-efficient clothes washer	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving faucets or water-saving aerators on existing faucets	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving shower heads	○	○	○	○	○	○	○	○	○	○	○
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	○	○	○	○	○	○	○	○	○	○	○
Repaired leaking faucets and/or toilets	○	○	○	○	○	○	○	○	○	○	○
Insulated hot water pipes	○	○	○	○	○	○	○	○	○	○	○
Checked humidifier for leaks	○	○	○	○	○	○	○	○	○	○	○
Planted alternative ground covers/trees/shrubs to replace grass	○	○	○	○	○	○	○	○	○	○	○
Purchased soaker hoses for outside watering	○	○	○	○	○	○	○	○	○	○	○
Purchased water-saving hose nozzles	○	○	○	○	○	○	○	○	○	○	○
Changed lawn watering schedule	○	○	○	○	○	○	○	○	○	○	○
Installed irrigation controller with a rain sensor	○	○	○	○	○	○	○	○	○	○	○
Replaced irrigation controller with one that contains a rain sensor	○	○	○	○	○	○	○	○	○	○	○
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc	○	○	○	○	○	○	○	○	○	○	○
Planted more trees to shade the landscape and reduce evaporation	○	○	○	○	○	○	○	○	○	○	○
Stopped watering some or all of an existing lawn	○	○	○	○	○	○	○	○	○	○	○
None of the above											

11. Have you ever participated in a utility-sponsored rebate program promoting efficient water use?

○ Yes, I have
○ The utility offered it, but I did not participate
○ The utility never offered one, but I would have participated if it did
○ The utility never offered one, but I would not have participated anyway



Section 3: Your Attitudes on Water Conservation

12. If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why. *(Mark ALL that apply)*

- ○ I save money on my water bill
- ○ I am concerned about my family's health
- ○ I am concerned about global climate change and how it may affect water supplies
- ○ I am concerned about water availability
- ○ I am concerned about a drought
- ○ I am concerned about water restrictions
- ○ I am concerned about the impact of water withdrawals on the environment
- ○ I changed my behavior after reading a brochure insert with my water bill
- ○ I changed my water usage after attending a workshop given by the water utility
- ○ My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water
- ○ I changed my water usage after seeing a television show about water conservation
- ○ It is the right thing to do
- ○ I do not know
- ○ Other __________________________
- ○ I do not conserve water

13. If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not. *(Mark ALL that apply)*

- ○ I do not have to pay for water
- ○ I do not think there is a water supply problem
- ○ I do not have time
- ○ I do not think about it
- ○ I cannot afford to purchase and install water-saving fixtures
- ○ I can afford to pay for as much water as I want or need
- ○ I do not know
- ○ I am already conserving as much as I am able
- ○ Other____________________________________

14. If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.

- ○ Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)
- ○ Yes, I change behavior and go beyond any locally mandated conservation rules
- ○ Yes, I change behavior because it is the right thing to do
- ○ No, I do not think about it
- ○ My region does not experience droughts
- ○ Other____________________________________

Section 4: Your Preferred Method of Getting Information

15. What would be the most effective way to reach you with information about water conservation that you will use? *(Mark ALL that apply)*

- ○ Newspapers ads about water conservation techniques
- ○ TV ads demonstrating water conservation tips
- ○ Radio ads discussing water conservation techniques
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- ○ Utility bill inserts about water conservation
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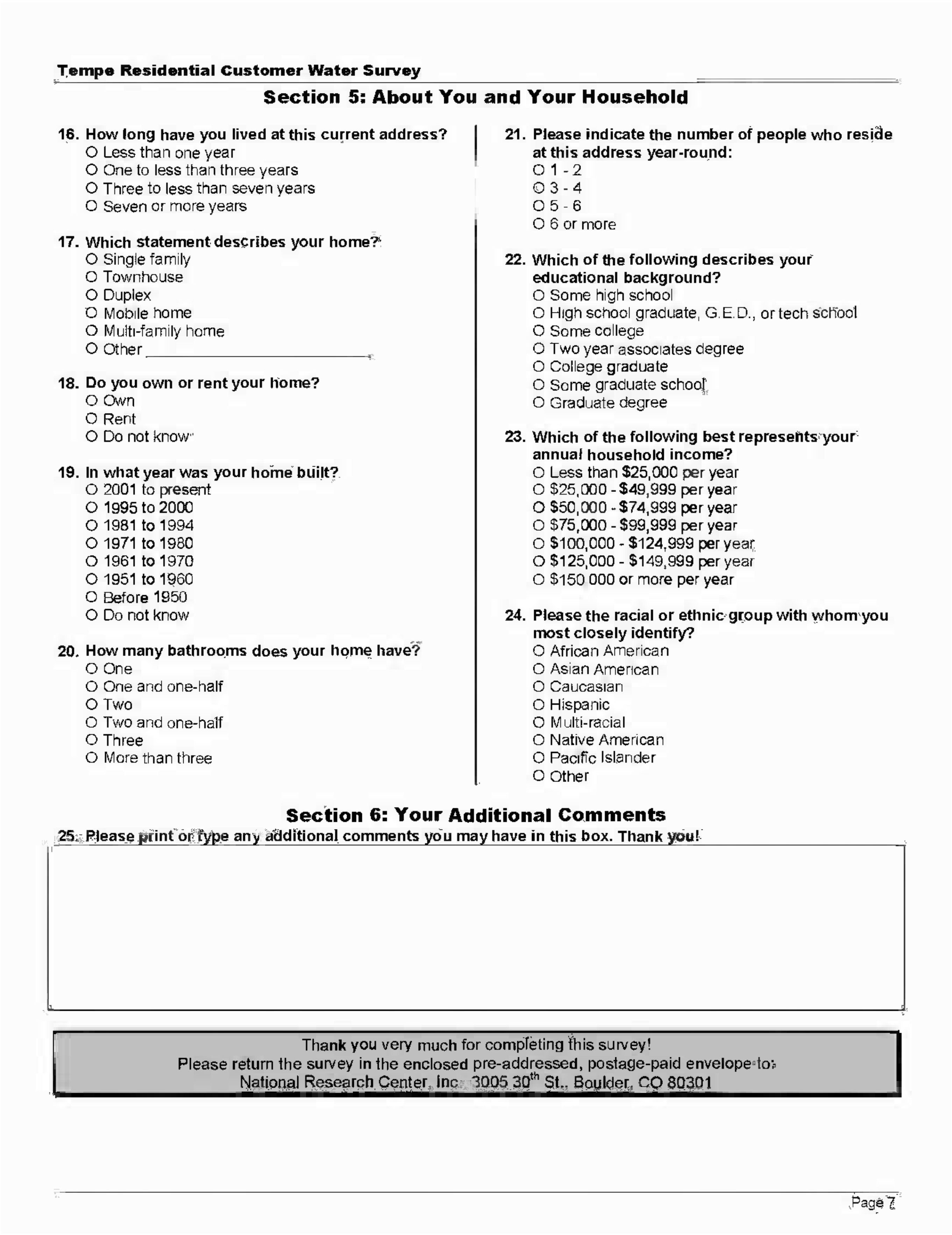
- ○ Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television
- ○ Demonstration of eco-friendly gardening and landscaping on television
- ○ Public meetings or forums
- ○ Information fairs at malls or parks
- ○ School or classroom discussions
- ○ The Weather Channel
- ○ Internet search
- ○ Emailed information
- ○ Free home water audits
- ○ Personal contact with water utility representative
- ○ Utility web site
- ○ Utility-sponsored class or conference
- ○ Local university extension services
- ○ Home improvement store
- ○ Nursery or landscape company
- ○ Plumber
- ○ Irrigation contractor
- ○ Don't know
- ○ Other______________________
- ○ Do not want any conservation information



Tempe Residential Customer Water Survey

Section 5: About You and Your Household

16. How long have you lived at this current address?
○ Less than one year
○ One to less than three years
○ Three to less than seven years
○ Seven or more years

17. Which statement describes your home?
○ Single family
○ Townhouse
○ Duplex
○ Mobile home
○ Multi-family home
○ Other ________________________

18. Do you own or rent your home?
○ Own
○ Rent
○ Do not know

19. In what year was your home built?
○ 2001 to present
○ 1995 to 2000
○ 1981 to 1994
○ 1971 to 1980
○ 1961 to 1970
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○ Do not know

20. How many bathrooms does your home have?
○ One
○ One and one-half
○ Two
○ Two and one-half
○ Three
○ More than three

21. Please indicate the number of people who reside at this address year-round:
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○ 3 - 4
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22. Which of the following describes your educational background?
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○ High school graduate, G.E.D., or tech school
○ Some college
○ Two year associates degree
○ College graduate
○ Some graduate school
○ Graduate degree

23. Which of the following best represents your annual household income?
○ Less than $25,000 per year
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○ $50,000 - $74,999 per year
○ $75,000 - $99,999 per year
○ $100,000 - $124,999 per year
○ $125,000 - $149,999 per year
○ $150,000 or more per year

24. Please the racial or ethnic group with whom you most closely identify?
○ African American
○ Asian American
○ Caucasian
○ Hispanic
○ Multi-racial
○ Native American
○ Pacific Islander
○ Other

Section 6: Your Additional Comments

25. Please print or type any additional comments you may have in this box. Thank you!

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National Research Center, Inc., 3005 30th St., Boulder, CO 80301

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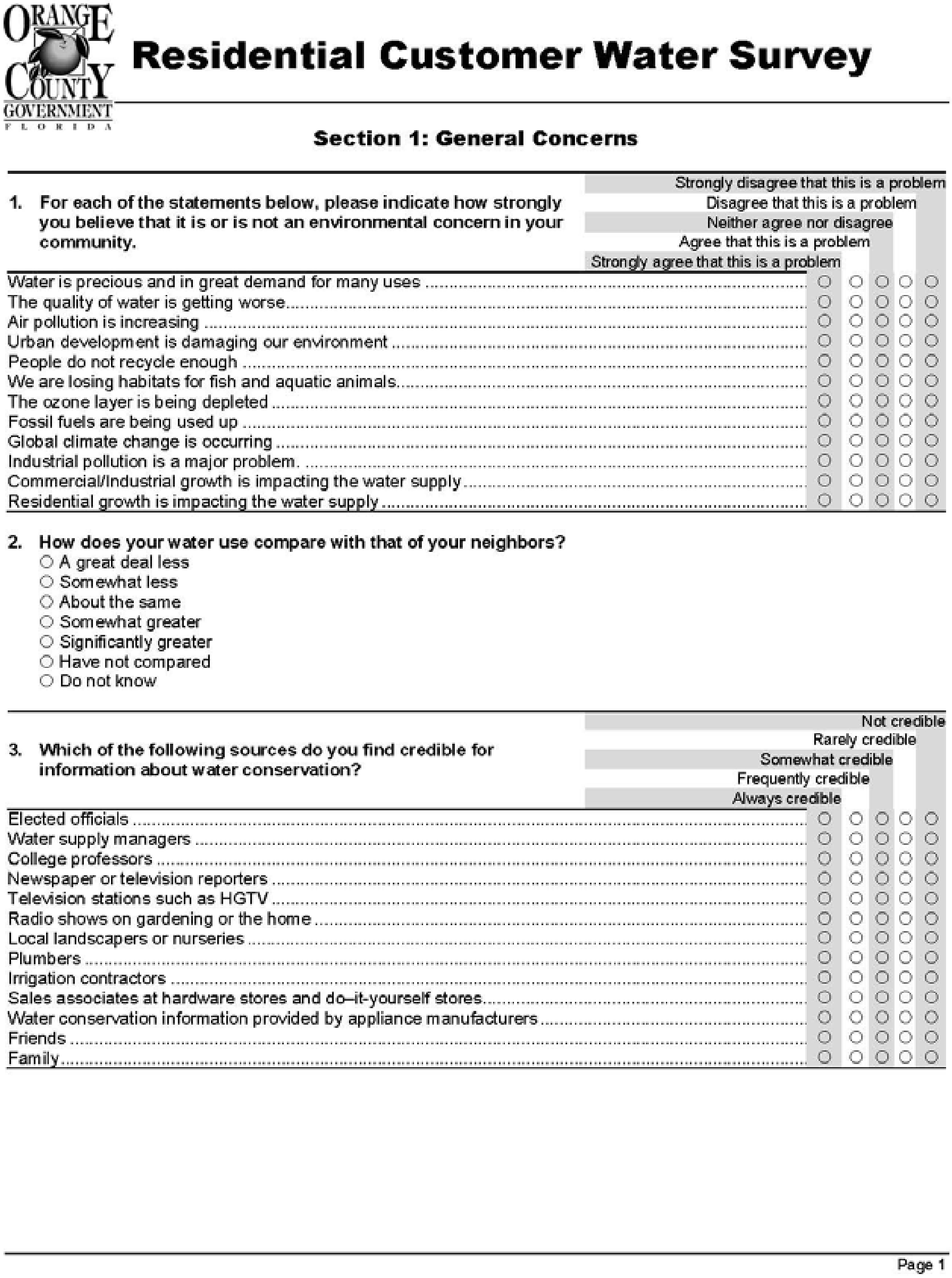
ORANGE COUNTY UTILITIES WATER DIVISION



Residential Customer Water Survey

Section 1: General Concerns

1. For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.

	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem
Water is precious and in great demand for many uses	○	○	○	○	○
The quality of water is getting worse	○	○	○	○	○
Air pollution is increasing	○	○	○	○	○
Urban development is damaging our environment	○	○	○	○	○
People do not recycle enough	○	○	○	○	○
We are losing habitats for fish and aquatic animals	○	○	○	○	○
The ozone layer is being depleted	○	○	○	○	○
Fossil fuels are being used up	○	○	○	○	○
Global climate change is occurring	○	○	○	○	○
Industrial pollution is a major problem.	○	○	○	○	○
Commercial/Industrial growth is impacting the water supply	○	○	○	○	○
Residential growth is impacting the water supply	○	○	○	○	○

2. How does your water use compare with that of your neighbors?

○ A great deal less
○ Somewhat less
○ About the same
○ Somewhat greater
○ Significantly greater
○ Have not compared
○ Do not know

3. Which of the following sources do you find credible for information about water conservation?

	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible
Elected officials	○	○	○	○	○
Water supply managers	○	○	○	○	○
College professors	○	○	○	○	○
Newspaper or television reporters	○	○	○	○	○
Television stations such as HGTV	○	○	○	○	○
Radio shows on gardening or the home	○	○	○	○	○
Local landscapers or nurseries	○	○	○	○	○
Plumbers	○	○	○	○	○
Irrigation contractors	○	○	○	○	○
Sales associates at hardware stores and do–it-yourself stores.	○	○	○	○	○
Water conservation information provided by appliance manufacturers	○	○	○	○	○
Friends	○	○	○	○	○
Family	○	○	○	○	○

Page 1

Section 2: Water Utility Messages

4. For each of the messages below, please indicate where you saw or heard each message. *(Mark ALL that apply)*

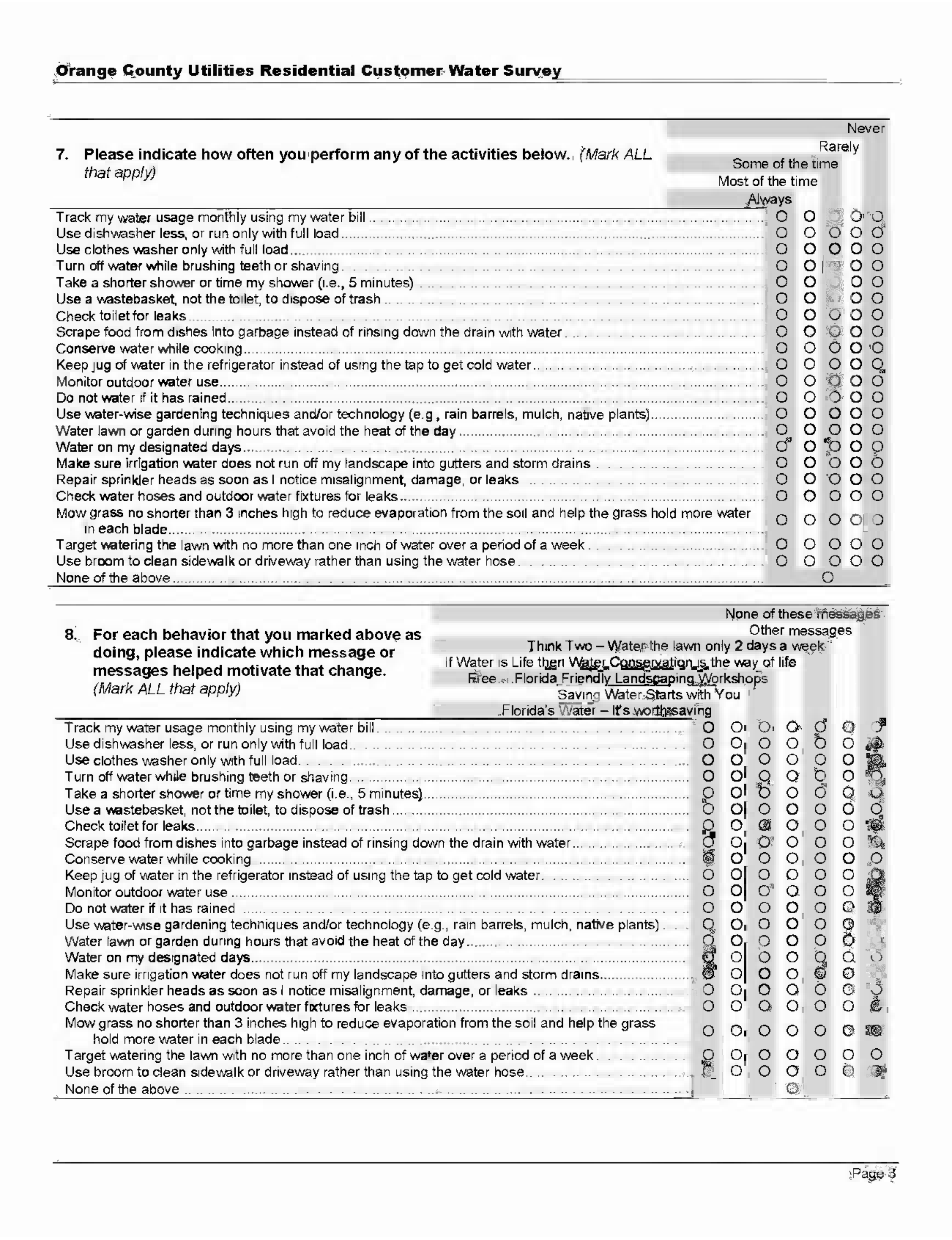
	Radio	Network TV	Cable/Satellite channel	Web site	[illegible]ovement store	Outdoor ads	Water bill inserts	Direct mailing from water utility	Educational events	Newspapers/Magazines	Brochures	I did not see or hear this message
Florida's Water – It's worth saving	○	○	○	○	○	○	○	○	○	○	○	○
Saving Water Starts with You	○	○	○	○	○	○	○	○	○	○	○	○
Free... Florida Friendly Landscaping Workshops...	○	○	○	○	○	○	○	○	○	○	○	○
If Water is Life then Water Conservation is the way of life	○	○	○	○	○	○	○	○	○	○	○	○
Think Two – Water the lawn only 2 days a week	○	○	○	○	○	○	○	○	○	○	○	○

5. For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).

	More than ten times	Five to ten times	Two to four times	Once	Never
Florida's Water – It's worth saving	○	○	○	○	○
Saving Water Starts with You	○	○	○	○	○
Free... Florida Friendly Landscaping Workshops	○	○	○	○	○
If Water is Life then Water Conservation is the way of life	○	○	○	○	○
Think Two – Water the lawn only 2 days a week	○	○	○	○	○

6. For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.

	was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message
Florida's Water – It's worth saving	○	○	○	○	
Saving Water Starts with You	○	○	○	○	
Free... Florida Friendly Landscaping Workshops	○	○	○	○	
If Water is Life then Water Conservation is the way of life	○	○	○	○	
Think Two – Water the lawn only 2 days a week	○	○	○	○	



Orange County Utilities Residential Customer Water Survey

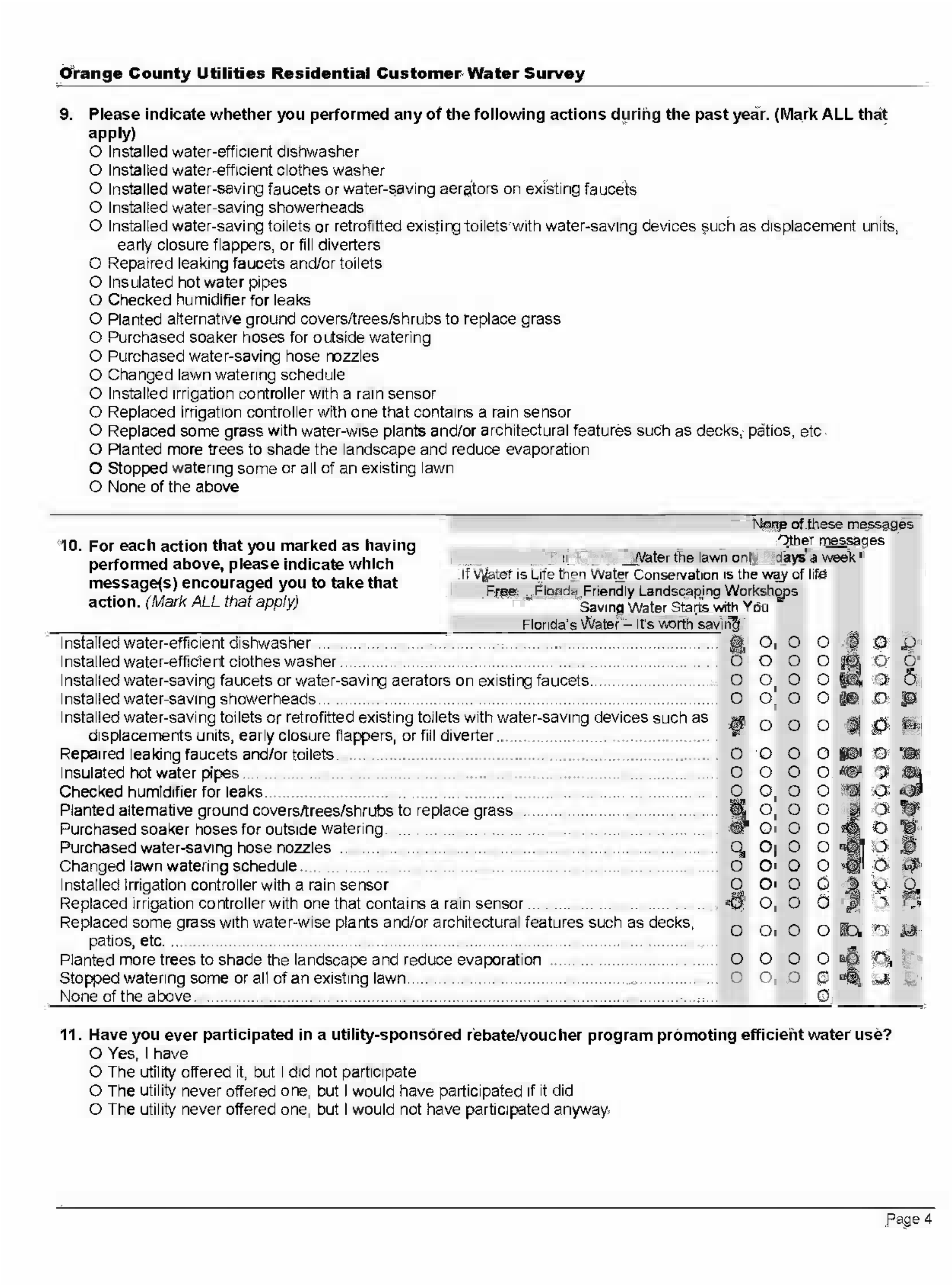
7. Please indicate how often you perform any of the activities below. *(Mark ALL that apply)*

	Always	Most of the time	Some of the time	Rarely	Never
Track my water usage monthly using my water bill	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○
Take a shorter shower or time my shower (i.e., 5 minutes)	○	○	○	○	○
Use a wastebasket, not the toilet, to dispose of trash	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○
Use water-wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○
Water on my designated days	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○
None of the above			○		

8. For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change. *(Mark ALL that apply)*

	Florida's Water – It's worth saving	Saving Water Starts with You	Free…Florida Friendly Landscaping Workshops	If Water is Life then Water Conservation is the way of life	Think Two – Water the lawn only 2 days a week	Other messages	None of these messages
Track my water usage monthly using my water bill	○	○	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○	○	○
Take a shorter shower or time my shower (i.e., 5 minutes)	○	○	○	○	○	○	○
Use a wastebasket, not the toilet, to dispose of trash	○	○	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○	○	○
Use water-wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○	○	○
Water on my designated days	○	○	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○	○	○
None of the above				○			

Page 3



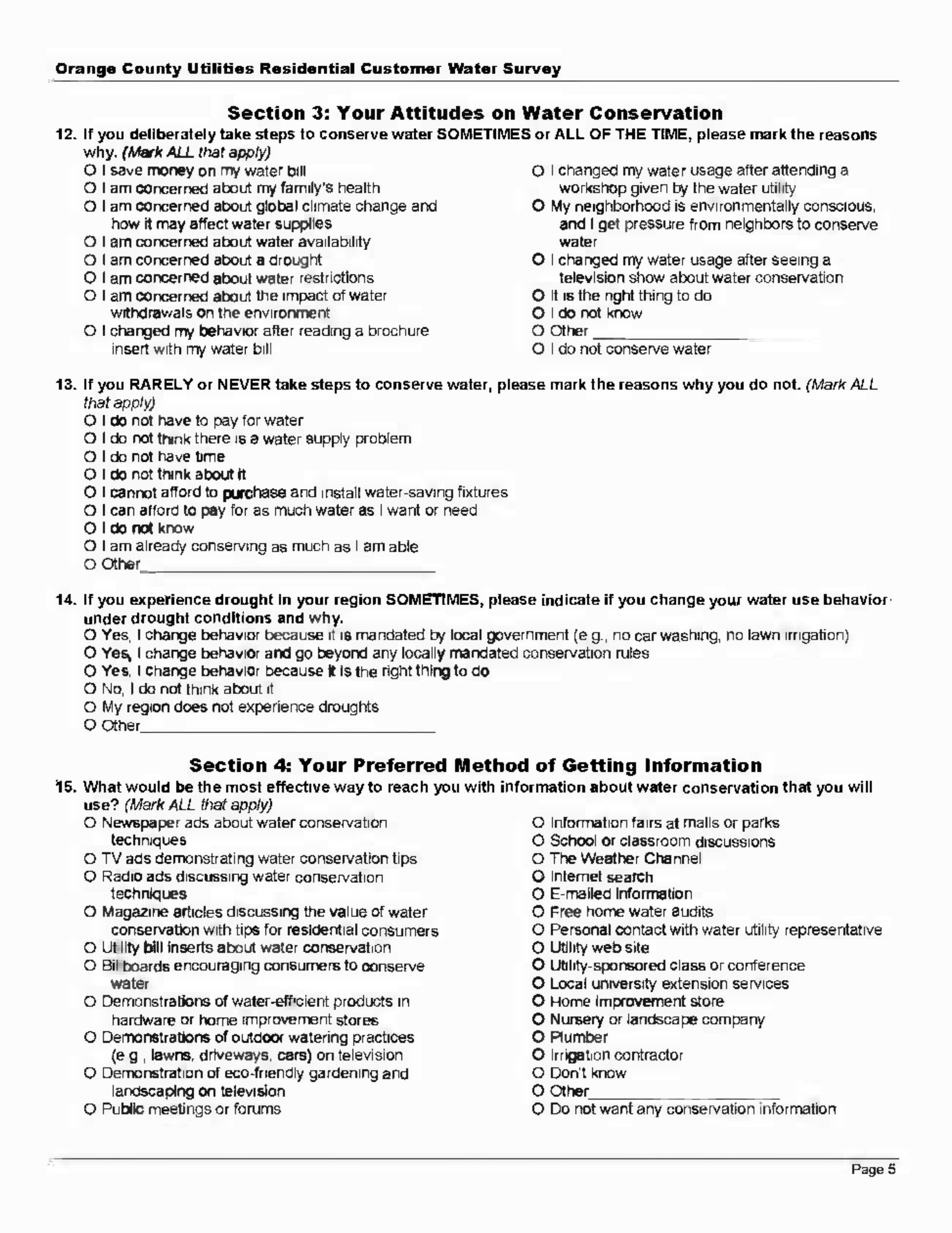
Orange County Utilities Residential Customer Water Survey

9. Please indicate whether you performed any of the following actions during the past year. (Mark ALL that apply)
- ○ Installed water-efficient dishwasher
- ○ Installed water-efficient clothes washer
- ○ Installed water-saving faucets or water-saving aerators on existing faucets
- ○ Installed water-saving showerheads
- ○ Installed water-saving toilets or retrofitted existing toilets with water-saving devices such as displacement units, early closure flappers, or fill diverters
- ○ Repaired leaking faucets and/or toilets
- ○ Insulated hot water pipes
- ○ Checked humidifier for leaks
- ○ Planted alternative ground covers/trees/shrubs to replace grass
- ○ Purchased soaker hoses for outside watering
- ○ Purchased water-saving hose nozzles
- ○ Changed lawn watering schedule
- ○ Installed irrigation controller with a rain sensor
- ○ Replaced irrigation controller with one that contains a rain sensor
- ○ Replaced some grass with water-wise plants and/or architectural features such as decks, patios, etc.
- ○ Planted more trees to shade the landscape and reduce evaporation
- ○ Stopped watering some or all of an existing lawn
- ○ None of the above

10. For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action. *(Mark ALL that apply)*

	Florida's Water – It's worth saving	Saving Water Starts with You	Free Florida Friendly Landscaping Workshops	If Water is Life then Water Conservation is the way of life	[illegible] Water the lawn only [illegible] days a week	Other messages	None of these messages
Installed water-efficient dishwasher	○	○	○	○	○	○	○
Installed water-efficient clothes washer	○	○	○	○	○	○	○
Installed water-saving faucets or water-saving aerators on existing faucets	○	○	○	○	○	○	○
Installed water-saving showerheads	○	○	○	○	○	○	○
Installed water-saving toilets or retrofitted existing toilets with water-saving devices such as displacements units, early closure flappers, or fill diverter	○	○	○	○	○	○	○
Repaired leaking faucets and/or toilets	○	○	○	○	○	○	○
Insulated hot water pipes	○	○	○	○	○	○	○
Checked humidifier for leaks	○	○	○	○	○	○	○
Planted alternative ground covers/trees/shrubs to replace grass	○	○	○	○	○	○	○
Purchased soaker hoses for outside watering	○	○	○	○	○	○	○
Purchased water-saving hose nozzles	○	○	○	○	○	○	○
Changed lawn watering schedule	○	○	○	○	○	○	○
Installed irrigation controller with a rain sensor	○	○	○	○	○	○	○
Replaced irrigation controller with one that contains a rain sensor	○	○	○	○	○	○	○
Replaced some grass with water-wise plants and/or architectural features such as decks, patios, etc.	○	○	○	○	○	○	○
Planted more trees to shade the landscape and reduce evaporation	○	○	○	○	○	○	○
Stopped watering some or all of an existing lawn	○	○	○	○	○	○	○
None of the above				○			

11. Have you ever participated in a utility-sponsored rebate/voucher program promoting efficient water use?
- ○ Yes, I have
- ○ The utility offered it, but I did not participate
- ○ The utility never offered one, but I would have participated if it did
- ○ The utility never offered one, but I would not have participated anyway



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○ I am concerned about a drought
○ I am concerned about water restrictions
○ I am concerned about the impact of water withdrawals on the environment
○ I changed my behavior after reading a brochure insert with my water bill
○ I changed my water usage after attending a workshop given by the water utility
○ My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water
○ I changed my water usage after seeing a television show about water conservation
○ It is the right thing to do
○ I do not know
○ Other ____________________
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13. If you RARELY or NEVER take steps to conserve water, please mark the reasons why you do not. *(Mark ALL that apply)*

○ I do not have to pay for water
○ I do not think there is a water supply problem
○ I do not have time
○ I do not think about it
○ I cannot afford to purchase and install water-saving fixtures
○ I can afford to pay for as much water as I want or need
○ I do not know
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14. If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.

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○ Yes, I change behavior and go beyond any locally mandated conservation rules
○ Yes, I change behavior because it is the right thing to do
○ No, I do not think about it
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Section 4: Your Preferred Method of Getting Information

15. What would be the most effective way to reach you with information about water conservation that you will use? *(Mark ALL that apply)*

○ Newspaper ads about water conservation techniques
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○ E-mailed information
○ Free home water audits
○ Personal contact with water utility representative
○ Utility web site
○ Utility-sponsored class or conference
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○ Home improvement store
○ Nursery or landscape company
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○ Irrigation contractor
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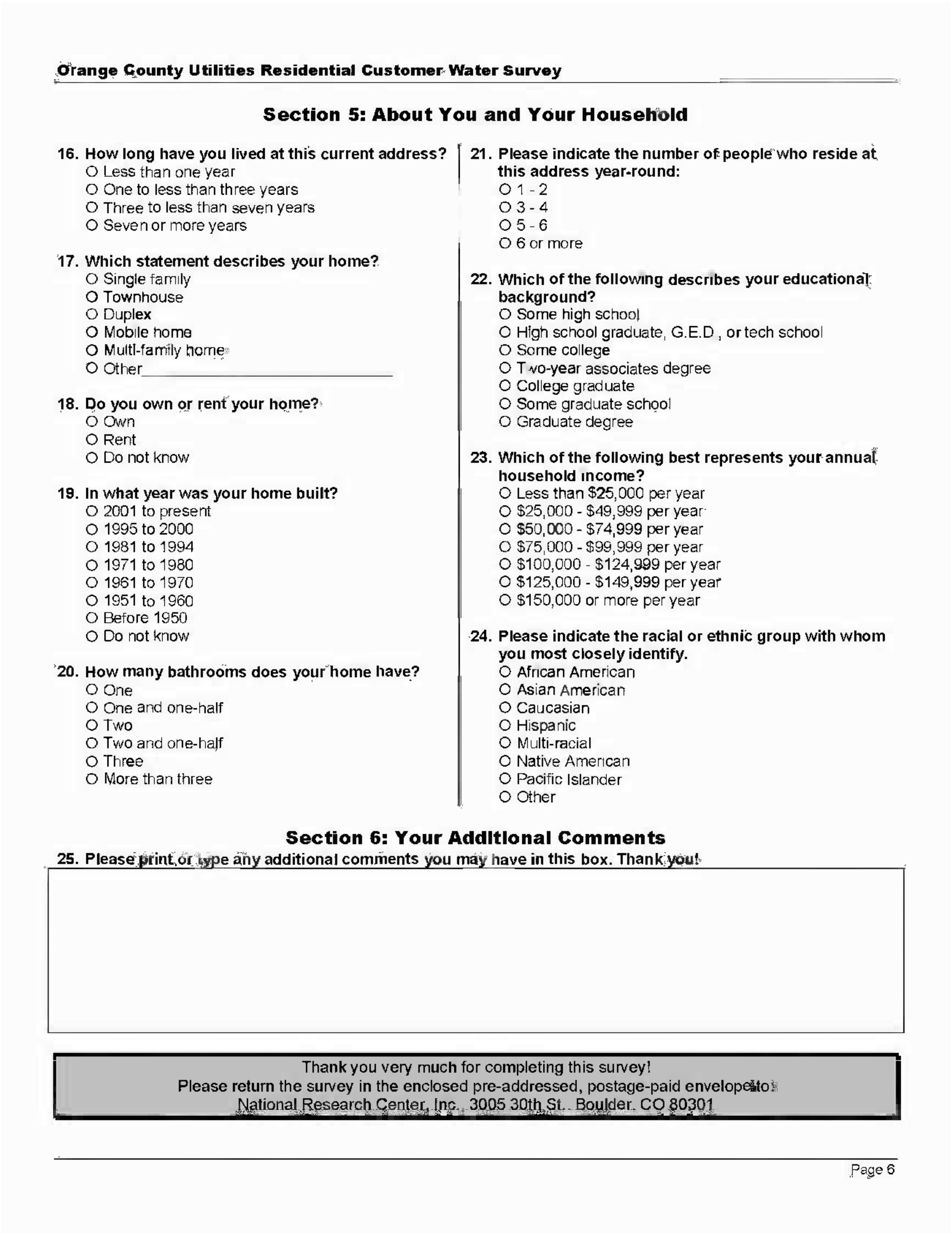

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18. Do you own or rent your home?
○ Own
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○ Do not know

19. In what year was your home built?
○ 2001 to present
○ 1995 to 2000
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○ 1971 to 1980
○ 1961 to 1970
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○ Before 1950
○ Do not know

20. How many bathrooms does your home have?
○ One
○ One and one-half
○ Two
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21. Please indicate the number of people who reside at this address year-round:
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○ 3 - 4
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22. Which of the following describes your educational background?
○ Some high school
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23. Which of the following best represents your annual household income?
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○ $75,000 - $99,999 per year
○ $100,000 - $124,999 per year
○ $125,000 - $149,999 per year
○ $150,000 or more per year

24. Please indicate the racial or ethnic group with whom you most closely identify.
○ African American
○ Asian American
○ Caucasian
○ Hispanic
○ Multi-racial
○ Native American
○ Pacific Islander
○ Other

Section 6: Your Additional Comments

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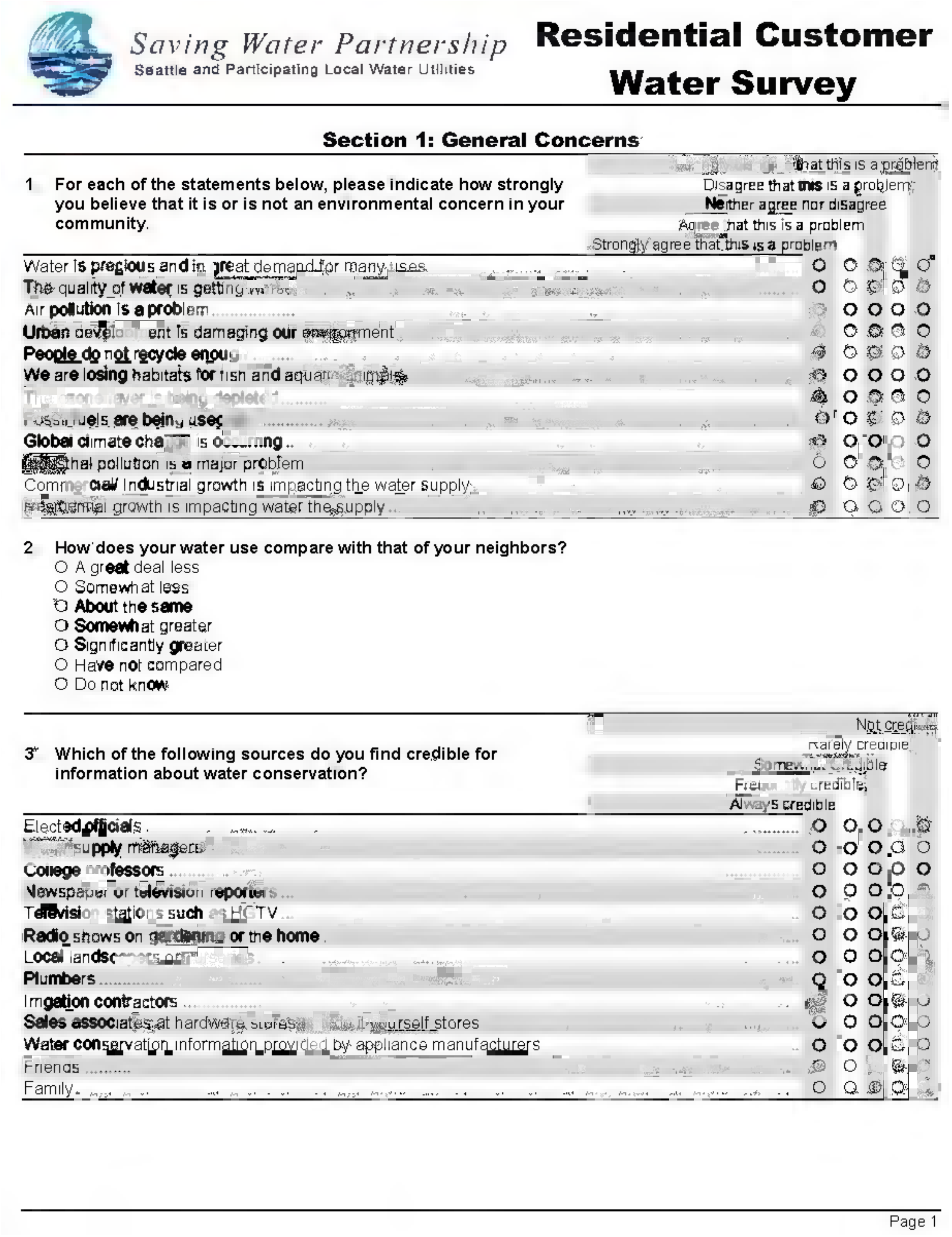
SEATTLE PUBLIC UTILITIES



Saving Water Partnership
Seattle and Participating Local Water Utilities

Residential Customer Water Survey

Section 1: General Concerns

1 For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.

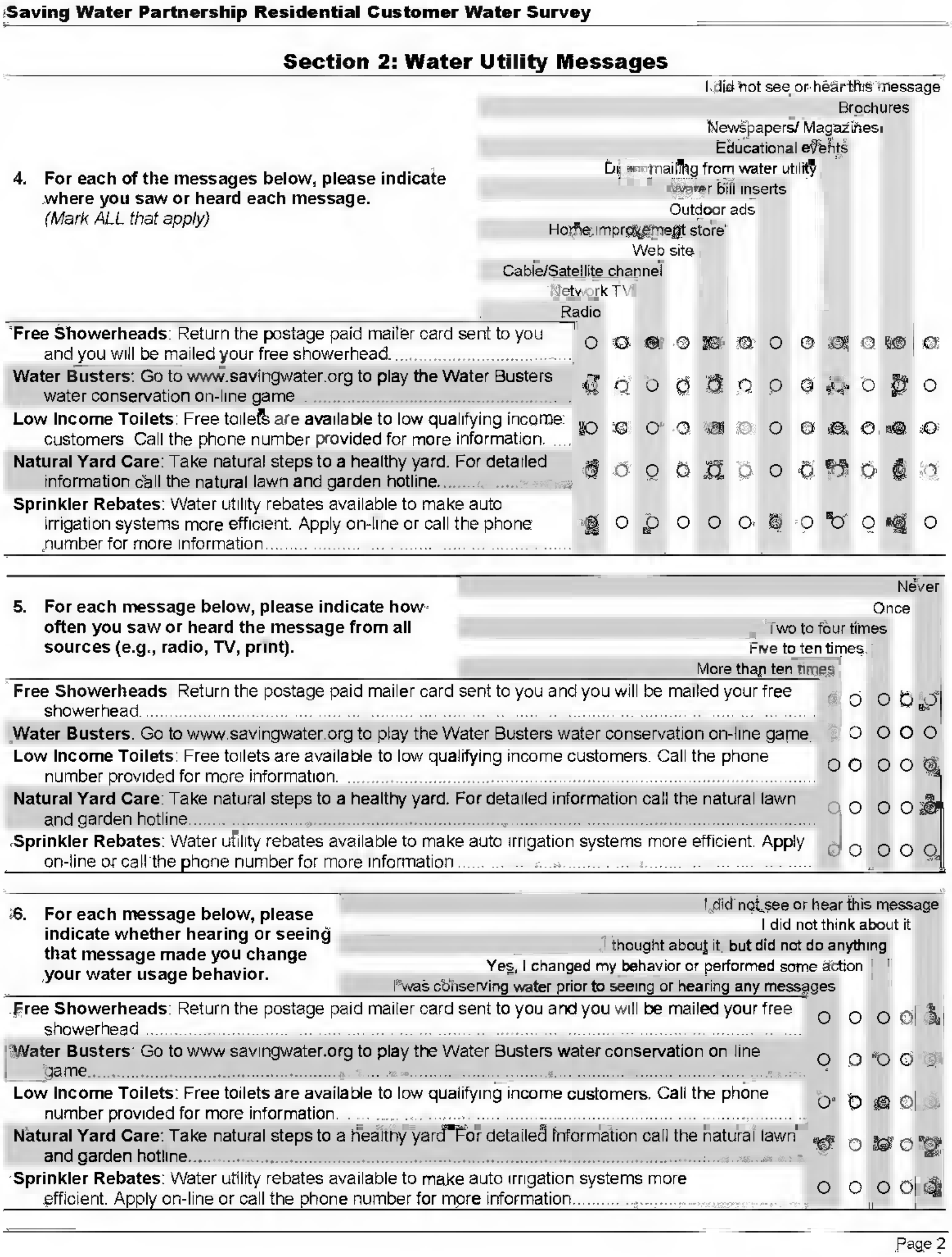
	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem
Water is precious and in great demand for many uses	○	○	○	○	○
The quality of water is getting worse	○	○	○	○	○
Air pollution is a problem	○	○	○	○	○
Urban development is damaging our environment	○	○	○	○	○
People do not recycle enough	○	○	○	○	○
We are losing habitats for fish and aquatic animals	○	○	○	○	○
The ozone layer is being depleted	○	○	○	○	○
Fossil fuels are being used	○	○	○	○	○
Global climate change is occurring	○	○	○	○	○
[illegible] pollution is a major problem	○	○	○	○	○
Commercial/Industrial growth is impacting the water supply	○	○	○	○	○
Residential growth is impacting water the supply	○	○	○	○	○

2 How does your water use compare with that of your neighbors?
○ A great deal less
○ Somewhat less
○ About the same
○ Somewhat greater
○ Significantly greater
○ Have not compared
○ Do not know

3 Which of the following sources do you find credible for information about water conservation?

	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible
Elected officials	○	○	○	○	○
Water supply managers	○	○	○	○	○
College professors	○	○	○	○	○
Newspaper or television reporters	○	○	○	○	○
Television stations such as HGTV	○	○	○	○	○
Radio shows on gardening or the home	○	○	○	○	○
Local landscapers or nurseries	○	○	○	○	○
Plumbers	○	○	○	○	○
Irrigation contractors	○	○	○	○	○
Sales associates at hardware stores and do-it-yourself stores	○	○	○	○	○
Water conservation information provided by appliance manufacturers	○	○	○	○	○
Friends	○	○	○	○	○
Family	○	○	○	○	○

Page 1



Saving Water Partnership Residential Customer Water Survey

Section 2: Water Utility Messages

4. **For each of the messages below, please indicate where you saw or heard each message.**
(Mark ALL that apply)

	Radio	Network TV	Cable/Satellite channel	Web site	Home improvement store	Outdoor ads	Water bill inserts	Direct mailing from water utility	Educational events	Newspapers/ Magazines	Brochures	I did not see or hear this message
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead.	○	○	○	○	○	○	○	○	○	○	○	○
Water Busters: Go to www.savingwater.org to play the Water Busters water conservation on-line game	○	○	○	○	○	○	○	○	○	○	○	○
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	○	○	○	○	○	○	○	○	○	○	○	○
Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline.	○	○	○	○	○	○	○	○	○	○	○	○
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information	○	○	○	○	○	○	○	○	○	○	○	○

5. **For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).**

	More than ten times	Five to ten times	Two to four times	Once	Never
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead.	○	○	○	○	○
Water Busters. Go to www.savingwater.org to play the Water Busters water conservation on-line game	○	○	○	○	○
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	○	○	○	○	○
Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline.	○	○	○	○	○
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information	○	○	○	○	○

6. **For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.**

	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead	○	○	○	○	○
Water Busters: Go to www.savingwater.org to play the Water Busters water conservation on line game.	○	○	○	○	○
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	○	○	○	○	○
Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline.	○	○	○	○	○
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information.	○	○	○	○	○

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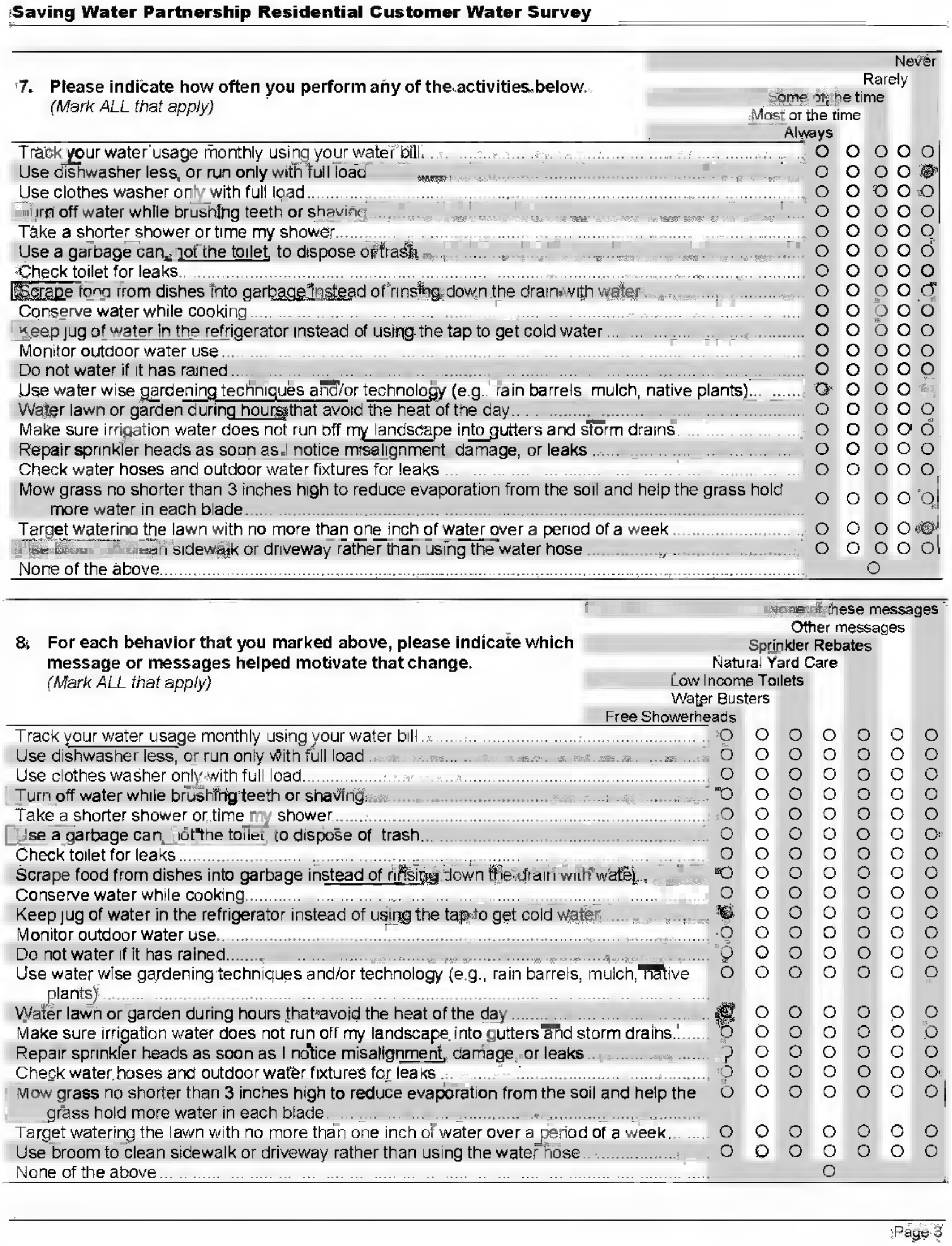

Saving Water Partnership Residential Customer Water Survey

7. Please indicate how often you perform any of the activities below. *(Mark ALL that apply)*

	Always	Most of the time	Some of the time	Rarely	Never
Track your water usage monthly using your water bill	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	●
Use clothes washer only with full load	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	●
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○
None of the above			○		

8. For each behavior that you marked above, please indicate which message or messages helped motivate that change. *(Mark ALL that apply)*

	Free Showerheads	Water Busters	Low Income Toilets	Natural Yard Care	Sprinkler Rebates	Other messages	None of these messages
Track your water usage monthly using your water bill	○	○	○	○	○	○	○
Use dishwasher less, or run only with full load	○	○	○	○	○	○	○
Use clothes washer only with full load	○	○	○	○	○	○	○
Turn off water while brushing teeth or shaving	○	○	○	○	○	○	○
Take a shorter shower or time my shower	○	○	○	○	○	○	○
Use a garbage can, not the toilet, to dispose of trash	○	○	○	○	○	○	○
Check toilet for leaks	○	○	○	○	○	○	○
Scrape food from dishes into garbage instead of rinsing down the drain with water	○	○	○	○	○	○	○
Conserve water while cooking	○	○	○	○	○	○	○
Keep jug of water in the refrigerator instead of using the tap to get cold water	●	○	○	○	○	○	○
Monitor outdoor water use	○	○	○	○	○	○	○
Do not water if it has rained	○	○	○	○	○	○	○
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	○	○	○	○	○	○	○
Water lawn or garden during hours that avoid the heat of the day	●	○	○	○	○	○	○
Make sure irrigation water does not run off my landscape into gutters and storm drains	○	○	○	○	○	○	○
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	○	○	○	○	○	○	○
Check water hoses and outdoor water fixtures for leaks	○	○	○	○	○	○	○
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	○	○	○	○	○	○	○
Target watering the lawn with no more than one inch of water over a period of a week	○	○	○	○	○	○	○
Use broom to clean sidewalk or driveway rather than using the water hose	○	○	○	○	○	○	○
None of the above				○			

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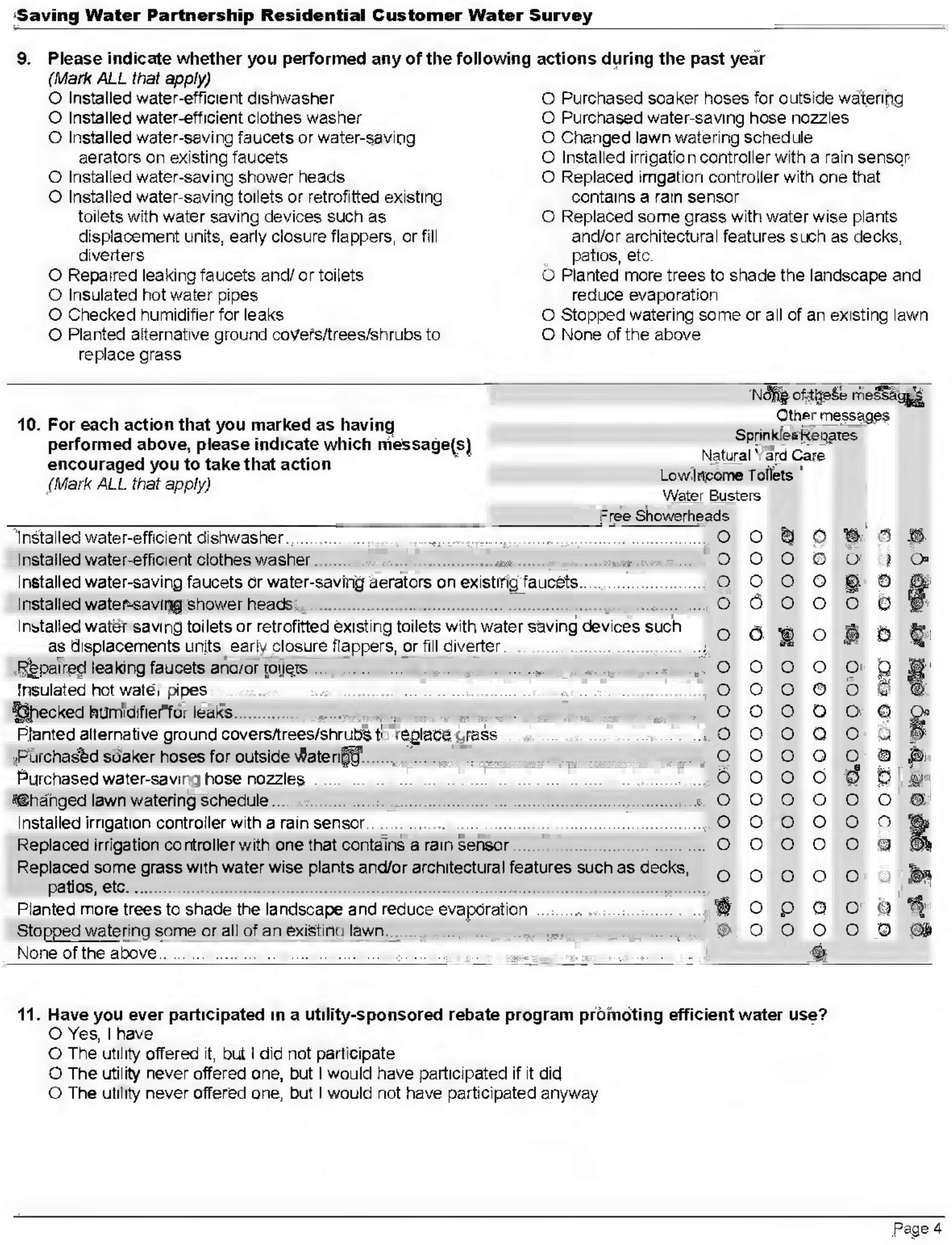


Saving Water Partnership Residential Customer Water Survey

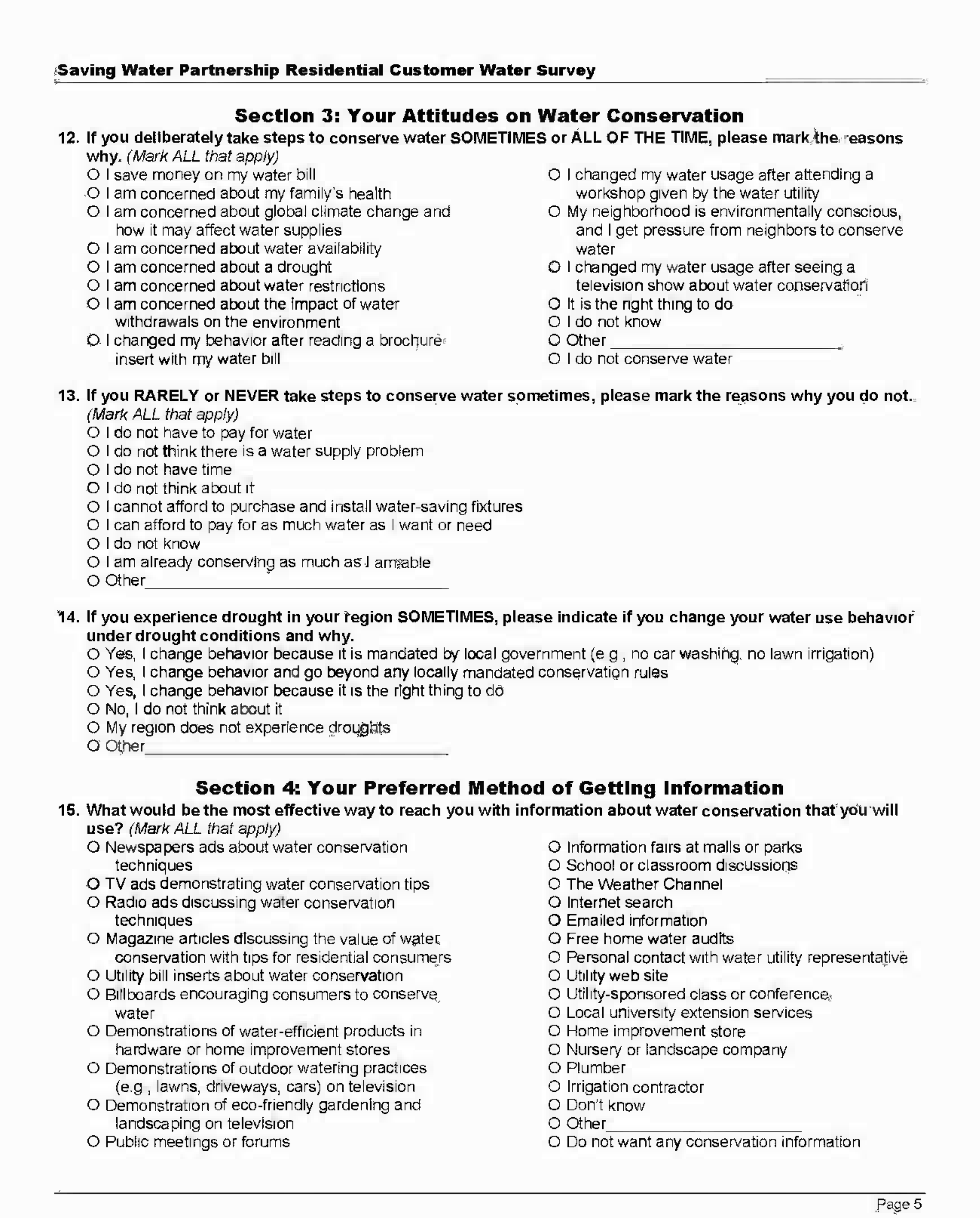
9. Please indicate whether you performed any of the following actions during the past year
(Mark ALL that apply)

○ Installed water-efficient dishwasher
○ Installed water-efficient clothes washer
○ Installed water-saving faucets or water-saving aerators on existing faucets
○ Installed water-saving shower heads
○ Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters
○ Repaired leaking faucets and/ or toilets
○ Insulated hot water pipes
○ Checked humidifier for leaks
○ Planted alternative ground covers/trees/shrubs to replace grass
○ Purchased soaker hoses for outside watering
○ Purchased water-saving hose nozzles
○ Changed lawn watering schedule
○ Installed irrigation controller with a rain sensor
○ Replaced irrigation controller with one that contains a rain sensor
○ Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.
○ Planted more trees to shade the landscape and reduce evaporation
○ Stopped watering some or all of an existing lawn
○ None of the above

10. For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action
(Mark ALL that apply)

	Free Showerheads	Water Busters	Low Income Toilets	Natural Yard Care	Sprinkler Rebates	Other messages	None of these messages
Installed water-efficient dishwasher	○	○	○	○	○	○	○
Installed water-efficient clothes washer	○	○	○	○	○	○	○
Installed water-saving faucets or water-saving aerators on existing faucets	○	○	○	○	○	○	○
Installed water-saving shower heads	○	○	○	○	○	○	○
Installed water saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	○	○	○	○	○	○	○
Repaired leaking faucets and/or toilets	○	○	○	○	○	○	○
Insulated hot water pipes	○	○	○	○	○	○	○
Checked humidifier for leaks	○	○	○	○	○	○	○
Planted alternative ground covers/trees/shrubs to replace grass	○	○	○	○	○	○	○
Purchased soaker hoses for outside watering	○	○	○	○	○	○	○
Purchased water-saving hose nozzles	○	○	○	○	○	○	○
Changed lawn watering schedule	○	○	○	○	○	○	○
Installed irrigation controller with a rain sensor	○	○	○	○	○	○	○
Replaced irrigation controller with one that contains a rain sensor	○	○	○	○	○	○	○
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	○	○	○	○	○	○	○
Planted more trees to shade the landscape and reduce evaporation	○	○	○	○	○	○	○
Stopped watering some or all of an existing lawn	○	○	○	○	○	○	○
None of the above				○			

11. Have you ever participated in a utility-sponsored rebate program promoting efficient water use?
○ Yes, I have
○ The utility offered it, but I did not participate
○ The utility never offered one, but I would have participated if it did
○ The utility never offered one, but I would not have participated anyway



Saving Water Partnership Residential Customer Water Survey

Section 3: Your Attitudes on Water Conservation

12. If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why. *(Mark ALL that apply)*

- ○ I save money on my water bill
- ○ I am concerned about my family's health
- ○ I am concerned about global climate change and how it may affect water supplies
- ○ I am concerned about water availability
- ○ I am concerned about a drought
- ○ I am concerned about water restrictions
- ○ I am concerned about the impact of water withdrawals on the environment
- ○ I changed my behavior after reading a brochure insert with my water bill
- ○ I changed my water usage after attending a workshop given by the water utility
- ○ My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water
- ○ I changed my water usage after seeing a television show about water conservation
- ○ It is the right thing to do
- ○ I do not know
- ○ Other ____________________
- ○ I do not conserve water

13. If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not. *(Mark ALL that apply)*

- ○ I do not have to pay for water
- ○ I do not think there is a water supply problem
- ○ I do not have time
- ○ I do not think about it
- ○ I cannot afford to purchase and install water-saving fixtures
- ○ I can afford to pay for as much water as I want or need
- ○ I do not know
- ○ I am already conserving as much as I am able
- ○ Other____________________

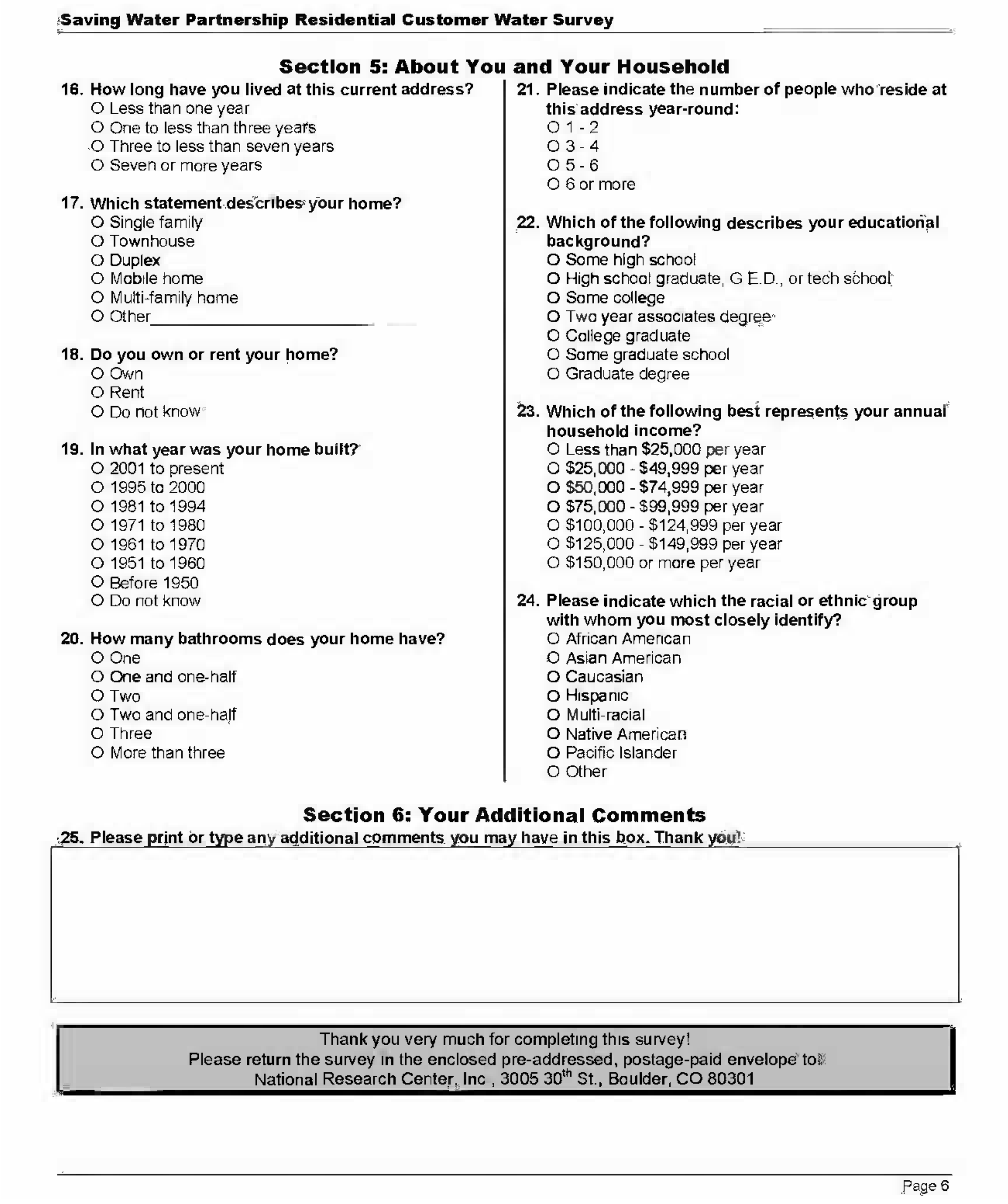
14. If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.

- ○ Yes, I change behavior because it is mandated by local government (e g , no car washing, no lawn irrigation)
- ○ Yes, I change behavior and go beyond any locally mandated conservation rules
- ○ Yes, I change behavior because it is the right thing to do
- ○ No, I do not think about it
- ○ My region does not experience droughts
- ○ Other____________________

Section 4: Your Preferred Method of Getting Information

15. What would be the most effective way to reach you with information about water conservation that you will use? *(Mark ALL that apply)*

- ○ Newspapers ads about water conservation techniques
- ○ TV ads demonstrating water conservation tips
- ○ Radio ads discussing water conservation techniques
- ○ Magazine articles discussing the value of water conservation with tips for residential consumers
- ○ Utility bill inserts about water conservation
- ○ Billboards encouraging consumers to conserve water
- ○ Demonstrations of water-efficient products in hardware or home improvement stores
- ○ Demonstrations of outdoor watering practices (e.g , lawns, driveways, cars) on television
- ○ Demonstration of eco-friendly gardening and landscaping on television
- ○ Public meetings or forums
- ○ Information fairs at malls or parks
- ○ School or classroom discussions
- ○ The Weather Channel
- ○ Internet search
- ○ Emailed information
- ○ Free home water audits
- ○ Personal contact with water utility representative
- ○ Utility web site
- ○ Utility-sponsored class or conference
- ○ Local university extension services
- ○ Home improvement store
- ○ Nursery or landscape company
- ○ Plumber
- ○ Irrigation contractor
- ○ Don't know
- ○ Other____________________
- ○ Do not want any conservation information



Saving Water Partnership Residential Customer Water Survey

Section 5: About You and Your Household

16. How long have you lived at this current address?
- ○ Less than one year
- ○ One to less than three years
- ○ Three to less than seven years
- ○ Seven or more years

17. Which statement describes your home?
- ○ Single family
- ○ Townhouse
- ○ Duplex
- ○ Mobile home
- ○ Multi-family home
- ○ Other________________________

18. Do you own or rent your home?
- ○ Own
- ○ Rent
- ○ Do not know

19. In what year was your home built?
- ○ 2001 to present
- ○ 1995 to 2000
- ○ 1981 to 1994
- ○ 1971 to 1980
- ○ 1961 to 1970
- ○ 1951 to 1960
- ○ Before 1950
- ○ Do not know

20. How many bathrooms does your home have?
- ○ One
- ○ One and one-half
- ○ Two
- ○ Two and one-half
- ○ Three
- ○ More than three

21. Please indicate the number of people who reside at this address year-round:
- ○ 1 - 2
- ○ 3 - 4
- ○ 5 - 6
- ○ 6 or more

22. Which of the following describes your educational background?
- ○ Some high school
- ○ High school graduate, G.E.D., or tech school
- ○ Some college
- ○ Two year associates degree
- ○ College graduate
- ○ Some graduate school
- ○ Graduate degree

23. Which of the following best represents your annual household income?
- ○ Less than $25,000 per year
- ○ $25,000 - $49,999 per year
- ○ $50,000 - $74,999 per year
- ○ $75,000 - $99,999 per year
- ○ $100,000 - $124,999 per year
- ○ $125,000 - $149,999 per year
- ○ $150,000 or more per year

24. Please indicate which the racial or ethnic group with whom you most closely identify?
- ○ African American
- ○ Asian American
- ○ Caucasian
- ○ Hispanic
- ○ Multi-racial
- ○ Native American
- ○ Pacific Islander
- ○ Other

Section 6: Your Additional Comments

25. Please print or type any additional comments you may have in this box. Thank you!

Thank you very much for completing this survey!
Please return the survey in the enclosed pre-addressed, postage-paid envelope to:
National Research Center, Inc., 3005 30th St., Boulder, CO 80301

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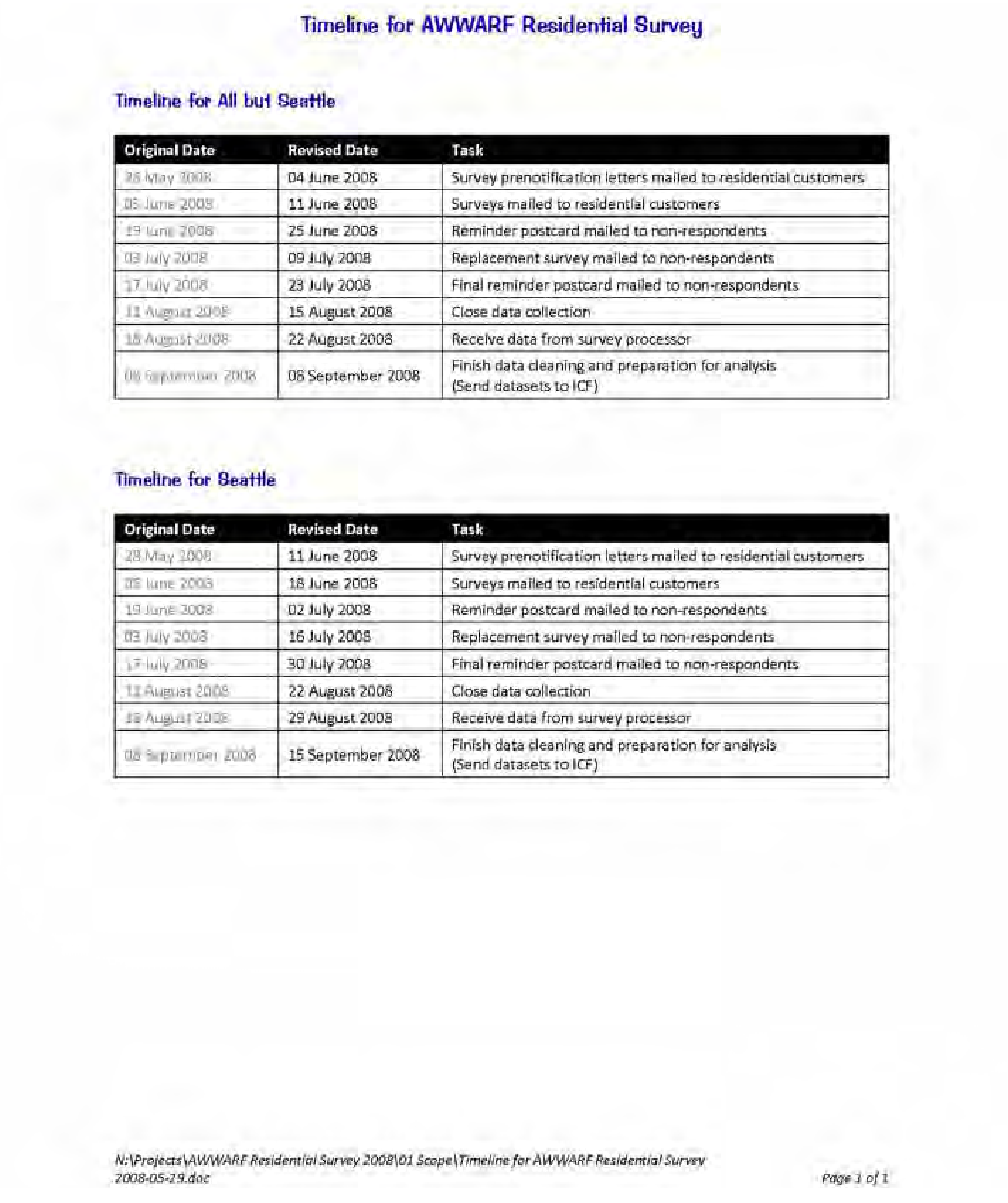
APPENDIX C:
SAMPLE SURVEY MATERIALS

This appendix presents sample materials, by utility partner, that we used to implement the survey:

1. Timeline for the Residential Survey
2. Survey prenotification letter printed on water utility's letterhead
3. Survey cover letter for first survey mailing
4. Reminder postcard 1 to non-respondents
5. Survey cover letter for second survey mailing to non-respondents
6. Final reminder postcard 2 to non-respondents

TIMELINE FOR THE RESIDENTIAL SURVEY



Timeline for AWWARF Residential Survey

Timeline for All but Seattle

Original Date	Revised Date	Task
28 May 2008	04 June 2008	Survey prenotification letters mailed to residential customers
05 June 2008	11 June 2008	Surveys mailed to residential customers
19 June 2008	25 June 2008	Reminder postcard mailed to non-respondents
03 July 2008	09 July 2008	Replacement survey mailed to non-respondents
17 July 2008	23 July 2008	Final reminder postcard mailed to non-respondents
11 August 2008	15 August 2008	Close data collection
18 August 2008	22 August 2008	Receive data from survey processor
08 September 2008	06 September 2008	Finish data cleaning and preparation for analysis (Send datasets to ICF)

Timeline for Seattle

Original Date	Revised Date	Task
28 May 2008	11 June 2008	Survey prenotification letters mailed to residential customers
05 June 2008	18 June 2008	Surveys mailed to residential customers
19 June 2008	02 July 2008	Reminder postcard mailed to non-respondents
03 July 2008	16 July 2008	Replacement survey mailed to non-respondents
17 July 2008	30 July 2008	Final reminder postcard mailed to non-respondents
11 August 2008	22 August 2008	Close data collection
18 August 2008	29 August 2008	Receive data from survey processor
08 September 2008	15 September 2008	Finish data cleaning and preparation for analysis (Send datasets to ICF)

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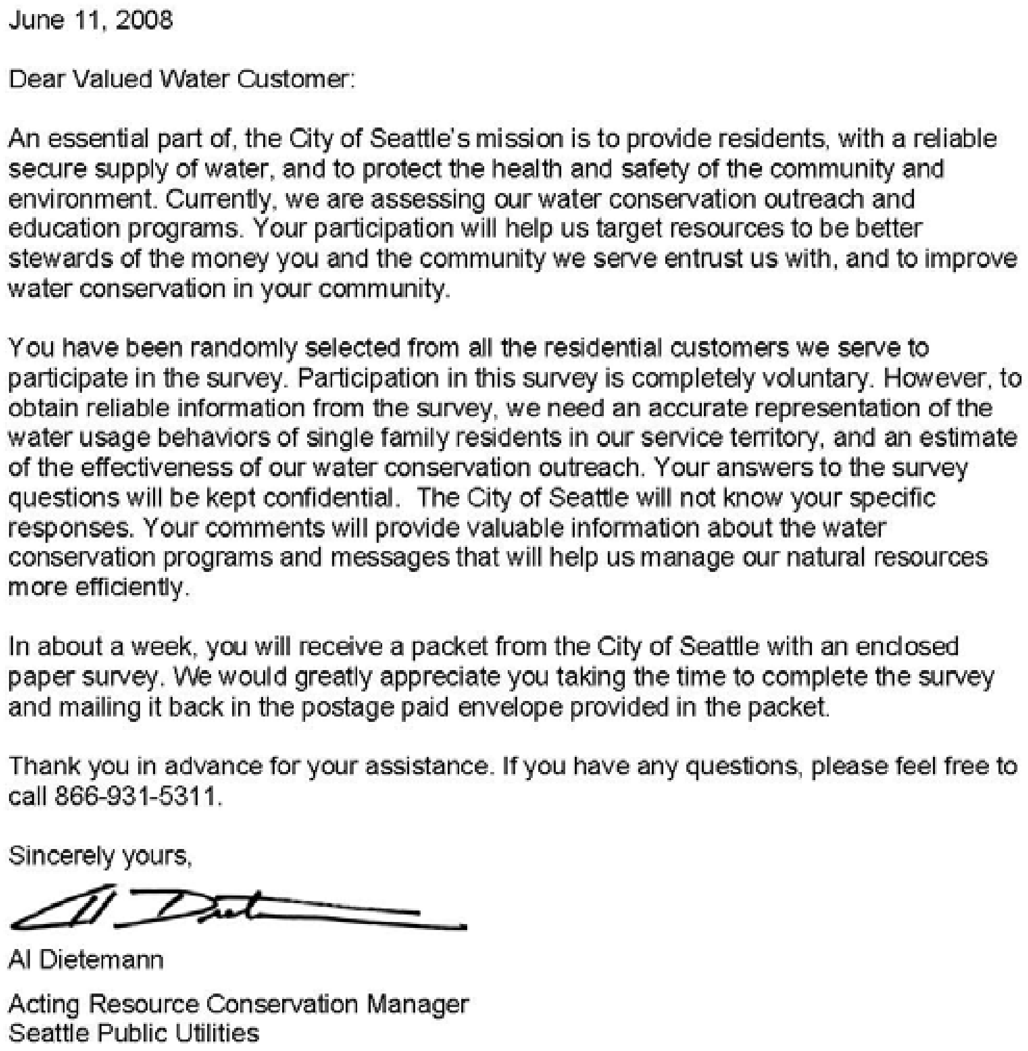
SURVEY PRENOTIFICATION LETTER PRINTED ON WATER UTILITY'S LETTERHEAD



June 11, 2008

Dear Valued Water Customer:

An essential part of, the City of Seattle's mission is to provide residents, with a reliable secure supply of water, and to protect the health and safety of the community and environment. Currently, we are assessing our water conservation outreach and education programs. Your participation will help us target resources to be better stewards of the money you and the community we serve entrust us with, and to improve water conservation in your community.

You have been randomly selected from all the residential customers we serve to participate in the survey. Participation in this survey is completely voluntary. However, to obtain reliable information from the survey, we need an accurate representation of the water usage behaviors of single family residents in our service territory, and an estimate of the effectiveness of our water conservation outreach. Your answers to the survey questions will be kept confidential. The City of Seattle will not know your specific responses. Your comments will provide valuable information about the water conservation programs and messages that will help us manage our natural resources more efficiently.

In about a week, you will receive a packet from the City of Seattle with an enclosed paper survey. We would greatly appreciate you taking the time to complete the survey and mailing it back in the postage paid envelope provided in the packet.

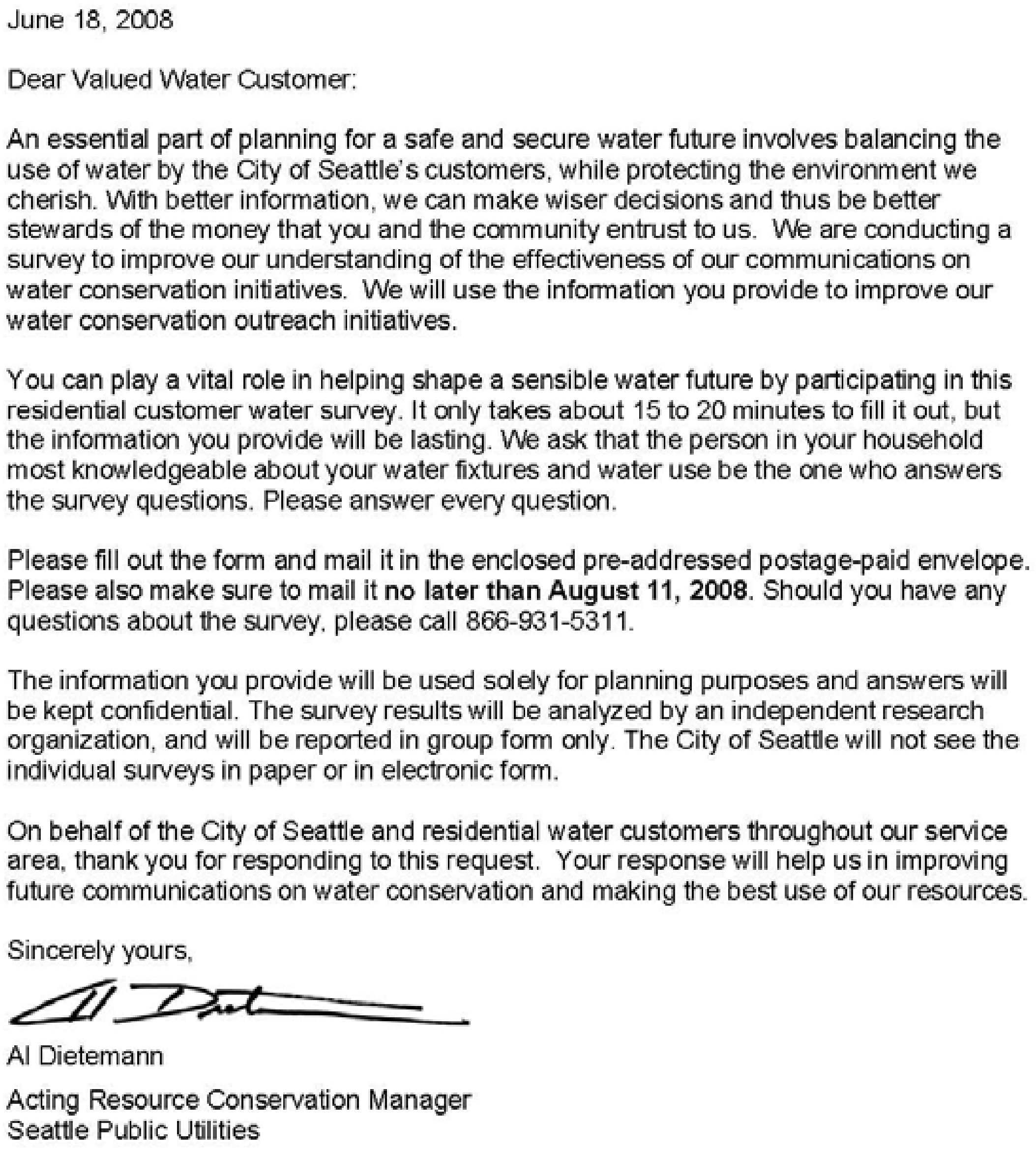
Thank you in advance for your assistance. If you have any questions, please feel free to call 866-931-5311.

Sincerely yours,

Al Dietemann

Acting Resource Conservation Manager
Seattle Public Utilities

SURVEY COVER LETTER FOR FIRST SURVEY MAILING



June 18, 2008

Dear Valued Water Customer:

An essential part of planning for a safe and secure water future involves balancing the use of water by the City of Seattle's customers, while protecting the environment we cherish. With better information, we can make wiser decisions and thus be better stewards of the money that you and the community entrust to us. We are conducting a survey to improve our understanding of the effectiveness of our communications on water conservation initiatives. We will use the information you provide to improve our water conservation outreach initiatives.

You can play a vital role in helping shape a sensible water future by participating in this residential customer water survey. It only takes about 15 to 20 minutes to fill it out, but the information you provide will be lasting. We ask that the person in your household most knowledgeable about your water fixtures and water use be the one who answers the survey questions. Please answer every question.

Please fill out the form and mail it in the enclosed pre-addressed postage-paid envelope. Please also make sure to mail it **no later than August 11, 2008.** Should you have any questions about the survey, please call 866-931-5311.

The information you provide will be used solely for planning purposes and answers will be kept confidential. The survey results will be analyzed by an independent research organization, and will be reported in group form only. The City of Seattle will not see the individual surveys in paper or in electronic form.

On behalf of the City of Seattle and residential water customers throughout our service area, thank you for responding to this request. Your response will help us in improving future communications on water conservation and making the best use of our resources.

Sincerely yours,

Al Dietemann

Acting Resource Conservation Manager
Seattle Public Utilities

REMINDER POSTCARD 1 TO NON-RESPONDENTS

Saving Water Partnership
Seattle and Participating Local Water Utilities

RESIDENTIAL CUSTOMER WATER SURVEY

Recently, we asked you to complete an important survey regarding our water conservation programs.

If you have already completed the survey, thank you for your feedback. If not, please take a few minutes to complete the survey to help us evaluate our water conservation outreach and education programs.

The information you provide will be used solely for planning purposes and answers will be kept confidential. The survey results are being analyzed by an independent research organization and will be reported in group form only.

If you have any questions, please call 866-931-5311 between 6 am and 2 pm Pacific Time.

THANK YOU

Saving Water Partnership
Seattle and Participating Local Water Utilities

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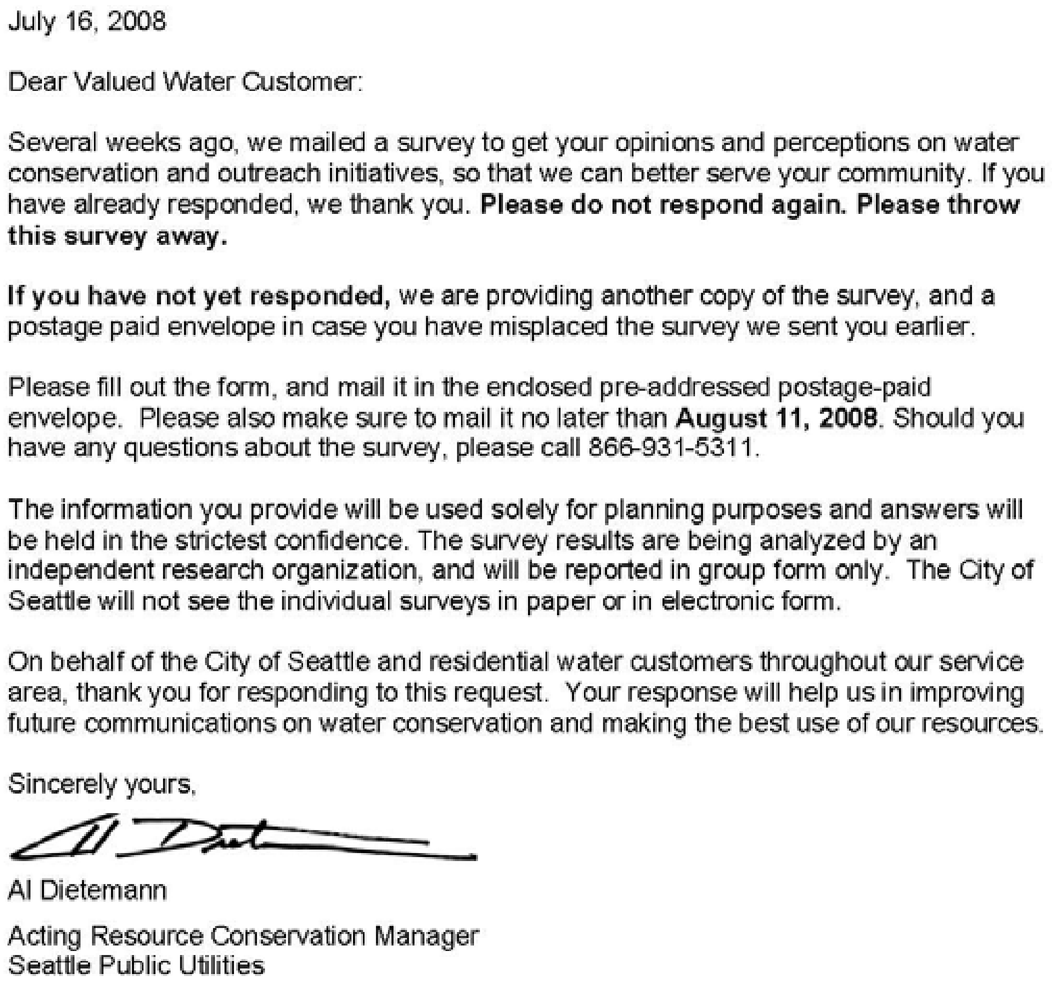
THANK YOU

SURVEY COVER LETTER FOR SECOND SUVEY MAILING TO NON-RESPONDENTS



July 16, 2008

Dear Valued Water Customer:

Several weeks ago, we mailed a survey to get your opinions and perceptions on water conservation and outreach initiatives, so that we can better serve your community. If you have already responded, we thank you. **Please do not respond again. Please throw this survey away.**

If you have not yet responded, we are providing another copy of the survey, and a postage paid envelope in case you have misplaced the survey we sent you earlier.

Please fill out the form, and mail it in the enclosed pre-addressed postage-paid envelope. Please also make sure to mail it no later than **August 11, 2008**. Should you have any questions about the survey, please call 866-931-5311.

The information you provide will be used solely for planning purposes and answers will be held in the strictest confidence. The survey results are being analyzed by an independent research organization, and will be reported in group form only. The City of Seattle will not see the individual surveys in paper or in electronic form.

On behalf of the City of Seattle and residential water customers throughout our service area, thank you for responding to this request. Your response will help us in improving future communications on water conservation and making the best use of our resources.

Sincerely yours,

Al Dietemann

Acting Resource Conservation Manager
Seattle Public Utilities

FINAL REMINDER POSTCARD 2 TO NON-RSPONDENTS

Saving Water Partnership
Seattle and Participating Local Water Utilities

RESIDENTIAL CUSTOMER WATER SURVEY

Recently we asked you to complete an important survey regarding our water conservation programs.

If you have already completed the survey, thank you for your feedback. If not, please take a few minutes to complete the survey to help us evaluate our water conservation outreach and education programs.

You only have two more weeks to send us your response and help conservation efforts in your community.

The information you provide will be used solely for planning purposes and answers will be kept confidential. The survey results are being analyzed by an independent research organization and will be reported in group form only.

If you have any questions, please call 866-931-5311 between 6 am and 2 pm Pacific Time.

THANK YOU

Saving Water Partnership
Seattle and Participating Local Water Utilities

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Seattle and Participating Local Water Utilities

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Seattle and Participating Local Water Utilities

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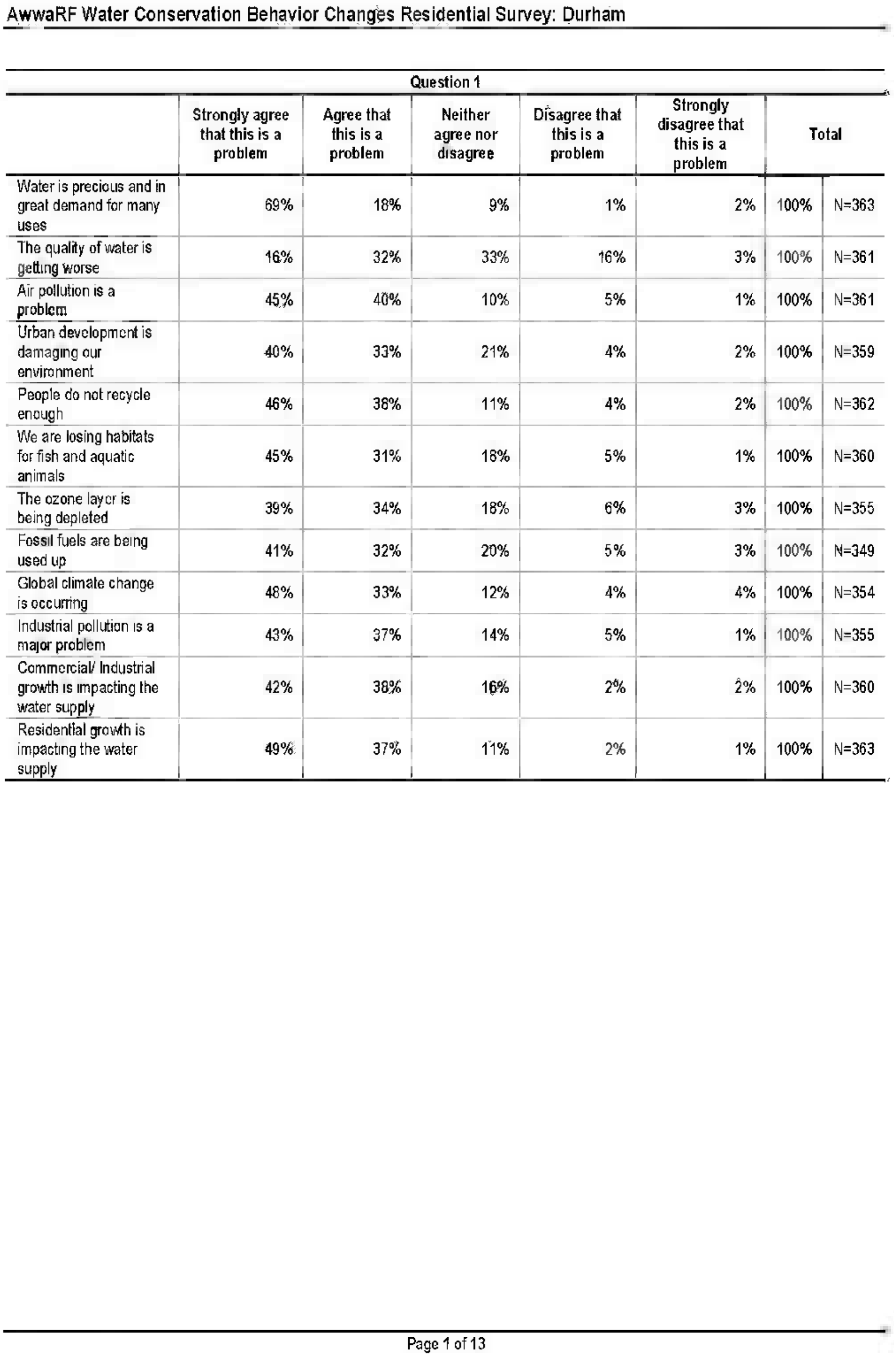
THANK YOU

APPENDIX D:
ENUMERATED SURVEY RESPONSES

CITY OF DURHAM DEPARTMENT OF WATER MANAGEMENT: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 1

	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	69%	18%	9%	1%	2%	100%	N=363
The quality of water is getting worse	16%	32%	33%	16%	3%	100%	N=361
Air pollution is a problem	45%	40%	10%	5%	1%	100%	N=361
Urban development is damaging our environment	40%	33%	21%	4%	2%	100%	N=359
People do not recycle enough	46%	38%	11%	4%	2%	100%	N=362
We are losing habitats for fish and aquatic animals	45%	31%	18%	5%	1%	100%	N=360
The ozone layer is being depleted	39%	34%	18%	6%	3%	100%	N=355
Fossil fuels are being used up	41%	32%	20%	5%	3%	100%	N=349
Global climate change is occurring	48%	33%	12%	4%	4%	100%	N=354
Industrial pollution is a major problem	43%	37%	14%	5%	1%	100%	N=355
Commercial/ Industrial growth is impacting the water supply	42%	38%	16%	2%	2%	100%	N=360
Residential growth is impacting the water supply	49%	37%	11%	2%	1%	100%	N=363

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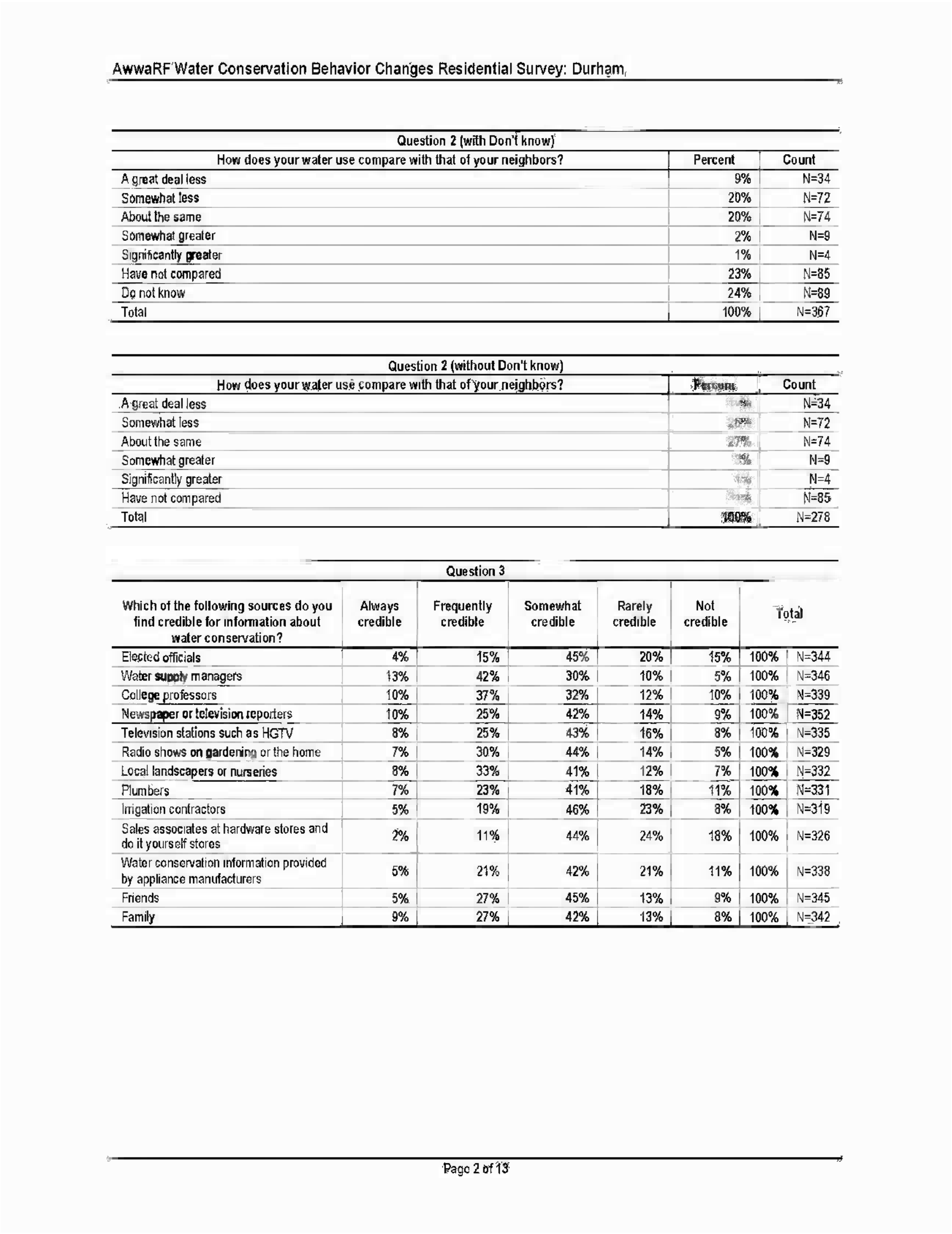

AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 2 (with Don't know) How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	9%	N=34
Somewhat less	20%	N=72
About the same	20%	N=74
Somewhat greater	2%	N=9
Significantly greater	1%	N=4
Have not compared	23%	N=85
Do not know	24%	N=89
Total	100%	N=367

Question 2 (without Don't know) How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	12%	N=34
Somewhat less	26%	N=72
About the same	27%	N=74
Somewhat greater	3%	N=9
Significantly greater	1%	N=4
Have not compared	31%	N=85
Total	100%	N=278

Question 3

Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	4%	15%	45%	20%	15%	100%	N=344
Water supply managers	13%	42%	30%	10%	5%	100%	N=346
College professors	10%	37%	32%	12%	10%	100%	N=339
Newspaper or television reporters	10%	25%	42%	14%	9%	100%	N=352
Television stations such as HGTV	8%	25%	43%	16%	8%	100%	N=335
Radio shows on gardening or the home	7%	30%	44%	14%	5%	100%	N=329
Local landscapers or nurseries	8%	33%	41%	12%	7%	100%	N=332
Plumbers	7%	23%	41%	18%	11%	100%	N=331
Irrigation contractors	5%	19%	46%	23%	8%	100%	N=319
Sales associates at hardware stores and do it yourself stores	2%	11%	44%	24%	18%	100%	N=326
Water conservation information provided by appliance manufacturers	5%	21%	42%	21%	11%	100%	N=338
Friends	5%	27%	45%	13%	9%	100%	N=345
Family	9%	27%	42%	13%	8%	100%	N=342

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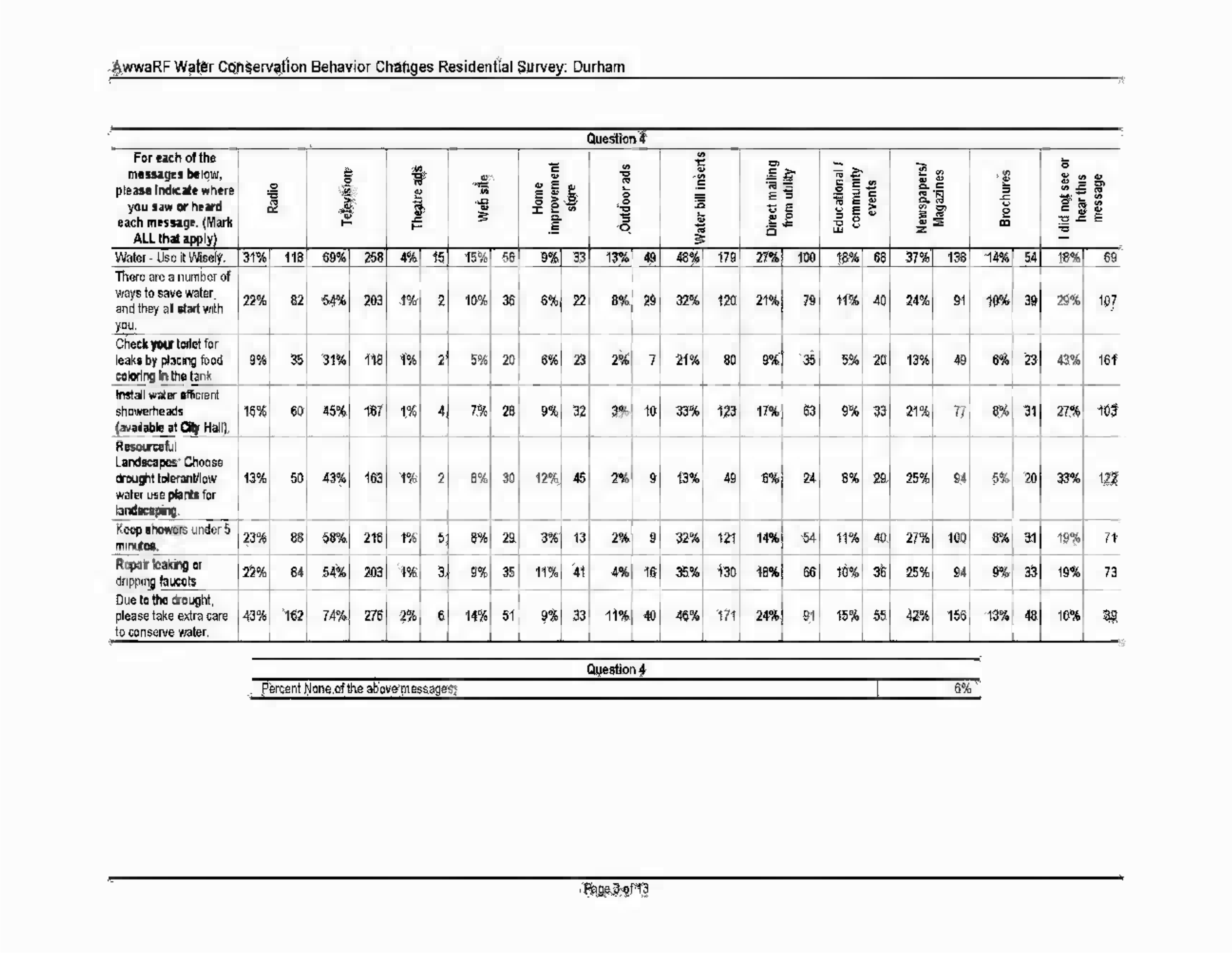

AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 4

For each of the messages below, please indicate where you saw or heard each message. (Mark ALL that apply)	Radio		Television		Theatre ads		Web site		Home improvement store		Outdoor ads		Water bill inserts		Direct mailing from utility		Educational / community events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Water - Use it Wisely.	31%	118	69%	258	4%	15	15%	56	9%	33	13%	49	48%	179	27%	100	18%	68	37%	136	14%	54	18%	69
There are a number of ways to save water, and they all start with you.	22%	82	54%	203	1%	2	10%	36	6%	22	8%	29	32%	120	21%	79	11%	40	24%	91	10%	39	29%	107
Check your toilet for leaks by placing food coloring in the tank	9%	35	31%	118	1%	2	5%	20	6%	23	2%	7	21%	80	9%	35	5%	20	13%	49	6%	23	43%	161
Install water efficient showerheads (available at City Hall).	16%	60	45%	167	1%	4	7%	28	9%	32	3%	10	33%	123	17%	63	9%	33	21%	77	8%	31	27%	103
Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping.	13%	50	43%	163	1%	2	8%	30	12%	45	2%	9	13%	49	6%	24	8%	29	25%	94	5%	20	33%	122
Keep showers under 5 minutes.	23%	88	58%	216	1%	5	8%	29	3%	13	2%	9	32%	121	14%	54	11%	40	27%	100	8%	31	19%	71
Repair leaking or dripping faucets	22%	84	54%	203	1%	3	9%	35	11%	41	4%	16	35%	130	18%	66	10%	36	25%	94	9%	33	19%	73
Due to the drought, please take extra care to conserve water.	43%	162	74%	276	2%	6	14%	51	9%	33	11%	40	46%	171	24%	91	15%	55	42%	156	13%	48	10%	39

Question 4

Percent None of the above messages:	6%

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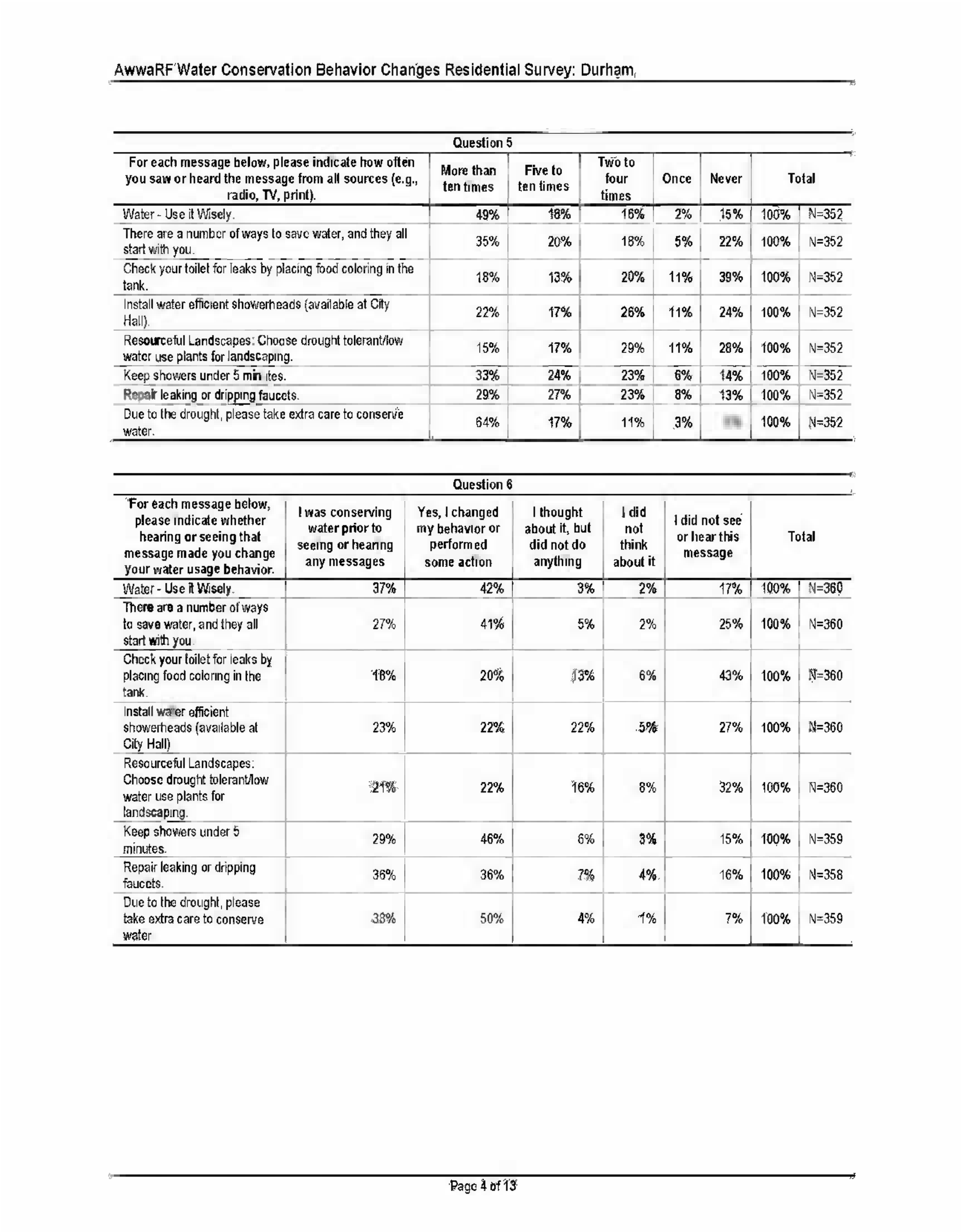


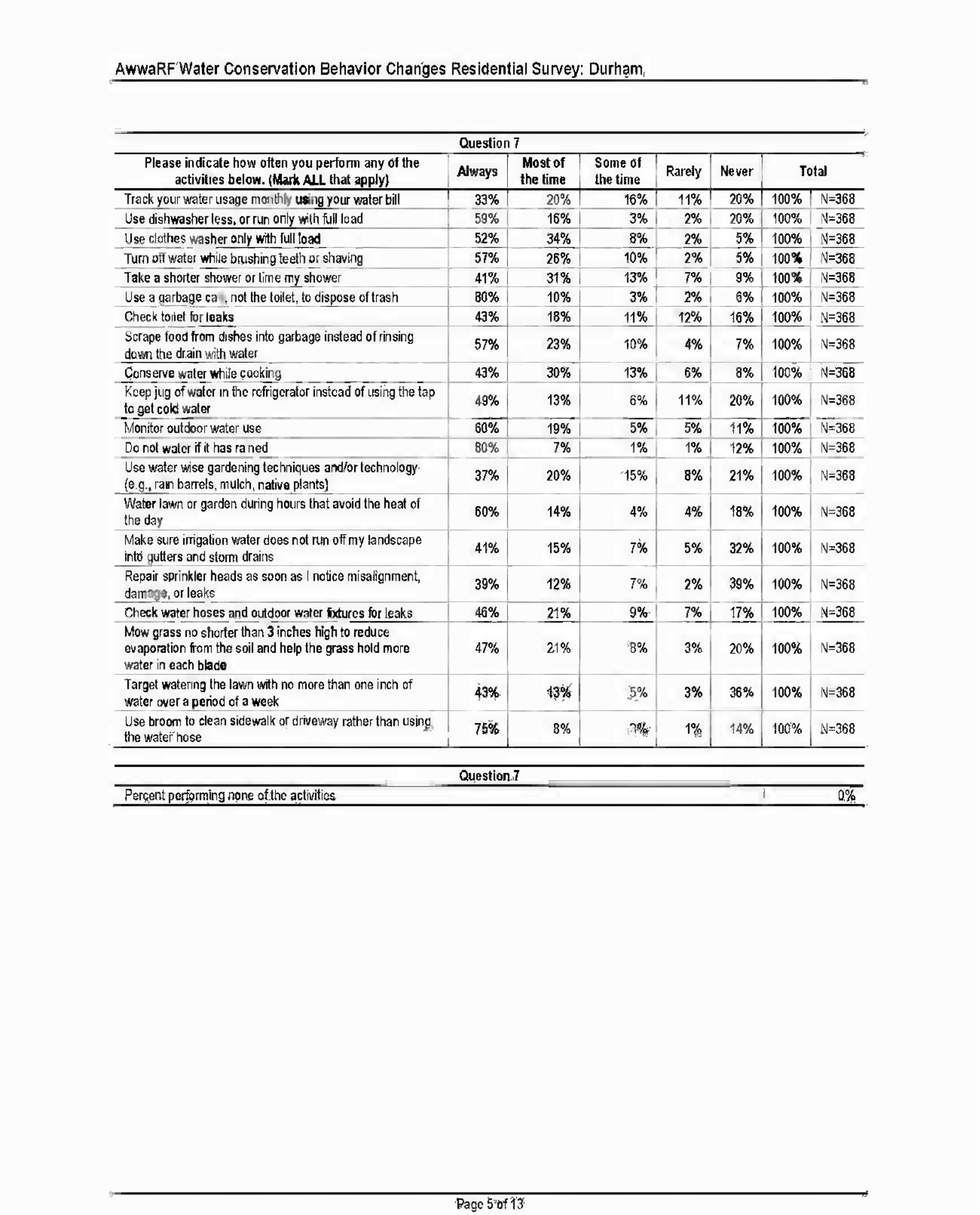
AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 5

For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
Water - Use it Wisely.	49%	18%	16%	2%	15%	100%	N=352
There are a number of ways to save water, and they all start with you.	35%	20%	18%	5%	22%	100%	N=352
Check your toilet for leaks by placing food coloring in the tank.	18%	13%	20%	11%	39%	100%	N=352
Install water efficient showerheads (available at City Hall).	22%	17%	26%	11%	24%	100%	N=352
Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping.	15%	17%	29%	11%	28%	100%	N=352
Keep showers under 5 minutes.	33%	24%	23%	6%	14%	100%	N=352
Repair leaking or dripping faucets.	29%	27%	23%	8%	13%	100%	N=352
Due to the drought, please take extra care to conserve water.	64%	17%	11%	3%	[illegible]	100%	N=352

Question 6

For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
Water - Use it Wisely.	37%	42%	3%	2%	17%	100%	N=360
There are a number of ways to save water, and they all start with you.	27%	41%	5%	2%	25%	100%	N=360
Check your toilet for leaks by placing food coloring in the tank.	18%	20%	13%	6%	43%	100%	N=360
Install water efficient showerheads (available at City Hall)	23%	22%	22%	5%	27%	100%	N=360
Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping.	21%	22%	16%	8%	32%	100%	N=360
Keep showers under 5 minutes.	29%	46%	6%	3%	15%	100%	N=359
Repair leaking or dripping faucets.	36%	36%	7%	4%	16%	100%	N=358
Due to the drought, please take extra care to conserve water	38%	50%	4%	1%	7%	100%	N=359



AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 7

Please indicate how often you perform any of the activities below. (Mark ALL that apply)	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track your water usage monthly using your water bill	33%	20%	16%	11%	20%	100%	N=368
Use dishwasher less, or run only with full load	59%	16%	3%	2%	20%	100%	N=368
Use clothes washer only with full load	52%	34%	8%	2%	5%	100%	N=368
Turn off water while brushing teeth or shaving	57%	26%	10%	2%	5%	100%	N=368
Take a shorter shower or time my shower	41%	31%	13%	7%	9%	100%	N=368
Use a garbage can, not the toilet, to dispose of trash	80%	10%	3%	2%	6%	100%	N=368
Check toilet for leaks	43%	18%	11%	12%	16%	100%	N=368
Scrape food from dishes into garbage instead of rinsing down the drain with water	57%	23%	10%	4%	7%	100%	N=368
Conserve water while cooking	43%	30%	13%	6%	8%	100%	N=368
Keep jug of water in the refrigerator instead of using the tap to get cold water	49%	13%	6%	11%	20%	100%	N=368
Monitor outdoor water use	60%	19%	5%	5%	11%	100%	N=368
Do not water if it has rained	80%	7%	1%	1%	12%	100%	N=368
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	37%	20%	15%	8%	21%	100%	N=368
Water lawn or garden during hours that avoid the heat of the day	60%	14%	4%	4%	18%	100%	N=368
Make sure irrigation water does not run off my landscape into gutters and storm drains	41%	15%	7%	5%	32%	100%	N=368
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	39%	12%	7%	2%	39%	100%	N=368
Check water hoses and outdoor water fixtures for leaks	46%	21%	9%	7%	17%	100%	N=368
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	47%	21%	8%	3%	20%	100%	N=368
Target watering the lawn with no more than one inch of water over a period of a week	43%	13%	5%	3%	36%	100%	N=368
Use broom to clean sidewalk or driveway rather than using the water hose	75%	8%	3%	1%	14%	100%	N=368

Question 7

Percent performing none of the activities	0%

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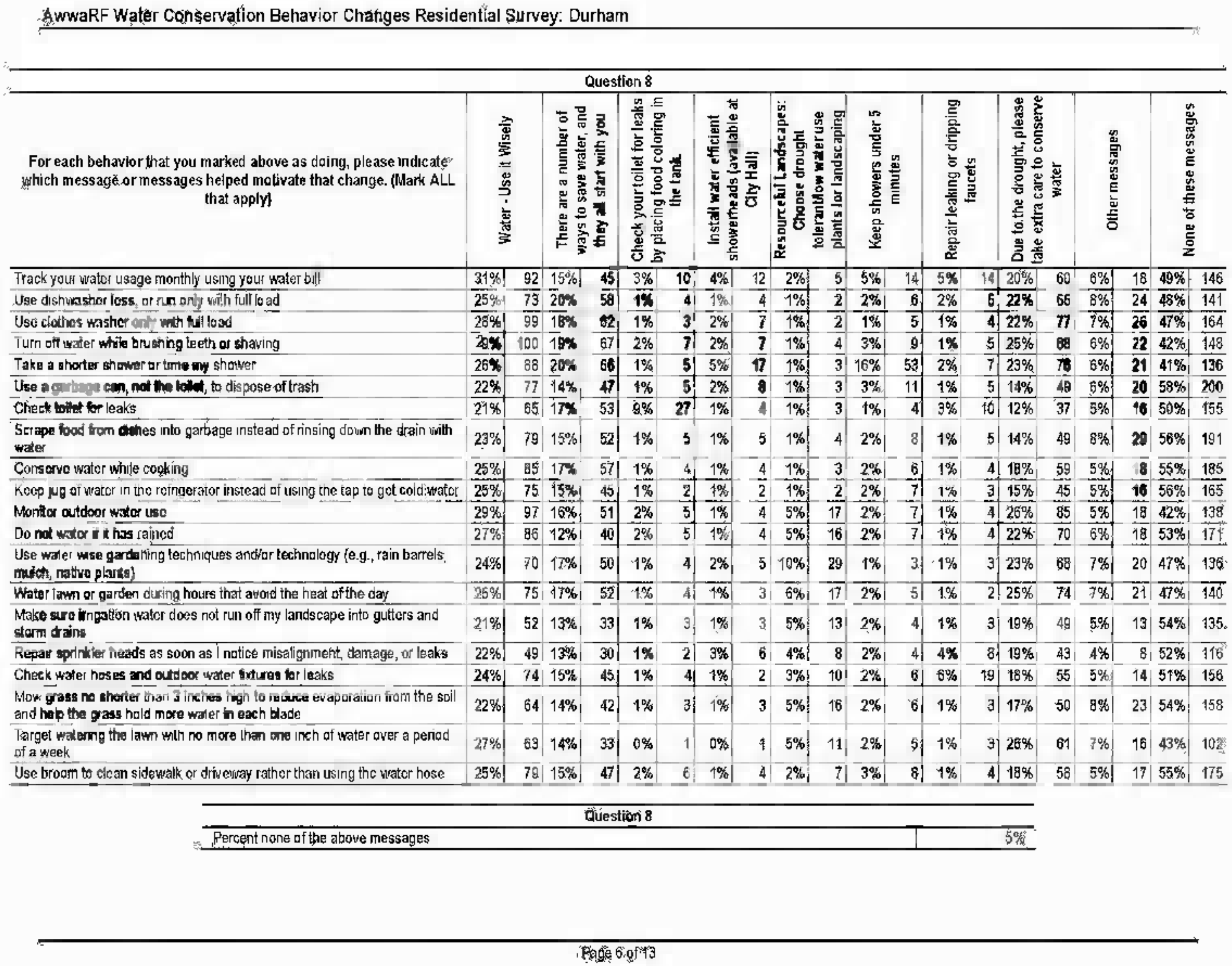

AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 8

For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change. (Mark ALL that apply)	Water - Use it Wisely		There are a number of ways to save water, and they all start with you		Check your toilet for leaks by placing food coloring in the tank		Install water efficient showerheads (available at City Hall)		Resourceful Landscapes: Choose drought tolerant/low water use plants for landscaping		Keep showers under 5 minutes		Repair leaking or dripping faucets		Due to the drought, please take extra care to conserve water		Other messages		None of these messages	
Track your water usage monthly using your water bill	31%	92	15%	45	3%	10	4%	12	2%	5	5%	14	5%	14	20%	60	6%	18	49%	146
Use dishwasher less, or run only with full load	25%	73	20%	58	1%	4	1%	4	1%	2	2%	6	2%	6	22%	66	8%	24	48%	141
Use clothes washer only with full load	28%	99	18%	62	1%	3	2%	7	1%	2	1%	5	1%	4	22%	77	7%	26	47%	164
Turn off water while brushing teeth or shaving	29%	100	19%	67	2%	7	2%	7	1%	4	3%	9	1%	5	25%	88	6%	22	42%	148
Take a shorter shower or time my shower	26%	88	20%	66	1%	5	5%	17	1%	3	16%	53	2%	7	23%	78	6%	21	41%	136
Use a garbage can, not the toilet, to dispose of trash	22%	77	14%	47	1%	5	2%	8	1%	3	3%	11	1%	5	14%	49	6%	20	58%	200
Check toilet for leaks	21%	65	17%	53	9%	27	1%	4	1%	3	1%	4	3%	10	12%	37	5%	16	50%	155
Scrape food from dishes into garbage instead of rinsing down the drain with water	23%	79	15%	52	1%	5	1%	5	1%	4	2%	8	1%	5	14%	49	6%	20	56%	191
Conserve water while cooking	25%	85	17%	57	1%	4	1%	4	1%	3	2%	6	1%	4	18%	59	5%	18	55%	185
Keep jug of water in the refrigerator instead of using the tap to get cold water	25%	75	15%	45	1%	2	1%	2	1%	2	2%	7	1%	3	15%	45	5%	16	56%	165
Monitor outdoor water use	29%	97	16%	51	2%	5	1%	4	5%	17	2%	7	1%	4	26%	85	5%	18	42%	138
Do not water if it has rained	27%	86	12%	40	2%	5	1%	4	5%	16	2%	7	1%	4	22%	70	6%	18	53%	171
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	24%	70	17%	50	1%	4	2%	5	10%	29	1%	3	1%	3	23%	68	7%	20	47%	136
Water lawn or garden during hours that avoid the heat of the day	25%	75	17%	52	1%	4	1%	3	6%	17	2%	5	1%	2	25%	74	7%	21	47%	140
Make sure irrigation water does not run off my landscape into gutters and storm drains	21%	52	13%	33	1%	3	1%	3	5%	13	2%	4	1%	3	19%	49	5%	13	54%	135
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	22%	49	13%	30	1%	2	3%	6	4%	8	2%	4	4%	8	19%	43	4%	8	52%	116
Check water hoses and outdoor water fixtures for leaks	24%	74	15%	45	1%	4	1%	2	3%	10	2%	6	6%	19	18%	55	5%	14	51%	156
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	22%	64	14%	42	1%	3	1%	3	5%	16	2%	6	1%	3	17%	50	8%	23	54%	158
Target watering the lawn with no more than one inch of water over a period of a week	27%	63	14%	33	0%	1	0%	1	5%	11	2%	5	1%	3	26%	61	7%	16	43%	102
Use broom to clean sidewalk or driveway rather than using the water hose	25%	79	15%	47	2%	6	1%	4	2%	7	3%	8	1%	4	18%	58	5%	17	55%	175

Question 8	
Percent none of the above messages	5%

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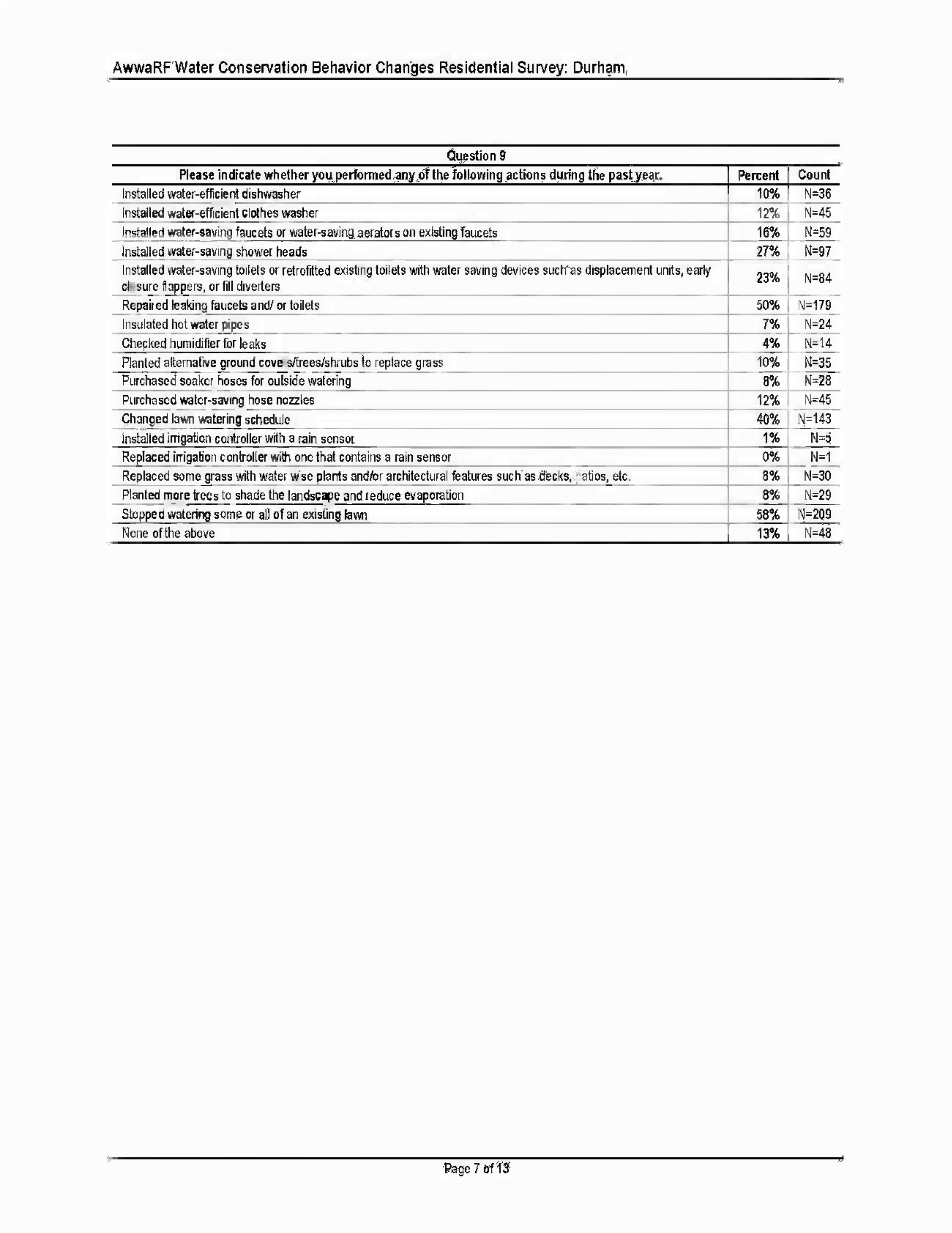
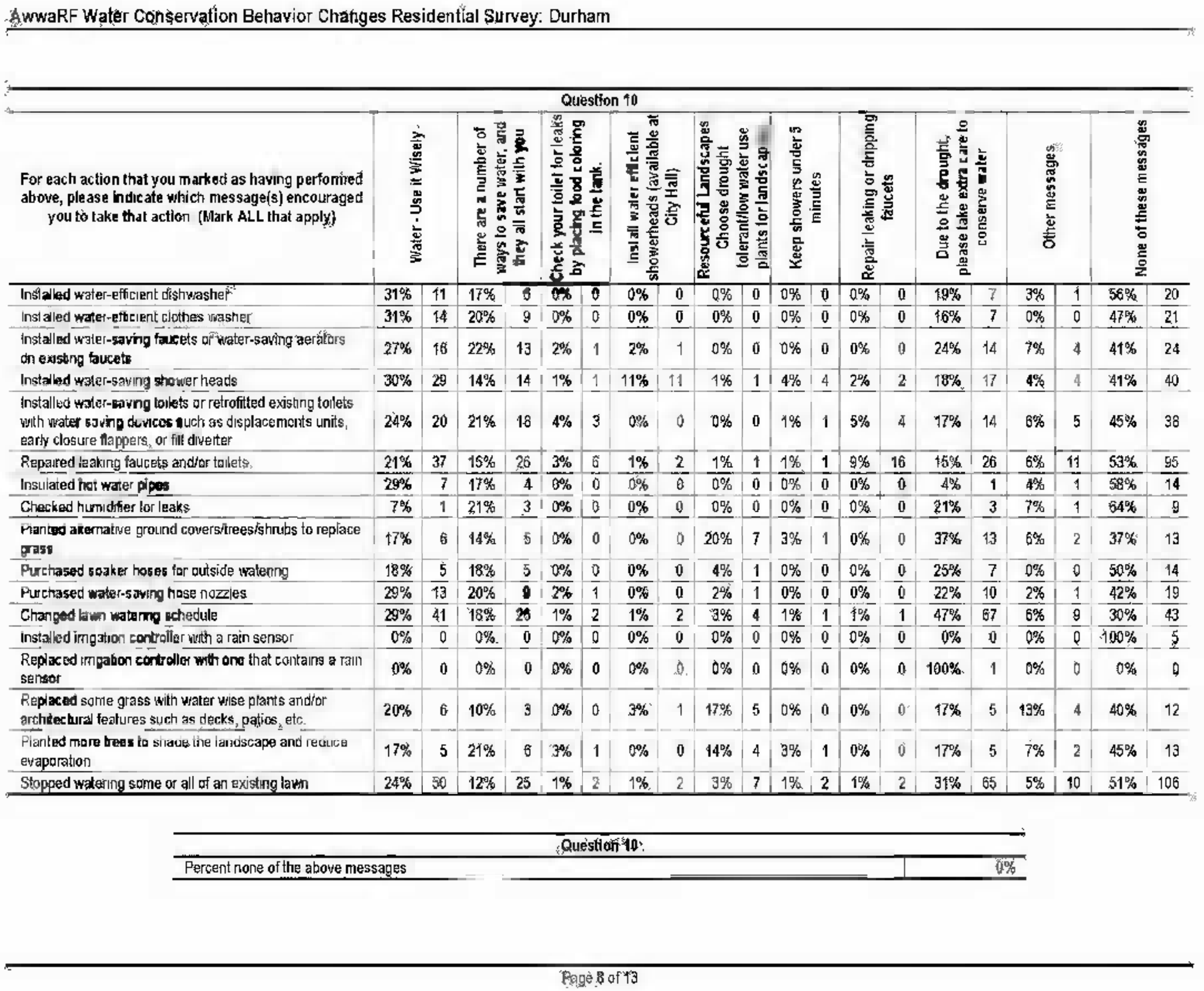


Question 9 Please indicate whether you performed any of the following actions during the past year.	Percent	Count
Installed water-efficient dishwasher	10%	N=36
Installed water-efficient clothes washer	12%	N=45
Installed water-saving faucets or water-saving aerators on existing faucets	16%	N=59
Installed water-saving shower heads	27%	N=97
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	23%	N=84
Repaired leaking faucets and/ or toilets	50%	N=179
Insulated hot water pipes	7%	N=24
Checked humidifier for leaks	4%	N=14
Planted alternative ground covers/trees/shrubs to replace grass	10%	N=35
Purchased soaker hoses for outside watering	8%	N=28
Purchased water-saving hose nozzles	12%	N=45
Changed lawn watering schedule	40%	N=143
Installed irrigation controller with a rain sensor	1%	N=5
Replaced irrigation controller with one that contains a rain sensor	0%	N=1
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	8%	N=30
Planted more trees to shade the landscape and reduce evaporation	8%	N=29
Stopped watering some or all of an existing lawn	58%	N=209
None of the above	13%	N=48



AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 10

For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action (Mark ALL that apply)	Water - Use it Wisely -		There are a number of ways to save water, and they all start with you		Check your toilet for leaks by placing food coloring in the tank.		Install water efficient showerheads (available at City Hall)		Resourceful Landscapes Choose drought tolerant/low water use plants for landscap		Keep showers under 5 minutes		Repair leaking or dripping faucets		Due to the drought, please take extra care to conserve water		Other messages		None of these messages	
Installed water-efficient dishwasher	31%	11	17%	6	0%	0	0%	0	0%	0	0%	0	0%	0	19%	7	3%	1	56%	20
Installed water-efficient clothes washer	31%	14	20%	9	0%	0	0%	0	0%	0	0%	0	0%	0	16%	7	0%	0	47%	21
Installed water-saving faucets or water-saving aerators on existing faucets	27%	16	22%	13	2%	1	2%	1	0%	0	0%	0	0%	0	24%	14	7%	4	41%	24
Installed water-saving shower heads	30%	29	14%	14	1%	1	11%	11	1%	1	4%	4	2%	2	18%	17	4%	4	41%	40
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	24%	20	21%	18	4%	3	0%	0	0%	0	1%	1	5%	4	17%	14	6%	5	45%	38
Repaired leaking faucets and/or toilets	21%	37	15%	26	3%	6	1%	2	1%	1	1%	1	9%	16	15%	26	6%	11	53%	95
Insulated hot water pipes	29%	7	17%	4	0%	0	0%	0	0%	0	0%	0	0%	0	4%	1	4%	1	58%	14
Checked humidifier for leaks	7%	1	21%	3	0%	0	0%	0	0%	0	0%	0	0%	0	21%	3	7%	1	64%	9
Planted alternative ground covers/trees/shrubs to replace grass	17%	6	14%	5	0%	0	0%	0	20%	7	3%	1	0%	0	37%	13	6%	2	37%	13
Purchased soaker hoses for outside watering	18%	5	18%	5	0%	0	0%	0	4%	1	0%	0	0%	0	25%	7	0%	0	50%	14
Purchased water-saving hose nozzles	29%	13	20%	9	2%	1	0%	0	2%	1	0%	0	0%	0	22%	10	2%	1	42%	19
Changed lawn watering schedule	29%	41	18%	26	1%	2	1%	2	3%	4	1%	1	1%	1	47%	67	6%	9	30%	43
Installed irrigation controller with a rain sensor	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	100%	5
Replaced irrigation controller with one that contains a rain sensor	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	100%	1	0%	0	0%	0
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	20%	6	10%	3	0%	0	3%	1	17%	5	0%	0	0%	0	17%	5	13%	4	40%	12
Planted more trees to shade the landscape and reduce evaporation	17%	5	21%	6	3%	1	0%	0	14%	4	3%	1	0%	0	17%	5	7%	2	45%	13
Stopped watering some or all of an existing lawn	24%	50	12%	25	1%	2	1%	2	3%	7	1%	2	1%	2	31%	65	5%	10	51%	106

	Question 10
Percent none of the above messages	0%

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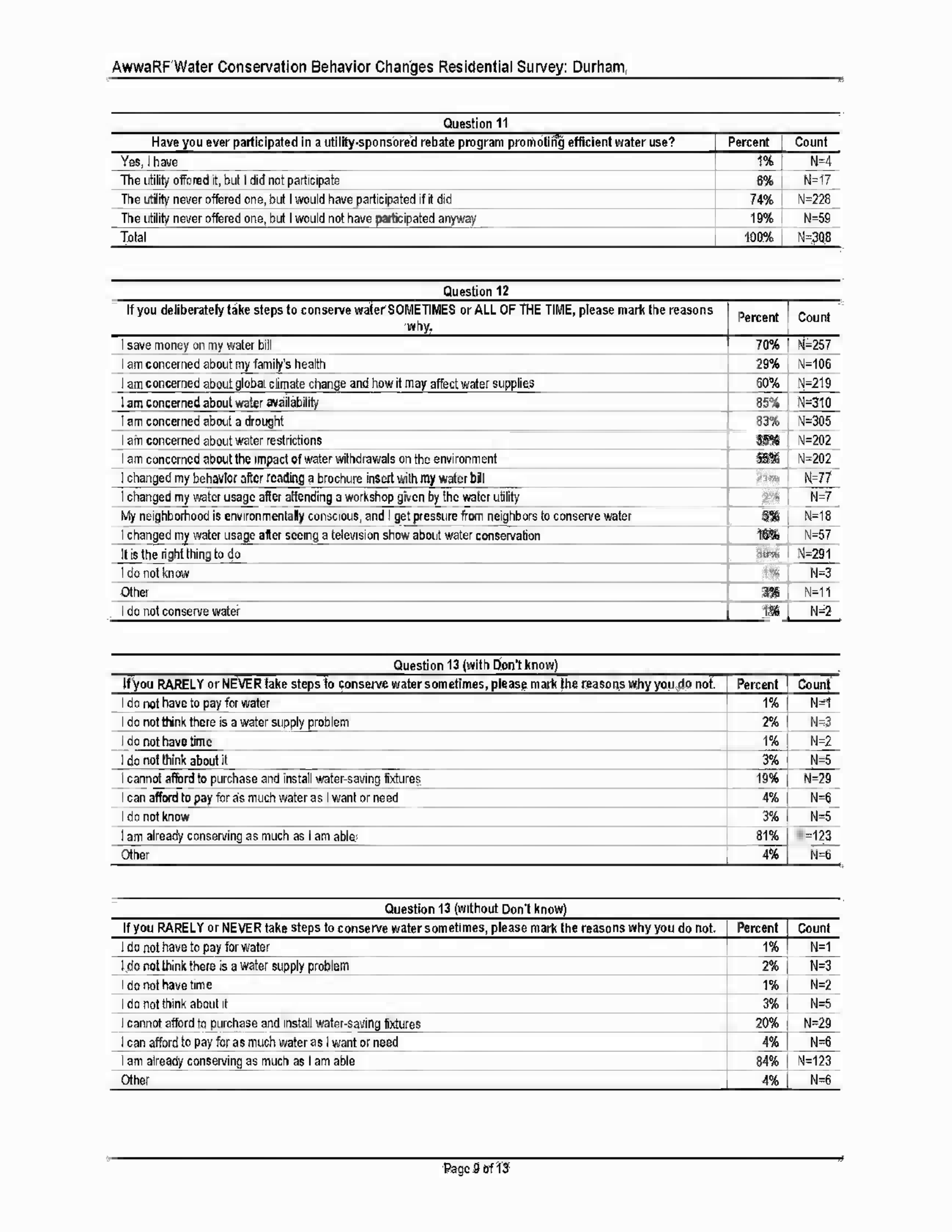

AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 11

Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	1%	N=4
The utility offered it, but I did not participate	6%	N=17
The utility never offered one, but I would have participated if it did	74%	N=228
The utility never offered one, but I would not have participated anyway	19%	N=59
Total	100%	N=308

Question 12

If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	70%	N=257
I am concerned about my family's health	29%	N=106
I am concerned about global climate change and how it may affect water supplies	60%	N=219
I am concerned about water availability	85%	N=310
I am concerned about a drought	83%	N=305
I am concerned about water restrictions	55%	N=202
I am concerned about the impact of water withdrawals on the environment	55%	N=202
I changed my behavior after reading a brochure insert with my water bill	21%	N=77
I changed my water usage after attending a workshop given by the water utility	2%	N=7
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	5%	N=18
I changed my water usage after seeing a television show about water conservation	16%	N=57
It is the right thing to do	80%	N=291
I do not know	1%	N=3
Other	3%	N=11
I do not conserve water	1%	N=2

Question 13 (with Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	2%	N=3
I do not have time	1%	N=2
I do not think about it	3%	N=5
I cannot afford to purchase and install water-saving fixtures	19%	N=29
I can afford to pay for as much water as I want or need	4%	N=6
I do not know	3%	N=5
I am already conserving as much as I am able	81%	[illegible]=123
Other	4%	N=6

Question 13 (without Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	2%	N=3
I do not have time	1%	N=2
I do not think about it	3%	N=5
I cannot afford to purchase and install water-saving fixtures	20%	N=29
I can afford to pay for as much water as I want or need	4%	N=6
I am already conserving as much as I am able	84%	N=123
Other	4%	N=6

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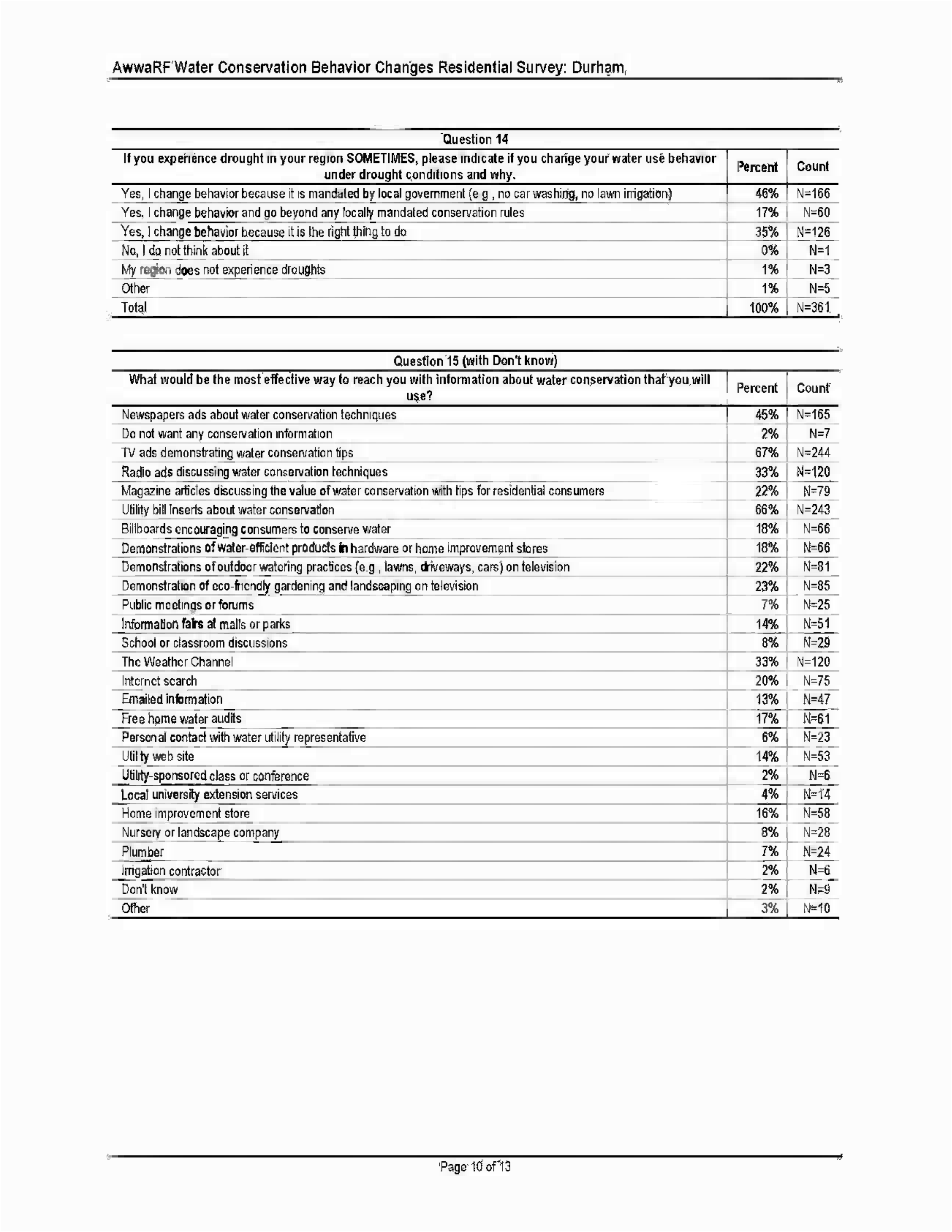
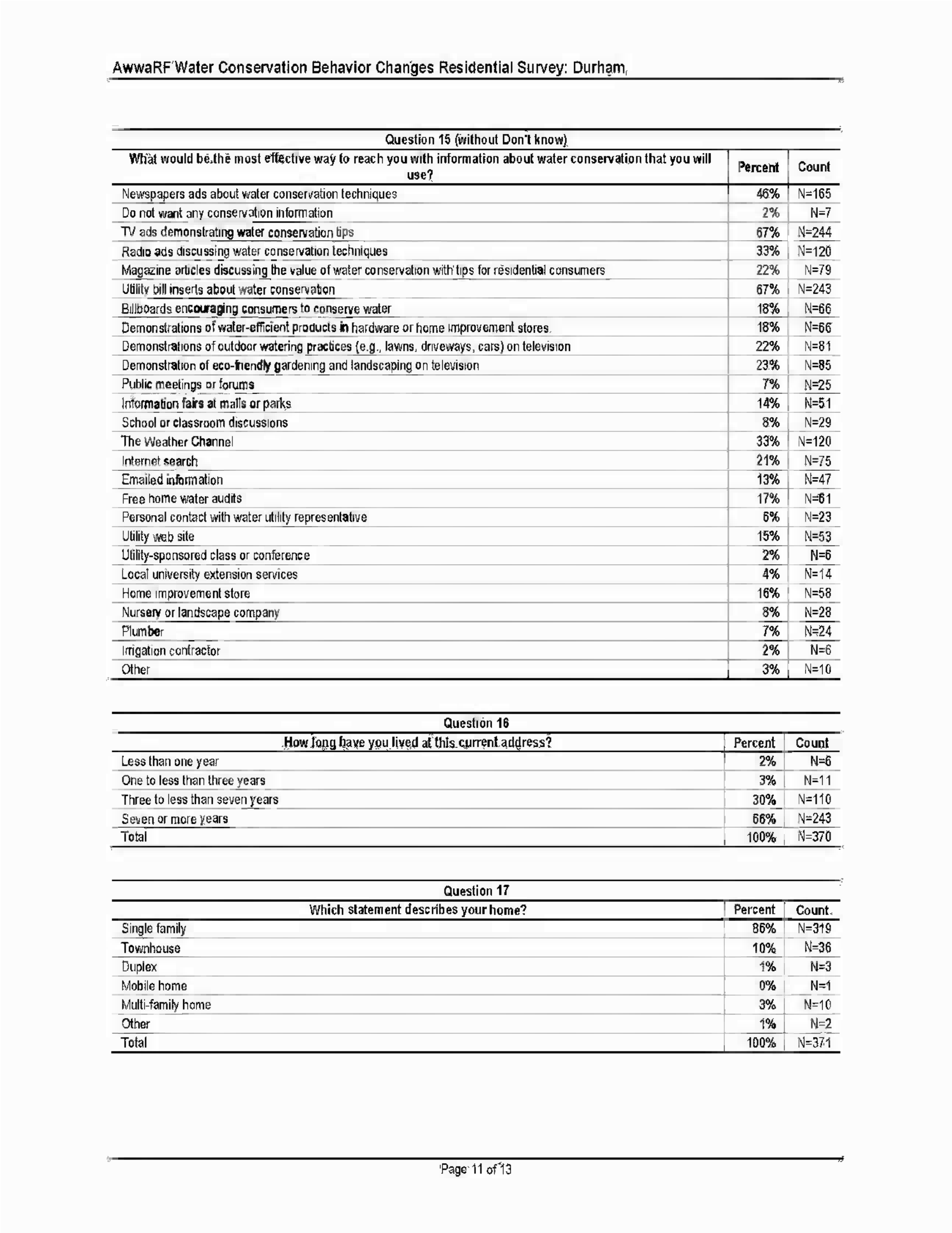


AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 14 If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	46%	N=166
Yes, I change behavior and go beyond any locally mandated conservation rules	17%	N=60
Yes, I change behavior because it is the right thing to do	35%	N=126
No, I do not think about it	0%	N=1
My region does not experience droughts	1%	N=3
Other	1%	N=5
Total	100%	N=361

Question 15 (with Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	45%	N=165
Do not want any conservation information	2%	N=7
TV ads demonstrating water conservation tips	67%	N=244
Radio ads discussing water conservation techniques	33%	N=120
Magazine articles discussing the value of water conservation with tips for residential consumers	22%	N=79
Utility bill Inserts about water conservation	66%	N=243
Billboards encouraging consumers to conserve water	18%	N=66
Demonstrations of water-efficient products in hardware or home improvement stores	18%	N=66
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	22%	N=81
Demonstration of eco-friendly gardening and landscaping on television	23%	N=85
Public meetings or forums	7%	N=25
Information fairs at malls or parks	14%	N=51
School or classroom discussions	8%	N=29
The Weather Channel	33%	N=120
Internet search	20%	N=75
Emailed information	13%	N=47
Free home water audits	17%	N=61
Personal contact with water utility representative	6%	N=23
Utility web site	14%	N=53
Utility-sponsored class or conference	2%	N=6
Local university extension services	4%	N=14
Home improvement store	16%	N=58
Nursery or landscape company	8%	N=28
Plumber	7%	N=24
Irrigation contractor	2%	N=6
Don't know	2%	N=9
Other	3%	N=10



AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 15 (without Don't know)

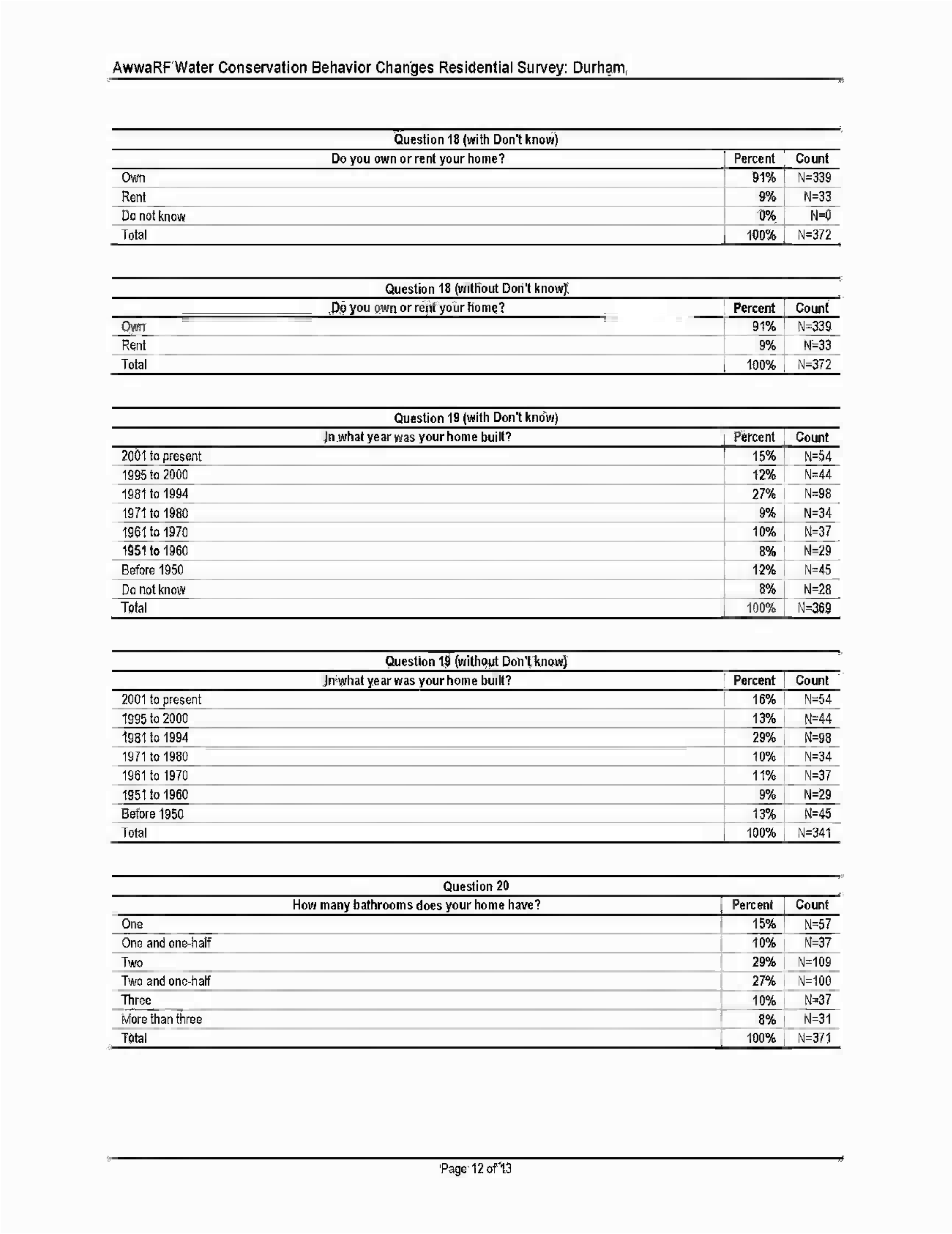
What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	46%	N=165
Do not want any conservation information	2%	N=7
TV ads demonstrating water conservation tips	67%	N=244
Radio ads discussing water conservation techniques	33%	N=120
Magazine articles discussing the value of water conservation with tips for residential consumers	22%	N=79
Utility bill inserts about water conservation	67%	N=243
Billboards encouraging consumers to conserve water	18%	N=66
Demonstrations of water-efficient products in hardware or home improvement stores.	18%	N=66
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	22%	N=81
Demonstration of eco-friendly gardening and landscaping on television	23%	N=85
Public meetings or forums	7%	N=25
Information fairs at malls or parks	14%	N=51
School or classroom discussions	8%	N=29
The Weather Channel	33%	N=120
Internet search	21%	N=75
Emailed information	13%	N=47
Free home water audits	17%	N=61
Personal contact with water utility representative	6%	N=23
Utility web site	15%	N=53
Utility-sponsored class or conference	2%	N=6
Local university extension services	4%	N=14
Home improvement store	16%	N=58
Nursery or landscape company	8%	N=28
Plumber	7%	N=24
Irrigation contractor	2%	N=6
Other	3%	N=10

Question 16

How long have you lived at this current address?	Percent	Count
Less than one year	2%	N=6
One to less than three years	3%	N=11
Three to less than seven years	30%	N=110
Seven or more years	66%	N=243
Total	100%	N=370

Question 17

Which statement describes your home?	Percent	Count
Single family	86%	N=319
Townhouse	10%	N=36
Duplex	1%	N=3
Mobile home	0%	N=1
Multi-family home	3%	N=10
Other	1%	N=2
Total	100%	N=371



Question 18 (with Don't know)

Do you own or rent your home?	Percent	Count
Own	91%	N=339
Rent	9%	N=33
Do not know	0%	N=0
Total	100%	N=372

Question 18 (without Don't know)

Do you own or rent your home?	Percent	Count
Own	91%	N=339
Rent	9%	N=33
Total	100%	N=372

Question 19 (with Don't know)

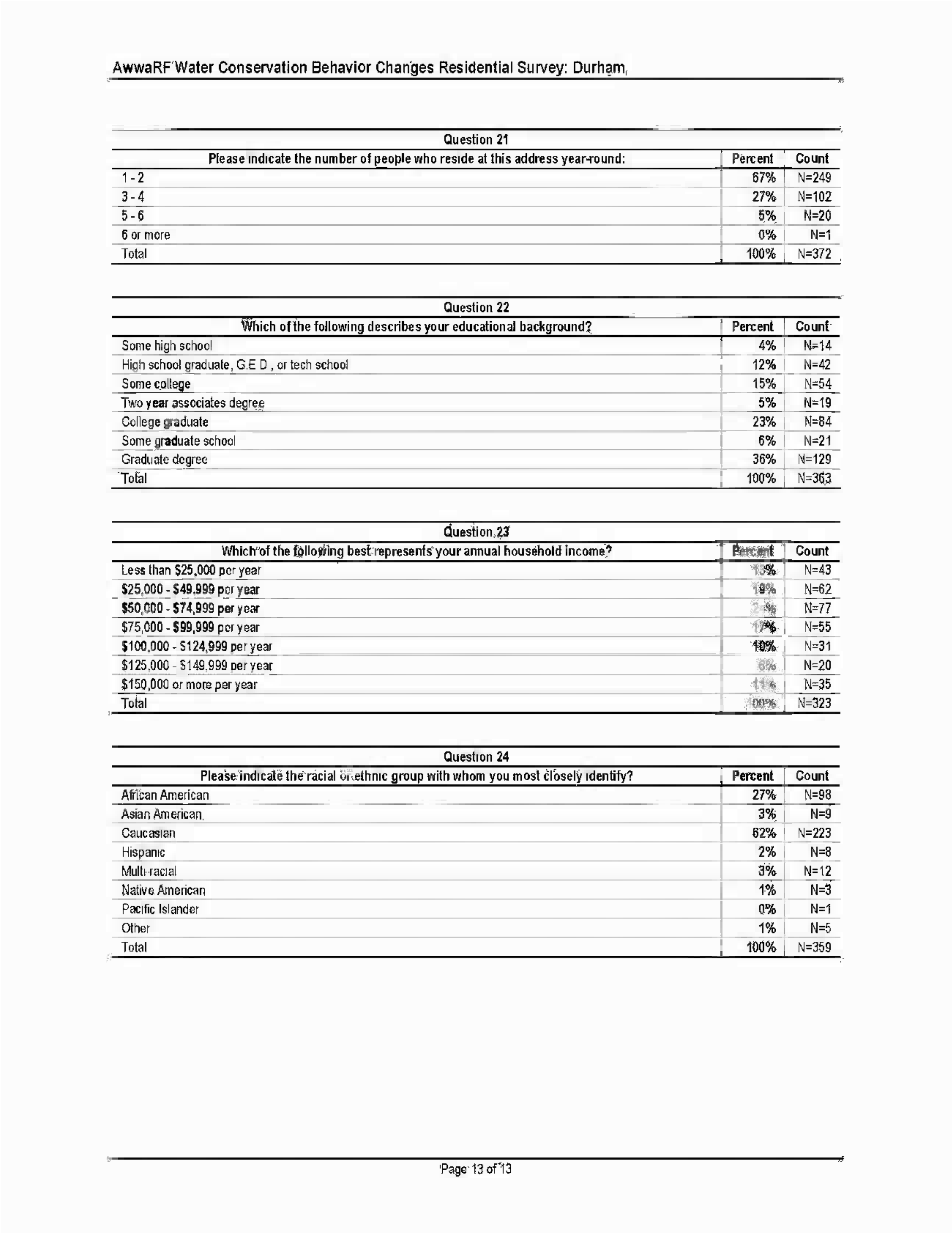
In what year was your home built?	Percent	Count
2001 to present	15%	N=54
1995 to 2000	12%	N=44
1981 to 1994	27%	N=98
1971 to 1980	9%	N=34
1961 to 1970	10%	N=37
1951 to 1960	8%	N=29
Before 1950	12%	N=45
Do not know	8%	N=28
Total	100%	N=369

Question 19 (without Don't know)

In what year was your home built?	Percent	Count
2001 to present	16%	N=54
1995 to 2000	13%	N=44
1981 to 1994	29%	N=98
1971 to 1980	10%	N=34
1961 to 1970	11%	N=37
1951 to 1960	9%	N=29
Before 1950	13%	N=45
Total	100%	N=341

Question 20

How many bathrooms does your home have?	Percent	Count
One	15%	N=57
One and one-half	10%	N=37
Two	29%	N=109
Two and one-half	27%	N=100
Three	10%	N=37
More than three	8%	N=31
Total	100%	N=371



AwwaRF Water Conservation Behavior Changes Residential Survey: Durham

Question 21 Please indicate the number of people who reside at this address year-round:	Percent	Count
1 - 2	67%	N=249
3 - 4	27%	N=102
5 - 6	5%	N=20
6 or more	0%	N=1
Total	100%	N=372

Question 22 Which of the following describes your educational background?	Percent	Count
Some high school	4%	N=14
High school graduate, G.E D , or tech school	12%	N=42
Some college	15%	N=54
Two year associates degree	5%	N=19
College graduate	23%	N=84
Some graduate school	6%	N=21
Graduate degree	36%	N=129
Total	100%	N=363

Question 23 Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	13%	N=43
$25,000 - $49,999 per year	19%	N=62
$50,000 - $74,999 per year	24%	N=77
$75,000 - $99,999 per year	17%	N=55
$100,000 - $124,999 per year	10%	N=31
$125,000 - $149,999 per year	6%	N=20
$150,000 or more per year	11%	N=35
Total	100%	N=323

Question 24 Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	27%	N=98
Asian American	3%	N=9
Caucasian	62%	N=223
Hispanic	2%	N=8
Multi-racial	3%	N=12
Native American	1%	N=3
Pacific Islander	0%	N=1
Other	1%	N=5
Total	100%	N=359

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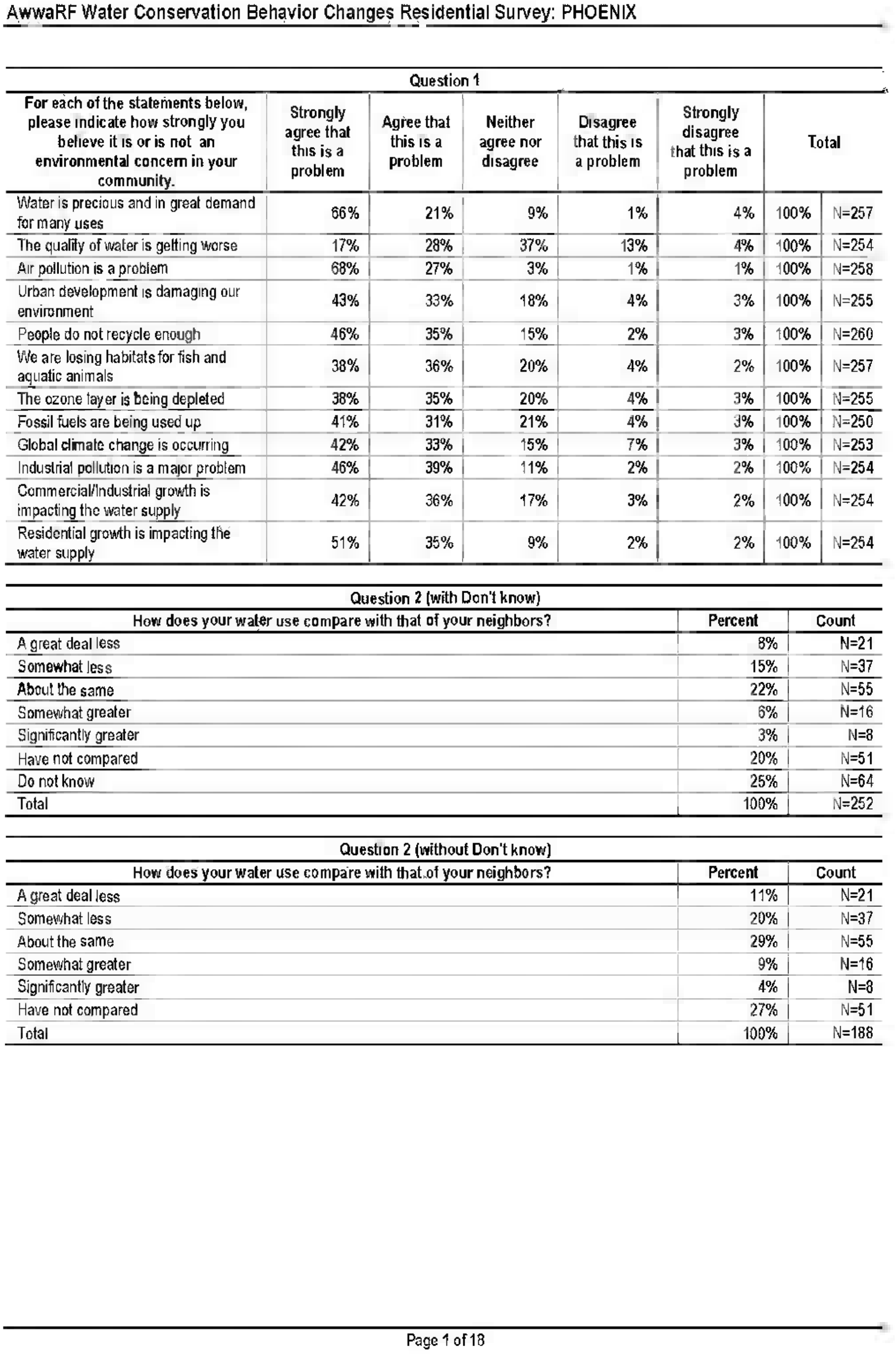
CITY OF PHOENIX WATER SERVICES DEPARTMENT: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 1

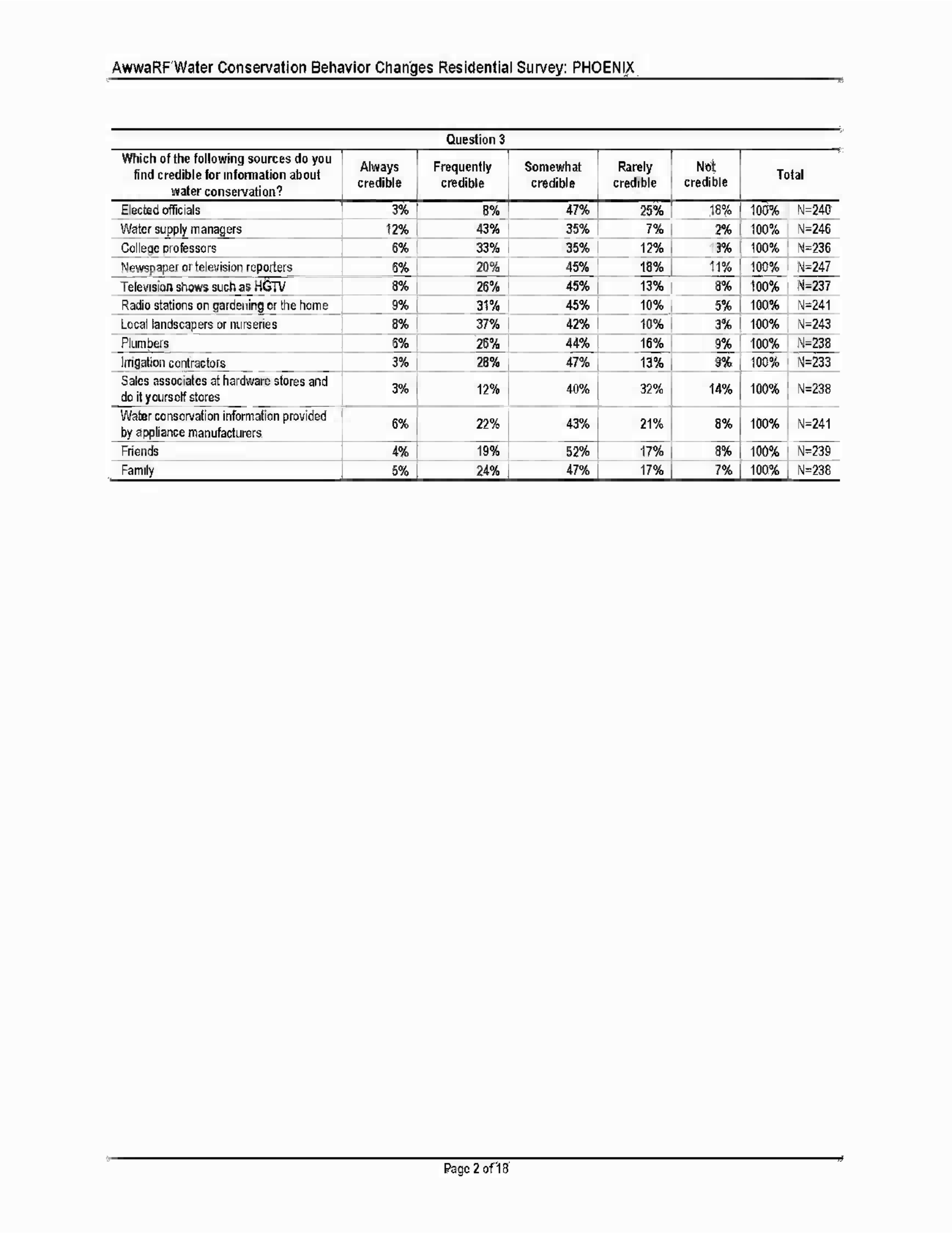
For each of the statements below, please indicate how strongly you believe it is or is not an environmental concern in your community.	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	66%	21%	9%	1%	4%	100%	N=257
The quality of water is getting worse	17%	28%	37%	13%	4%	100%	N=254
Air pollution is a problem	68%	27%	3%	1%	1%	100%	N=258
Urban development is damaging our environment	43%	33%	18%	4%	3%	100%	N=255
People do not recycle enough	46%	35%	15%	2%	3%	100%	N=260
We are losing habitats for fish and aquatic animals	38%	36%	20%	4%	2%	100%	N=257
The ozone layer is being depleted	38%	35%	20%	4%	3%	100%	N=255
Fossil fuels are being used up	41%	31%	21%	4%	3%	100%	N=250
Global climate change is occurring	42%	33%	15%	7%	3%	100%	N=253
Industrial pollution is a major problem	46%	39%	11%	2%	2%	100%	N=254
Commercial/Industrial growth is impacting the water supply	42%	36%	17%	3%	2%	100%	N=254
Residential growth is impacting the water supply	51%	35%	9%	2%	2%	100%	N=254

Question 2 (with Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	8%	N=21
Somewhat less	15%	N=37
About the same	22%	N=55
Somewhat greater	6%	N=16
Significantly greater	3%	N=8
Have not compared	20%	N=51
Do not know	25%	N=64
Total	100%	N=252

Question 2 (without Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	11%	N=21
Somewhat less	20%	N=37
About the same	29%	N=55
Somewhat greater	9%	N=16
Significantly greater	4%	N=8
Have not compared	27%	N=51
Total	100%	N=188



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 3

Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	3%	8%	47%	25%	18%	100%	N=240
Water supply managers	12%	43%	35%	7%	2%	100%	N=246
College professors	6%	33%	35%	12%	13%	100%	N=236
Newspaper or television reporters	6%	20%	45%	18%	11%	100%	N=247
Television shows such as HGTV	8%	26%	45%	13%	8%	100%	N=237
Radio stations on gardening or the home	9%	31%	45%	10%	5%	100%	N=241
Local landscapers or nurseries	8%	37%	42%	10%	3%	100%	N=243
Plumbers	6%	26%	44%	16%	9%	100%	N=238
Irrigation contractors	3%	28%	47%	13%	9%	100%	N=233
Sales associates at hardware stores and do it yourself stores	3%	12%	40%	32%	14%	100%	N=238
Water conservation information provided by appliance manufacturers	6%	22%	43%	21%	8%	100%	N=241
Friends	4%	19%	52%	17%	8%	100%	N=239
Family	5%	24%	47%	17%	7%	100%	N=238

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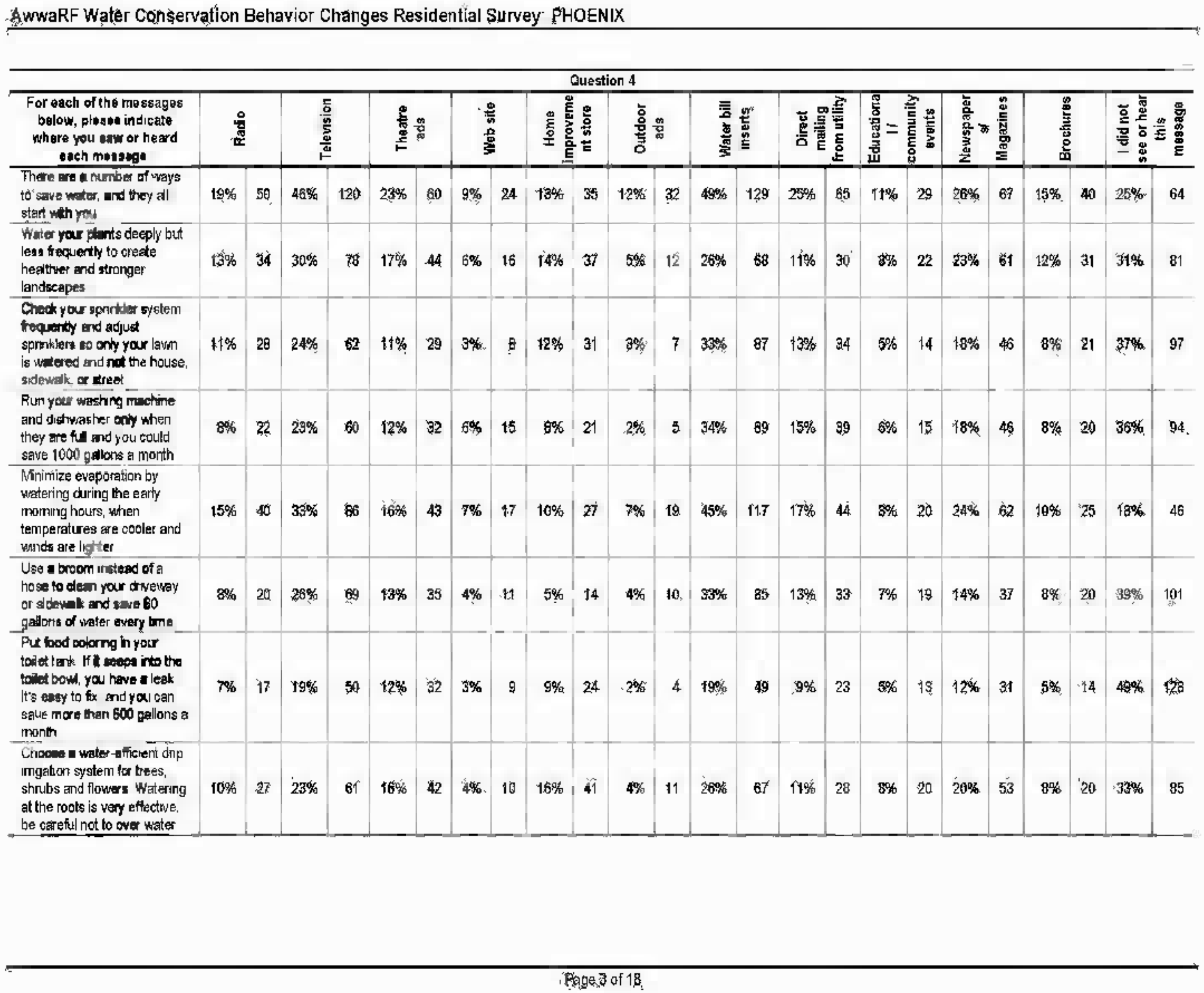
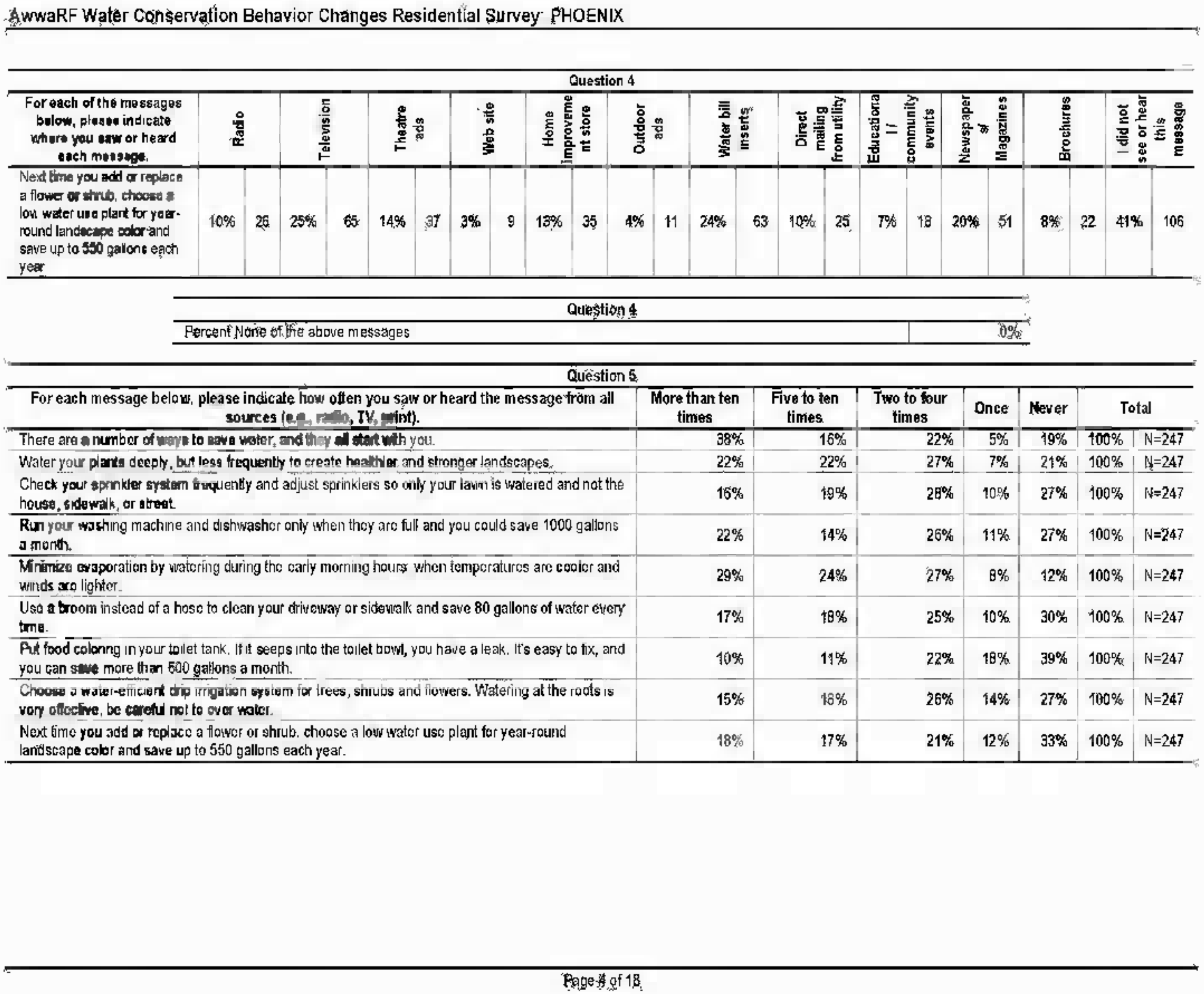


AwwaRF Water Conservation Behavior Changes Residential Survey PHOENIX

Question 4

For each of the messages below, please indicate where you saw or heard each message	Radio		Television		Theatre ads		Web site		Home Improvement store		Outdoor ads		Water bill inserts		Direct mailing from utility		Educational / community events		Newspapers / Magazines		Brochures		I did not see or hear this message	
There are a number of ways to save water, and they all start with you	19%	50	46%	120	23%	60	9%	24	13%	35	12%	32	49%	129	25%	65	11%	29	26%	67	15%	40	25%	64
Water your plants deeply but less frequently to create healthier and stronger landscapes	13%	34	30%	78	17%	44	6%	16	14%	37	5%	12	26%	68	11%	30	8%	22	23%	61	12%	31	31%	81
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	11%	28	24%	62	11%	29	3%	8	12%	31	3%	7	33%	87	13%	34	5%	14	18%	46	8%	21	37%	97
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	8%	22	23%	60	12%	32	6%	15	8%	21	2%	5	34%	89	15%	39	6%	15	18%	46	8%	20	36%	94
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	15%	40	33%	86	16%	43	7%	17	10%	27	7%	19	45%	117	17%	44	8%	20	24%	62	10%	25	18%	46
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	8%	20	26%	69	13%	35	4%	11	5%	14	4%	10	33%	85	13%	33	7%	19	14%	37	8%	20	39%	101
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 500 gallons a month	7%	17	19%	50	12%	32	3%	9	9%	24	2%	4	19%	49	9%	23	5%	13	12%	31	5%	14	49%	128
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	10%	27	23%	61	16%	42	4%	10	16%	41	4%	11	26%	67	11%	28	8%	20	20%	53	8%	20	33%	85



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 4

For each of the messages below, please indicate where you saw or heard each message.	Radio		Television		Theatre ads		Web site		Home Improvement store		Outdoor ads		Water bill inserts		Direct mailing from utility		Educational / community events		Newspaper s/ Magazines		Brochures		I did not see or hear this message	
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	10%	26	25%	65	14%	37	3%	9	13%	35	4%	11	24%	63	10%	25	7%	18	20%	51	8%	22	41%	106

Question 4

Percent None of the above messages	0%

Question 5

For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
There are a number of ways to save water, and they all start with you.	38%	16%	22%	5%	19%	100%	N=247
Water your plants deeply, but less frequently to create healthier and stronger landscapes.	22%	22%	27%	7%	21%	100%	N=247
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	16%	19%	28%	10%	27%	100%	N=247
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.	22%	14%	26%	11%	27%	100%	N=247
Minimize evaporation by watering during the early morning hours when temperatures are cooler and winds are lighter.	29%	24%	27%	8%	12%	100%	N=247
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.	17%	18%	25%	10%	30%	100%	N=247
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 500 gallons a month.	10%	11%	22%	18%	39%	100%	N=247
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	15%	18%	26%	14%	27%	100%	N=247
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	18%	17%	21%	12%	33%	100%	N=247

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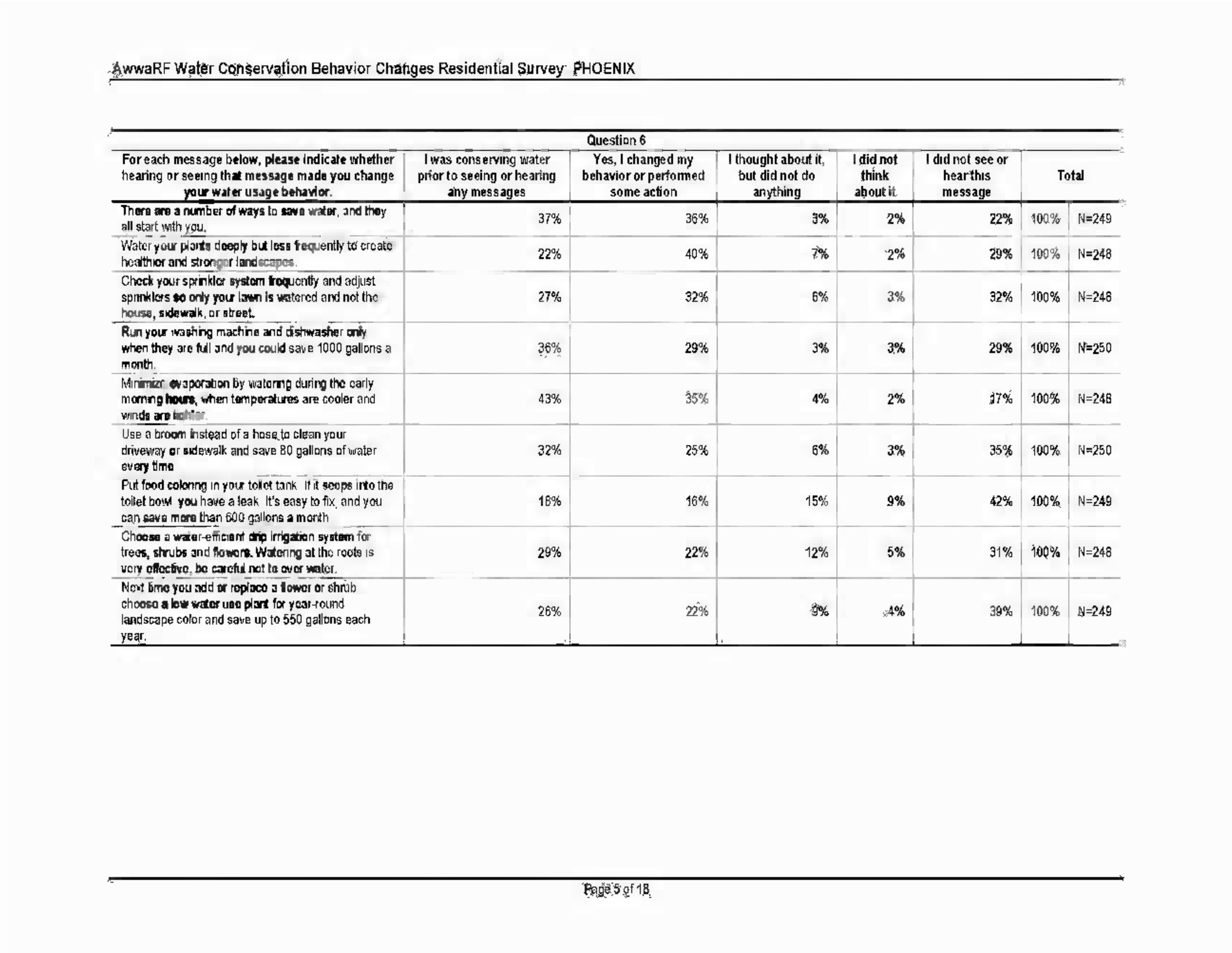

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.	Question 6 I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
There are a number of ways to save water, and they all start with you.	37%	36%	3%	2%	22%	100%	N=249
Water your plants deeply but less frequently to create healthier and stronger landscapes.	22%	40%	7%	2%	29%	100%	N=248
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	27%	32%	6%	3%	32%	100%	N=248
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.	36%	29%	3%	3%	29%	100%	N=250
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.	43%	35%	4%	2%	17%	100%	N=248
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	32%	25%	6%	3%	35%	100%	N=250
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	18%	16%	15%	9%	42%	100%	N=249
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	29%	22%	12%	5%	31%	100%	N=248
Next time you add or replace a flower or shrub choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	26%	22%	9%	4%	39%	100%	N=249

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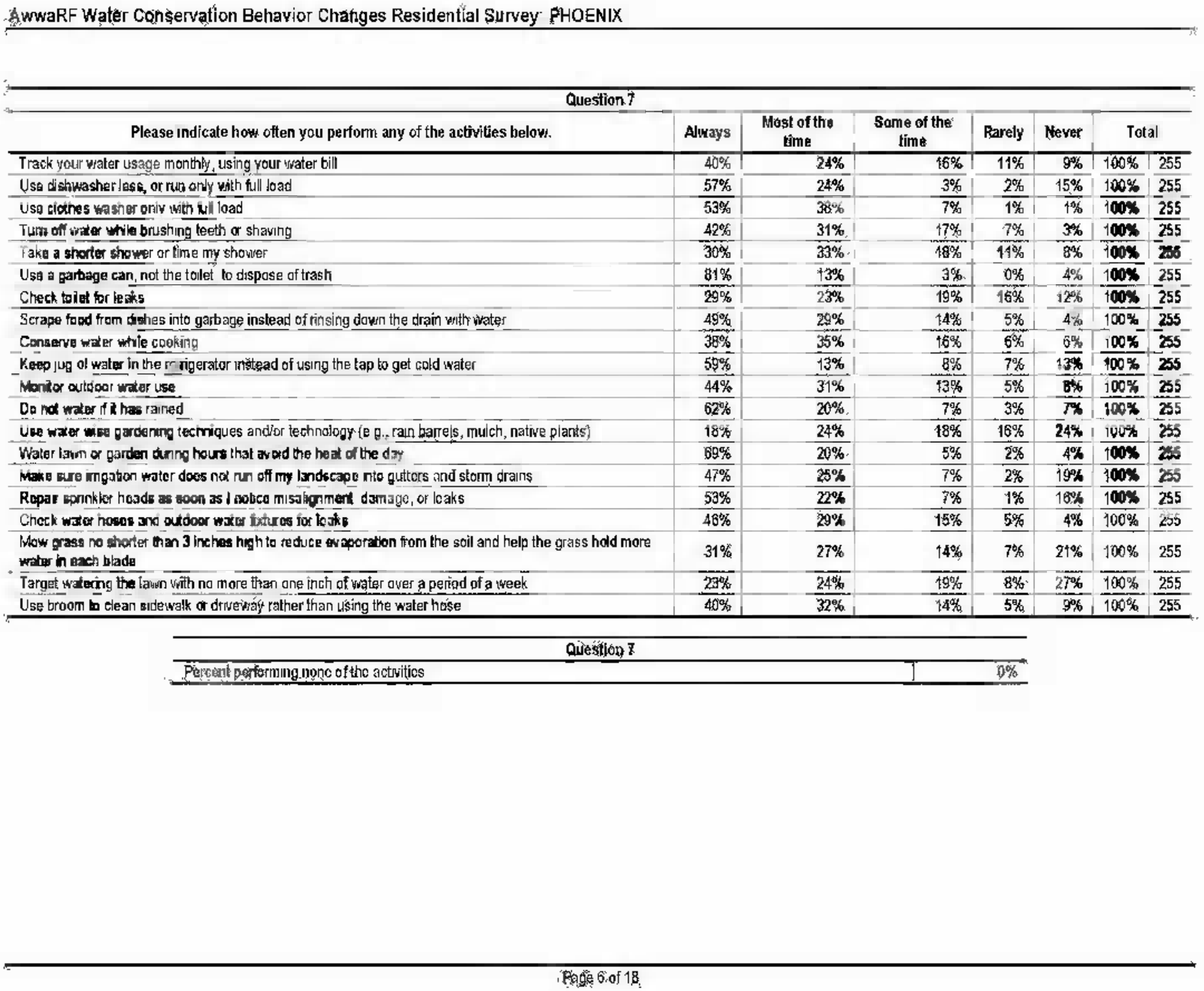

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 7							
Please indicate how often you perform any of the activities below.	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track your water usage monthly, using your water bill	40%	24%	16%	11%	9%	100%	255
Use dishwasher less, or run only with full load	57%	24%	3%	2%	15%	100%	255
Use clothes washer only with full load	53%	38%	7%	1%	1%	100%	255
Turn off water while brushing teeth or shaving	42%	31%	17%	7%	3%	100%	255
Take a shorter shower or time my shower	30%	33%	18%	11%	8%	100%	255
Use a garbage can, not the toilet to dispose of trash	81%	13%	3%	0%	4%	100%	255
Check toilet for leaks	29%	23%	19%	16%	12%	100%	255
Scrape food from dishes into garbage instead of rinsing down the drain with water	49%	29%	14%	5%	4%	100%	255
Conserve water while cooking	38%	35%	16%	6%	6%	100%	255
Keep jug of water in the refrigerator instead of using the tap to get cold water	59%	13%	8%	7%	13%	100%	255
Monitor outdoor water use	44%	31%	13%	5%	8%	100%	255
Do not water if it has rained	62%	20%	7%	3%	7%	100%	255
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	18%	24%	18%	16%	24%	100%	255
Water lawn or garden during hours that avoid the heat of the day	69%	20%	5%	2%	4%	100%	255
Make sure irrigation water does not run off my landscape into gutters and storm drains	47%	25%	7%	2%	19%	100%	255
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	53%	22%	7%	1%	16%	100%	255
Check water hoses and outdoor water fixtures for leaks	46%	29%	15%	5%	4%	100%	255
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	31%	27%	14%	7%	21%	100%	255
Target watering the lawn with no more than one inch of water over a period of a week	23%	24%	19%	8%	27%	100%	255
Use broom to clean sidewalk or driveway rather than using the water hose	40%	32%	14%	5%	9%	100%	255

Question 7	
Percent performing none of the activities	0%

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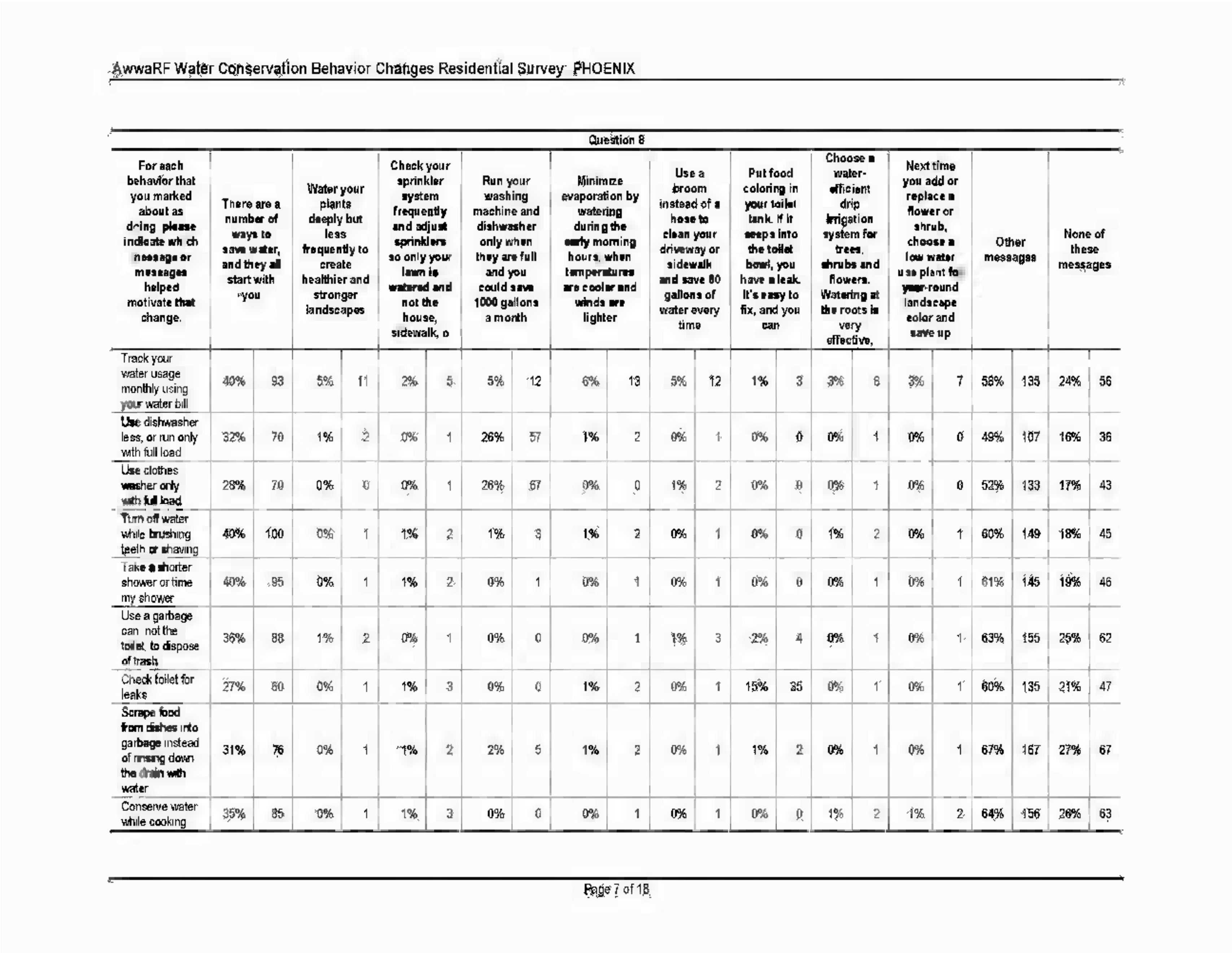

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 8

For each behavior that you marked about as doing please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Track your water usage monthly using your water bill	40%	93	5%	11	2%	5	5%	12	6%	13	5%	12	1%	3	3%	6	3%	7	58%	135	24%	56
Use dishwasher less, or run only with full load	32%	70	1%	2	0%	1	26%	57	1%	2	0%	1	0%	0	0%	1	0%	0	49%	107	16%	36
Use clothes washer only with full load	28%	70	0%	0	0%	1	26%	67	0%	0	1%	2	0%	0	0%	1	0%	0	52%	133	17%	43
Turn off water while brushing teeth or shaving	40%	100	0%	1	1%	2	1%	3	1%	2	0%	1	0%	0	1%	2	0%	1	60%	149	18%	45
Take a shorter shower or time my shower	40%	95	0%	1	1%	2	0%	1	0%	1	0%	1	0%	0	0%	1	0%	1	61%	145	19%	46
Use a garbage can not the toilet, to dispose of trash	36%	88	1%	2	0%	1	0%	0	0%	1	1%	3	2%	4	0%	1	0%	1	63%	155	25%	62
Check toilet for leaks	27%	60	0%	1	1%	3	0%	0	1%	2	0%	1	15%	35	0%	1	0%	1	60%	135	21%	47
Scrape food from dishes into garbage instead of rinsing down the drain with water	31%	76	0%	1	1%	2	2%	5	1%	2	0%	1	1%	2	0%	1	0%	1	67%	167	27%	67
Conserve water while cooking	35%	85	0%	1	1%	3	0%	0	0%	1	0%	1	0%	0	1%	2	1%	2	64%	156	26%	63

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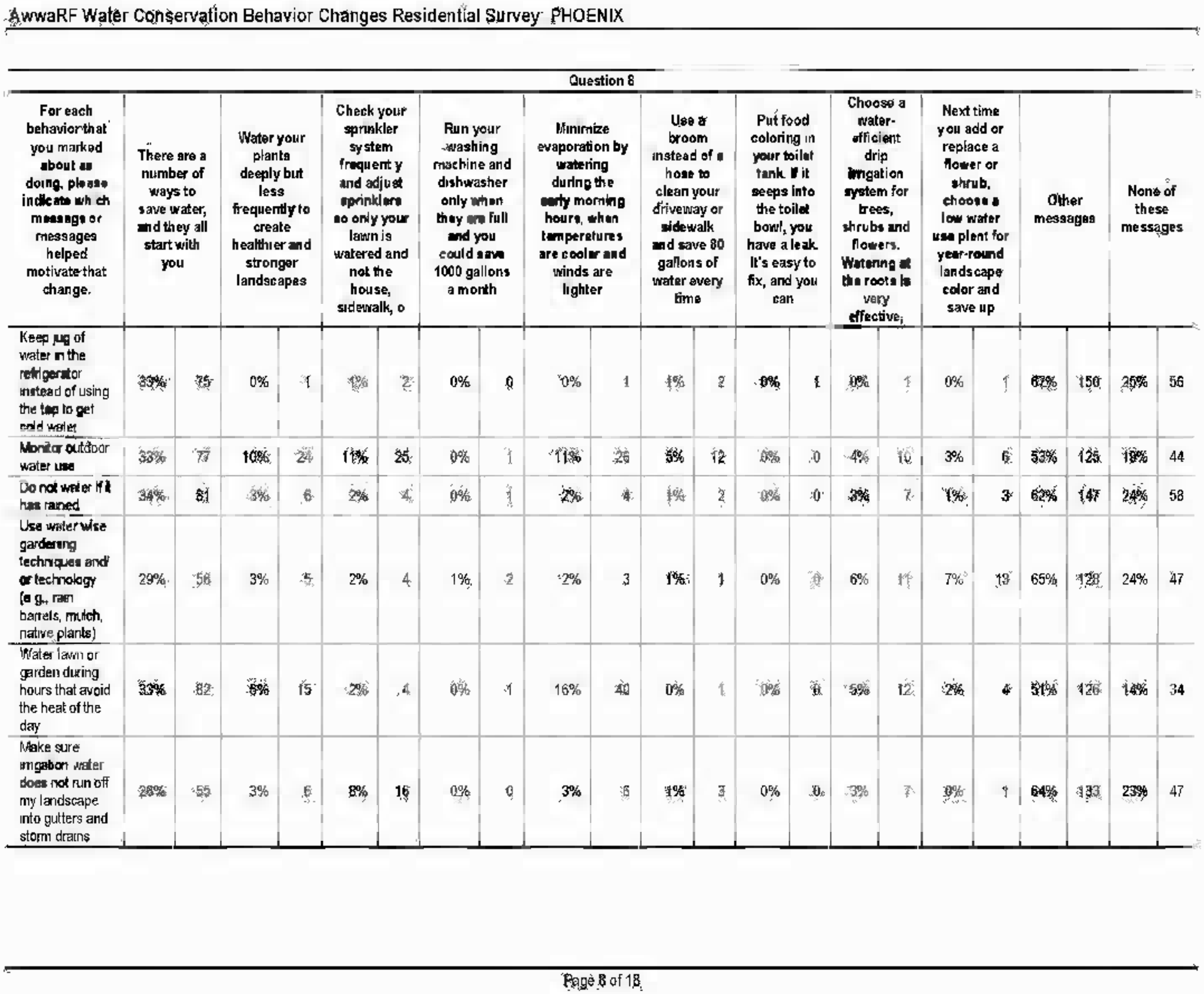

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 8

For each behavior that you marked about as doing, please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective;		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Keep jug of water in the refrigerator instead of using the tap to get cold water	33%	75	0%	1	1%	2	0%	0	0%	1	1%	2	0%	1	0%	1	0%	1	67%	150	25%	56
Monitor outdoor water use	33%	77	10%	24	11%	25	0%	1	11%	26	5%	12	0%	0	4%	10	3%	6	53%	125	19%	44
Do not water if it has rained	34%	81	3%	6	2%	4	0%	1	2%	4	1%	2	0%	0	3%	7	1%	3	62%	147	24%	58
Use water wise gardening techniques and/ or technology (e.g., rain barrels, mulch, native plants)	29%	56	3%	5	2%	4	1%	2	2%	3	1%	1	0%	0	6%	11	7%	13	65%	128	24%	47
Water lawn or garden during hours that avoid the heat of the day	33%	82	6%	15	2%	4	0%	1	16%	40	0%	1	0%	0	5%	12	2%	4	51%	126	14%	34
Make sure irrigation water does not run off my landscape into gutters and storm drains	28%	55	3%	6	8%	16	0%	0	3%	6	1%	3	0%	0	3%	7	0%	1	64%	133	23%	47

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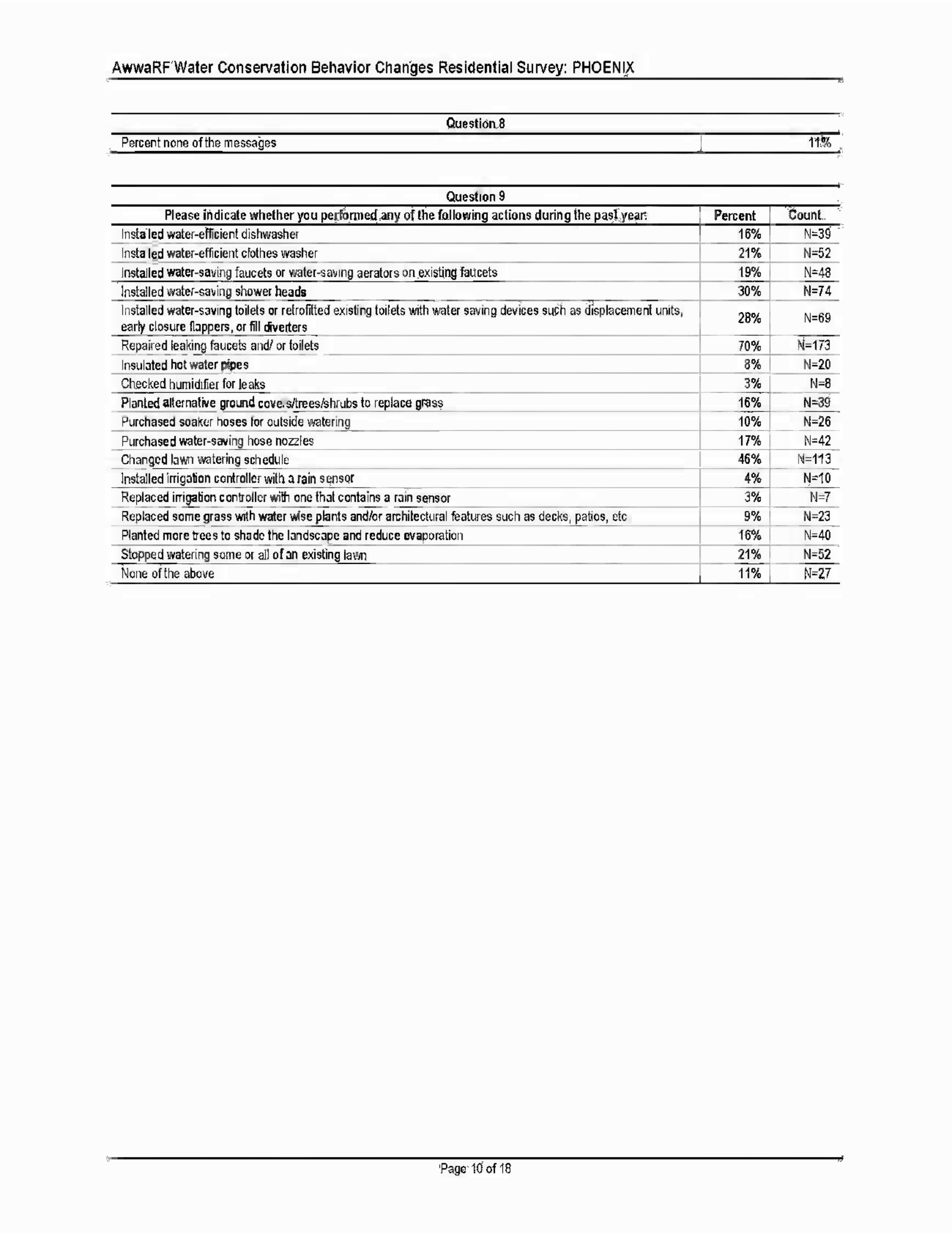
AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

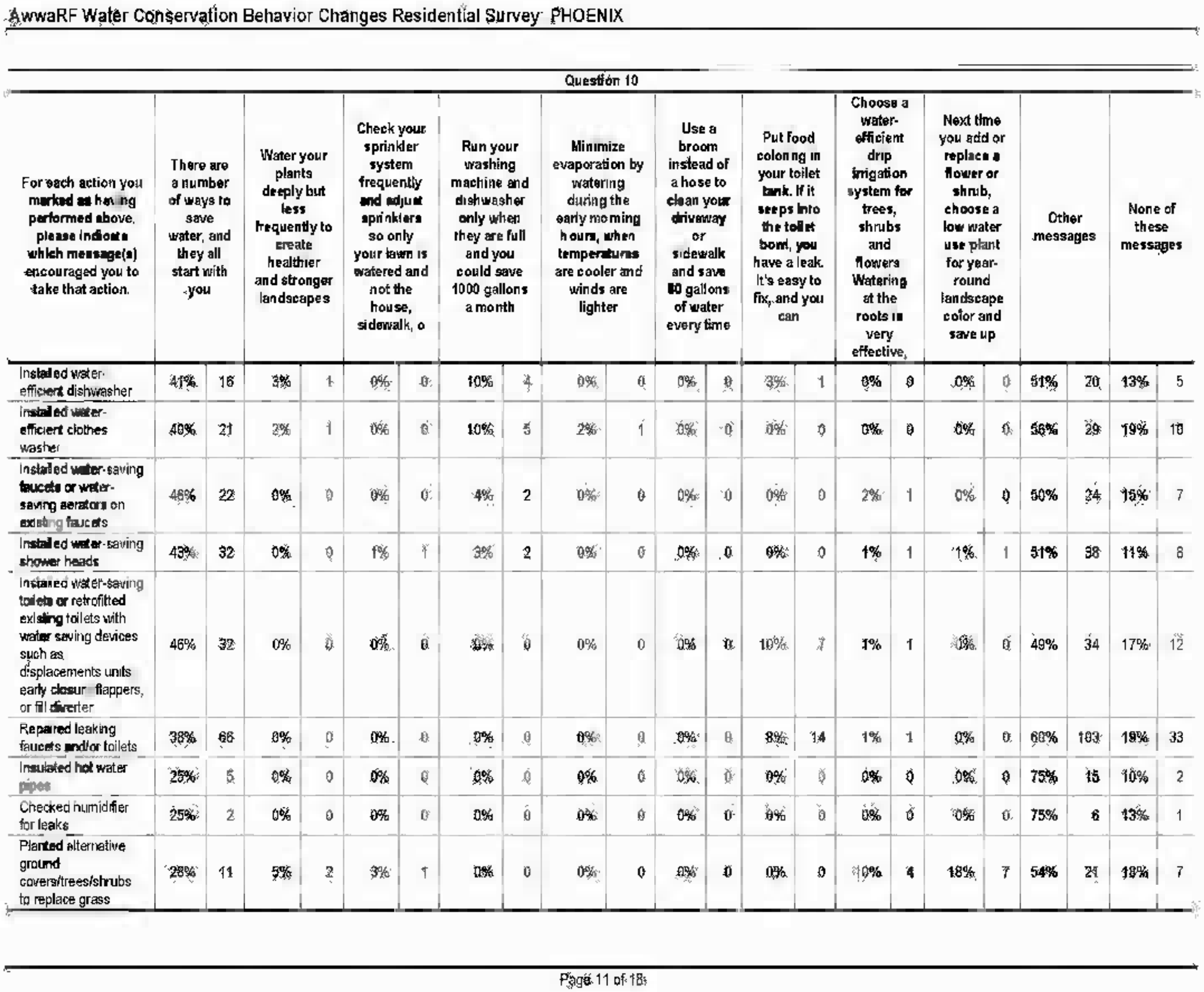
	Question 8																					
For each behavior that you marked about as doing, please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Repair sprinkler heads as soon as I notice misalignment, damage or leaks	[illegible]	[illegible]	3%	[illegible]	8%	17	0%	0	2%	4	1%	2	0%	[illegible]	3%	[illegible]	0%	1	64%	138	25%	54
Check water hoses and outdoor water fixtures for leaks	25%	21	3%	[illegible]	7%	16	1%	2	2%	4	1%	2	0%	[illegible]	2%	[illegible]	0%	1	65%	159	24%	60
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	25%	52	4%	9	1%	3	1%	2	2%	5	0%	1	0%	0	2%	5	0%	1	68%	139	25%	51
Target watering the lawn with no more than one inch of water over a period of a week	28%	53	6%	11	2%	3	1%	2	3%	6	1%	1	0%	0	3%	6	1%	2	67%	127	22%	42
Use broom to clean sidewalk or driveway rather than using the water hose	34%	79	1%	2	1%	2	0%	1	1%	2	14%	33	0%	0	1%	2	0%	1	56%	131	20%	47



Question 8	
Percent none of the messages	11%

Question 9

Please indicate whether you performed any of the following actions during the past year:	Percent	Count
Installed water-efficient dishwasher	16%	N=39
Installed water-efficient clothes washer	21%	N=52
Installed water-saving faucets or water-saving aerators on existing faucets	19%	N=48
Installed water-saving shower heads	30%	N=74
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	28%	N=69
Repaired leaking faucets and/ or toilets	70%	N=173
Insulated hot water pipes	8%	N=20
Checked humidifier for leaks	3%	N=8
Planted alternative ground covers/trees/shrubs to replace grass	16%	N=39
Purchased soaker hoses for outside watering	10%	N=26
Purchased water-saving hose nozzles	17%	N=42
Changed lawn watering schedule	46%	N=113
Installed irrigation controller with a rain sensor	4%	N=10
Replaced irrigation controller with one that contains a rain sensor	3%	N=7
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc	9%	N=23
Planted more trees to shade the landscape and reduce evaporation	16%	N=40
Stopped watering some or all of an existing lawn	21%	N=52
None of the above	11%	N=27



AwwaRF Water Conservation Behavior Changes Residential Survey PHOENIX

Question 10

For each action you marked as having performed above, please indicate which message(s) encouraged you to take that action.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Installed water-efficient dishwasher	41%	16	3%	1	0%	0	10%	4	0%	0	0%	0	3%	1	0%	0	0%	0	51%	20	13%	5
Installed water-efficient clothes washer	40%	21	2%	1	0%	0	10%	5	2%	1	0%	0	0%	0	0%	0	0%	0	56%	29	19%	10
Installed water-saving faucets or water-saving aerators on existing faucets	46%	22	0%	0	0%	0	4%	2	0%	0	0%	0	0%	0	2%	1	0%	0	50%	24	15%	7
Installed water-saving shower heads	43%	32	0%	0	1%	1	3%	2	0%	0	0%	0	0%	0	1%	1	1%	1	51%	38	11%	8
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units early closure flappers, or fill diverter	46%	32	0%	0	0%	0	0%	0	0%	0	0%	0	10%	7	1%	1	0%	0	49%	34	17%	12
Repaired leaking faucets and/or toilets	38%	66	0%	0	0%	0	0%	0	0%	0	0%	0	8%	14	1%	1	0%	0	60%	103	19%	33
Insulated hot water pipes	25%	5	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	75%	15	10%	2
Checked humidifier for leaks	25%	2	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	75%	6	13%	1
Planted alternative ground covers/trees/shrubs to replace grass	28%	11	5%	2	3%	1	0%	0	0%	0	0%	0	0%	0	10%	4	18%	7	54%	21	18%	7

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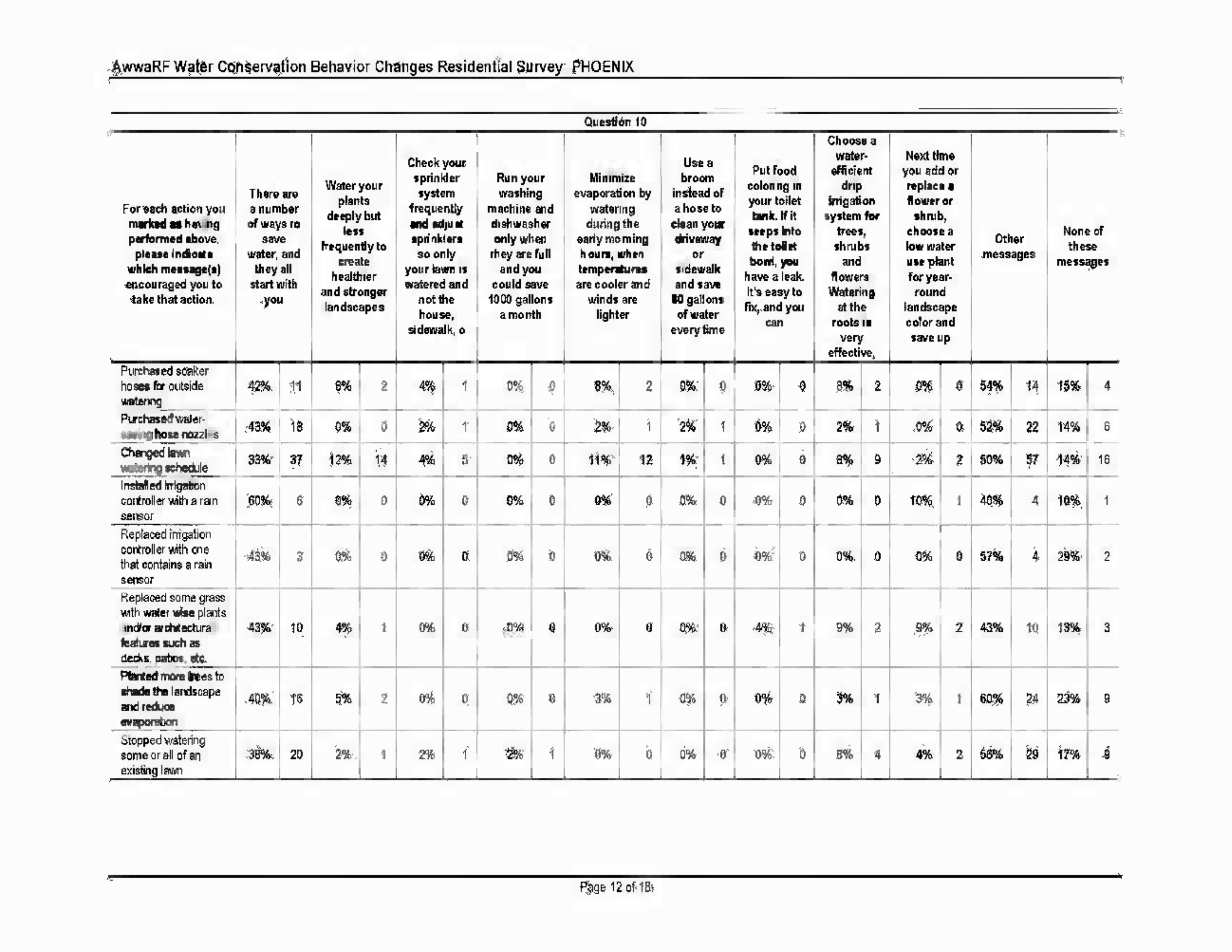

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

	Question 10																							
For each action you marked as having performed above, please indicate which message(s) encouraged you to take that action.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Purchased soaker hoses for outside watering	42%	11	8%	2	4%	1	0%	0	8%	2	0%	0	0%	0	8%	2	0%	0	54%	14	15%	4
Purchased water-saving hose nozzles	43%	18	0%	0	2%	1	0%	0	2%	1	2%	1	0%	0	2%	1	0%	0	52%	22	14%	6
Changed lawn watering schedule	33%	37	12%	14	4%	5	0%	0	11%	12	1%	1	0%	0	8%	9	2%	2	50%	57	14%	16
Installed irrigation controller with a rain sensor	60%	6	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	10%	1	40%	4	10%	1
Replaced irrigation controller with one that contains a rain sensor	43%	3	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	57%	4	29%	2
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	43%	10	4%	1	0%	0	0%	0	0%	0	0%	0	4%	1	9%	2	9%	2	43%	10	13%	3
Planted more trees to shade the landscape and reduce evaporation	40%	16	5%	2	0%	0	0%	0	3%	1	0%	0	0%	0	3%	1	3%	1	60%	24	23%	9
Stopped watering some or all of an existing lawn	38%	20	2%	1	2%	1	2%	1	0%	0	0%	0	0%	0	5%	4	4%	2	56%	29	17%	9

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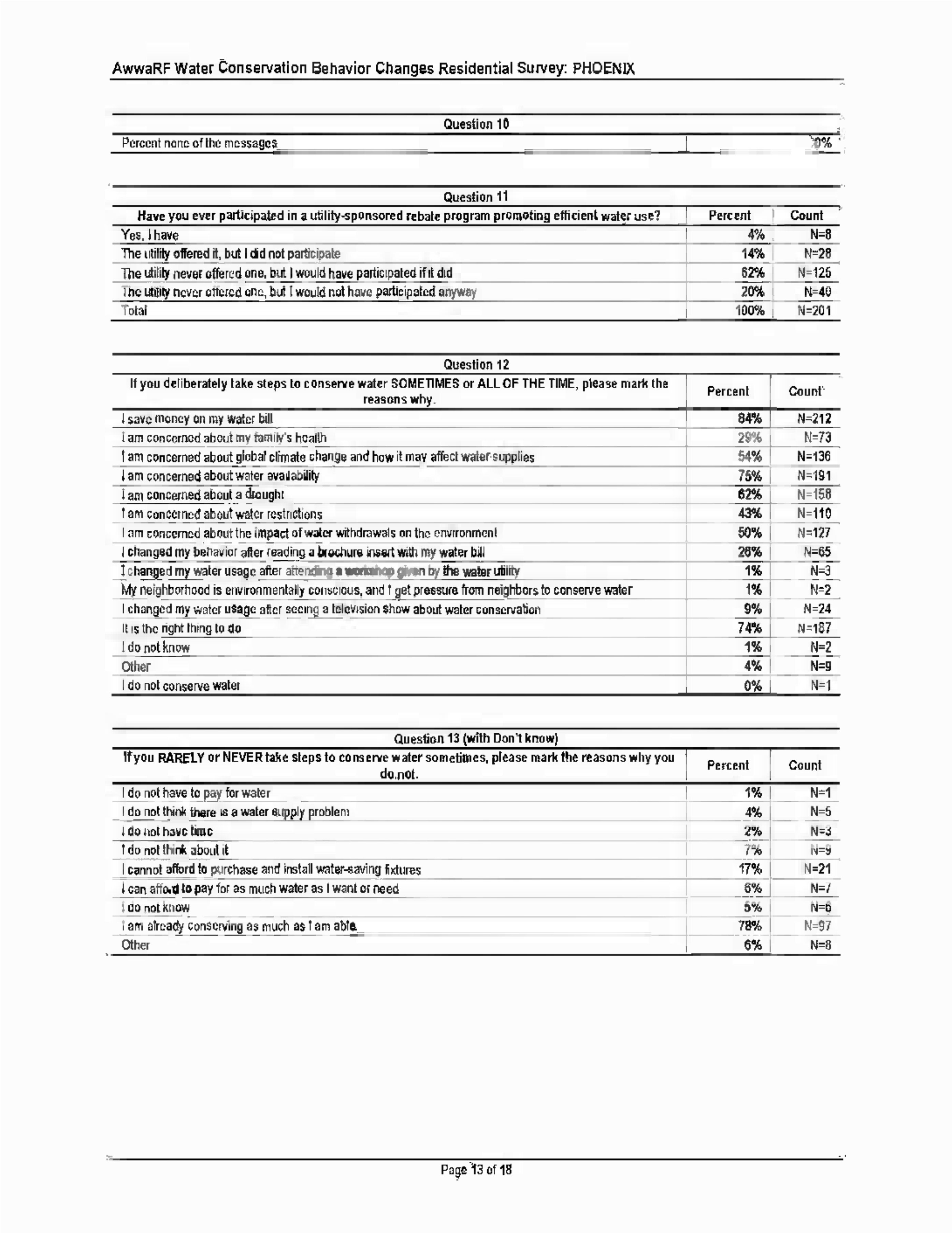

AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 10	
Percent none of the messages	0%

Question 11		
Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	4%	N=8
The utility offered it, but I did not participate	14%	N=28
The utility never offered one, but I would have participated if it did	62%	N=125
The utility never offered one, but I would not have participated anyway	20%	N=40
Total	100%	N=201

Question 12		
If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	84%	N=212
I am concerned about my family's health	29%	N=73
I am concerned about global climate change and how it may affect water supplies	54%	N=136
I am concerned about water availability	75%	N=191
I am concerned about a drought	62%	N=158
I am concerned about water restrictions	43%	N=110
I am concerned about the impact of water withdrawals on the environment	50%	N=127
I changed my behavior after reading a brochure insert with my water bill	26%	N=65
I changed my water usage after attending a workshop given by the water utility	1%	N=3
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	1%	N=2
I changed my water usage after seeing a television show about water conservation	9%	N=24
It is the right thing to do	74%	N=187
I do not know	1%	N=2
Other	4%	N=9
I do not conserve water	0%	N=1

Question 13 (with Don't know)		
If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	4%	N=5
I do not have time	2%	N=3
I do not think about it	7%	N=9
I cannot afford to purchase and install water-saving fixtures	17%	N=21
I can afford to pay for as much water as I want or need	6%	N=7
I do not know	5%	N=6
I am already conserving as much as I am able	78%	N=97
Other	6%	N=8

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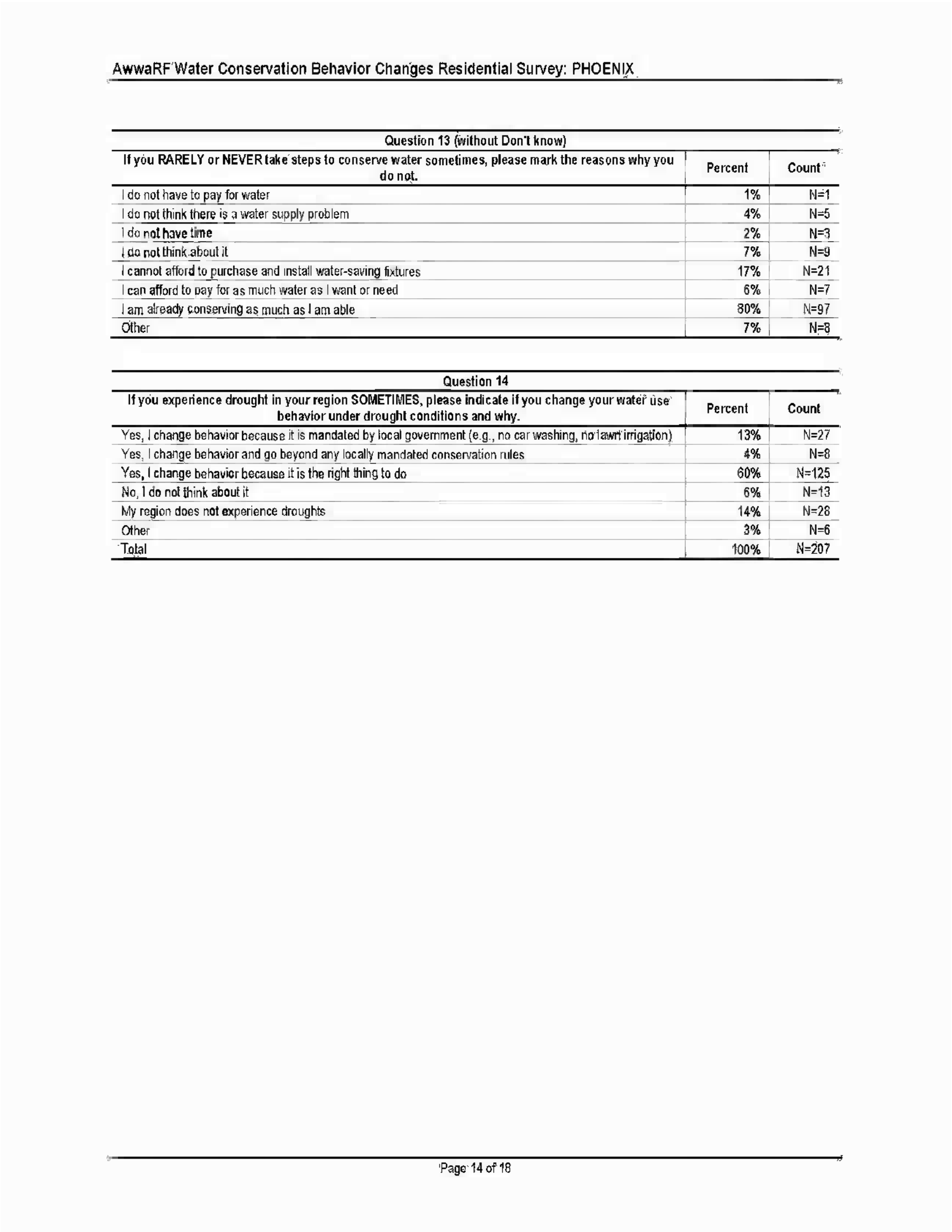


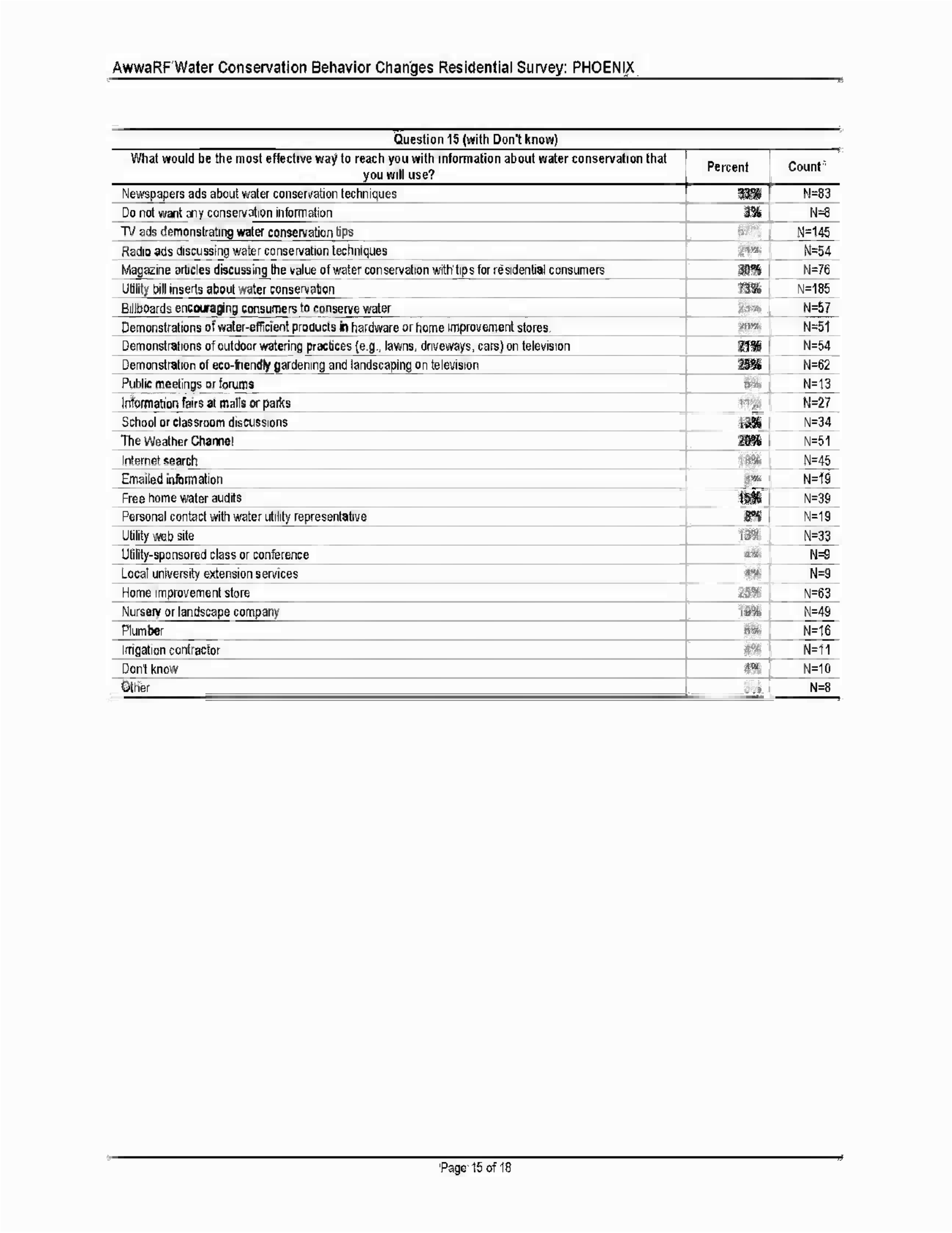
AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 13 (without Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	4%	N=5
I do not have time	2%	N=3
I do not think about it	7%	N=9
I cannot afford to purchase and install water-saving fixtures	17%	N=21
I can afford to pay for as much water as I want or need	6%	N=7
I am already conserving as much as I am able	80%	N=97
Other	7%	N=8

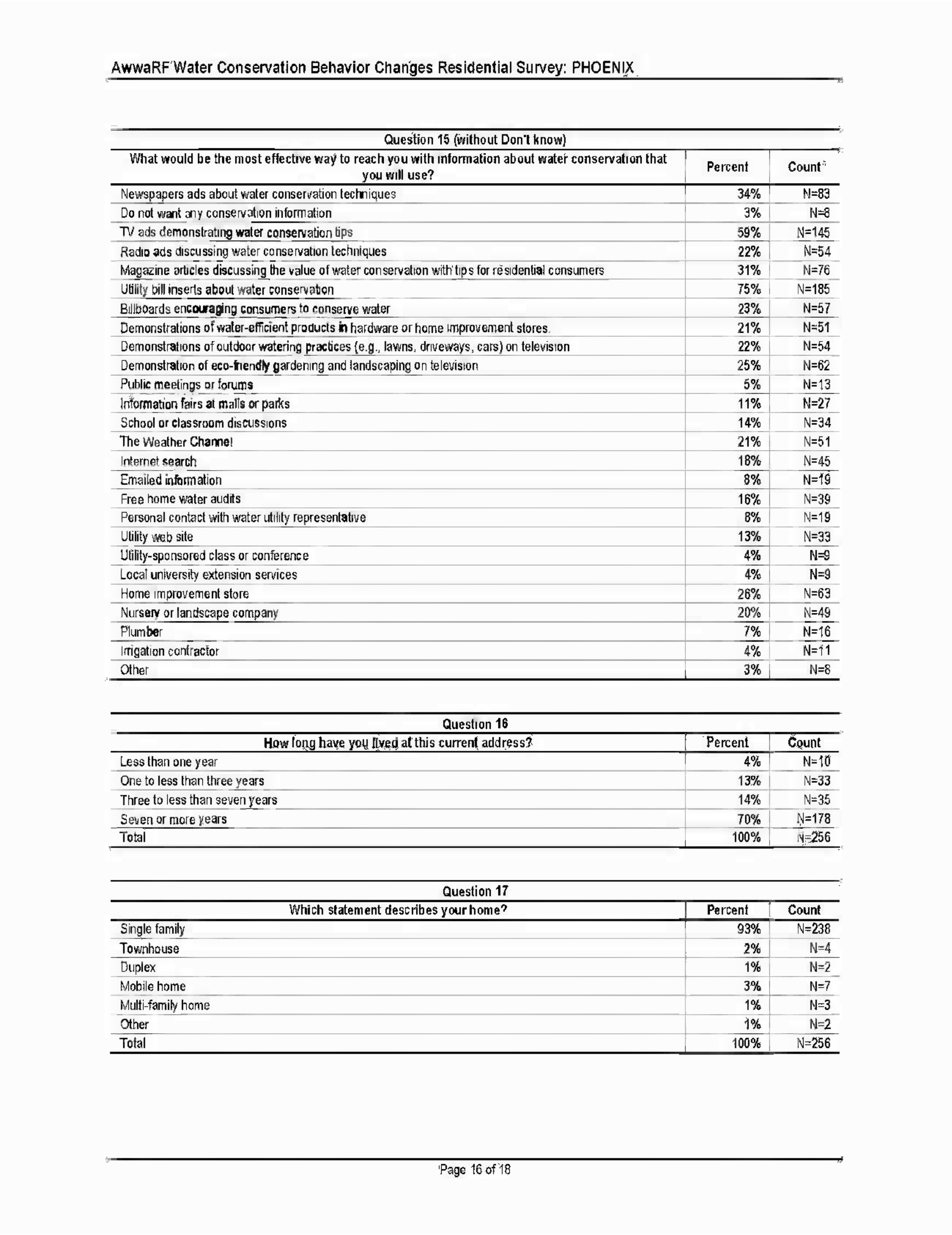
Question 14

If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	13%	N=27
Yes, I change behavior and go beyond any locally mandated conservation rules	4%	N=8
Yes, I change behavior because it is the right thing to do	60%	N=125
No, I do not think about it	6%	N=13
My region does not experience droughts	14%	N=28
Other	3%	N=6
Total	100%	N=207



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 15 (with Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	33%	N=83
Do not want any conservation information	3%	N=8
TV ads demonstrating water conservation tips	57%	N=145
Radio ads discussing water conservation techniques	21%	N=54
Magazine articles discussing the value of water conservation with tips for residential consumers	30%	N=76
Utility bill inserts about water conservation	73%	N=185
Billboards encouraging consumers to conserve water	23%	N=57
Demonstrations of water-efficient products in hardware or home improvement stores.	20%	N=51
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	21%	N=54
Demonstration of eco-friendly gardening and landscaping on television	25%	N=62
Public meetings or forums	5%	N=13
Information fairs at malls or parks	11%	N=27
School or classroom discussions	13%	N=34
The Weather Channel	20%	N=51
Internet search	18%	N=45
Emailed information	8%	N=19
Free home water audits	15%	N=39
Personal contact with water utility representative	8%	N=19
Utility web site	13%	N=33
Utility-sponsored class or conference	4%	N=9
Local university extension services	4%	N=9
Home improvement store	25%	N=63
Nursery or landscape company	19%	N=49
Plumber	6%	N=16
Irrigation contractor	4%	N=11
Don't know	4%	N=10
Other	3%	N=8

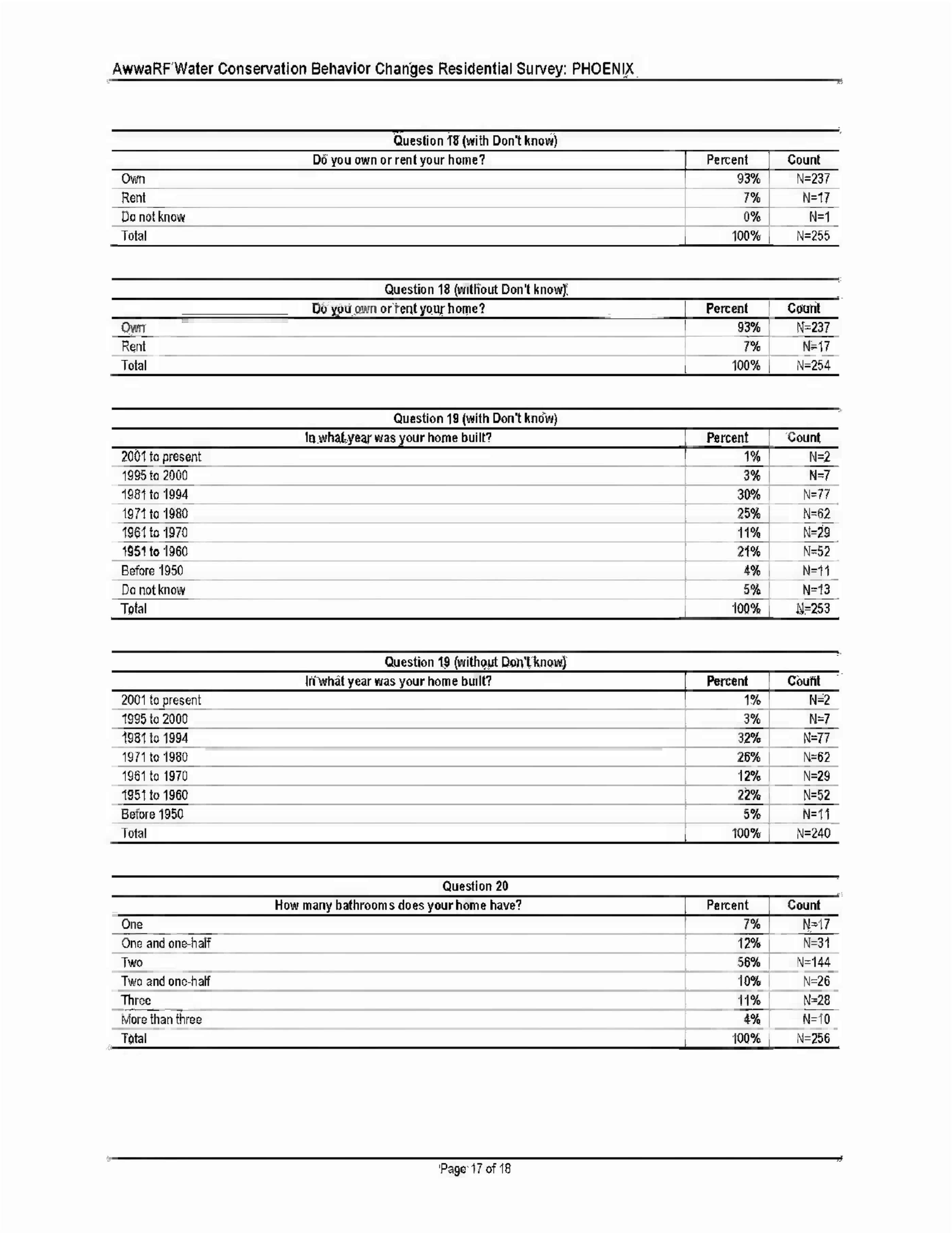


AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 15 (without Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	34%	N=83
Do not want any conservation information	3%	N=8
TV ads demonstrating water conservation tips	59%	N=145
Radio ads discussing water conservation techniques	22%	N=54
Magazine articles discussing the value of water conservation with tips for residential consumers	31%	N=76
Utility bill inserts about water conservation	75%	N=185
Billboards encouraging consumers to conserve water	23%	N=57
Demonstrations of water-efficient products in hardware or home improvement stores.	21%	N=51
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	22%	N=54
Demonstration of eco-friendly gardening and landscaping on television	25%	N=62
Public meetings or forums	5%	N=13
Information fairs at malls or parks	11%	N=27
School or classroom discussions	14%	N=34
The Weather Channel	21%	N=51
Internet search	18%	N=45
Emailed information	8%	N=19
Free home water audits	16%	N=39
Personal contact with water utility representative	8%	N=19
Utility web site	13%	N=33
Utility-sponsored class or conference	4%	N=9
Local university extension services	4%	N=9
Home improvement store	26%	N=63
Nursery or landscape company	20%	N=49
Plumber	7%	N=16
Irrigation contractor	4%	N=11
Other	3%	N=8

Question 16 How long have you lived at this current address?	Percent	Count
Less than one year	4%	N=10
One to less than three years	13%	N=33
Three to less than seven years	14%	N=35
Seven or more years	70%	N=178
Total	100%	N=256

Question 17 Which statement describes your home?	Percent	Count
Single family	93%	N=238
Townhouse	2%	N=4
Duplex	1%	N=2
Mobile home	3%	N=7
Multi-family home	1%	N=3
Other	1%	N=2
Total	100%	N=256



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 18 (with Don't know)

Do you own or rent your home?	Percent	Count
Own	93%	N=237
Rent	7%	N=17
Do not know	0%	N=1
Total	100%	N=255

Question 18 (without Don't know)

Do you own or rent your home?	Percent	Count
Own	93%	N=237
Rent	7%	N=17
Total	100%	N=254

Question 19 (with Don't know)

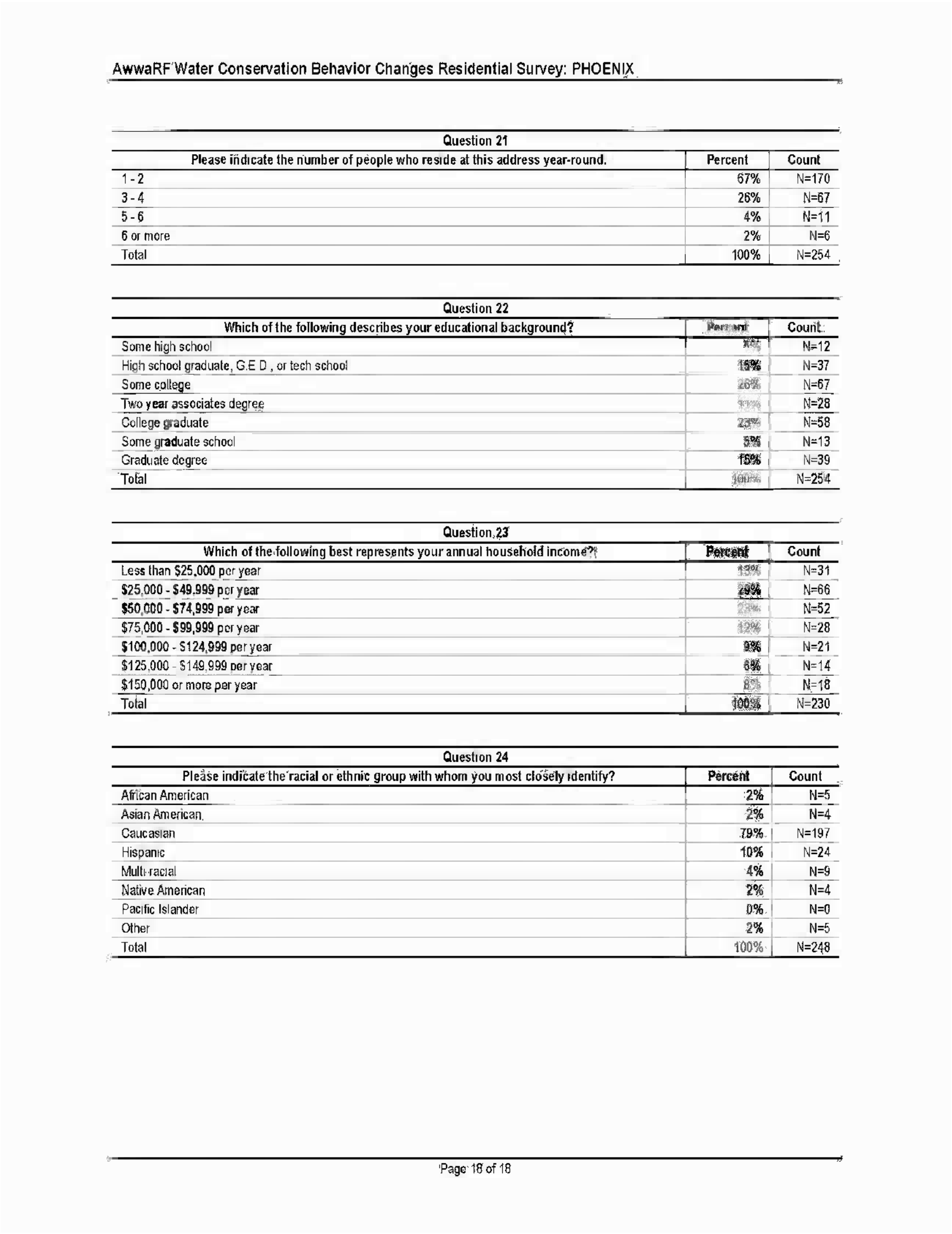
In what year was your home built?	Percent	Count
2001 to present	1%	N=2
1995 to 2000	3%	N=7
1981 to 1994	30%	N=77
1971 to 1980	25%	N=62
1961 to 1970	11%	N=29
1951 to 1960	21%	N=52
Before 1950	4%	N=11
Do not know	5%	N=13
Total	100%	N=253

Question 19 (without Don't know)

In what year was your home built?	Percent	Count
2001 to present	1%	N=2
1995 to 2000	3%	N=7
1981 to 1994	32%	N=77
1971 to 1980	26%	N=62
1961 to 1970	12%	N=29
1951 to 1960	22%	N=52
Before 1950	5%	N=11
Total	100%	N=240

Question 20

How many bathrooms does your home have?	Percent	Count
One	7%	N=17
One and one-half	12%	N=31
Two	56%	N=144
Two and one-half	10%	N=26
Three	11%	N=28
More than three	4%	N=10
Total	100%	N=256



AwwaRF Water Conservation Behavior Changes Residential Survey: PHOENIX

Question 21

Please indicate the number of people who reside at this address year-round.	Percent	Count
1 - 2	67%	N=170
3 - 4	26%	N=67
5 - 6	4%	N=11
6 or more	2%	N=6
Total	100%	N=254

Question 22

Which of the following describes your educational background?	Percent	Count
Some high school	5%	N=12
High school graduate, G.E.D., or tech school	15%	N=37
Some college	26%	N=67
Two year associates degree	11%	N=28
College graduate	23%	N=58
Some graduate school	5%	N=13
Graduate degree	15%	N=39
Total	100%	N=254

Question 23

Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	13%	N=31
$25,000 - $49,999 per year	29%	N=66
$50,000 - $74,999 per year	23%	N=52
$75,000 - $99,999 per year	12%	N=28
$100,000 - $124,999 per year	9%	N=21
$125,000 - $149,999 per year	6%	N=14
$150,000 or more per year	8%	N=18
Total	100%	N=230

Question 24

Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	2%	N=5
Asian American	2%	N=4
Caucasian	79%	N=197
Hispanic	10%	N=24
Multi-racial	4%	N=9
Native American	2%	N=4
Pacific Islander	0%	N=0
Other	2%	N=5
Total	100%	N=248

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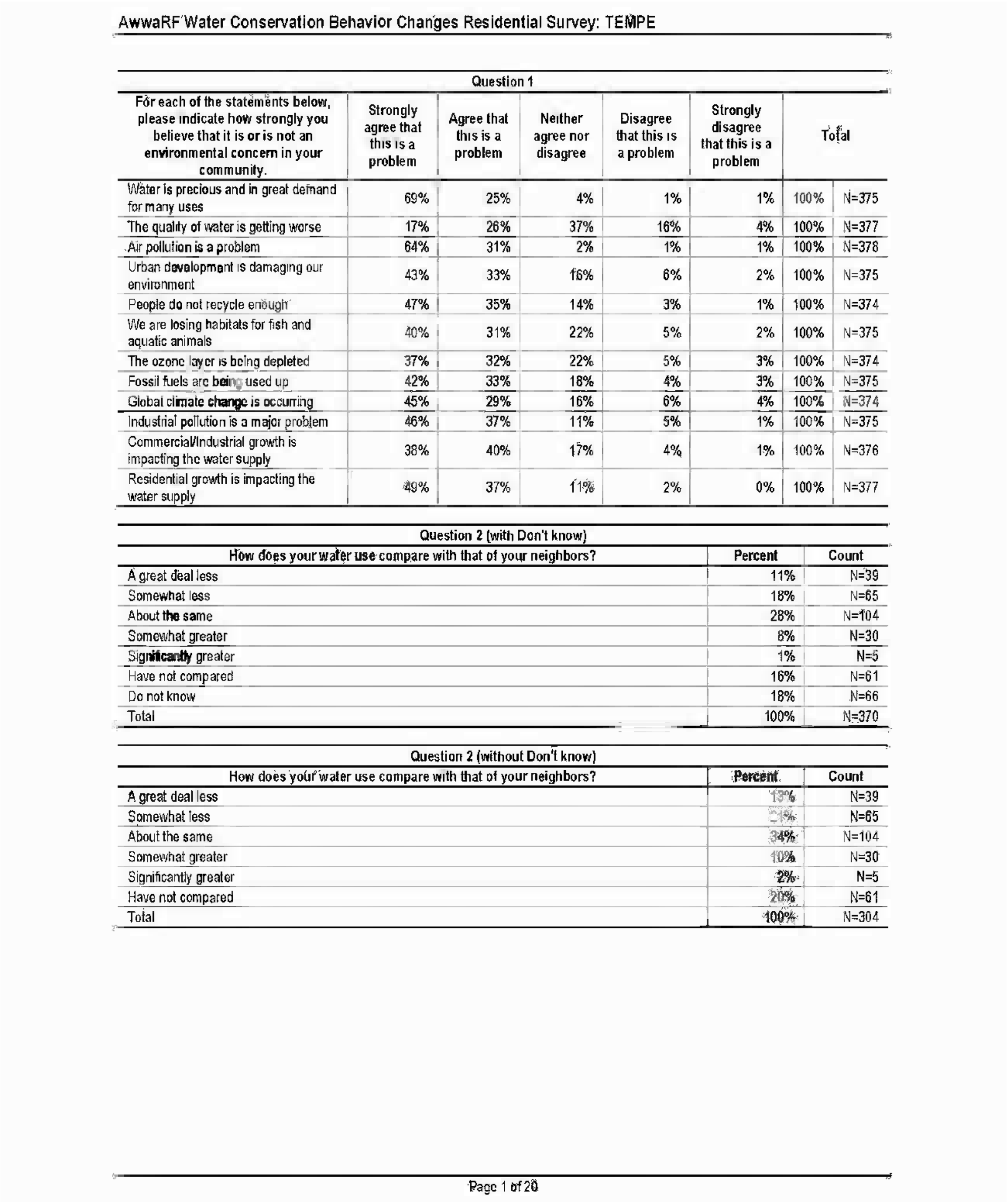
CITY OF TEMPE WATER UTILITIES DEPARTMENT: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 1

For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	69%	25%	4%	1%	1%	100%	N=375
The quality of water is getting worse	17%	26%	37%	16%	4%	100%	N=377
Air pollution is a problem	64%	31%	2%	1%	1%	100%	N=378
Urban development is damaging our environment	43%	33%	16%	6%	2%	100%	N=375
People do not recycle enough	47%	35%	14%	3%	1%	100%	N=374
We are losing habitats for fish and aquatic animals	40%	31%	22%	5%	2%	100%	N=375
The ozone layer is being depleted	37%	32%	22%	5%	3%	100%	N=374
Fossil fuels are being used up	42%	33%	18%	4%	3%	100%	N=375
Global climate change is occurring	45%	29%	16%	6%	4%	100%	N=374
Industrial pollution is a major problem	46%	37%	11%	5%	1%	100%	N=375
Commercial/Industrial growth is impacting the water supply	38%	40%	17%	4%	1%	100%	N=376
Residential growth is impacting the water supply	49%	37%	11%	2%	0%	100%	N=377

Question 2 (with Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	11%	N=39
Somewhat less	18%	N=65
About the same	28%	N=104
Somewhat greater	8%	N=30
Significantly greater	1%	N=5
Have not compared	16%	N=61
Do not know	18%	N=66
Total	100%	N=370

Question 2 (without Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	13%	N=39
Somewhat less	21%	N=65
About the same	34%	N=104
Somewhat greater	10%	N=30
Significantly greater	2%	N=5
Have not compared	20%	N=61
Total	100%	N=304

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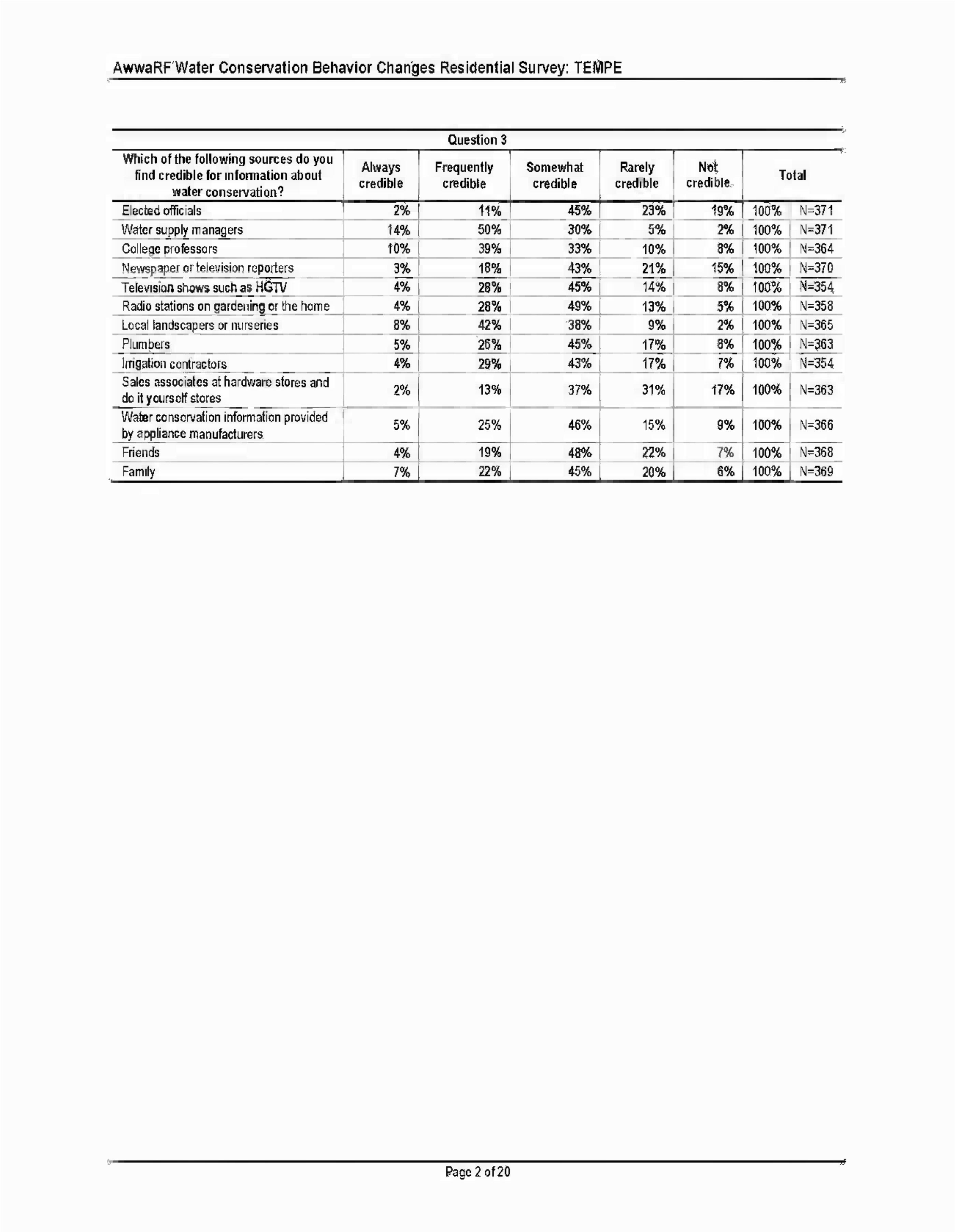


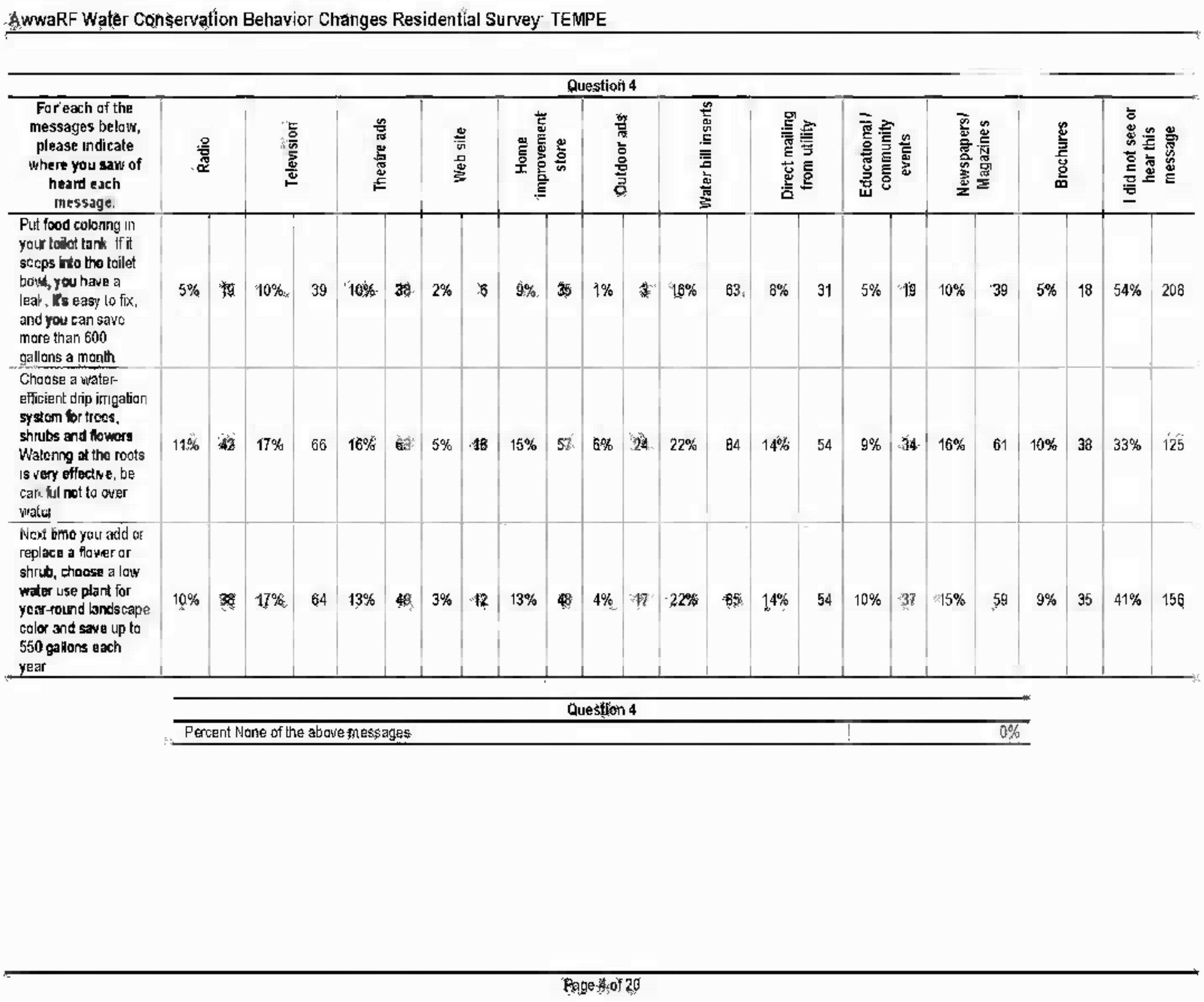
Question 3

Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	2%	11%	45%	23%	19%	100%	N=371
Water supply managers	14%	50%	30%	5%	2%	100%	N=371
College professors	10%	39%	33%	10%	8%	100%	N=364
Newspaper or television reporters	3%	18%	43%	21%	15%	100%	N=370
Television shows such as HGTV	4%	28%	45%	14%	8%	100%	N=354
Radio stations on gardening or the home	4%	28%	49%	13%	5%	100%	N=358
Local landscapers or nurseries	8%	42%	38%	9%	2%	100%	N=365
Plumbers	5%	26%	45%	17%	8%	100%	N=363
Irrigation contractors	4%	29%	43%	17%	7%	100%	N=354
Sales associates at hardware stores and do it yourself stores	2%	13%	37%	31%	17%	100%	N=363
Water conservation information provided by appliance manufacturers	5%	25%	46%	15%	9%	100%	N=366
Friends	4%	19%	48%	22%	7%	100%	N=368
Family	7%	22%	45%	20%	6%	100%	N=369

AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 4

For each of the messages below, please indicate where you saw of heard each message.	Radio		Television		Theatre ads		Web site		Home improvement store		Outdoor ads		Water bill inserts		Direct mailing from utility		Educational / community events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
There are a number of ways to save water, and they all start with you	23%	86	41%	157	22%	85	9%	34	9%	33	9%	33	44%	168	30%	114	15%	56	29%	111	14%	54	25%	95
Water your plants deeply but less frequently to create healthier and stronger landscapes	14%	54	26%	100	17%	66	6%	22	16%	61	6%	24	24%	91	15%	58	14%	54	23%	87	12%	46	26%	98
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street	13%	48	23%	86	13%	50	3%	12	11%	43	5%	20	31%	118	18%	67	8%	31	19%	74	9%	34	31%	120
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	9%	35	20%	75	14%	55	4%	17	7%	27	4%	14	34%	129	19%	72	10%	38	16%	61	10%	40	39%	149
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter	18%	70	27%	102	16%	63	4%	16	11%	42	5%	21	39%	148	19%	72	12%	47	24%	92	12%	47	19%	73
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	12%	47	22%	83	12%	47	3%	12	5%	19	4%	15	27%	104	13%	50	6%	23	14%	54	7%	26	40%	151



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 4

For each of the messages below, please indicate where you saw of heard each message.	Radio		Television		Theatre ads		Web site		Home improvement store		Outdoor ads		Water bill inserts		Direct mailing from utility		Educational / community events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	5%	19	10%	39	10%	38	2%	6	9%	35	1%	3	16%	63	8%	31	5%	19	10%	39	5%	18	54%	208
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water	11%	42	17%	66	16%	63	5%	18	15%	57	6%	24	22%	84	14%	54	9%	34	16%	61	10%	38	33%	125
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year	10%	38	17%	64	13%	49	3%	12	13%	48	4%	17	22%	85	14%	54	10%	37	15%	59	9%	35	41%	156

Question 4

Percent None of the above messages	0%

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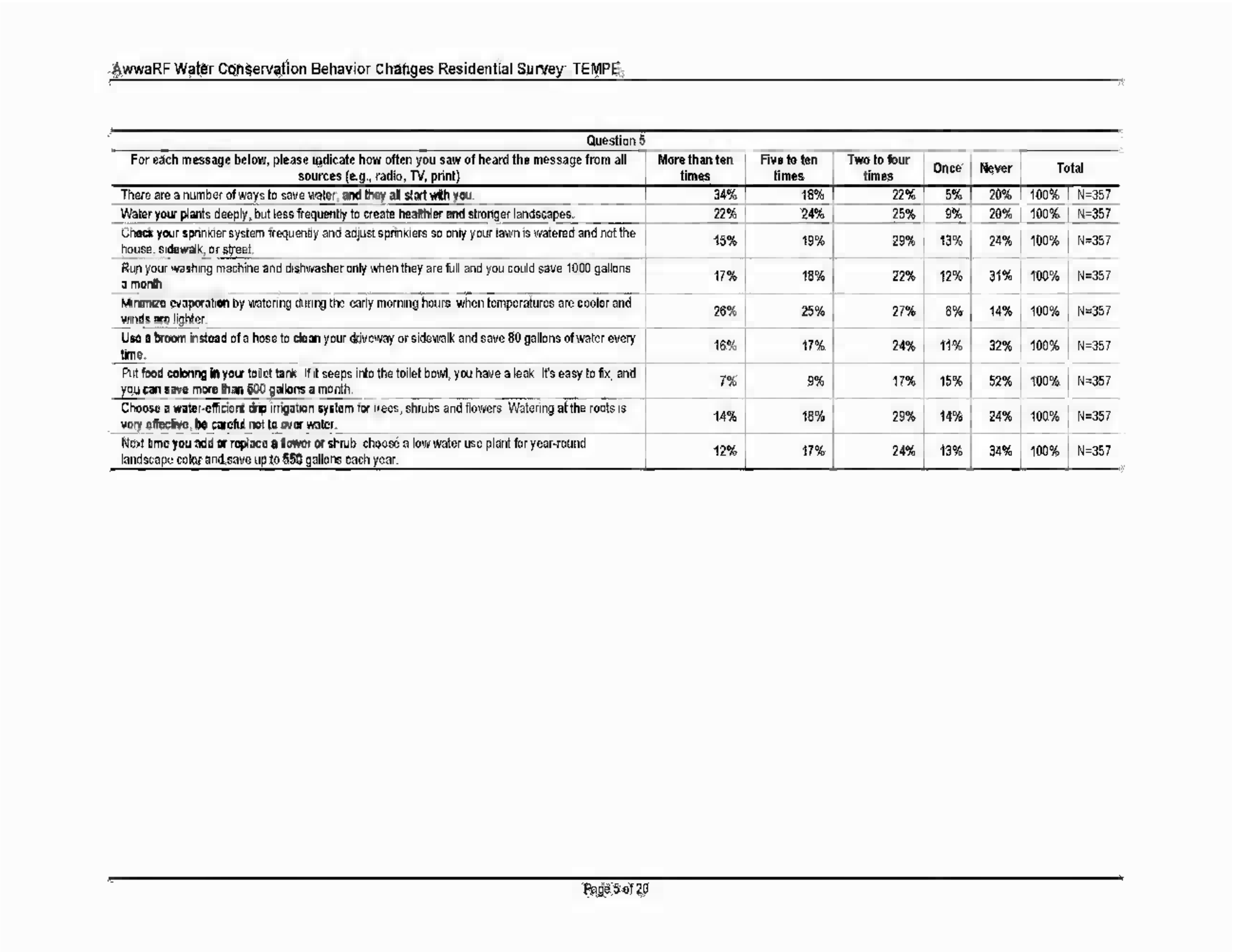
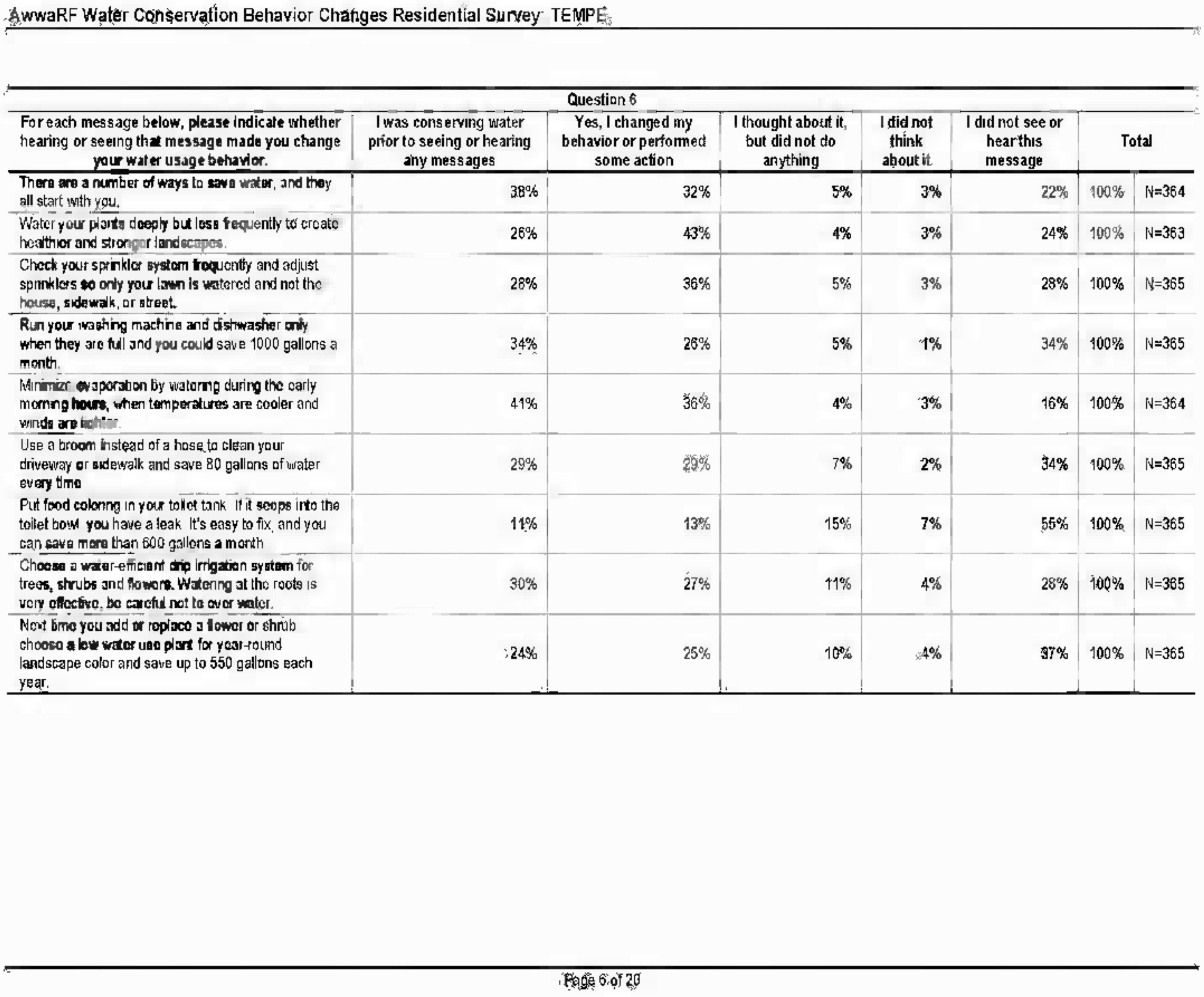


AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 5

For each message below, please indicate how often you saw of heard the message from all sources (e.g., radio, TV, print)	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
There are a number of ways to save water, and they all start with you.	34%	18%	22%	5%	20%	100%	N=357
Water your plants deeply, but less frequently to create healthier and stronger landscapes.	22%	24%	25%	9%	20%	100%	N=357
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	15%	19%	29%	13%	24%	100%	N=357
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month	17%	18%	22%	12%	31%	100%	N=357
Minimize evaporation by watering during the early morning hours when temperatures are cooler and winds are lighter.	26%	25%	27%	8%	14%	100%	N=357
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.	16%	17%	24%	11%	32%	100%	N=357
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 500 gallons a month.	7%	9%	17%	15%	52%	100%	N=357
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	14%	18%	29%	14%	24%	100%	N=357
Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	12%	17%	24%	13%	34%	100%	N=357



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

	Question 6						
For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
There are a number of ways to save water, and they all start with you.	38%	32%	5%	3%	22%	100%	N=364
Water your plants deeply but less frequently to create healthier and stronger landscapes.	26%	43%	4%	3%	24%	100%	N=363
Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.	28%	36%	5%	3%	28%	100%	N=365
Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.	34%	26%	5%	1%	34%	100%	N=365
Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.	41%	36%	4%	3%	16%	100%	N=364
Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time	29%	29%	7%	2%	34%	100%	N=365
Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month	11%	13%	15%	7%	55%	100%	N=365
Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.	30%	27%	11%	4%	28%	100%	N=365
Next time you add or replace a flower or shrub choose a low water use plant for year-round landscape color and save up to 550 gallons each year.	24%	25%	10%	4%	37%	100%	N=365

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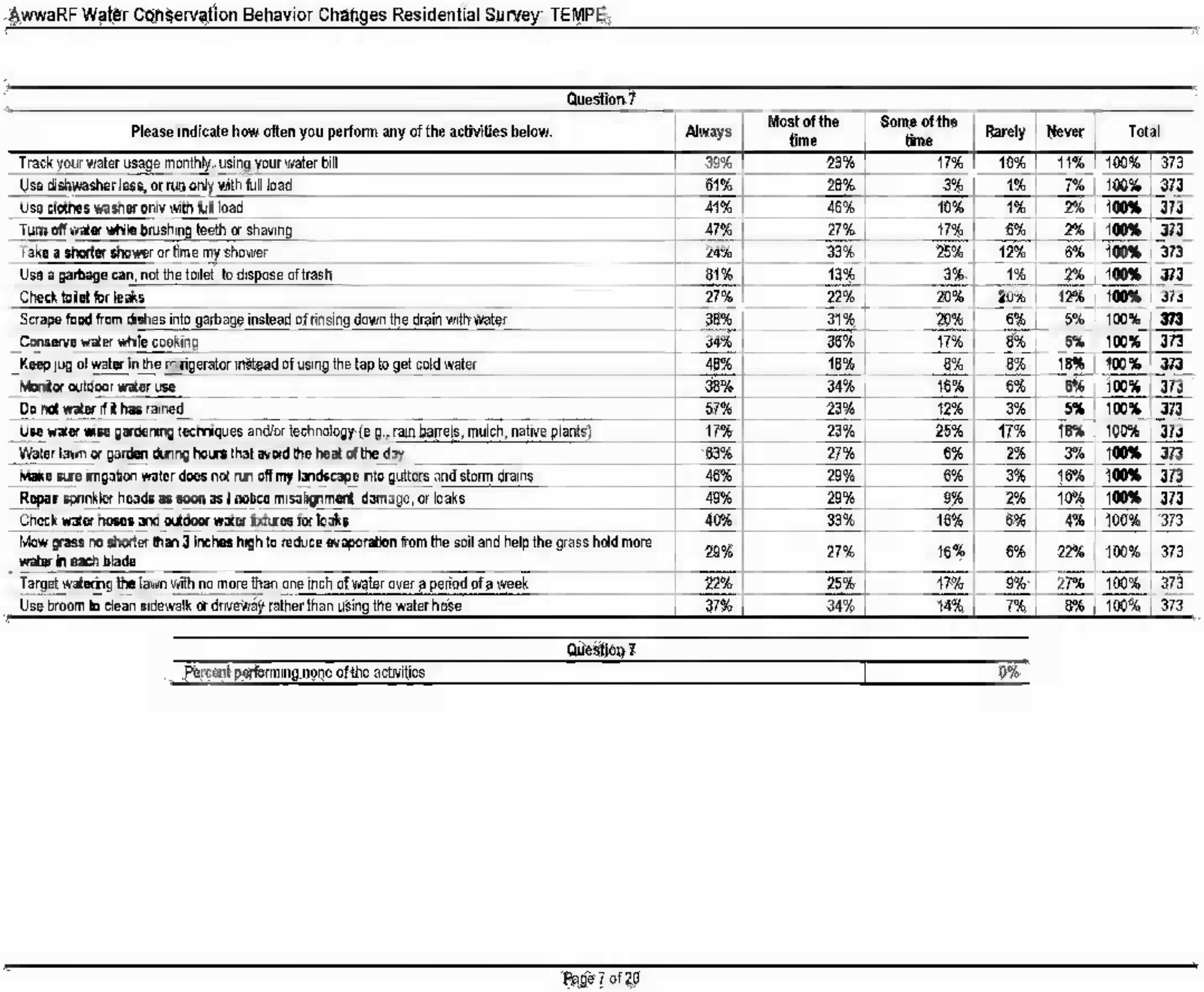

AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 7

Please indicate how often you perform any of the activities below.	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track your water usage monthly, using your water bill	39%	23%	17%	10%	11%	100%	373
Use dishwasher less, or run only with full load	61%	28%	3%	1%	7%	100%	373
Use clothes washer only with full load	41%	46%	10%	1%	2%	100%	373
Turn off water while brushing teeth or shaving	47%	27%	17%	6%	2%	100%	373
Take a shorter shower or time my shower	24%	33%	25%	12%	6%	100%	373
Use a garbage can, not the toilet, to dispose of trash	81%	13%	3%	1%	2%	100%	373
Check toilet for leaks	27%	22%	20%	20%	12%	100%	373
Scrape food from dishes into garbage instead of rinsing down the drain with water	38%	31%	20%	6%	5%	100%	373
Conserve water while cooking	34%	36%	17%	8%	5%	100%	373
Keep jug of water in the refrigerator instead of using the tap to get cold water	48%	18%	8%	8%	18%	100%	373
Monitor outdoor water use	38%	34%	16%	6%	6%	100%	373
Do not water if it has rained	57%	23%	12%	3%	5%	100%	373
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	17%	23%	25%	17%	18%	100%	373
Water lawn or garden during hours that avoid the heat of the day	63%	27%	6%	2%	3%	100%	373
Make sure irrigation water does not run off my landscape into gutters and storm drains	46%	29%	6%	3%	16%	100%	373
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	49%	29%	9%	2%	10%	100%	373
Check water hoses and outdoor water fixtures for leaks	40%	33%	16%	6%	4%	100%	373
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	29%	27%	16%	6%	22%	100%	373
Target watering the lawn with no more than one inch of water over a period of a week	22%	25%	17%	9%	27%	100%	373
Use broom to clean sidewalk or driveway rather than using the water hose	37%	34%	14%	7%	8%	100%	373

Question 7

Percent performing none of the activities	0%

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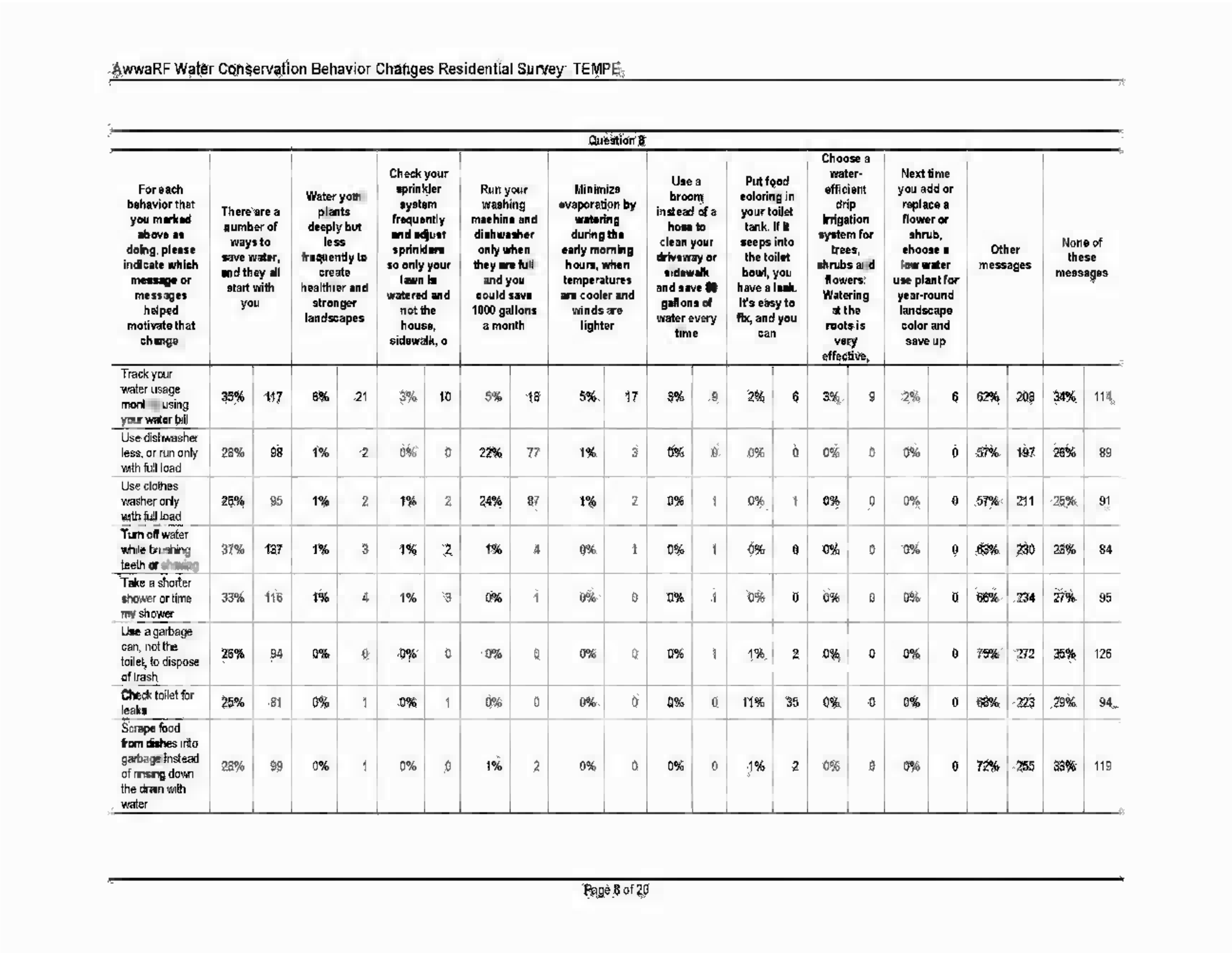

AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change	Question 8																			
	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Track your water usage monthly using your water bill	35%	117	6%	21	3%	10	5%	18	5%	17	3%	9	2%	6	3%	9	2%	6	62%	208	34%	114
Use dishwasher less, or run only with full load	28%	98	1%	2	0%	0	22%	77	1%	3	0%	0	0%	0	0%	0	0%	0	57%	197	26%	89
Use clothes washer only with full load	25%	95	1%	2	1%	2	24%	87	1%	2	0%	1	0%	1	0%	0	0%	0	57%	211	25%	91
Turn off water while brushing teeth or shaving	37%	137	1%	3	1%	2	1%	4	0%	1	0%	1	0%	0	0%	0	0%	0	63%	230	23%	84
Take a shorter shower or time my shower	33%	116	1%	4	1%	3	0%	1	0%	0	0%	1	0%	0	0%	0	0%	0	66%	234	27%	95
Use a garbage can, not the toilet, to dispose of trash	26%	94	0%	0	0%	0	0%	0	0%	0	0%	1	1%	2	0%	0	0%	0	75%	272	35%	126
Check toilet for leaks	25%	81	0%	1	0%	1	0%	0	0%	0	0%	0	11%	35	0%	0	0%	0	68%	223	29%	94
Scrape food from dishes into garbage instead of rinsing down the drain with water	28%	99	0%	1	0%	0	1%	2	0%	0	0%	0	1%	2	0%	0	0%	0	72%	255	33%	119

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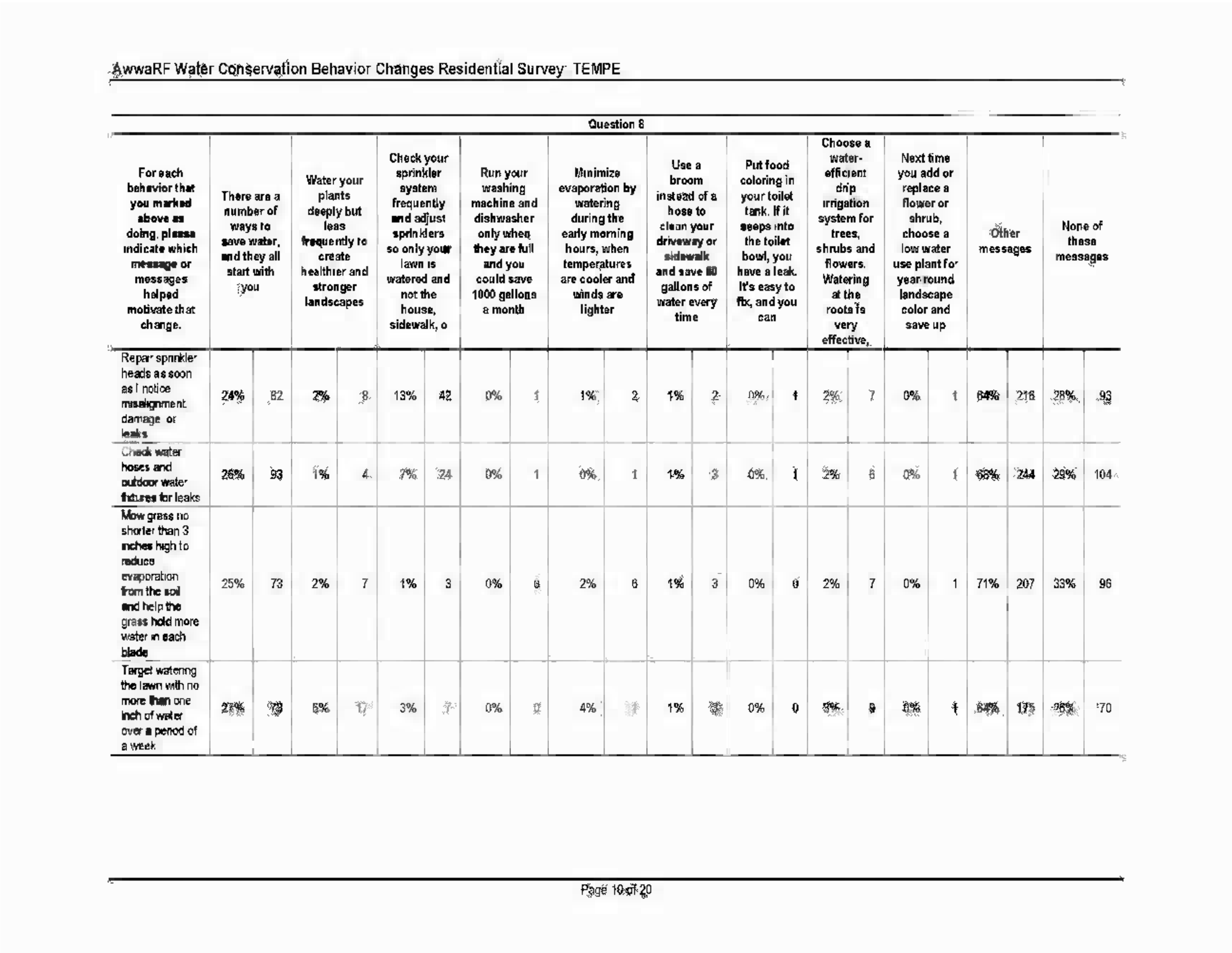
AwwaRF Water Conservation Behavior Changes Residential Survey TEMPE

Question 8

For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Conserve water while cooking	27%	93	1%	3	0%	0	1%	2	0%	0	0%	1	0%	0	0%	0	0%	0	72%	253	33%	114
Keep jug of water in the refrigerator instead of using the tap to get cold water	28%	86	0%	1	1%	3	0%	0	0%	0	0%	1	0%	0	0%	0	0%	0	71%	216	33%	102
Monitor outdoor water use	28%	99	6%	21	6%	21	1%	2	5%	16	2%	7	0%	1	3%	12	3%	9	61%	214	23%	82
Do not water if it has rained	33%	116	3%	9	2%	6	0%	0	1%	5	0%	0	0%	0	1%	4	1%	2	64%	228	29%	103
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	22%	68	5%	16	3%	9	0%	0	3%	9	0%	1	0%	0	6%	19	6%	18	66%	202	25%	78
Water lawn or garden during hours that avoid the heat of the day	28%	101	7%	25	3%	11	0%	0	19%	68	1%	3	0%	0	3%	12	1%	2	54%	195	17%	63
Make sure irrigation water does not run off my landscape into gutters and storm drains	25%	78	2%	6	10%	32	0%	1	2%	6	1%	3	0%	0	2%	5	0%	1	66%	205	27%	84



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 8

For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	24%	82	2%	8	13%	42	0%	1	1%	2	1%	2	0%	1	2%	7	0%	1	64%	216	28%	93
Check water hoses and outdoor water fixtures for leaks	26%	93	1%	4	7%	24	0%	1	0%	1	1%	3	0%	1	2%	6	0%	1	68%	244	29%	104
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	25%	73	2%	7	1%	3	0%	0	2%	6	1%	3	0%	0	2%	7	0%	1	71%	207	33%	96
Target watering the lawn with no more than one inch of water over a period of a week	27%	79	6%	17	3%	7	0%	0	4%	[illegible]	1%	3	0%	0	3%	9	0%	1	64%	175	26%	70

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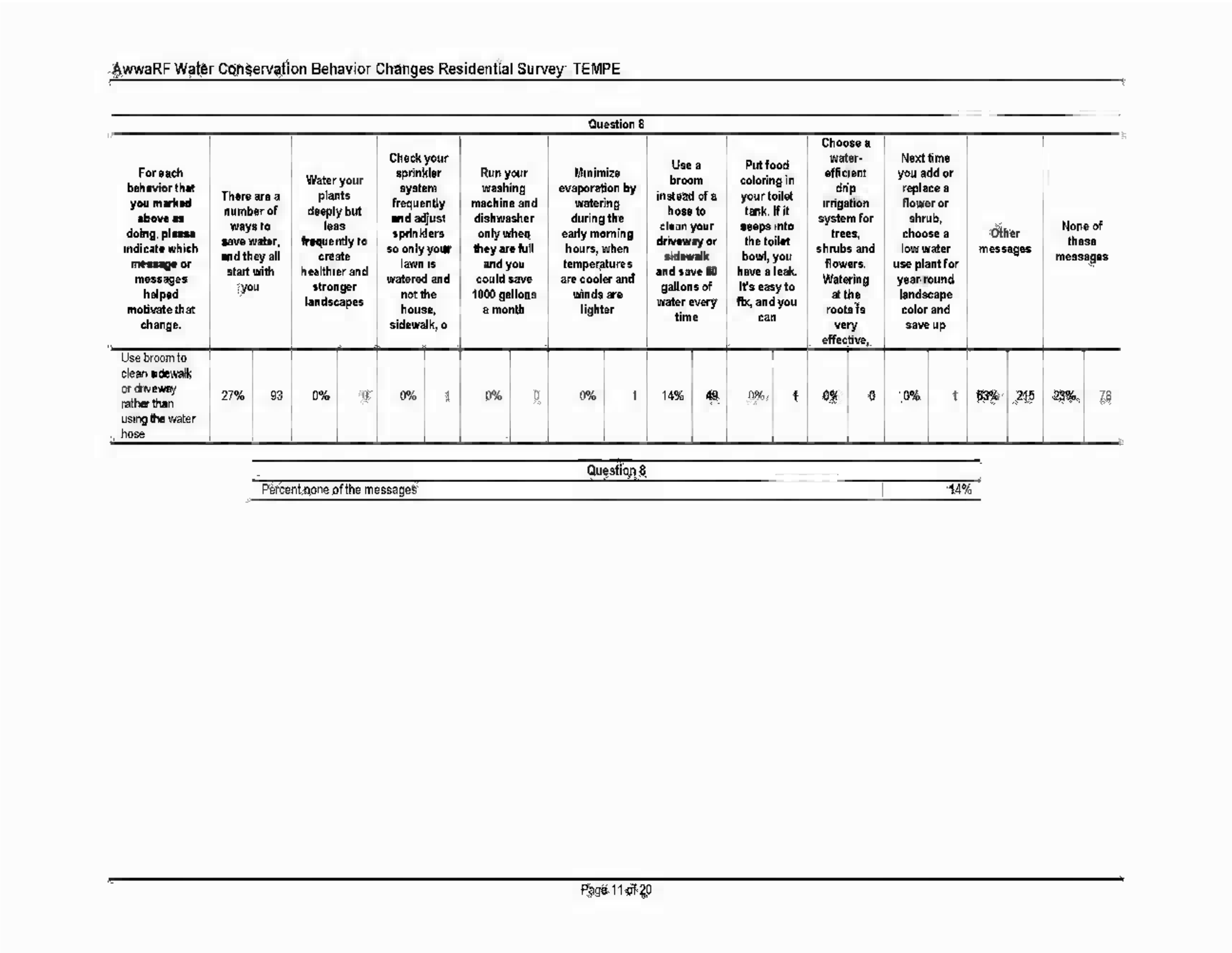

AwwaRF Water Conservation Behavior Changes Residential Survey TEMPE

Question 8

For each behavior that you marked above as doing, please indicate which message or messages helped motivate that change.	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Use broom to clean sidewalk or driveway rather than using the water hose	27%	93	0%	0	0%	1	0%	0	0%	1	14%	49	0%	1	0%	0	0%	1	63%	215	23%	78

Question 8

Percent none of the messages	14%

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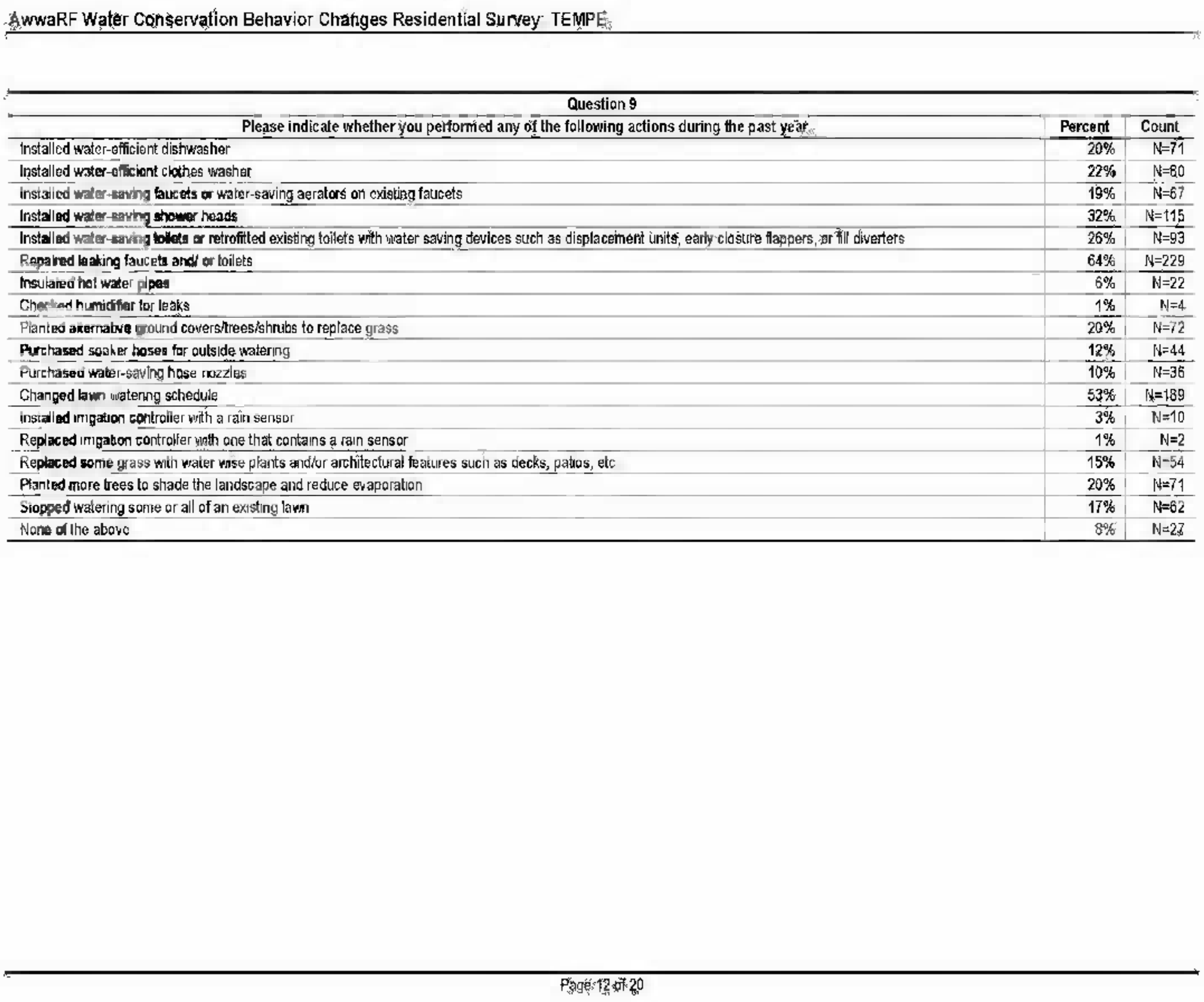
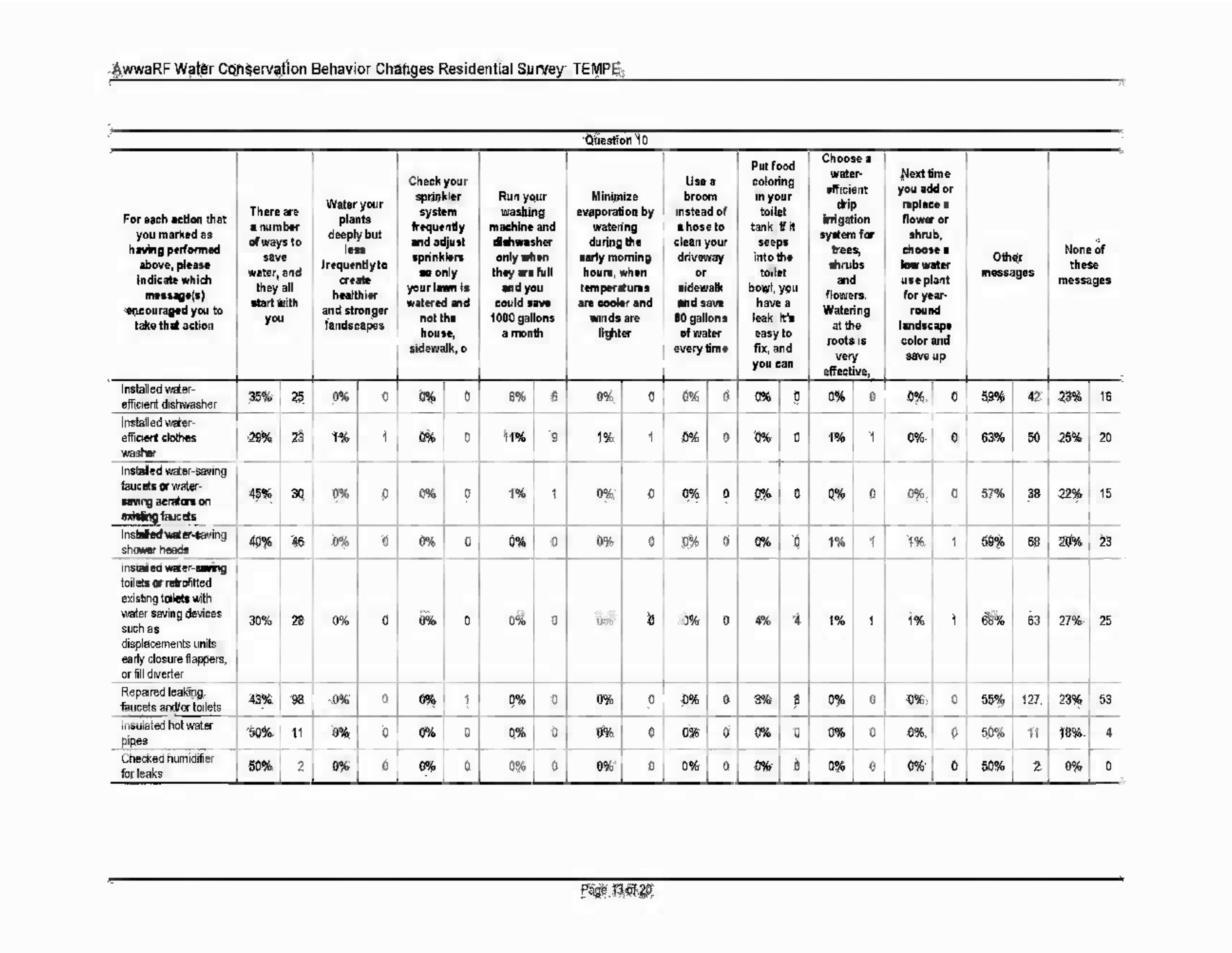


Question 9

Please indicate whether you performed any of the following actions during the past year	Percent	Count
Installed water-efficient dishwasher	20%	N=71
Installed water-efficient clothes washer	22%	N=80
Installed water-saving faucets or water-saving aerators on existing faucets	19%	N=67
Installed water-saving shower heads	32%	N=115
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	26%	N=93
Repaired leaking faucets and/ or toilets	64%	N=229
Insulated hot water pipes	6%	N=22
Checked humidifier for leaks	1%	N=4
Planted alternative ground covers/trees/shrubs to replace grass	20%	N=72
Purchased soaker hoses for outside watering	12%	N=44
Purchased water-saving hose nozzles	10%	N=36
Changed lawn watering schedule	53%	N=189
Installed irrigation controller with a rain sensor	3%	N=10
Replaced irrigation controller with one that contains a rain sensor	1%	N=2
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc	15%	N=54
Planted more trees to shade the landscape and reduce evaporation	20%	N=71
Stopped watering some or all of an existing lawn	17%	N=62
None of the above	8%	N=27



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 10

For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Installed water-efficient dishwasher	35%	25	0%	0	0%	0	6%	6	0%	0	0%	0	0%	0	0%	0	0%	0	59%	42	23%	16
Installed water-efficient clothes washer	29%	23	1%	1	0%	0	11%	9	1%	1	0%	0	0%	0	1%	1	0%	0	63%	50	25%	20
Installed water-saving faucets or water-saving aerators on existing faucets	45%	30	0%	0	0%	0	1%	1	0%	0	0%	0	0%	0	0%	0	0%	0	57%	38	22%	15
Installed water-saving shower heads	40%	46	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	1%	1	1%	1	59%	68	20%	23
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units early closure flappers, or fill diverter	30%	28	0%	0	0%	0	0%	0	0%	0	0%	0	4%	4	1%	1	1%	1	68%	63	27%	25
Repaired leaking faucets and/or toilets	43%	98	0%	0	0%	1	0%	0	0%	0	0%	0	3%	8	0%	0	0%	0	55%	127	23%	53
Insulated hot water pipes	50%	11	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	50%	11	18%	4
Checked humidifier for leaks	50%	2	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	50%	2	0%	0

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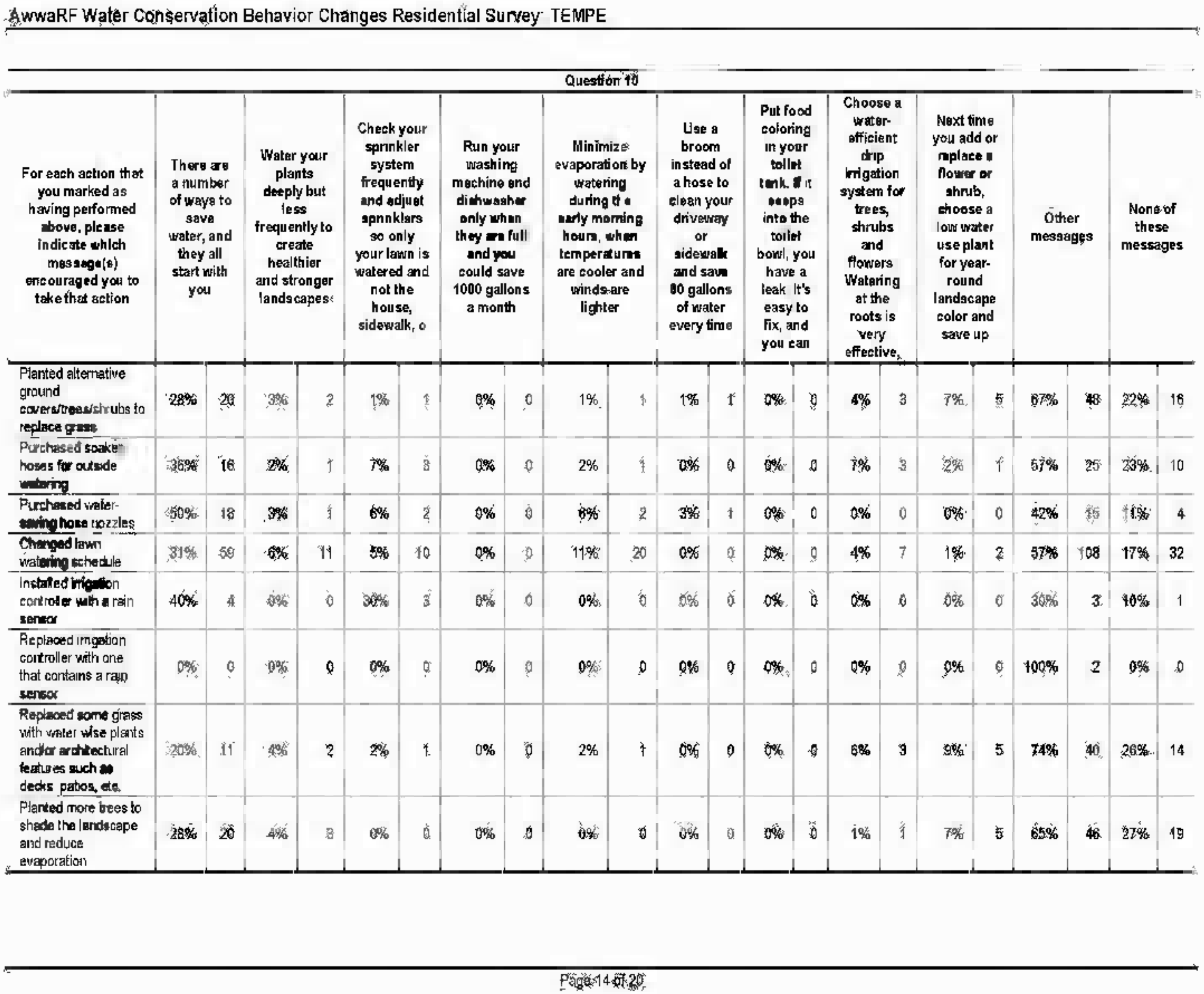

AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 10

For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Planted alternative ground covers/trees/shrubs to replace grass	28%	20	3%	2	1%	1	0%	0	1%	1	1%	1	0%	0	4%	3	7%	5	67%	48	22%	16
Purchased soaker hoses for outside watering	36%	16	2%	1	7%	3	0%	0	2%	1	0%	0	0%	0	7%	3	2%	1	57%	25	23%	10
Purchased water-saving hose nozzles	50%	18	3%	1	6%	2	0%	0	6%	2	3%	1	0%	0	0%	0	0%	0	42%	15	11%	4
Changed lawn watering schedule	31%	59	6%	11	5%	10	0%	0	11%	20	0%	0	0%	0	4%	7	1%	2	57%	108	17%	32
Installed irrigation controller with a rain sensor	40%	4	0%	0	30%	3	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	30%	3	10%	1
Replaced irrigation controller with one that contains a rain sensor	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	100%	2	0%	0
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	20%	11	4%	2	2%	1	0%	0	2%	1	0%	0	0%	0	6%	3	9%	5	74%	40	26%	14
Planted more trees to shade the landscape and reduce evaporation	28%	20	4%	3	0%	0	0%	0	0%	0	0%	0	0%	0	1%	1	7%	5	65%	46	27%	19

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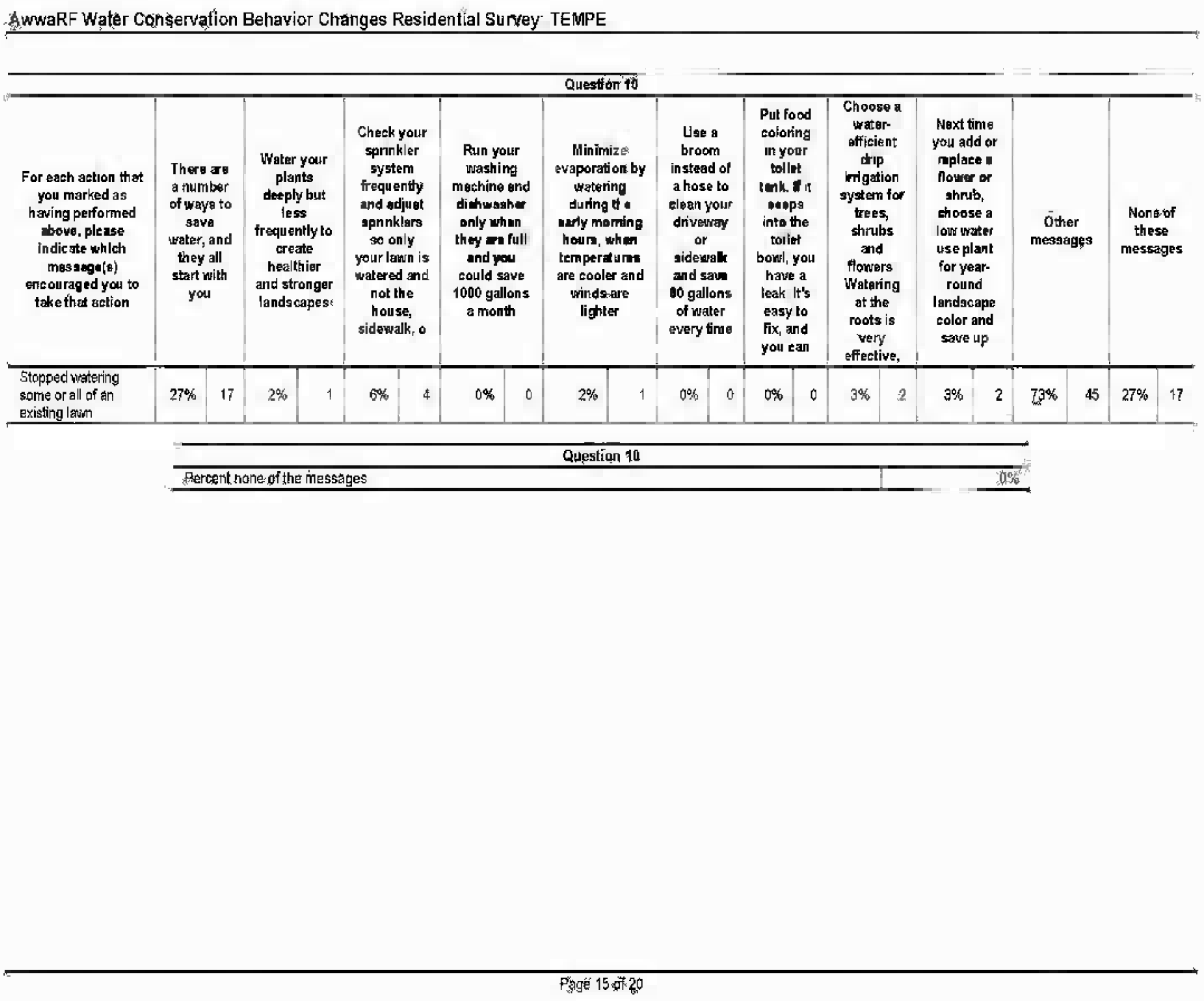
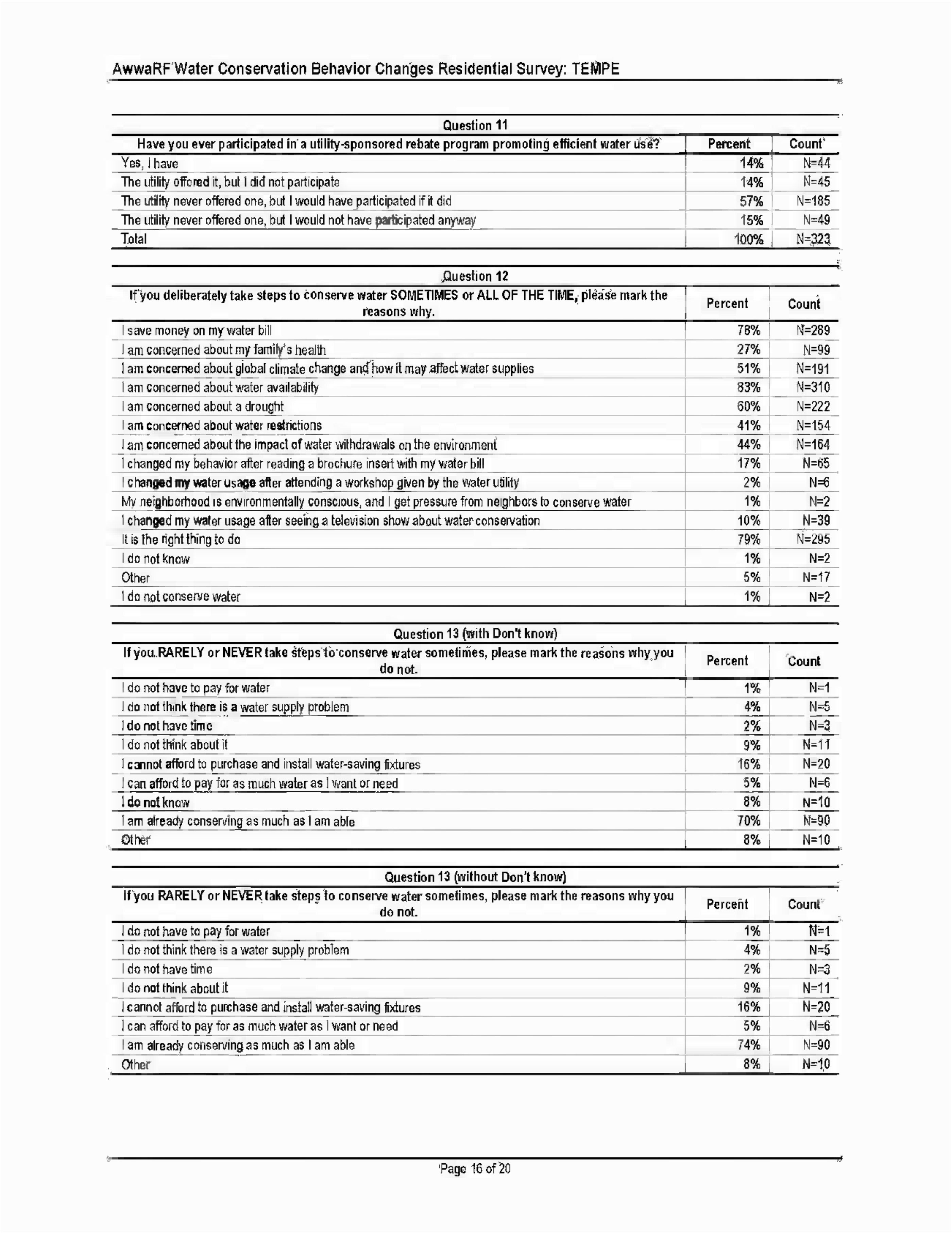


AwwaRF Water Conservation Behavior Changes Residential Survey TEMPE

Question 10

For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action	There are a number of ways to save water, and they all start with you		Water your plants deeply but less frequently to create healthier and stronger landscapes		Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, o		Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month		Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter		Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time		Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can		Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective,		Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up		Other messages		None of these messages	
Stopped watering some or all of an existing lawn	27%	17	2%	1	6%	4	0%	0	2%	1	0%	0	0%	0	3%	2	3%	2	73%	45	27%	17

Question 10	
Percent none of the messages	0%



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 11

Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	14%	N=44
The utility offered it, but I did not participate	14%	N=45
The utility never offered one, but I would have participated if it did	57%	N=185
The utility never offered one, but I would not have participated anyway	15%	N=49
Total	100%	N=323

Question 12

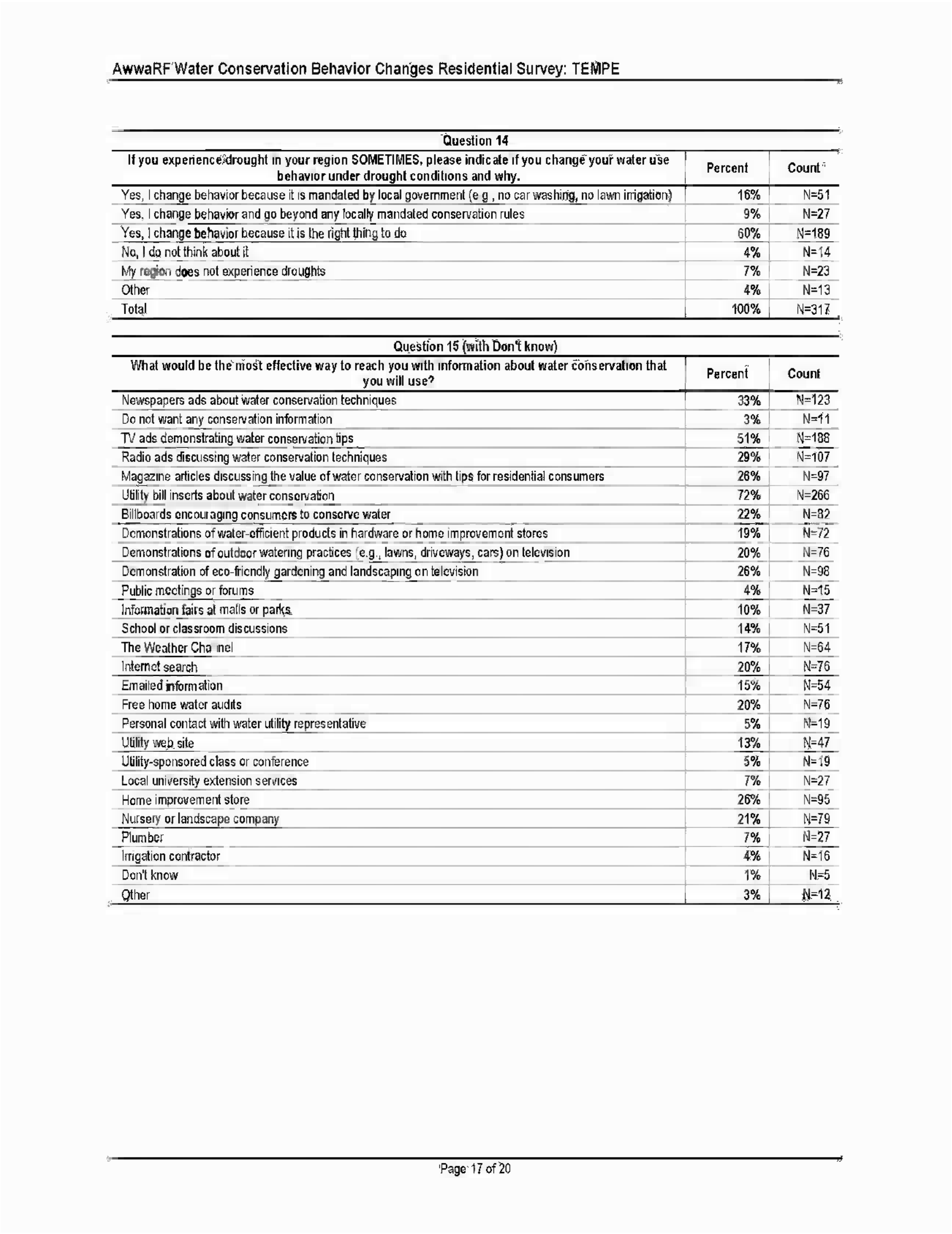
If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	78%	N=289
I am concerned about my family's health	27%	N=99
I am concerned about global climate change and how it may affect water supplies	51%	N=191
I am concerned about water availability	83%	N=310
I am concerned about a drought	60%	N=222
I am concerned about water restrictions	41%	N=154
I am concerned about the impact of water withdrawals on the environment	44%	N=164
I changed my behavior after reading a brochure insert with my water bill	17%	N=65
I changed my water usage after attending a workshop given by the water utility	2%	N=6
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	1%	N=2
I changed my water usage after seeing a television show about water conservation	10%	N=39
It is the right thing to do	79%	N=295
I do not know	1%	N=2
Other	5%	N=17
I do not conserve water	1%	N=2

Question 13 (with Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	4%	N=5
I do not have time	2%	N=3
I do not think about it	9%	N=11
I cannot afford to purchase and install water-saving fixtures	16%	N=20
I can afford to pay for as much water as I want or need	5%	N=6
I do not know	8%	N=10
I am already conserving as much as I am able	70%	N=90
Other	8%	N=10

Question 13 (without Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	4%	N=5
I do not have time	2%	N=3
I do not think about it	9%	N=11
I cannot afford to purchase and install water-saving fixtures	16%	N=20
I can afford to pay for as much water as I want or need	5%	N=6
I am already conserving as much as I am able	74%	N=90
Other	8%	N=10



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 14 If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	16%	N=51
Yes, I change behavior and go beyond any locally mandated conservation rules	9%	N=27
Yes, I change behavior because it is the right thing to do	60%	N=189
No, I do not think about it	4%	N=14
My region does not experience droughts	7%	N=23
Other	4%	N=13
Total	100%	N=317

Question 15 (with Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	33%	N=123
Do not want any conservation information	3%	N=11
TV ads demonstrating water conservation tips	51%	N=188
Radio ads discussing water conservation techniques	29%	N=107
Magazine articles discussing the value of water conservation with tips for residential consumers	26%	N=97
Utility bill inserts about water conservation	72%	N=266
Billboards encouraging consumers to conserve water	22%	N=82
Demonstrations of water-efficient products in hardware or home improvement stores	19%	N=72
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	20%	N=76
Demonstration of eco-friendly gardening and landscaping on television	26%	N=98
Public meetings or forums	4%	N=15
Information fairs at malls or parks	10%	N=37
School or classroom discussions	14%	N=51
The Weather Channel	17%	N=64
Internet search	20%	N=76
Emailed information	15%	N=54
Free home water audits	20%	N=76
Personal contact with water utility representative	5%	N=19
Utility web site	13%	N=47
Utility-sponsored class or conference	5%	N=19
Local university extension services	7%	N=27
Home improvement store	26%	N=95
Nursery or landscape company	21%	N=79
Plumber	7%	N=27
Irrigation contractor	4%	N=16
Don't know	1%	N=5
Other	3%	N=12

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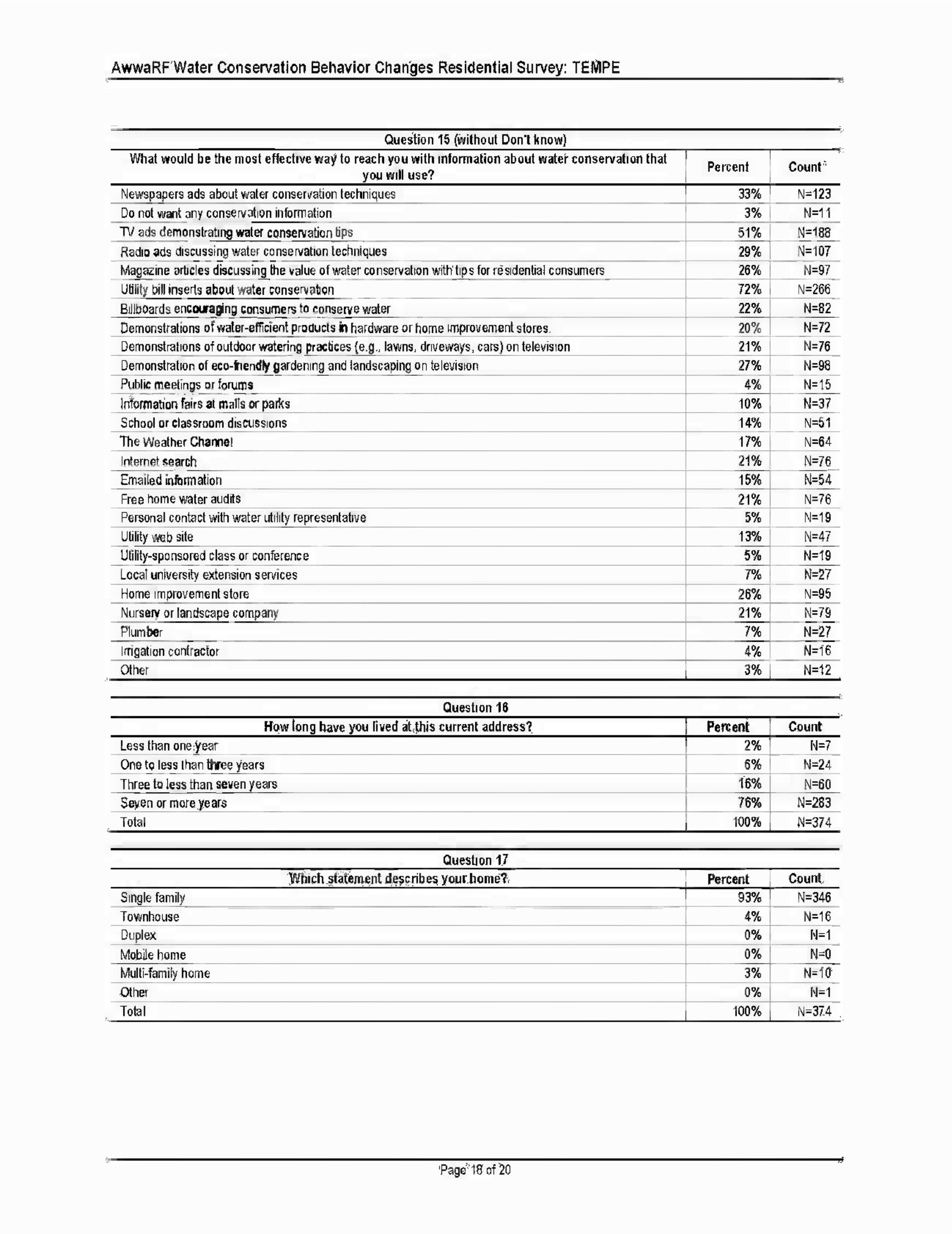


AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 15 (without Don't know)

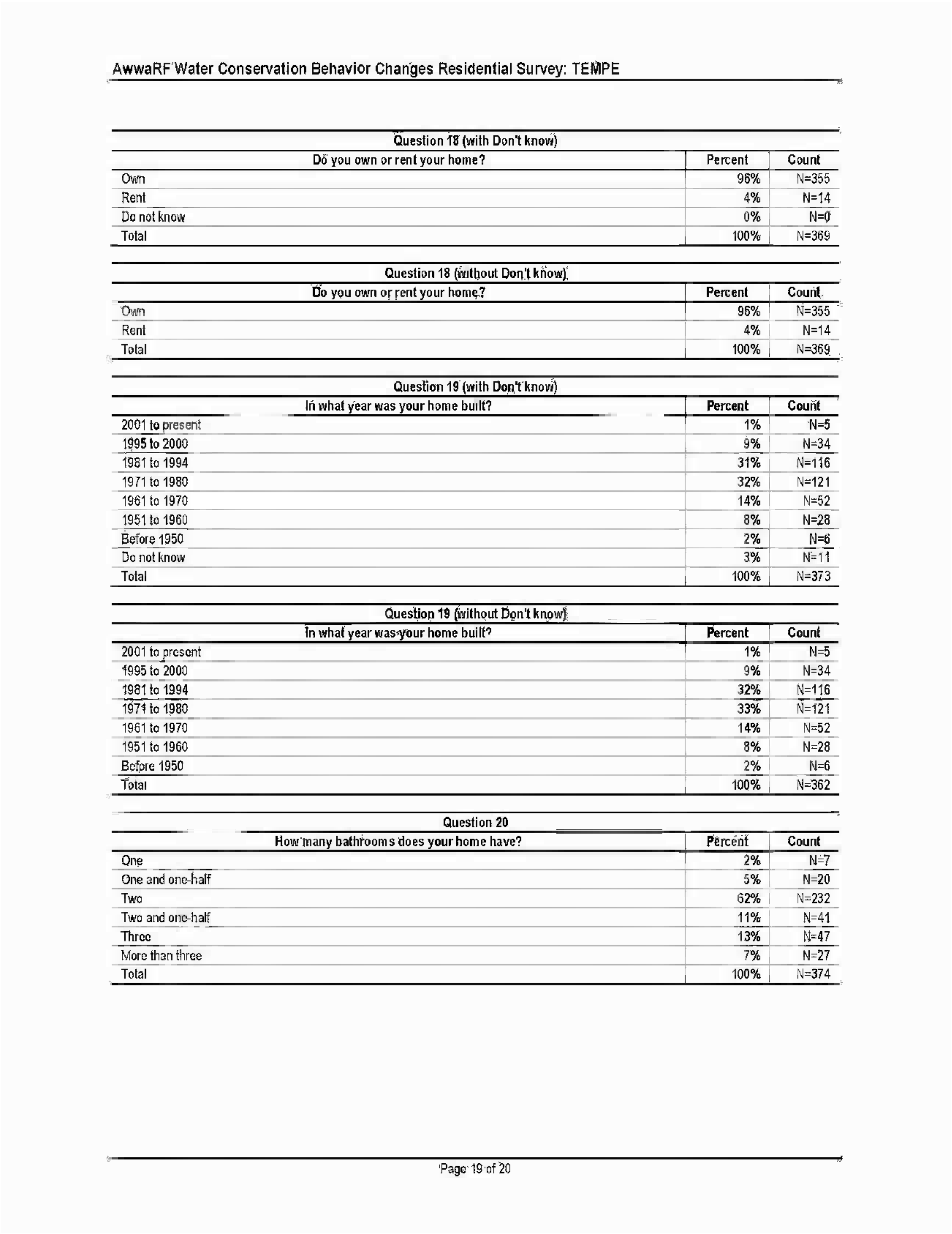
What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	33%	N=123
Do not want any conservation information	3%	N=11
TV ads demonstrating water conservation tips	51%	N=188
Radio ads discussing water conservation techniques	29%	N=107
Magazine articles discussing the value of water conservation with tips for residential consumers	26%	N=97
Utility bill inserts about water conservation	72%	N=266
Billboards encouraging consumers to conserve water	22%	N=82
Demonstrations of water-efficient products in hardware or home improvement stores.	20%	N=72
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	21%	N=76
Demonstration of eco-friendly gardening and landscaping on television	27%	N=98
Public meetings or forums	4%	N=15
Information fairs at malls or parks	10%	N=37
School or classroom discussions	14%	N=51
The Weather Channel	17%	N=64
Internet search	21%	N=76
Emailed information	15%	N=54
Free home water audits	21%	N=76
Personal contact with water utility representative	5%	N=19
Utility web site	13%	N=47
Utility-sponsored class or conference	5%	N=19
Local university extension services	7%	N=27
Home improvement store	26%	N=95
Nursery or landscape company	21%	N=79
Plumber	7%	N=27
Irrigation contractor	4%	N=16
Other	3%	N=12

Question 16

How long have you lived at this current address?	Percent	Count
Less than one year	2%	N=7
One to less than three years	6%	N=24
Three to less than seven years	16%	N=60
Seven or more years	76%	N=283
Total	100%	N=374

Question 17

Which statement describes your home?	Percent	Count
Single family	93%	N=346
Townhouse	4%	N=16
Duplex	0%	N=1
Mobile home	0%	N=0
Multi-family home	3%	N=10
Other	0%	N=1
Total	100%	N=374



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

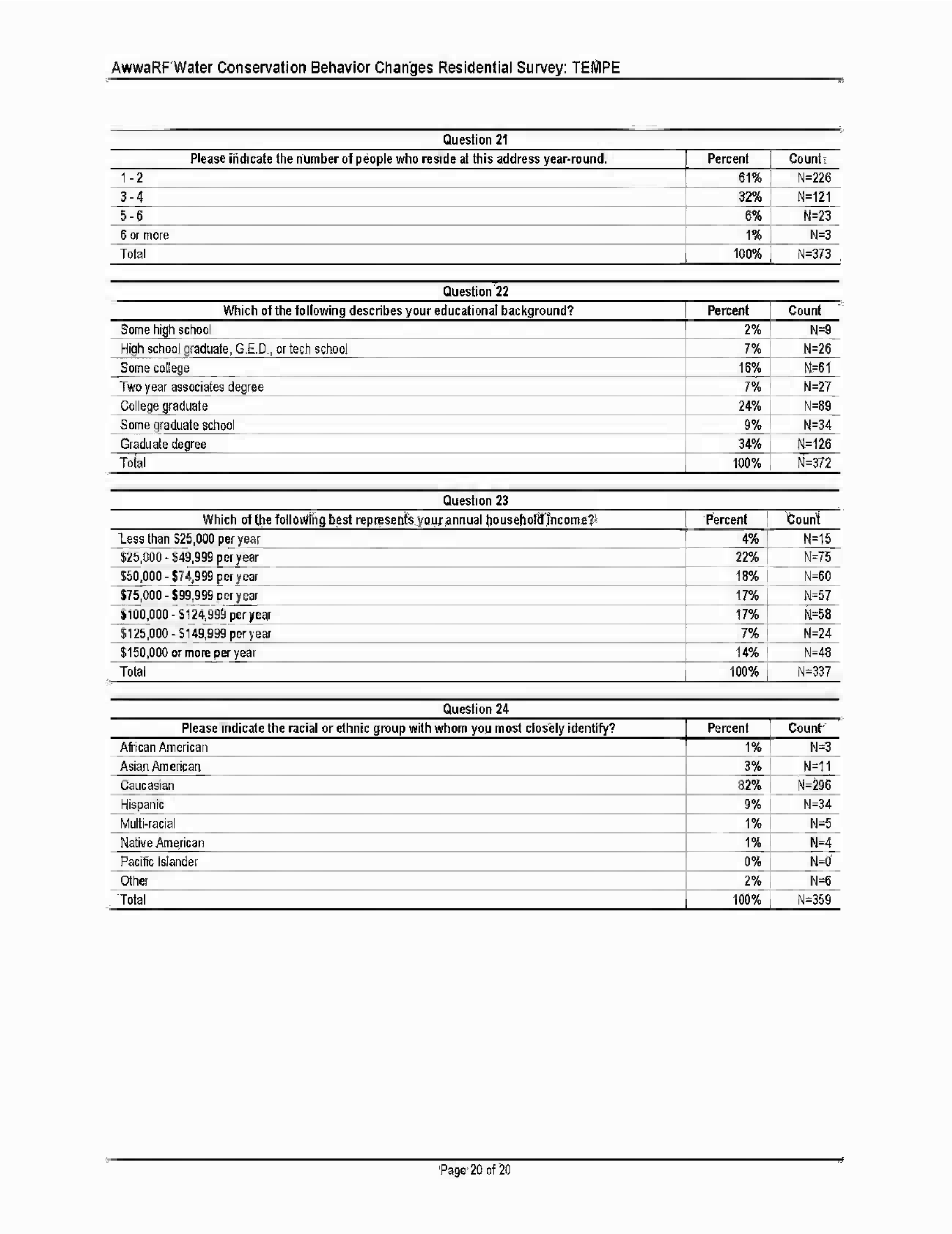
Question 18 (with Don't know) Do you own or rent your home?	Percent	Count
Own	96%	N=355
Rent	4%	N=14
Do not know	0%	N=0
Total	100%	N=369

Question 18 (without Don't know) Do you own or rent your home?	Percent	Count
Own	96%	N=355
Rent	4%	N=14
Total	100%	N=369

Question 19 (with Don't know) In what year was your home built?	Percent	Count
2001 to present	1%	N=5
1995 to 2000	9%	N=34
1981 to 1994	31%	N=116
1971 to 1980	32%	N=121
1961 to 1970	14%	N=52
1951 to 1960	8%	N=28
Before 1950	2%	N=6
Do not know	3%	N=11
Total	100%	N=373

Question 19 (without Don't know) In what year was your home built?	Percent	Count
2001 to present	1%	N=5
1995 to 2000	9%	N=34
1981 to 1994	32%	N=116
1971 to 1980	33%	N=121
1961 to 1970	14%	N=52
1951 to 1960	8%	N=28
Before 1950	2%	N=6
Total	100%	N=362

Question 20 How many bathrooms does your home have?	Percent	Count
One	2%	N=7
One and one-half	5%	N=20
Two	62%	N=232
Two and one-half	11%	N=41
Three	13%	N=47
More than three	7%	N=27
Total	100%	N=374



AwwaRF Water Conservation Behavior Changes Residential Survey: TEMPE

Question 21

Please indicate the number of people who reside at this address year-round.	Percent	Count
1 - 2	61%	N=226
3 - 4	32%	N=121
5 - 6	6%	N=23
6 or more	1%	N=3
Total	100%	N=373

Question 22

Which of the following describes your educational background?	Percent	Count
Some high school	2%	N=9
High school graduate, G.E.D., or tech school	7%	N=26
Some college	16%	N=61
Two year associates degree	7%	N=27
College graduate	24%	N=89
Some graduate school	9%	N=34
Graduate degree	34%	N=126
Total	100%	N=372

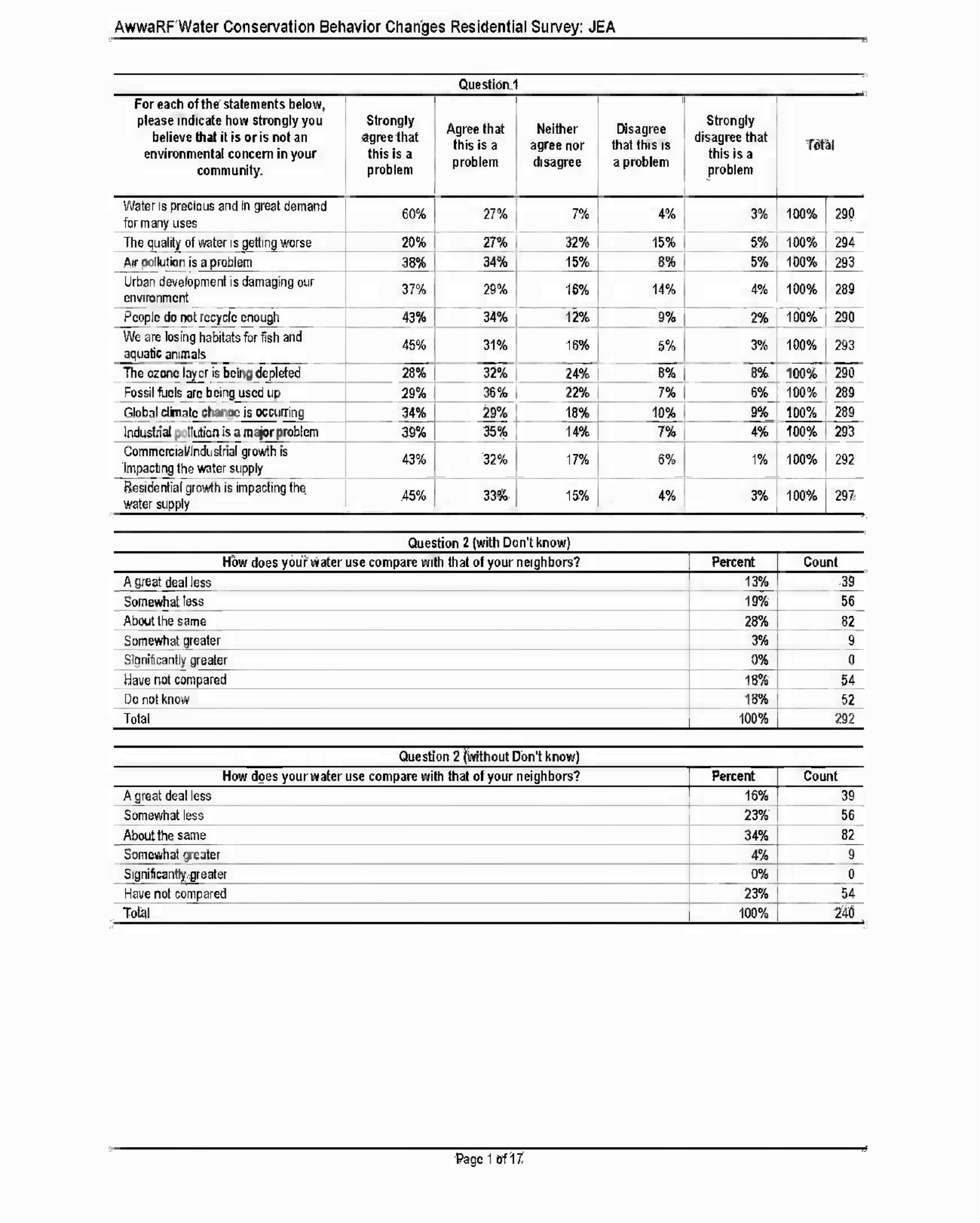
Question 23

Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	4%	N=15
$25,000 - $49,999 per year	22%	N=75
$50,000 - $74,999 per year	18%	N=60
$75,000 - $99,999 per year	17%	N=57
$100,000 - $124,999 per year	17%	N=58
$125,000 - $149,999 per year	7%	N=24
$150,000 or more per year	14%	N=48
Total	100%	N=337

Question 24

Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	1%	N=3
Asian American	3%	N=11
Caucasian	82%	N=296
Hispanic	9%	N=34
Multi-racial	1%	N=5
Native American	1%	N=4
Pacific Islander	0%	N=0
Other	2%	N=6
Total	100%	N=359

JEA: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 1

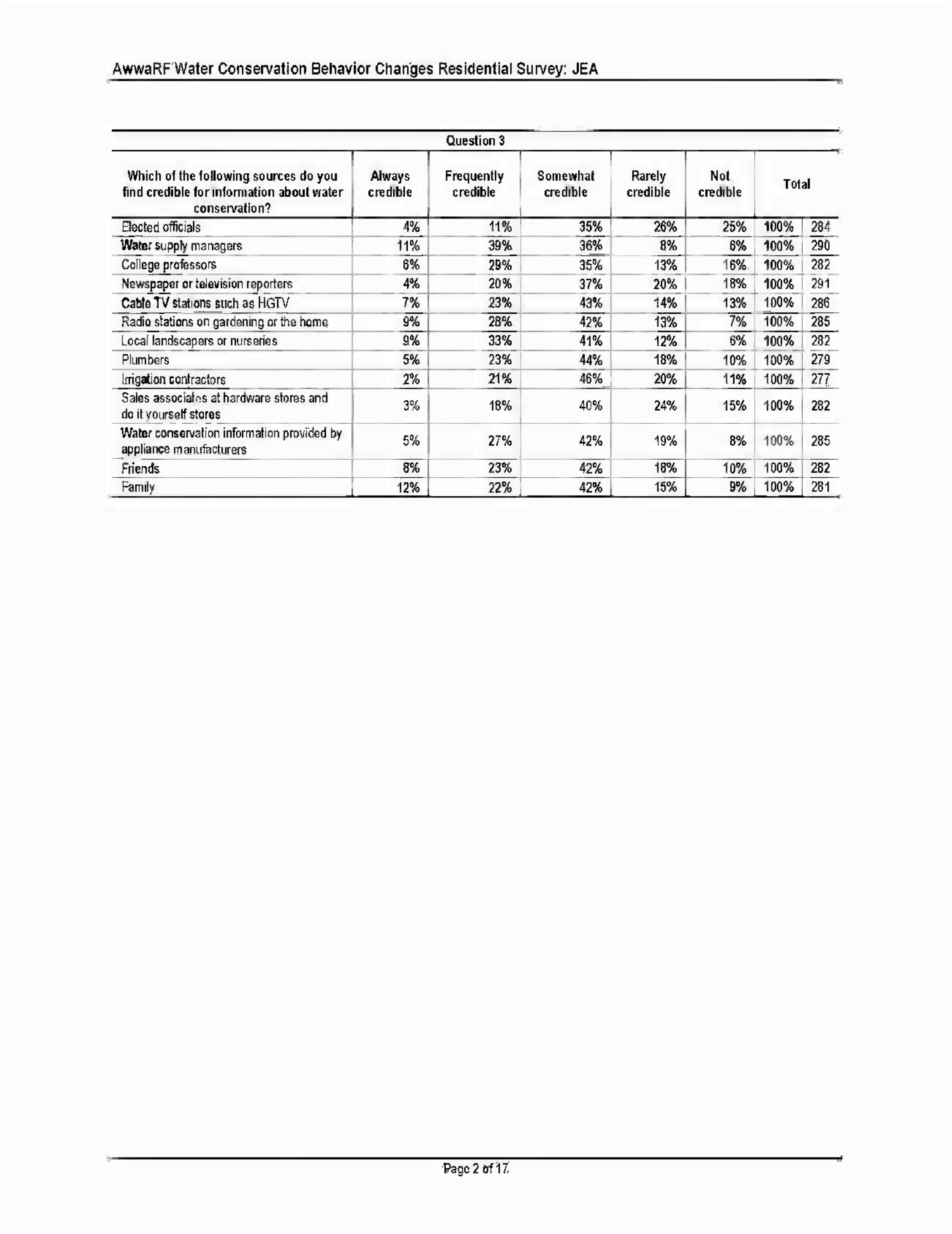
For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	60%	27%	7%	4%	3%	100%	290
The quality of water is getting worse	20%	27%	32%	15%	5%	100%	294
Air pollution is a problem	38%	34%	15%	8%	5%	100%	293
Urban development is damaging our environment	37%	29%	16%	14%	4%	100%	289
People do not recycle enough	43%	34%	12%	9%	2%	100%	290
We are losing habitats for fish and aquatic animals	45%	31%	16%	5%	3%	100%	293
The ozone layer is being depleted	28%	32%	24%	8%	8%	100%	290
Fossil fuels are being used up	29%	36%	22%	7%	6%	100%	289
Global climate change is occurring	34%	29%	18%	10%	9%	100%	289
Industrial pollution is a major problem	39%	35%	14%	7%	4%	100%	293
Commercial/Industrial growth is impacting the water supply	43%	32%	17%	6%	1%	100%	292
Residential growth is impacting the water supply	45%	33%	15%	4%	3%	100%	297

Question 2 (with Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	13%	39
Somewhat less	19%	56
About the same	28%	82
Somewhat greater	3%	9
Significantly greater	0%	0
Have not compared	18%	54
Do not know	18%	52
Total	100%	292

Question 2 (without Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	16%	39
Somewhat less	23%	56
About the same	34%	82
Somewhat greater	4%	9
Significantly greater	0%	0
Have not compared	23%	54
Total	100%	240

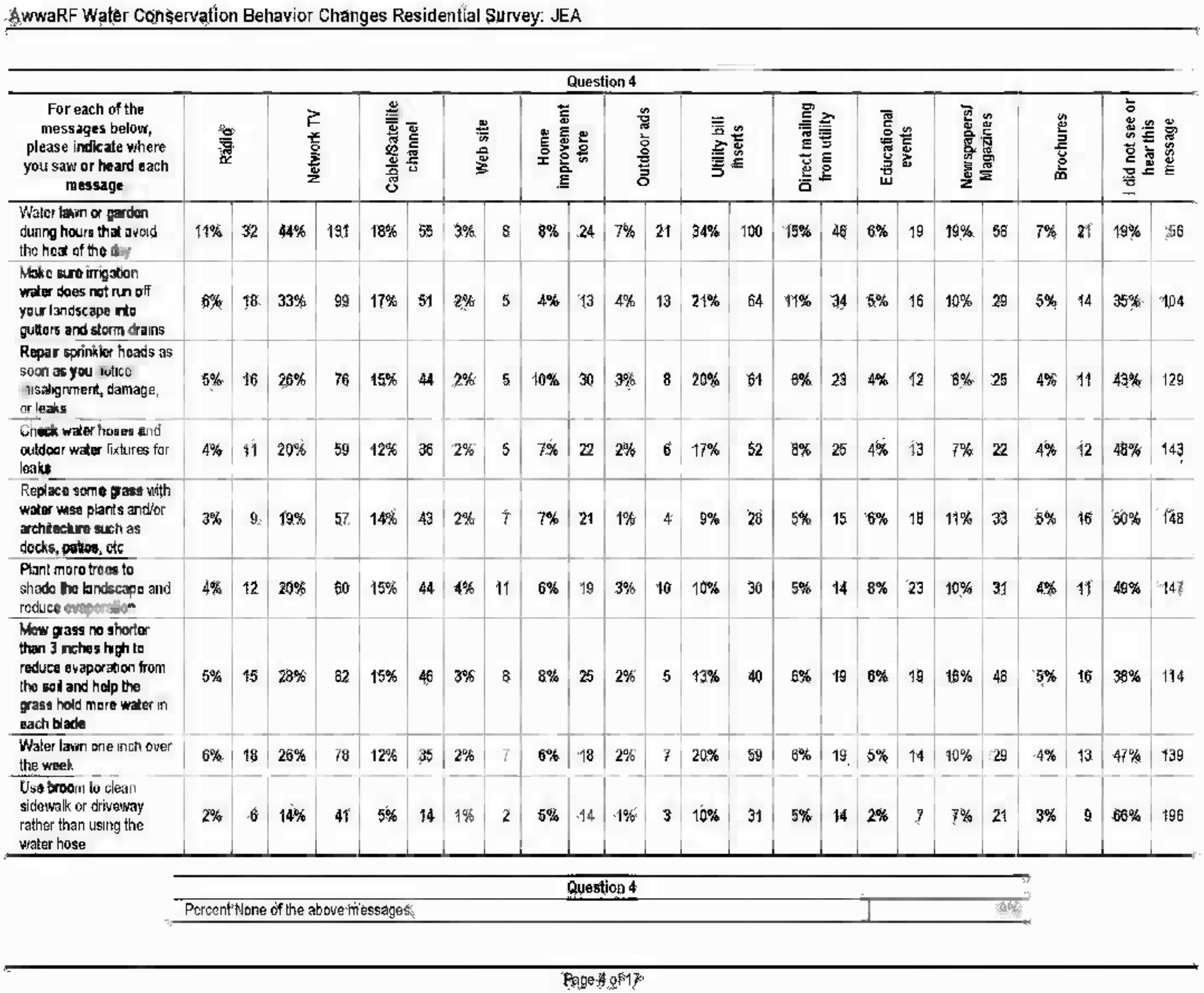


Question 3

Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	4%	11%	35%	26%	25%	100%	284
Water supply managers	11%	39%	36%	8%	6%	100%	290
College professors	6%	29%	35%	13%	16%	100%	282
Newspaper or television reporters	4%	20%	37%	20%	18%	100%	291
Cable TV stations such as HGTV	7%	23%	43%	14%	13%	100%	286
Radio stations on gardening or the home	9%	28%	42%	13%	7%	100%	285
Local landscapers or nurseries	9%	33%	41%	12%	6%	100%	282
Plumbers	5%	23%	44%	18%	10%	100%	279
Irrigation contractors	2%	21%	46%	20%	11%	100%	277
Sales associates at hardware stores and do it yourself stores	3%	18%	40%	24%	15%	100%	282
Water conservation information provided by appliance manufacturers	5%	27%	42%	19%	8%	100%	285
Friends	8%	23%	42%	18%	10%	100%	282
Family	12%	22%	42%	15%	9%	100%	281

Question 4

For each of the messages below, please indicate where you saw or heard each message	Radio		Network TV		Cable/Satellite channel		Web site		Home improvement store		Outdoor ads		Utility bill inserts		Direct mailing from utility		Educational events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Track your water usage monthly using your water bill	5%	15	16%	47	8%	25	3%	8	4%	12	2%	7	43%	129	13%	39	3%	8	7%	21	5%	15	41%	121
Use dishwasher less, or run only with full load	6%	18	32%	94	13%	39	1%	4	8%	23	2%	5	28%	83	13%	39	2%	7	14%	42	10%	29	32%	94
Use clothes washer only with full load	5%	16	30%	88	14%	42	2%	5	7%	20	1%	4	30%	89	12%	36	4%	13	16%	48	11%	32	30%	90
Turn off water while brushing teeth or shaving	6%	18	38%	113	16%	48	2%	5	4%	11	1%	3	24%	72	9%	28	6%	19	15%	46	7%	22	28%	84
Take a shorter shower or time your shower	8%	23	28%	83	14%	41	1%	4	5%	15	1%	3	29%	85	8%	24	6%	17	13%	39	5%	16	32%	94
Use a garbage can, not the toilet, to dispose of trash	4%	11	12%	36	5%	14	2%	5	6%	19	2%	5	11%	33	4%	11	3%	8	8%	25	3%	8	66%	196
Check toilet for leaks	6%	17	29%	87	13%	40	2%	7	10%	31	1%	3	31%	91	13%	38	4%	12	11%	33	5%	15	31%	91
Scrape food from dishes into garbage instead of rinsing down the drain with water	3%	8	11%	33	6%	18	1%	3	5%	14	1%	3	11%	33	4%	12	4%	12	7%	22	3%	10	66%	197
Conserve water while cooking	2%	7	10%	29	4%	13	1%	3	3%	10	0%	1	9%	27	5%	15	2%	7	6%	17	2%	6	72%	214
Keep jug of water in the refrigerator instead of using the tap to get cold water	3%	8	12%	36	5%	15	1%	4	3%	10	0%	0	7%	22	4%	12	2%	6	6%	19	2%	7	70%	208
Monitor outdoor water use	9%	28	34%	100	12%	36	3%	8	6%	17	5%	14	29%	87	11%	34	4%	13	14%	43	3%	10	36%	106
Do not water if it has rained	10%	29	39%	116	18%	54	3%	10	6%	18	4%	12	31%	91	12%	36	4%	13	17%	50	6%	18	27%	80
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	5%	16	31%	91	20%	59	3%	8	8%	25	2%	7	19%	57	10%	31	6%	19	15%	44	6%	18	37%	111



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 4

For each of the messages below, please indicate where you saw or heard each message	Radio		Network TV		Cable/Satellite channel		Web site		Home improvement store		Outdoor ads		Utility bill inserts		Direct mailing from utility		Educational events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Water lawn or garden during hours that avoid the heat of the day	11%	32	44%	131	18%	55	3%	8	8%	24	7%	21	34%	100	15%	46	6%	19	19%	56	7%	21	19%	56
Make sure irrigation water does not run off your landscape into gutters and storm drains	6%	18	33%	99	17%	51	2%	5	4%	13	4%	13	21%	64	11%	34	5%	16	10%	29	5%	14	35%	104
Repair sprinkler heads as soon as you notice misalignment, damage, or leaks	5%	16	26%	76	15%	44	2%	5	10%	30	3%	8	20%	61	8%	23	4%	12	8%	25	4%	11	43%	129
Check water hoses and outdoor water fixtures for leaks	4%	11	20%	59	12%	36	2%	5	7%	22	2%	6	17%	52	8%	25	4%	13	7%	22	4%	12	48%	143
Replace some grass with water wise plants and/or architecture such as docks, patios, etc	3%	9	19%	57	14%	43	2%	7	7%	21	1%	4	9%	28	5%	15	6%	18	11%	33	5%	16	50%	148
Plant more trees to shade the landscape and reduce evaporation	4%	12	20%	60	15%	44	4%	11	6%	19	3%	10	10%	30	5%	14	8%	23	10%	31	4%	11	49%	147
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	5%	15	28%	82	15%	46	3%	8	8%	25	2%	5	13%	40	6%	19	6%	19	16%	48	5%	16	38%	114
Water lawn one inch over the week	6%	18	26%	78	12%	35	2%	7	6%	18	2%	7	20%	59	6%	19	5%	14	10%	29	4%	13	47%	139
Use broom to clean sidewalk or driveway rather than using the water hose	2%	6	14%	41	5%	14	1%	2	5%	14	1%	3	10%	31	5%	14	2%	7	7%	21	3%	9	66%	196

	Question 4
Percent None of the above messages	0%

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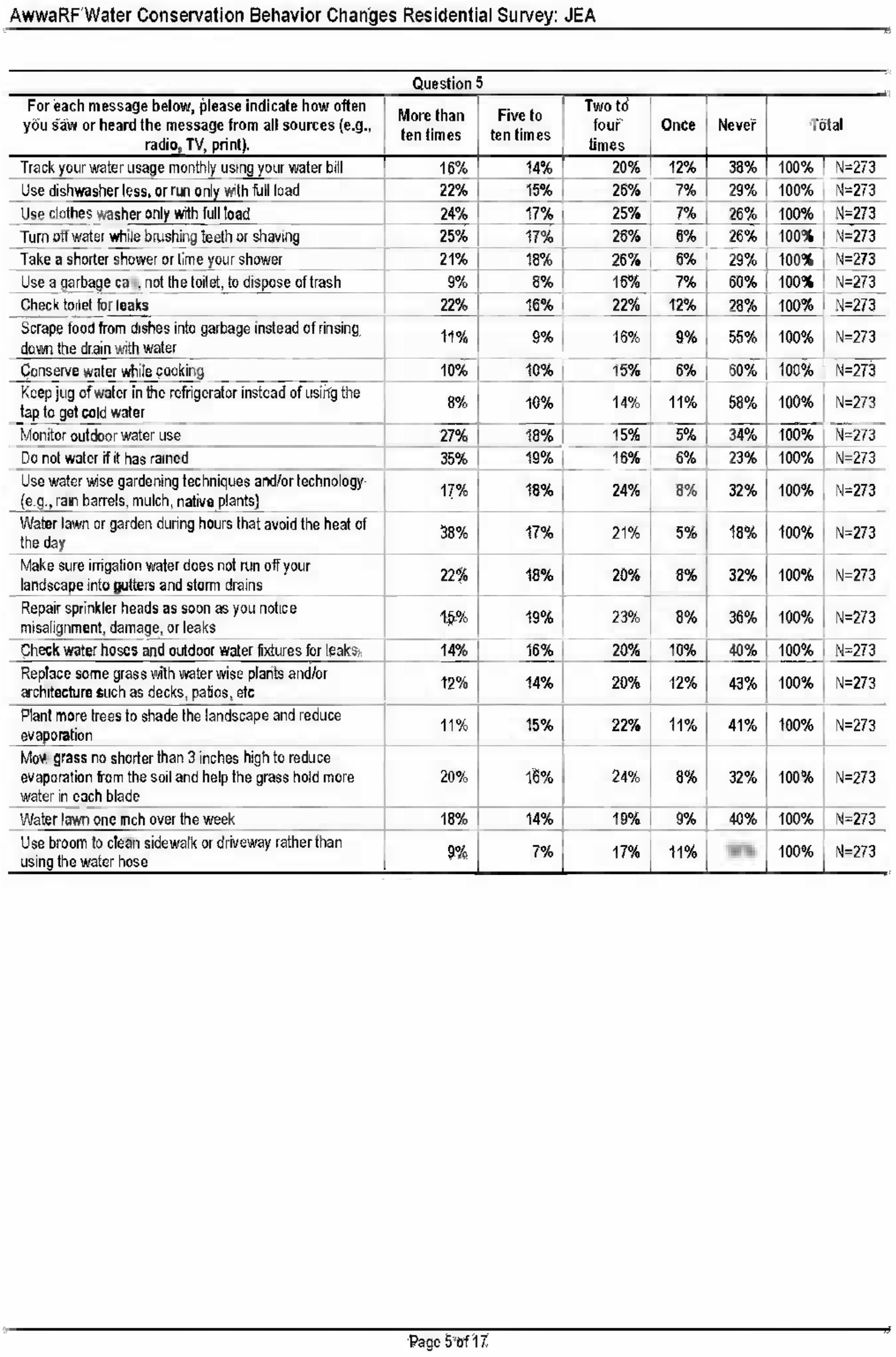

AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 5

For each message below, please indicate how often you saw or heard the message from all sources (e.g., radio, TV, print).	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
Track your water usage monthly using your water bill	16%	14%	20%	12%	38%	100%	N=273
Use dishwasher less, or run only with full load	22%	15%	26%	7%	29%	100%	N=273
Use clothes washer only with full load	24%	17%	25%	7%	26%	100%	N=273
Turn off water while brushing teeth or shaving	25%	17%	26%	6%	26%	100%	N=273
Take a shorter shower or time your shower	21%	18%	26%	6%	29%	100%	N=273
Use a garbage can, not the toilet, to dispose of trash	9%	8%	16%	7%	60%	100%	N=273
Check toilet for leaks	22%	16%	22%	12%	28%	100%	N=273
Scrape food from dishes into garbage instead of rinsing down the drain with water	11%	9%	16%	9%	55%	100%	N=273
Conserve water while cooking	10%	10%	15%	6%	60%	100%	N=273
Keep jug of water in the refrigerator instead of using the tap to get cold water	8%	10%	14%	11%	58%	100%	N=273
Monitor outdoor water use	27%	18%	15%	5%	34%	100%	N=273
Do not water if it has rained	35%	19%	16%	6%	23%	100%	N=273
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	17%	18%	24%	8%	32%	100%	N=273
Water lawn or garden during hours that avoid the heat of the day	38%	17%	21%	5%	18%	100%	N=273
Make sure irrigation water does not run off your landscape into gutters and storm drains	22%	18%	20%	8%	32%	100%	N=273
Repair sprinkler heads as soon as you notice misalignment, damage, or leaks	15%	19%	23%	8%	36%	100%	N=273
Check water hoses and outdoor water fixtures for leaks	14%	16%	20%	10%	40%	100%	N=273
Replace some grass with water wise plants and/or architecture such as decks, patios, etc	12%	14%	20%	12%	43%	100%	N=273
Plant more trees to shade the landscape and reduce evaporation	11%	15%	22%	11%	41%	100%	N=273
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	20%	16%	24%	8%	32%	100%	N=273
Water lawn one inch over the week	18%	14%	19%	9%	40%	100%	N=273
Use broom to clean sidewalk or driveway rather than using the water hose	9%	7%	17%	11%	[illegible]	100%	N=273

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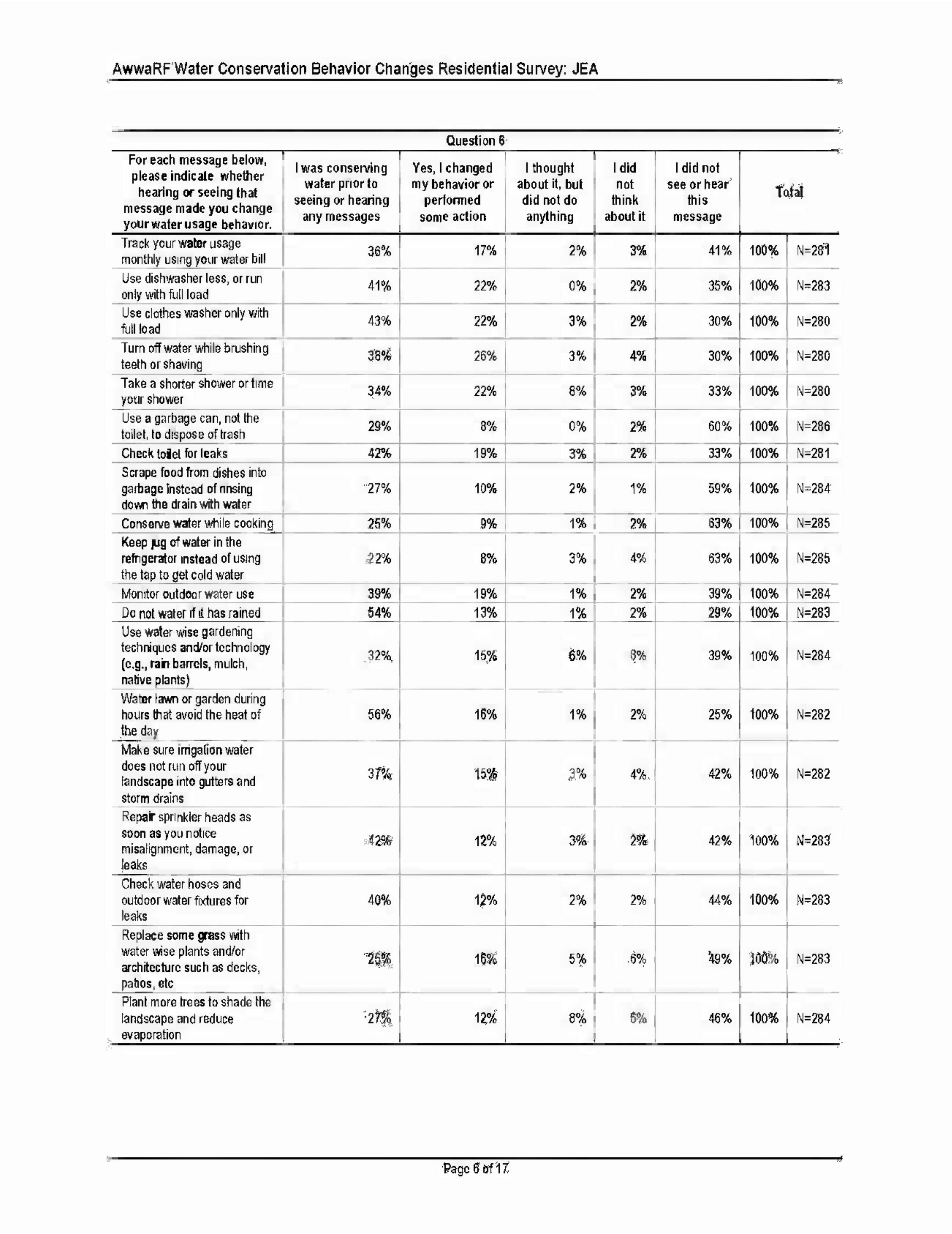

AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 6

For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
Track your water usage monthly using your water bill	36%	17%	2%	3%	41%	100%	N=281
Use dishwasher less, or run only with full load	41%	22%	0%	2%	35%	100%	N=283
Use clothes washer only with full load	43%	22%	3%	2%	30%	100%	N=280
Turn off water while brushing teeth or shaving	38%	26%	3%	4%	30%	100%	N=280
Take a shorter shower or time your shower	34%	22%	8%	3%	33%	100%	N=280
Use a garbage can, not the toilet, to dispose of trash	29%	8%	0%	2%	60%	100%	N=286
Check toilet for leaks	42%	19%	3%	2%	33%	100%	N=281
Scrape food from dishes into garbage instead of rinsing down the drain with water	27%	10%	2%	1%	59%	100%	N=284
Conserve water while cooking	25%	9%	1%	2%	63%	100%	N=285
Keep jug of water in the refrigerator instead of using the tap to get cold water	22%	8%	3%	4%	63%	100%	N=285
Monitor outdoor water use	39%	19%	1%	2%	39%	100%	N=284
Do not water if it has rained	54%	13%	1%	2%	29%	100%	N=283
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	32%	15%	6%	8%	39%	100%	N=284
Water lawn or garden during hours that avoid the heat of the day	56%	16%	1%	2%	25%	100%	N=282
Make sure irrigation water does not run off your landscape into gutters and storm drains	37%	15%	3%	4%	42%	100%	N=282
Repair sprinkler heads as soon as you notice misalignment, damage, or leaks	42%	12%	3%	2%	42%	100%	N=283
Check water hoses and outdoor water fixtures for leaks	40%	12%	2%	2%	44%	100%	N=283
Replace some grass with water wise plants and/or architecture such as decks, patios, etc	25%	16%	5%	6%	49%	100%	N=283
Plant more trees to shade the landscape and reduce evaporation	27%	12%	8%	6%	46%	100%	N=284

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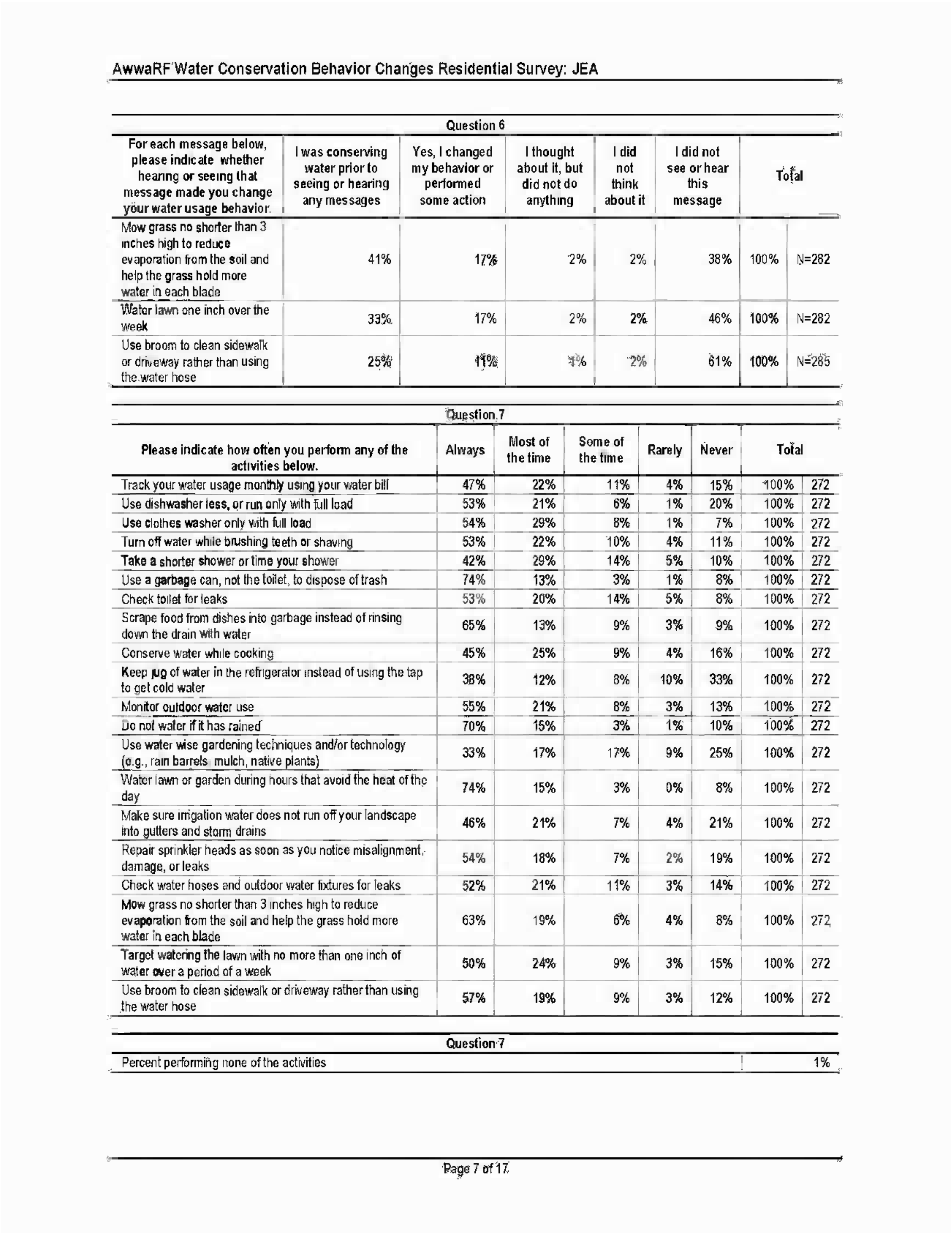

AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 6							
For each message below, please indicate whether hearing or seeing that message made you change your water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	41%	17%	2%	2%	38%	100%	N=282
Water lawn one inch over the week	33%	17%	2%	2%	46%	100%	N=282
Use broom to clean sidewalk or driveway rather than using the water hose	25%	11%	1%	2%	61%	100%	N=285

Question 7							
Please indicate how often you perform any of the activities below.	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track your water usage monthly using your water bill	47%	22%	11%	4%	15%	100%	272
Use dishwasher less, or run only with full load	53%	21%	6%	1%	20%	100%	272
Use clothes washer only with full load	54%	29%	8%	1%	7%	100%	272
Turn off water while brushing teeth or shaving	53%	22%	10%	4%	11%	100%	272
Take a shorter shower or time your shower	42%	29%	14%	5%	10%	100%	272
Use a garbage can, not the toilet, to dispose of trash	74%	13%	3%	1%	8%	100%	272
Check toilet for leaks	53%	20%	14%	5%	8%	100%	272
Scrape food from dishes into garbage instead of rinsing down the drain with water	65%	13%	9%	3%	9%	100%	272
Conserve water while cooking	45%	25%	9%	4%	16%	100%	272
Keep jug of water in the refrigerator instead of using the tap to get cold water	38%	12%	8%	10%	33%	100%	272
Monitor outdoor water use	55%	21%	8%	3%	13%	100%	272
Do not water if it has rained	70%	15%	3%	1%	10%	100%	272
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	33%	17%	17%	9%	25%	100%	272
Water lawn or garden during hours that avoid the heat of the day	74%	15%	3%	0%	8%	100%	272
Make sure irrigation water does not run off your landscape into gutters and storm drains	46%	21%	7%	4%	21%	100%	272
Repair sprinkler heads as soon as you notice misalignment, damage, or leaks	54%	18%	7%	2%	19%	100%	272
Check water hoses and outdoor water fixtures for leaks	52%	21%	11%	3%	14%	100%	272
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	63%	19%	6%	4%	8%	100%	272
Target watering the lawn with no more than one inch of water over a period of a week	50%	24%	9%	3%	15%	100%	272
Use broom to clean sidewalk or driveway rather than using the water hose	57%	19%	9%	3%	12%	100%	272

Question 7	
Percent performing none of the activities	1%

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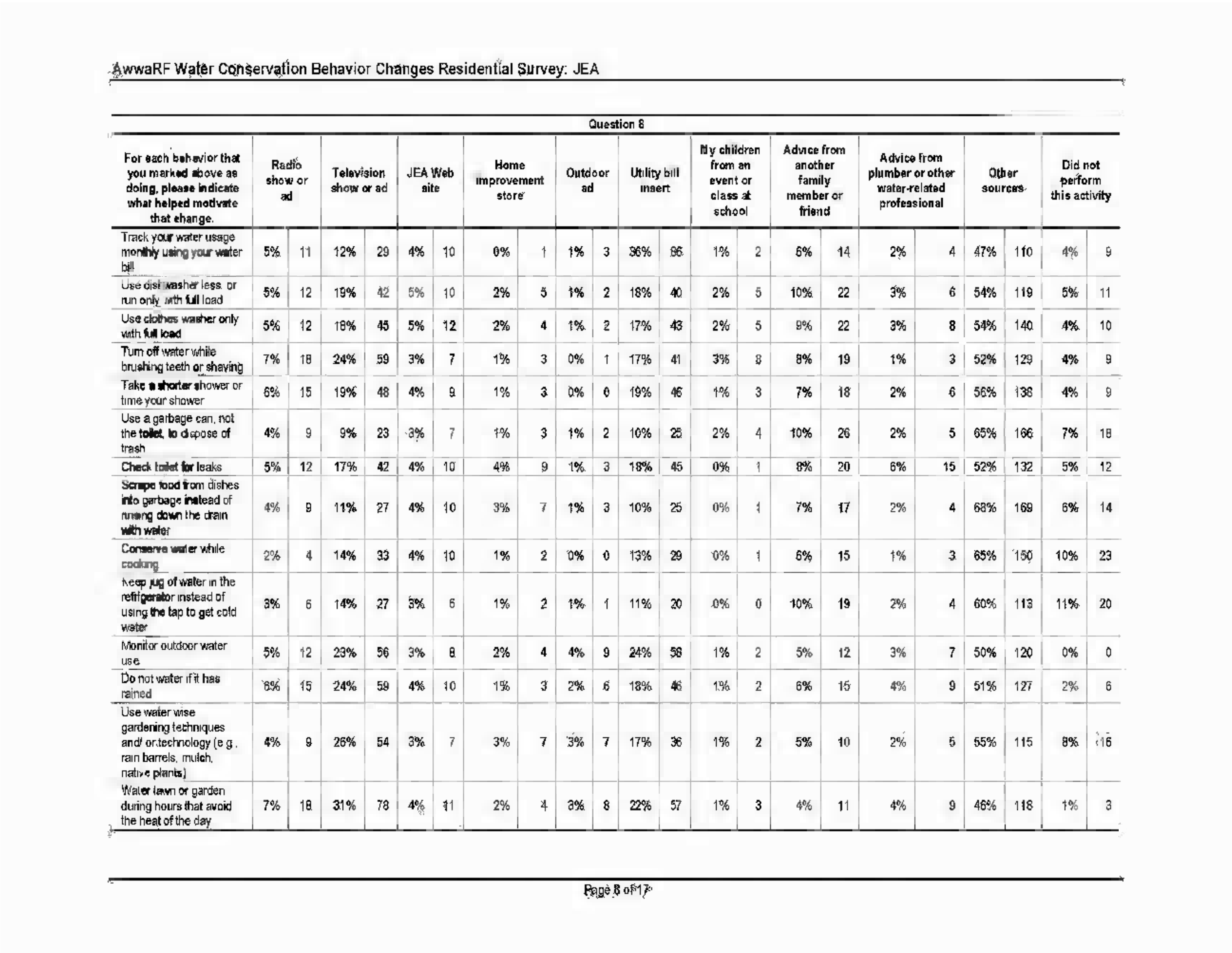

AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 8

For each behavior that you marked above as doing, please indicate what helped motivate that change.	Radio show or ad		Television show or ad		JEA Web site		Home improvement store		Outdoor ad		Utility bill insert		My children from an event or class at school		Advice from another family member or friend		Advice from plumber or other water-related professional		Other sources		Did not perform this activity	
Track your water usage monthly using your water bill	5%	11	12%	29	4%	10	0%	1	1%	3	36%	86	1%	2	6%	14	2%	4	47%	110	4%	9
Use dishwasher less, or run only with full load	5%	12	19%	42	5%	10	2%	5	1%	2	18%	40	2%	5	10%	22	3%	6	54%	119	5%	11
Use clothes washer only with full load	5%	12	18%	45	5%	12	2%	4	1%	2	17%	43	2%	5	9%	22	3%	8	54%	140	4%	10
Turn off water while brushing teeth or shaving	7%	18	24%	59	3%	7	1%	3	0%	1	17%	41	3%	8	8%	19	1%	3	52%	129	4%	9
Take a shorter shower or time your shower	6%	15	19%	48	4%	9	1%	3	0%	0	19%	46	1%	3	7%	18	2%	6	56%	138	4%	9
Use a garbage can, not the toilet, to dispose of trash	4%	9	9%	23	3%	7	1%	3	1%	2	10%	25	2%	4	10%	26	2%	5	65%	166	7%	18
Check toilet for leaks	5%	12	17%	42	4%	10	4%	9	1%	3	18%	45	0%	1	8%	20	6%	15	52%	132	5%	12
Scrape food from dishes into garbage instead of running down the drain with water	4%	9	11%	27	4%	10	3%	7	1%	3	10%	25	0%	1	7%	17	2%	4	68%	169	6%	14
Conserve water while cooking	2%	4	14%	33	4%	10	1%	2	0%	0	13%	29	0%	1	6%	15	1%	3	65%	150	10%	23
Keep jug of water in the refrigerator instead of using the tap to get cold water	3%	6	14%	27	3%	6	1%	2	1%	1	11%	20	0%	0	10%	19	2%	4	60%	113	11%	20
Monitor outdoor water use	5%	12	23%	56	3%	8	2%	4	4%	9	24%	58	1%	2	5%	12	3%	7	50%	120	0%	0
Do not water if it has rained	6%	15	24%	59	4%	10	1%	3	2%	6	18%	46	1%	2	6%	15	4%	9	51%	127	2%	6
Use water wise gardening techniques and/ or technology (e.g., rain barrels, mulch, native plants)	4%	9	26%	54	3%	7	3%	7	3%	7	17%	36	1%	2	5%	10	2%	5	55%	115	8%	16
Water lawn or garden during hours that avoid the heat of the day	7%	18	31%	78	4%	11	2%	4	3%	8	22%	57	1%	3	4%	11	4%	9	46%	118	1%	3

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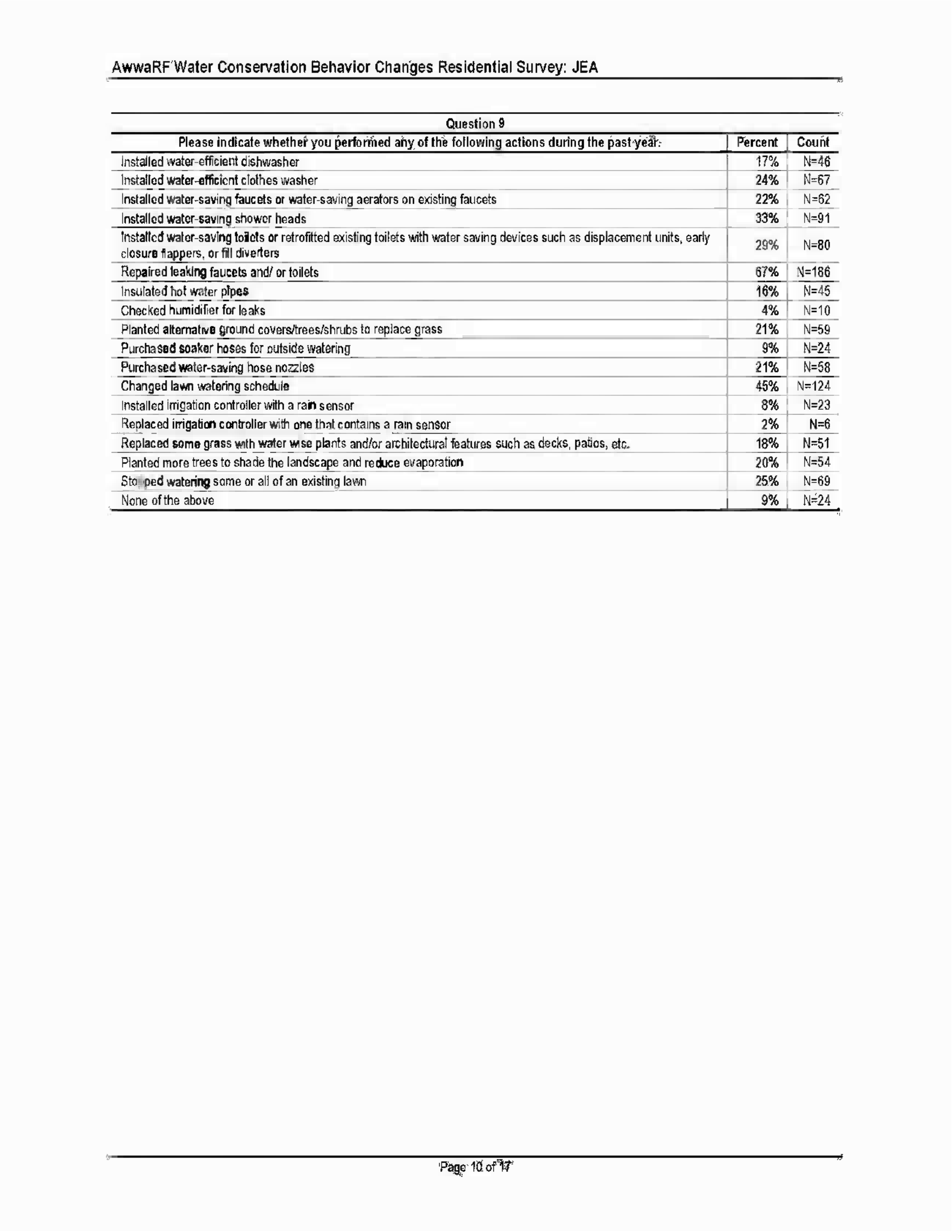
AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 8

For each behavior that you marked above as doing, please indicate what helped motivate that change.	Radio show or ad		Television show or ad		JEA Web site		Home improvement store		Outdoor ad		Utility bill insert		My children from an event or class at school		Advice from another family member or friend		Advice from plumber or other water-related professional		Other sources		Did not perform this activity	
Make sure irrigation water does not run off your landscape into gutters and storm drains	5%	12	26%	57	5%	12	1%	3	3%	7	20%	44	1%	2	3%	7	2%	4	51%	113	9%	19
Repair sprinkler heads as soon as you notice misalignment, damage, or leaks	6%	13	21%	48	5%	12	4%	9	1%	2	15%	34	0%	1	5%	11	5%	12	55%	124	5%	11
Check water hoses and outdoor water fixtures for leaks	4%	10	20%	49	5%	11	2%	4	0%	1	12%	28	0%	0	5%	13	2%	5	59%	142	6%	14
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	4%	11	22%	55	5%	12	3%	7	2%	6	13%	33	0%	1	5%	13	4%	10	60%	153	6%	14
Target watering the lawn with no more than one inch of water over a period of a week	4%	10	26%	61	5%	12	1%	3	2%	5	18%	42	0%	0	3%	8	3%	8	54%	127	8%	19
Use broom to clean sidewalk or driveway rather than using the water hose	3%	8	14%	34	3%	8	2%	4	2%	4	10%	25	0%	1	6%	14	2%	4	64%	158	7%	16

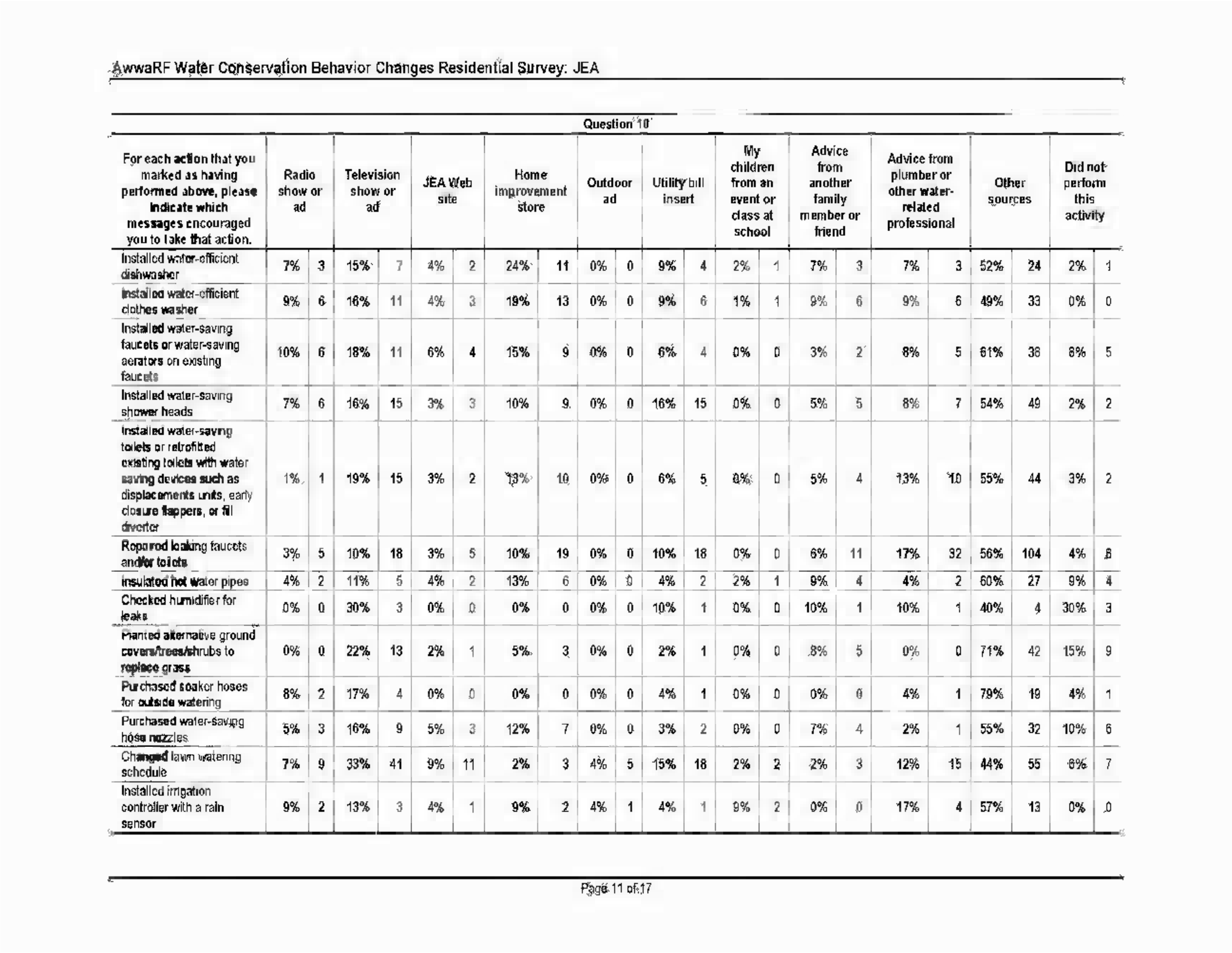
Question 8	
Percent none of the activities	8%



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 9

Please indicate whether you performed any of the following actions during the past year:	Percent	Count
Installed water-efficient dishwasher	17%	N=46
Installed water-efficient clothes washer	24%	N=67
Installed water-saving faucets or water-saving aerators on existing faucets	22%	N=62
Installed water-saving shower heads	33%	N=91
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	29%	N=80
Repaired leaking faucets and/ or toilets	67%	N=186
Insulated hot water pipes	16%	N=45
Checked humidifier for leaks	4%	N=10
Planted alternative ground covers/trees/shrubs to replace grass	21%	N=59
Purchased soaker hoses for outside watering	9%	N=24
Purchased water-saving hose nozzles	21%	N=58
Changed lawn watering schedule	45%	N=124
Installed irrigation controller with a rain sensor	8%	N=23
Replaced irrigation controller with one that contains a rain sensor	2%	N=6
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	18%	N=51
Planted more trees to shade the landscape and reduce evaporation	20%	N=54
Stopped watering some or all of an existing lawn	25%	N=69
None of the above	9%	N=24



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 10

For each action that you marked as having performed above, please indicate which messages encouraged you to take that action.	Radio show or ad		Television show or ad		JEA Web site		Home improvement store		Outdoor ad		Utility bill insert		My children from an event or class at school		Advice from another family member or friend		Advice from plumber or other water-related professional		Other sources		Did not perform this activity	
Installed water-efficient dishwasher	7%	3	15%	7	4%	2	24%	11	0%	0	9%	4	2%	1	7%	3	7%	3	52%	24	2%	1
Installed water-efficient clothes washer	9%	6	16%	11	4%	3	19%	13	0%	0	9%	6	1%	1	9%	6	9%	6	49%	33	0%	0
Installed water-saving faucets or water-saving aerators on existing faucets	10%	6	18%	11	6%	4	15%	9	0%	0	6%	4	0%	0	3%	2	8%	5	61%	38	8%	5
Installed water-saving shower heads	7%	6	16%	15	3%	3	10%	9	0%	0	16%	15	0%	0	5%	5	8%	7	54%	49	2%	2
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	1%	1	19%	15	3%	2	13%	10	0%	0	6%	5	0%	0	5%	4	13%	10	55%	44	3%	2
Repaired leaking faucets and/or toilets	3%	5	10%	18	3%	5	10%	19	0%	0	10%	18	0%	0	6%	11	17%	32	56%	104	4%	8
Insulated hot water pipes	4%	2	11%	5	4%	2	13%	6	0%	0	4%	2	2%	1	9%	4	4%	2	60%	27	9%	4
Checked humidifier for leaks	0%	0	30%	3	0%	0	0%	0	0%	0	10%	1	0%	0	10%	1	10%	1	40%	4	30%	3
Planted alternative ground covers/trees/shrubs to replace grass	0%	0	22%	13	2%	1	5%	3	0%	0	2%	1	0%	0	8%	5	0%	0	71%	42	15%	9
Purchased soaker hoses for outside watering	8%	2	17%	4	0%	0	0%	0	0%	0	4%	1	0%	0	0%	0	4%	1	79%	19	4%	1
Purchased water-saving hose nozzles	5%	3	16%	9	5%	3	12%	7	0%	0	3%	2	0%	0	7%	4	2%	1	55%	32	10%	6
Changed lawn watering schedule	7%	9	33%	41	9%	11	2%	3	4%	5	15%	18	2%	2	2%	3	12%	15	44%	55	6%	7
Installed irrigation controller with a rain sensor	9%	2	13%	3	4%	1	9%	2	4%	1	4%	1	9%	2	0%	0	17%	4	57%	13	0%	0

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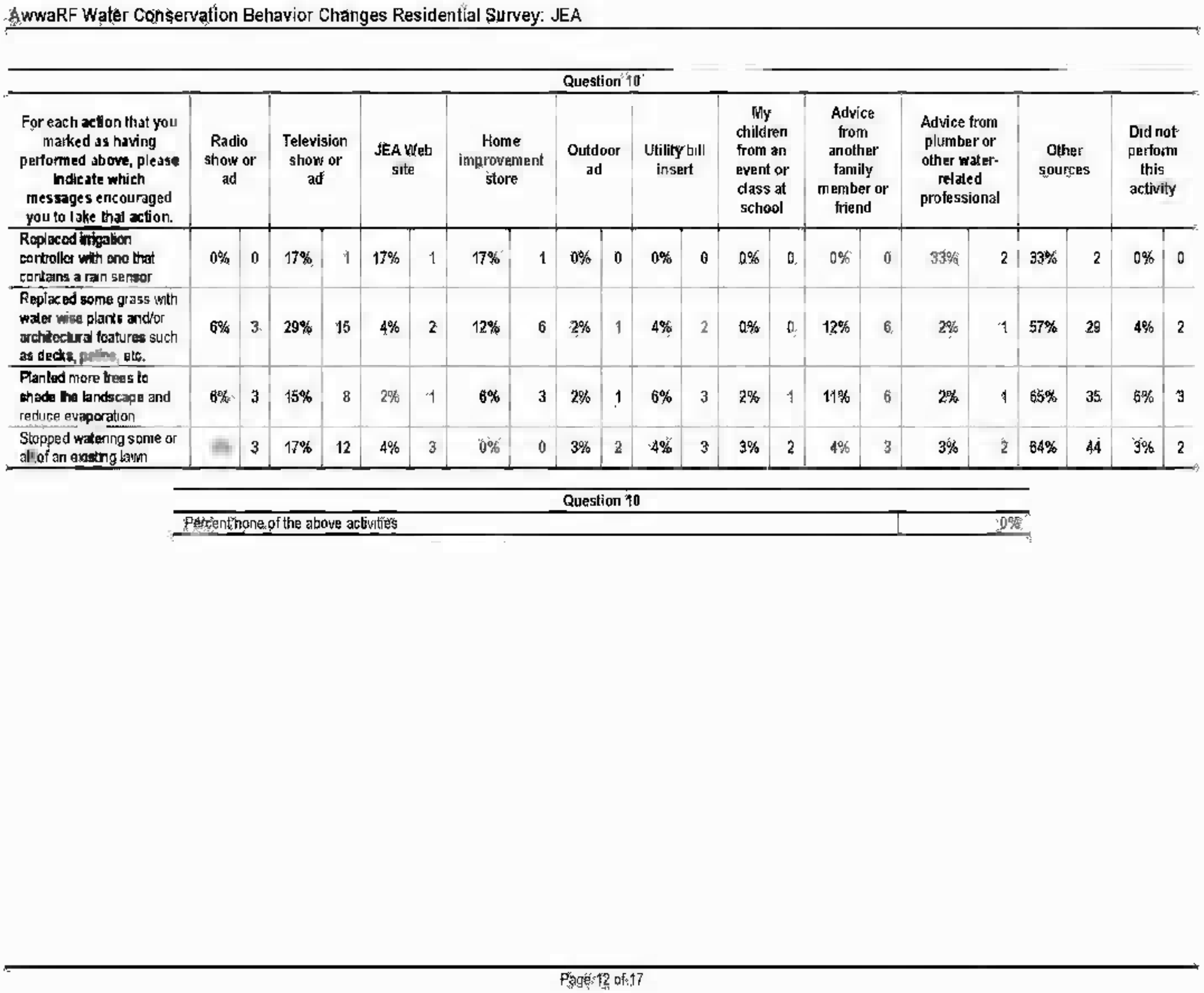

AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 10

For each action that you marked as having performed above, please indicate which messages encouraged you to take that action.	Radio show or ad		Television show or ad		JEA Web site		Home improvement store		Outdoor ad		Utility bill insert		My children from an event or class at school		Advice from another family member or friend		Advice from plumber or other water-related professional		Other sources		Did not perform this activity	
Replaced irrigation controller with one that contains a rain sensor	0%	0	17%	1	17%	1	17%	1	0%	0	0%	0	0%	0	0%	0	33%	2	33%	2	0%	0
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	6%	3	29%	15	4%	2	12%	6	2%	1	4%	2	0%	0	12%	6	2%	1	57%	29	4%	2
Planted more trees to shade the landscape and reduce evaporation	6%	3	15%	8	2%	1	6%	3	2%	1	6%	3	2%	1	11%	6	2%	1	65%	35	6%	3
Stopped watering some or all of an existing lawn	[illegible]	3	17%	12	4%	3	0%	0	3%	2	4%	3	3%	2	4%	3	3%	2	64%	44	3%	2

Question 10

Percent none of the above activities	0%

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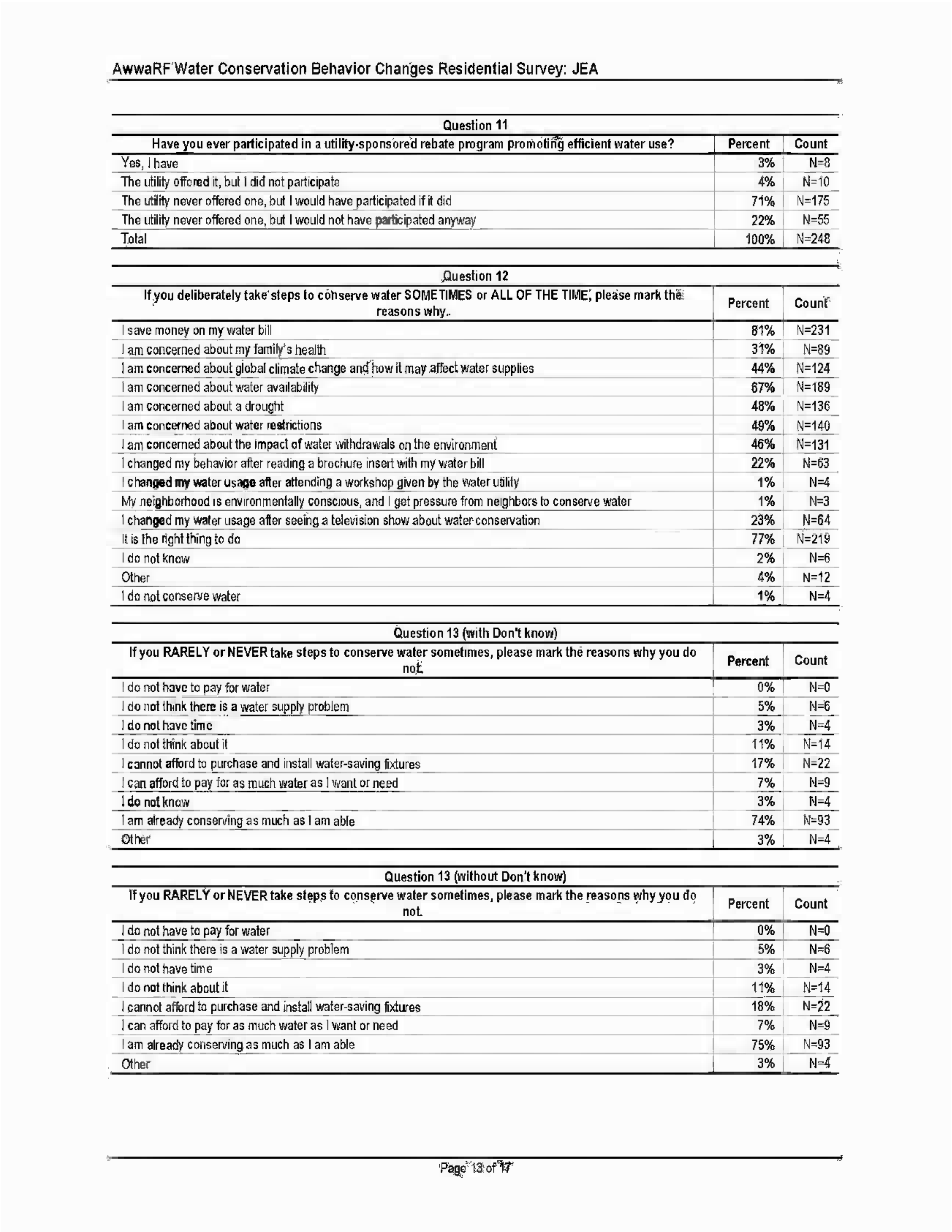
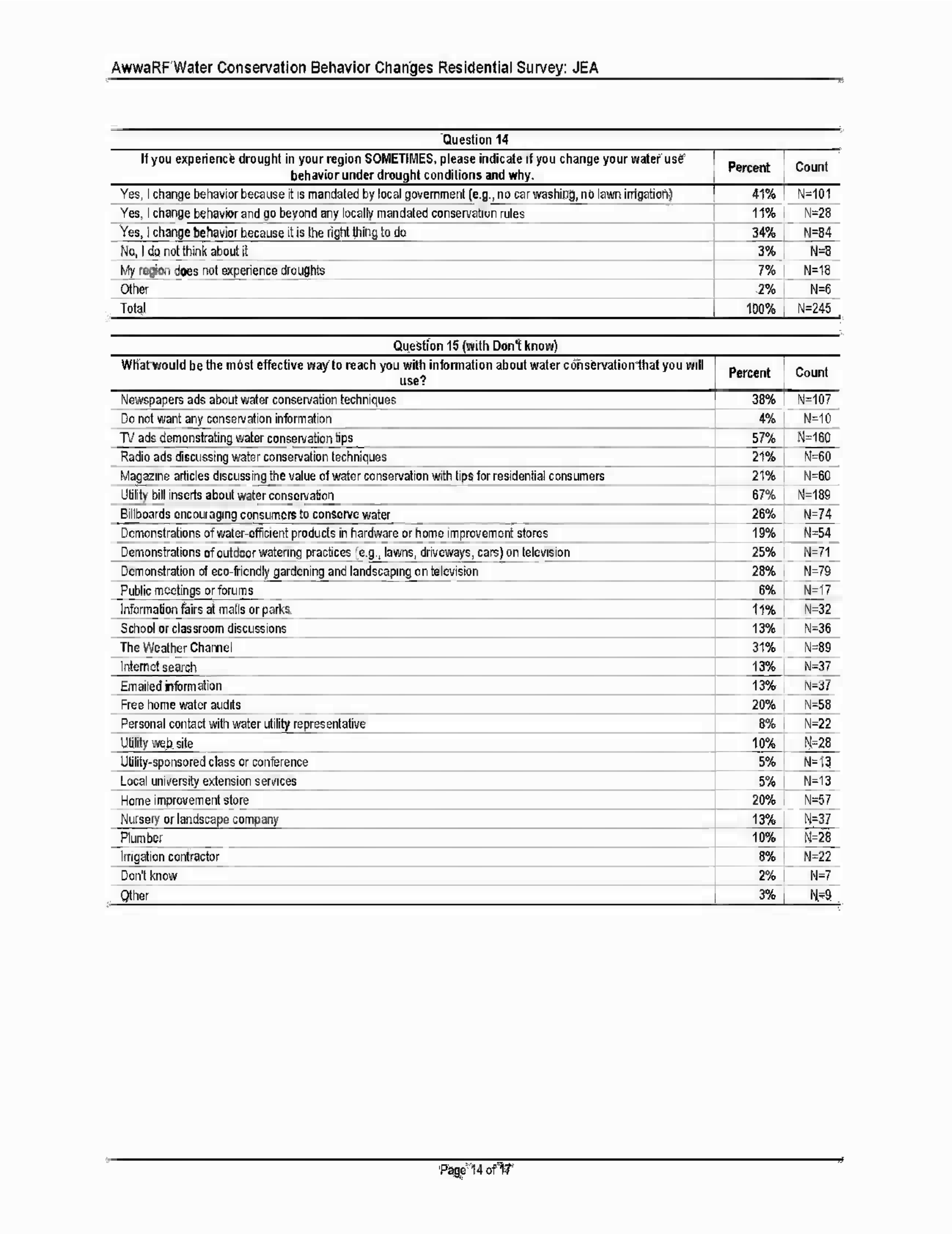


Question 11 Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	3%	N=8
The utility offered it, but I did not participate	4%	N=10
The utility never offered one, but I would have participated if it did	71%	N=175
The utility never offered one, but I would not have participated anyway	22%	N=55
Total	100%	N=248

Question 12 If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	81%	N=231
I am concerned about my family's health	31%	N=89
I am concerned about global climate change and how it may affect water supplies	44%	N=124
I am concerned about water availability	67%	N=189
I am concerned about a drought	48%	N=136
I am concerned about water restrictions	49%	N=140
I am concerned about the impact of water withdrawals on the environment	46%	N=131
I changed my behavior after reading a brochure insert with my water bill	22%	N=63
I changed my water usage after attending a workshop given by the water utility	1%	N=4
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	1%	N=3
I changed my water usage after seeing a television show about water conservation	23%	N=64
It is the right thing to do	77%	N=219
I do not know	2%	N=6
Other	4%	N=12
I do not conserve water	1%	N=4

Question 13 (with Don't know) If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	0%	N=0
I do not think there is a water supply problem	5%	N=6
I do not have time	3%	N=4
I do not think about it	11%	N=14
I cannot afford to purchase and install water-saving fixtures	17%	N=22
I can afford to pay for as much water as I want or need	7%	N=9
I do not know	3%	N=4
I am already conserving as much as I am able	74%	N=93
Other	3%	N=4

Question 13 (without Don't know) If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	0%	N=0
I do not think there is a water supply problem	5%	N=6
I do not have time	3%	N=4
I do not think about it	11%	N=14
I cannot afford to purchase and install water-saving fixtures	18%	N=22
I can afford to pay for as much water as I want or need	7%	N=9
I am already conserving as much as I am able	75%	N=93
Other	3%	N=4

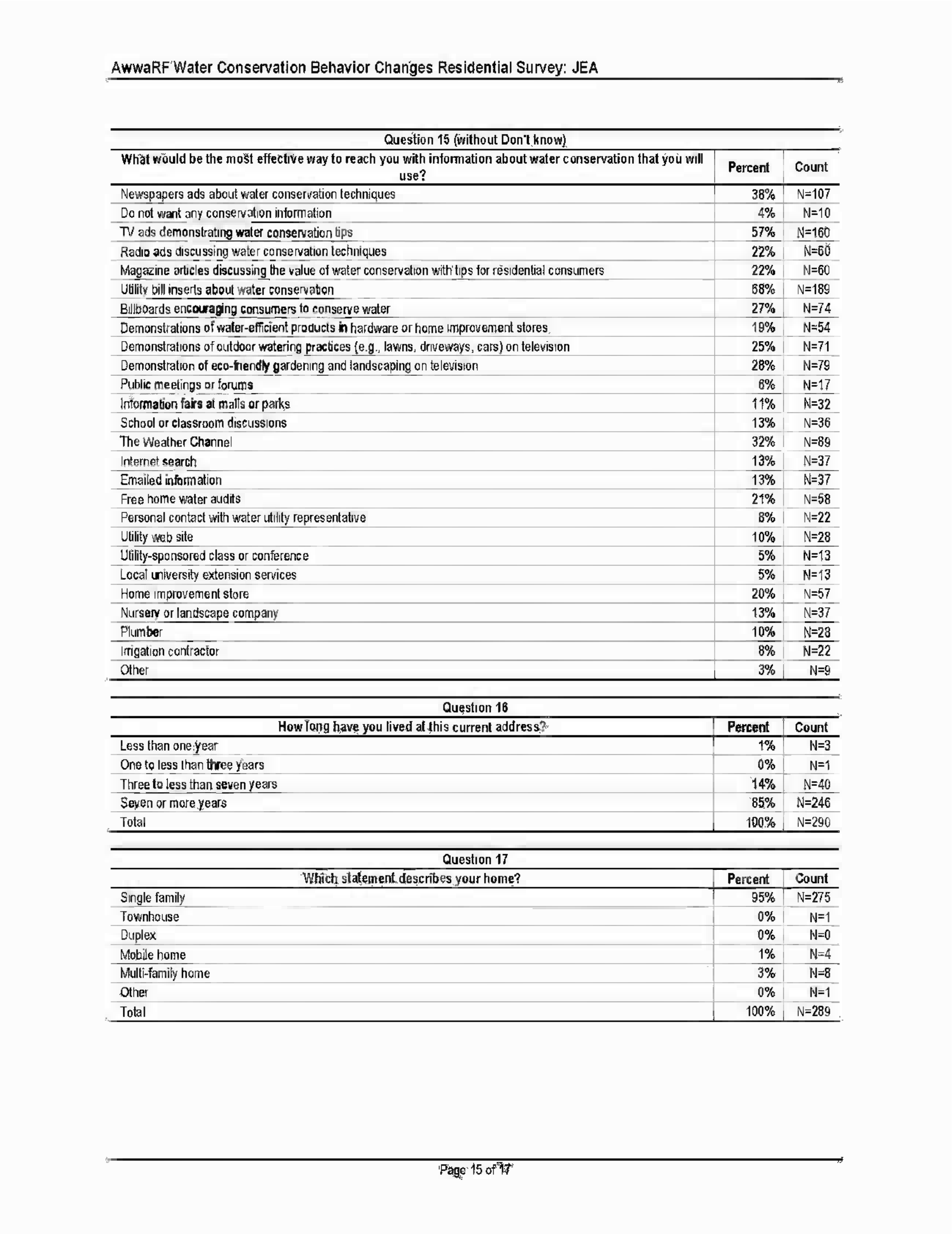


Question 14

If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	41%	N=101
Yes, I change behavior and go beyond any locally mandated conservation rules	11%	N=28
Yes, I change behavior because it is the right thing to do	34%	N=84
No, I do not think about it	3%	N=8
My region does not experience droughts	7%	N=18
Other	2%	N=6
Total	100%	N=245

Question 15 (with Don't know)

What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	38%	N=107
Do not want any conservation information	4%	N=10
TV ads demonstrating water conservation tips	57%	N=160
Radio ads discussing water conservation techniques	21%	N=60
Magazine articles discussing the value of water conservation with tips for residential consumers	21%	N=60
Utility bill inserts about water conservation	67%	N=189
Billboards encouraging consumers to conserve water	26%	N=74
Demonstrations of water-efficient products in hardware or home improvement stores	19%	N=54
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	25%	N=71
Demonstration of eco-friendly gardening and landscaping on television	28%	N=79
Public meetings or forums	6%	N=17
Information fairs at malls or parks	11%	N=32
School or classroom discussions	13%	N=36
The Weather Channel	31%	N=89
Internet search	13%	N=37
Emailed information	13%	N=37
Free home water audits	20%	N=58
Personal contact with water utility representative	8%	N=22
Utility web site	10%	N=28
Utility-sponsored class or conference	5%	N=13
Local university extension services	5%	N=13
Home improvement store	20%	N=57
Nursery or landscape company	13%	N=37
Plumber	10%	N=28
Irrigation contractor	8%	N=22
Don't know	2%	N=7
Other	3%	N=9



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 15 (without Don't know)

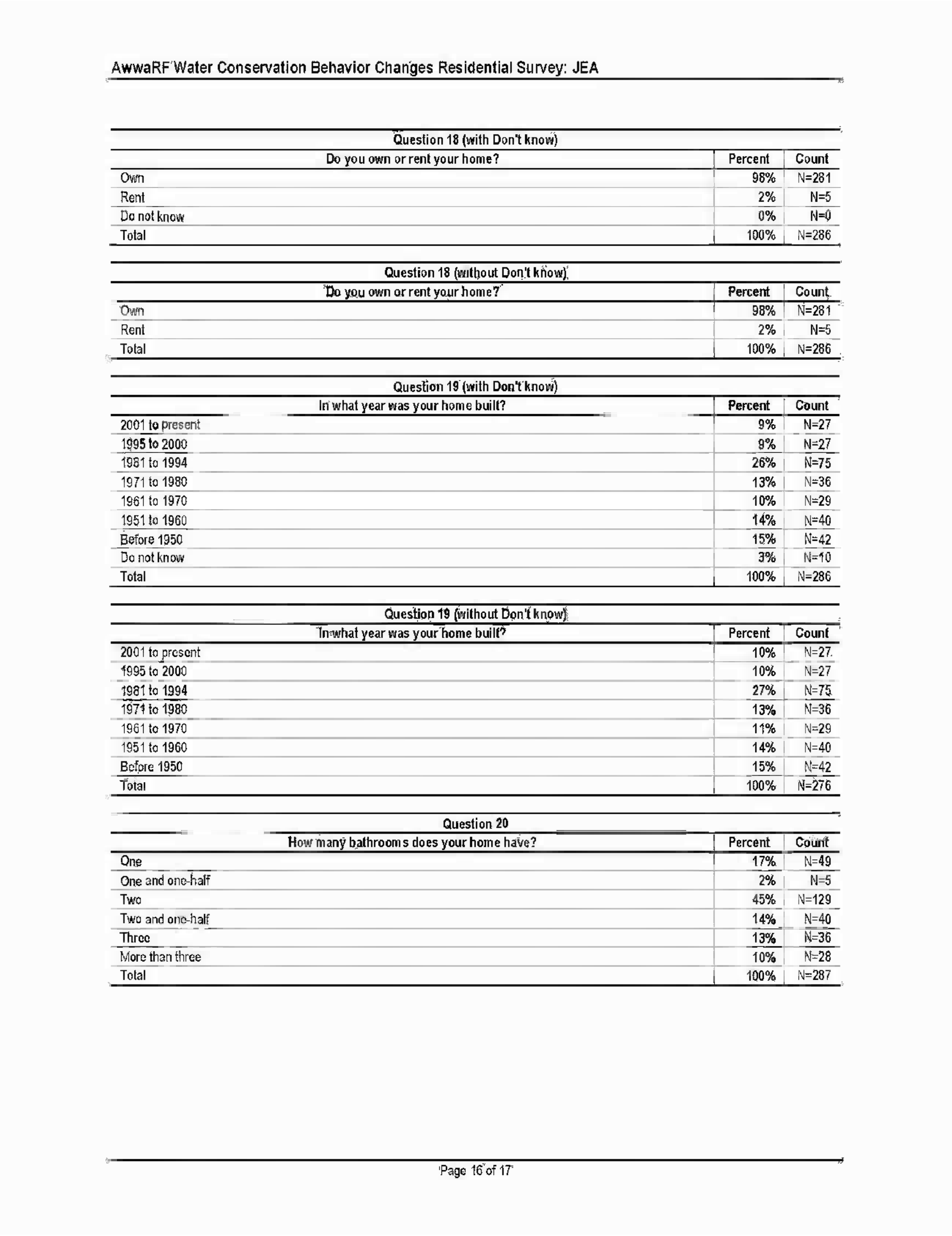
What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	38%	N=107
Do not want any conservation information	4%	N=10
TV ads demonstrating water conservation tips	57%	N=160
Radio ads discussing water conservation techniques	22%	N=60
Magazine articles discussing the value of water conservation with tips for residential consumers	22%	N=60
Utility bill inserts about water conservation	68%	N=189
Billboards encouraging consumers to conserve water	27%	N=74
Demonstrations of water-efficient products in hardware or home improvement stores	19%	N=54
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	25%	N=71
Demonstration of eco-friendly gardening and landscaping on television	28%	N=79
Public meetings or forums	6%	N=17
Information fairs at malls or parks	11%	N=32
School or classroom discussions	13%	N=36
The Weather Channel	32%	N=89
Internet search	13%	N=37
Emailed information	13%	N=37
Free home water audits	21%	N=58
Personal contact with water utility representative	8%	N=22
Utility web site	10%	N=28
Utility-sponsored class or conference	5%	N=13
Local university extension services	5%	N=13
Home improvement store	20%	N=57
Nursery or landscape company	13%	N=37
Plumber	10%	N=28
Irrigation contractor	8%	N=22
Other	3%	N=9

Question 16

How long have you lived at this current address?	Percent	Count
Less than one year	1%	N=3
One to less than three years	0%	N=1
Three to less than seven years	14%	N=40
Seven or more years	85%	N=246
Total	100%	N=290

Question 17

Which statement describes your home?	Percent	Count
Single family	95%	N=275
Townhouse	0%	N=1
Duplex	0%	N=0
Mobile home	1%	N=4
Multi-family home	3%	N=8
Other	0%	N=1
Total	100%	N=289



AwwaRF Water Conservation Behavior Changes Residential Survey: JEA

Question 18 (with Don't know) Do you own or rent your home?	Percent	Count
Own	98%	N=281
Rent	2%	N=5
Do not know	0%	N=0
Total	100%	N=286

Question 18 (without Don't know) Do you own or rent your home?	Percent	Count
Own	98%	N=281
Rent	2%	N=5
Total	100%	N=286

Question 19 (with Don't know) In what year was your home built?	Percent	Count
2001 to present	9%	N=27
1995 to 2000	9%	N=27
1981 to 1994	26%	N=75
1971 to 1980	13%	N=36
1961 to 1970	10%	N=29
1951 to 1960	14%	N=40
Before 1950	15%	N=42
Do not know	3%	N=10
Total	100%	N=286

Question 19 (without Don't know) In what year was your home built?	Percent	Count
2001 to present	10%	N=27
1995 to 2000	10%	N=27
1981 to 1994	27%	N=75
1971 to 1980	13%	N=36
1961 to 1970	11%	N=29
1951 to 1960	14%	N=40
Before 1950	15%	N=42
Total	100%	N=276

Question 20 How many bathrooms does your home have?	Percent	Count
One	17%	N=49
One and one-half	2%	N=5
Two	45%	N=129
Two and one-half	14%	N=40
Three	13%	N=36
More than three	10%	N=28
Total	100%	N=287

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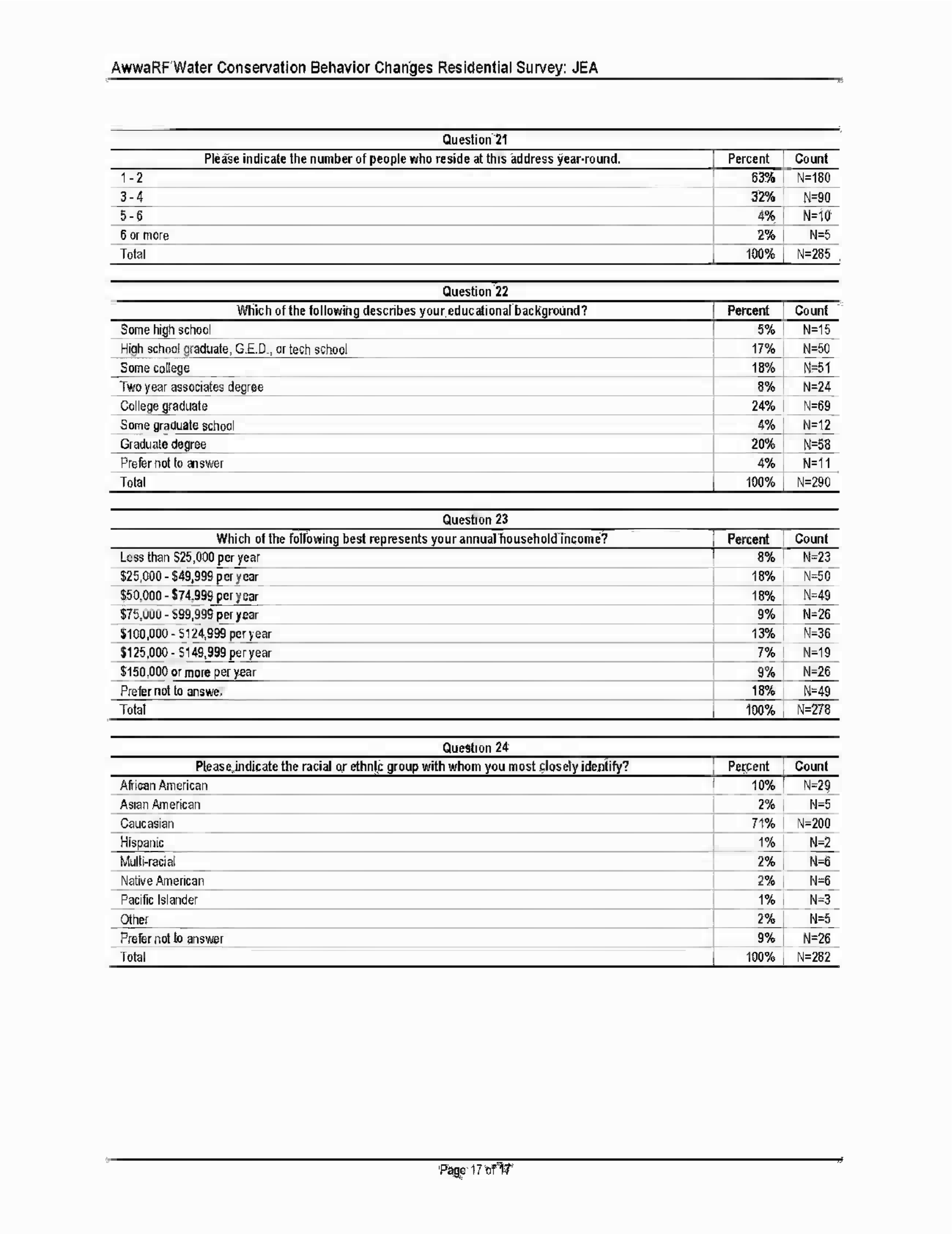


Question 21

Please indicate the number of people who reside at this address year-round.	Percent	Count
1 - 2	63%	N=180
3 - 4	32%	N=90
5 - 6	4%	N=10
6 or more	2%	N=5
Total	100%	N=285

Question 22

Which of the following describes your educational background?	Percent	Count
Some high school	5%	N=15
High school graduate, G.E.D., or tech school	17%	N=50
Some college	18%	N=51
Two year associates degree	8%	N=24
College graduate	24%	N=69
Some graduate school	4%	N=12
Graduate degree	20%	N=58
Prefer not to answer	4%	N=11
Total	100%	N=290

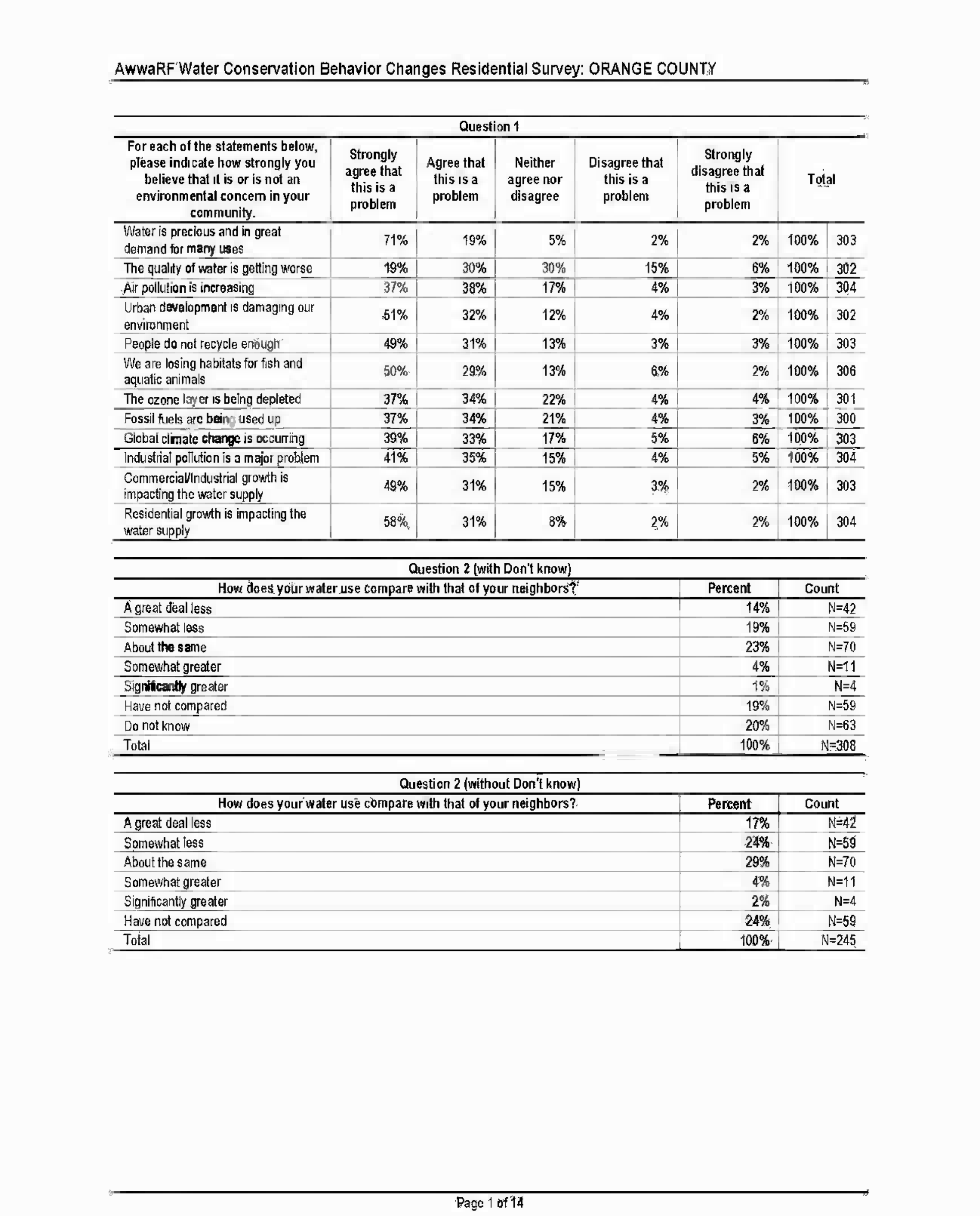
Question 23

Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	8%	N=23
$25,000 - $49,999 per year	18%	N=50
$50,000 - $74,999 per year	18%	N=49
$75,000 - $99,999 per year	9%	N=26
$100,000 - $124,999 per year	13%	N=36
$125,000 - $149,999 per year	7%	N=19
$150,000 or more per year	9%	N=26
Prefer not to answer	18%	N=49
Total	100%	N=278

Question 24

Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	10%	N=29
Asian American	2%	N=5
Caucasian	71%	N=200
Hispanic	1%	N=2
Multi-racial	2%	N=6
Native American	2%	N=6
Pacific Islander	1%	N=3
Other	2%	N=5
Prefer not to answer	9%	N=26
Total	100%	N=282

ORANGE COUNTY UTILITIES WATER DIVISION: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 1

For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	71%	19%	5%	2%	2%	100%	303
The quality of water is getting worse	19%	30%	30%	15%	6%	100%	302
Air pollution is increasing	37%	38%	17%	4%	3%	100%	304
Urban development is damaging our environment	51%	32%	12%	4%	2%	100%	302
People do not recycle enough	49%	31%	13%	3%	3%	100%	303
We are losing habitats for fish and aquatic animals	50%	29%	13%	6%	2%	100%	306
The ozone layer is being depleted	37%	34%	22%	4%	4%	100%	301
Fossil fuels are being used up	37%	34%	21%	4%	3%	100%	300
Global climate change is occurring	39%	33%	17%	5%	6%	100%	303
Industrial pollution is a major problem	41%	35%	15%	4%	5%	100%	304
Commercial/Industrial growth is impacting the water supply	49%	31%	15%	3%	2%	100%	303
Residential growth is impacting the water supply	58%	31%	8%	2%	2%	100%	304

Question 2 (with Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	14%	N=42
Somewhat less	19%	N=59
About the same	23%	N=70
Somewhat greater	4%	N=11
Significantly greater	1%	N=4
Have not compared	19%	N=59
Do not know	20%	N=63
Total	100%	N=308

Question 2 (without Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	17%	N=42
Somewhat less	24%	N=59
About the same	29%	N=70
Somewhat greater	4%	N=11
Significantly greater	2%	N=4
Have not compared	24%	N=59
Total	100%	N=245

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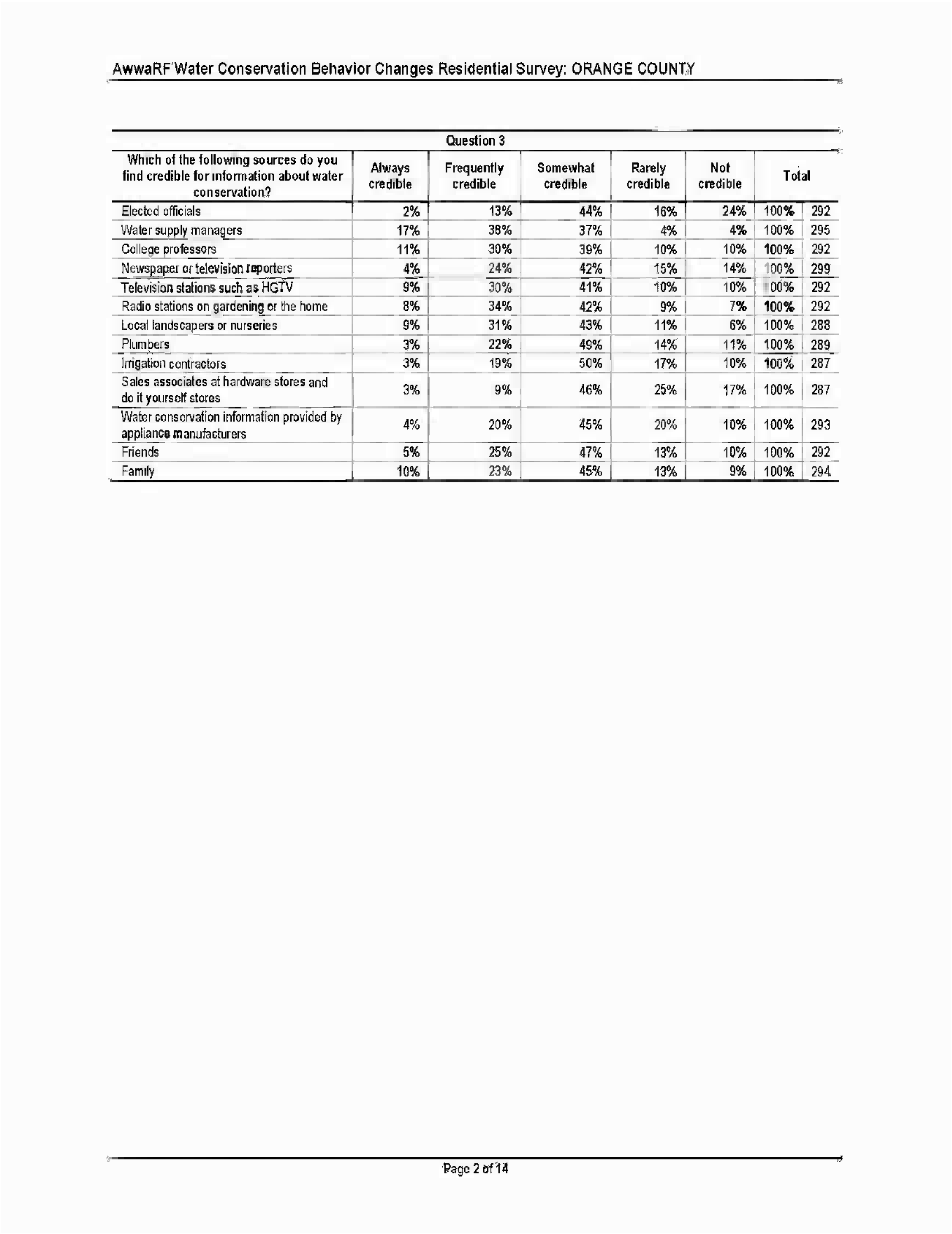


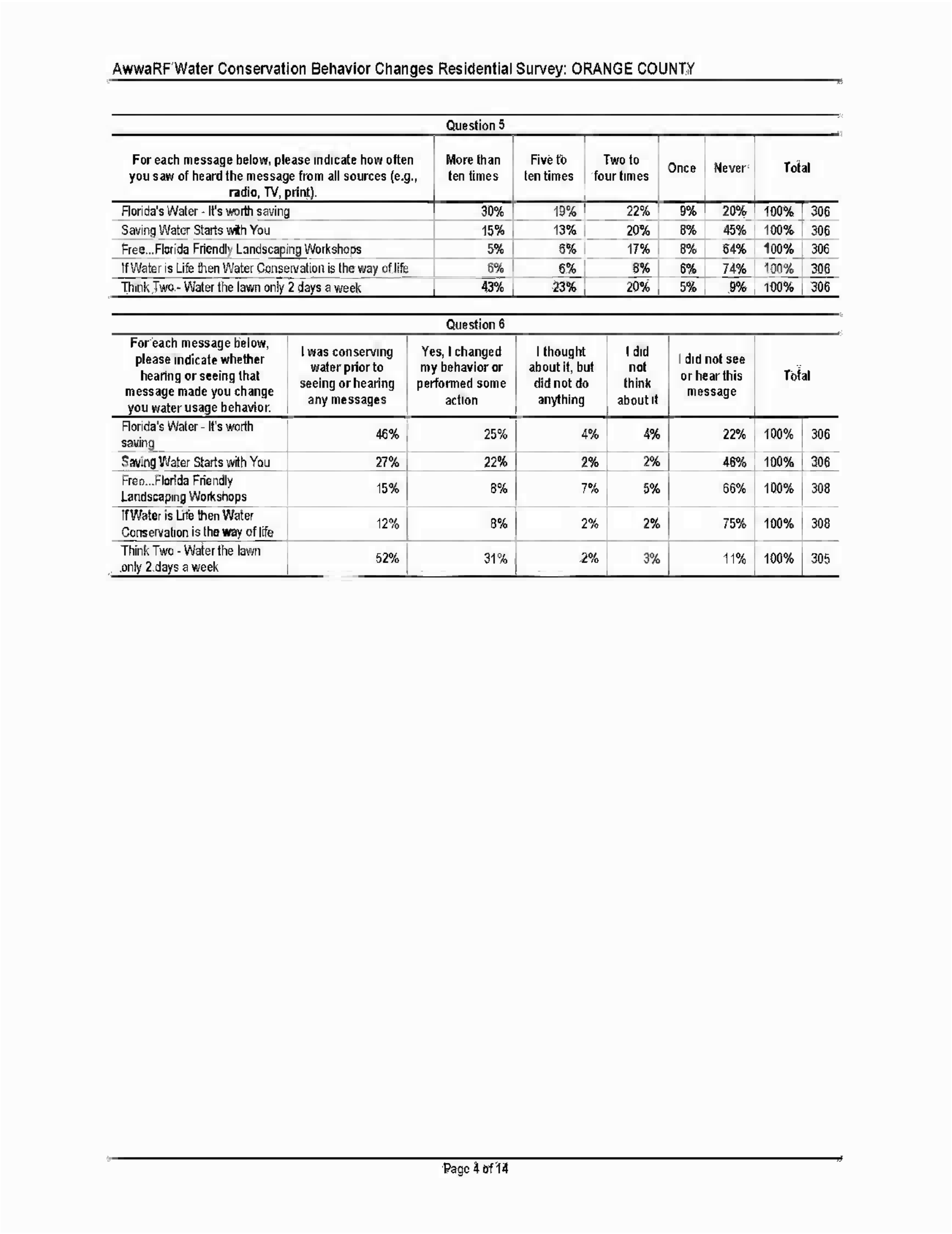
AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 3							
Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	2%	13%	44%	16%	24%	100%	292
Water supply managers	17%	38%	37%	4%	4%	100%	295
College professors	11%	30%	39%	10%	10%	100%	292
Newspaper or television reporters	4%	24%	42%	15%	14%	100%	299
Television stations such as HGTV	9%	30%	41%	10%	10%	100%	292
Radio stations on gardening or the home	8%	34%	42%	9%	7%	100%	292
Local landscapers or nurseries	9%	31%	43%	11%	6%	100%	288
Plumbers	3%	22%	49%	14%	11%	100%	289
Irrigation contractors	3%	19%	50%	17%	10%	100%	287
Sales associates at hardware stores and do it yourself stores	3%	9%	46%	25%	17%	100%	287
Water conservation information provided by appliance manufacturers	4%	20%	45%	20%	10%	100%	293
Friends	5%	25%	47%	13%	10%	100%	292
Family	10%	23%	45%	13%	9%	100%	294

AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

	Question 4																							
For each of the messages below, please indicate where you saw or heard each message.	Radio		Network TV		Cable/Satellite channel		Web site		Home improvement store		Outdoor ads		Water bill inserts		Direct mailing from water utility		Educational events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Florida's Water - It's worth saving	18%	57	48%	149	24%	75	4%	12	3%	9	7%	22	26%	81	16%	51	7%	22	13%	42	5%	16	22%	70
Saving Water Starts with You	12%	38	31%	96	15%	47	3%	8	3%	8	4%	13	19%	60	11%	33	6%	19	7%	23	4%	14	46%	143
Free Florida Friendly Landscaping Workshops	5%	15	8%	24	5%	15	1%	3	5%	16	1%	2	11%	33	8%	24	3%	8	9%	27	2%	7	63%	198
If Water is Life then Water Conservation is the way of life	5%	16	12%	38	5%	17	2%	5	1%	4	3%	9	5%	15	4%	12	3%	9	2%	6	3%	9	77%	241
Think Two - Water the lawn only 2 days a week	20%	61	58%	165	26%	82	2%	6	2%	5	7%	22	23%	73	18%	57	3%	10	11%	33	5%	15	11%	33

	Question 4
Percent none of the above messages	5%



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 5

For each message below, please indicate how often you saw of heard the message from all sources (e.g., radio, TV, print).	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
Florida's Water - It's worth saving	30%	19%	22%	9%	20%	100%	306
Saving Water Starts with You	15%	13%	20%	8%	45%	100%	306
Free...Florida Friendly Landscaping Workshops	5%	6%	17%	8%	64%	100%	306
If Water is Life then Water Conservation is the way of life	6%	6%	8%	6%	74%	100%	306
Think Two - Water the lawn only 2 days a week	43%	23%	20%	5%	9%	100%	306

Question 6

For each message below, please indicate whether hearing or seeing that message made you change you water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it	I did not see or hear this message	Total	
Florida's Water - It's worth saving	46%	25%	4%	4%	22%	100%	306
Saving Water Starts with You	27%	22%	2%	2%	46%	100%	306
Free...Florida Friendly Landscaping Workshops	15%	8%	7%	5%	66%	100%	308
If Water is Life then Water Conservation is the way of life	12%	8%	2%	2%	75%	100%	308
Think Two - Water the lawn only 2 days a week	52%	31%	2%	3%	11%	100%	305

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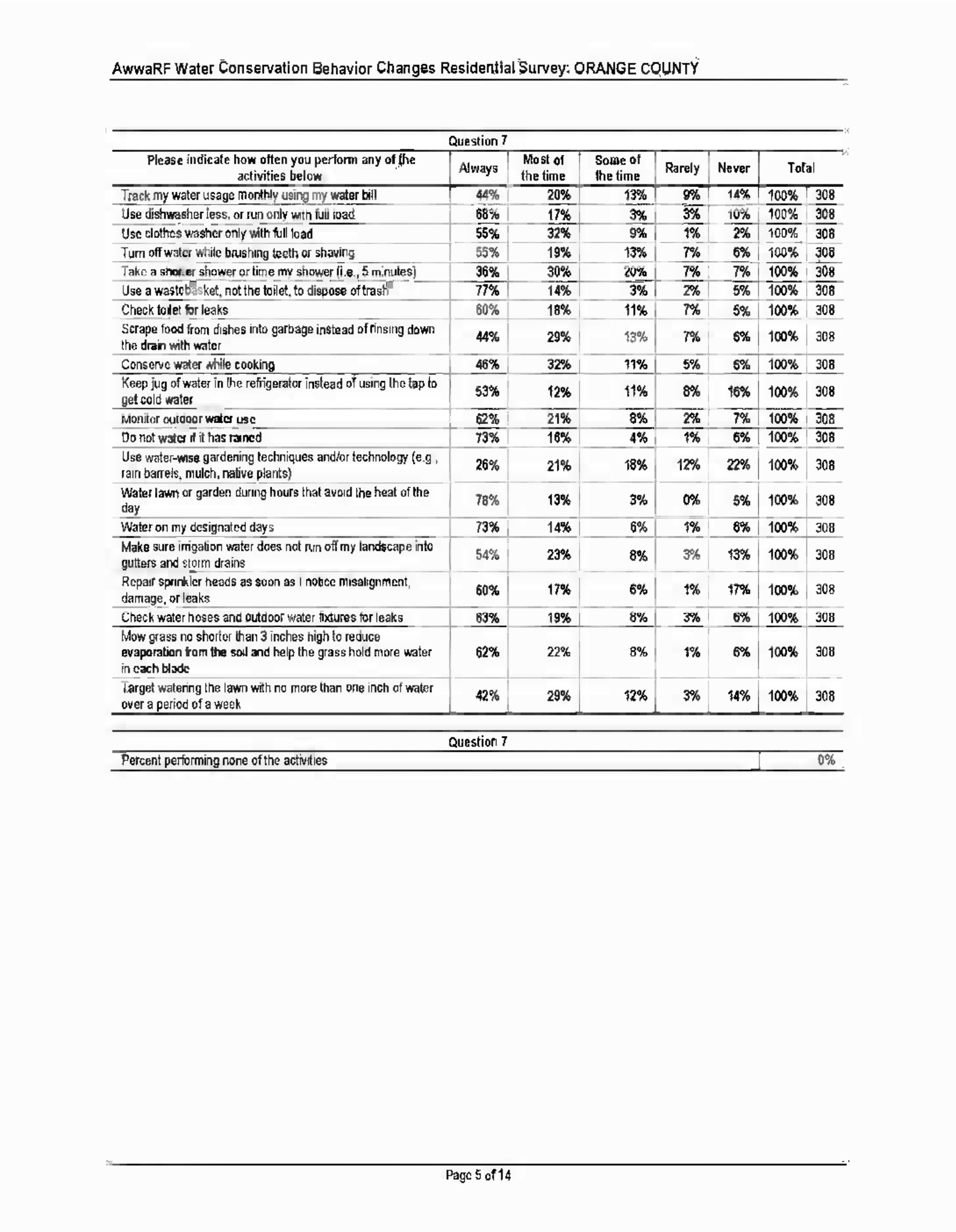

AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 7

Please indicate how often you perform any of the activities below	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track my water usage monthly using my water bill	44%	20%	13%	9%	14%	100%	308
Use dishwasher less, or run only with full load	68%	17%	3%	3%	10%	100%	308
Use clothes washer only with full load	55%	32%	9%	1%	2%	100%	308
Turn off water while brushing teeth or shaving	55%	19%	13%	7%	6%	100%	308
Take a shorter shower or time my shower (i.e., 5 minutes)	36%	30%	20%	7%	7%	100%	308
Use a wastebasket, not the toilet, to dispose of trash	77%	14%	3%	2%	5%	100%	308
Check toilet for leaks	60%	18%	11%	7%	5%	100%	308
Scrape food from dishes into garbage instead of rinsing down the drain with water	44%	29%	13%	7%	6%	100%	308
Conserve water while cooking	46%	32%	11%	5%	6%	100%	308
Keep jug of water in the refrigerator instead of using the tap to get cold water	53%	12%	11%	8%	16%	100%	308
Monitor outdoor water use	62%	21%	8%	2%	7%	100%	308
Do not water if it has rained	73%	16%	4%	1%	6%	100%	308
Use water-wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	26%	21%	18%	12%	22%	100%	308
Water lawn or garden during hours that avoid the heat of the day	78%	13%	3%	0%	5%	100%	308
Water on my designated days	73%	14%	6%	1%	6%	100%	308
Make sure irrigation water does not run off my landscape into gutters and storm drains	54%	23%	8%	3%	13%	100%	308
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	60%	17%	6%	1%	17%	100%	308
Check water hoses and outdoor water fixtures for leaks	63%	19%	8%	3%	6%	100%	308
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	62%	22%	8%	1%	6%	100%	308
Target watering the lawn with no more than one inch of water over a period of a week	42%	29%	12%	3%	14%	100%	308

Question 7

Percent performing none of the activities	0%

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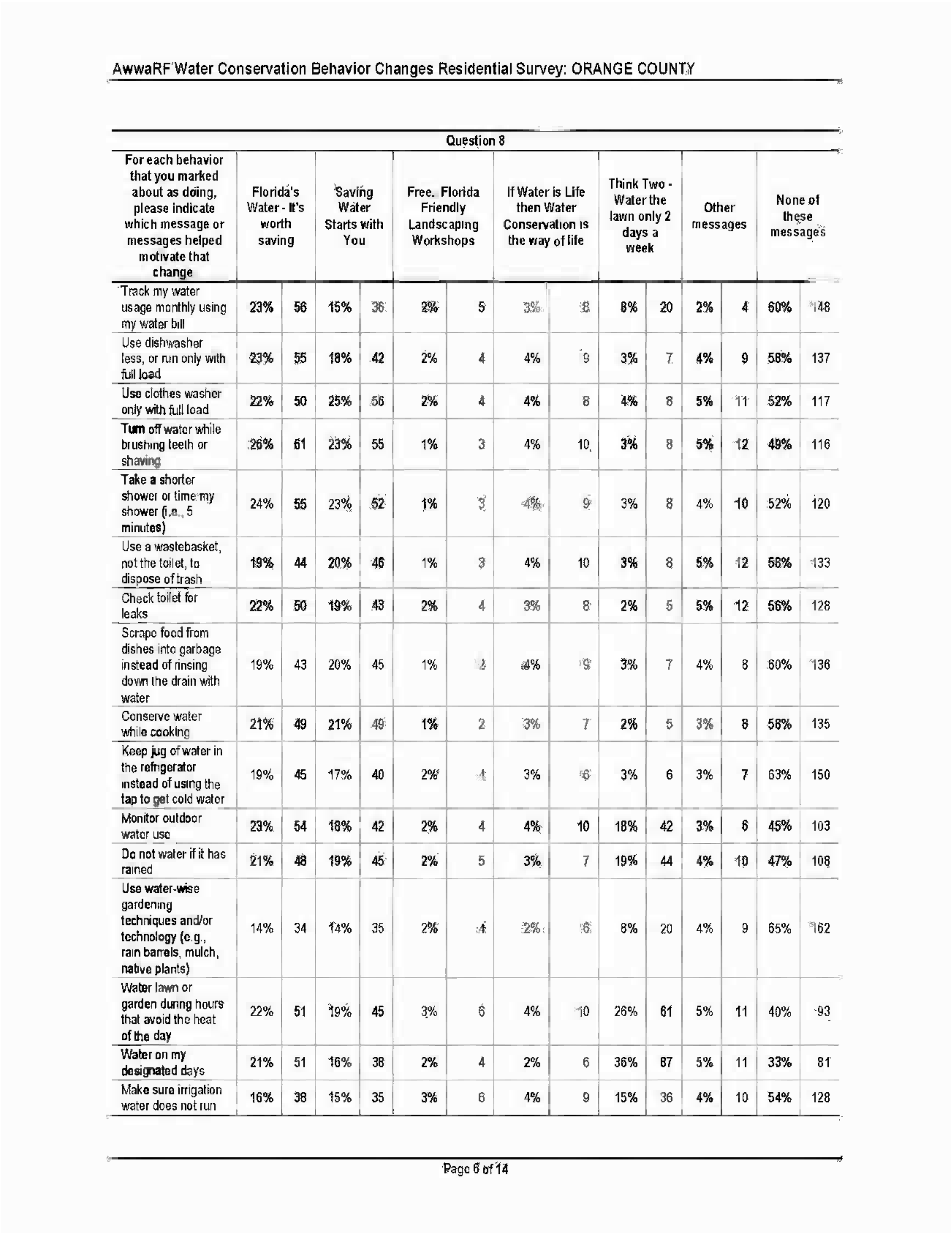

AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 8

For each behavior that you marked about as doing, please indicate which message or messages helped motivate that change	Florida's Water - It's worth saving		Saving Water Starts with You		Free. Florida Friendly Landscaping Workshops		If Water is Life then Water Conservation is the way of life		Think Two - Water the lawn only 2 days a week		Other messages		None of these messages	
Track my water usage monthly using my water bill	23%	56	15%	36	2%	5	3%	8	8%	20	2%	4	60%	148
Use dishwasher less, or run only with full load	23%	55	18%	42	2%	4	4%	9	3%	7	4%	9	56%	137
Use clothes washer only with full load	22%	50	25%	56	2%	4	4%	8	4%	8	5%	11	52%	117
Turn off water while brushing teeth or shaving	26%	61	23%	55	1%	3	4%	10	3%	8	5%	12	49%	116
Take a shorter shower or time my shower (i.e., 5 minutes)	24%	55	23%	52	1%	3	4%	9	3%	8	4%	10	52%	120
Use a wastebasket, not the toilet, to dispose of trash	19%	44	20%	46	1%	3	4%	10	3%	8	5%	12	56%	133
Check toilet for leaks	22%	50	19%	43	2%	4	3%	8	2%	5	5%	12	56%	128
Scrape food from dishes into garbage instead of rinsing down the drain with water	19%	43	20%	45	1%	2	4%	9	3%	7	4%	8	60%	136
Conserve water while cooking	21%	49	21%	49	1%	2	3%	7	2%	5	3%	8	58%	135
Keep jug of water in the refrigerator instead of using the tap to get cold water	19%	45	17%	40	2%	4	3%	6	3%	6	3%	7	63%	150
Monitor outdoor water use	23%	54	18%	42	2%	4	4%	10	18%	42	3%	6	45%	103
Do not water if it has rained	21%	48	19%	45	2%	5	3%	7	19%	44	4%	10	47%	108
Use water-wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	14%	34	14%	35	2%	4	2%	6	8%	20	4%	9	65%	162
Water lawn or garden during hours that avoid the heat of the day	22%	51	19%	45	3%	6	4%	10	26%	61	5%	11	40%	93
Water on my designated days	21%	51	16%	38	2%	4	2%	6	36%	87	5%	11	33%	81
Make sure irrigation water does not run	16%	38	15%	35	3%	6	4%	9	15%	36	4%	10	54%	128

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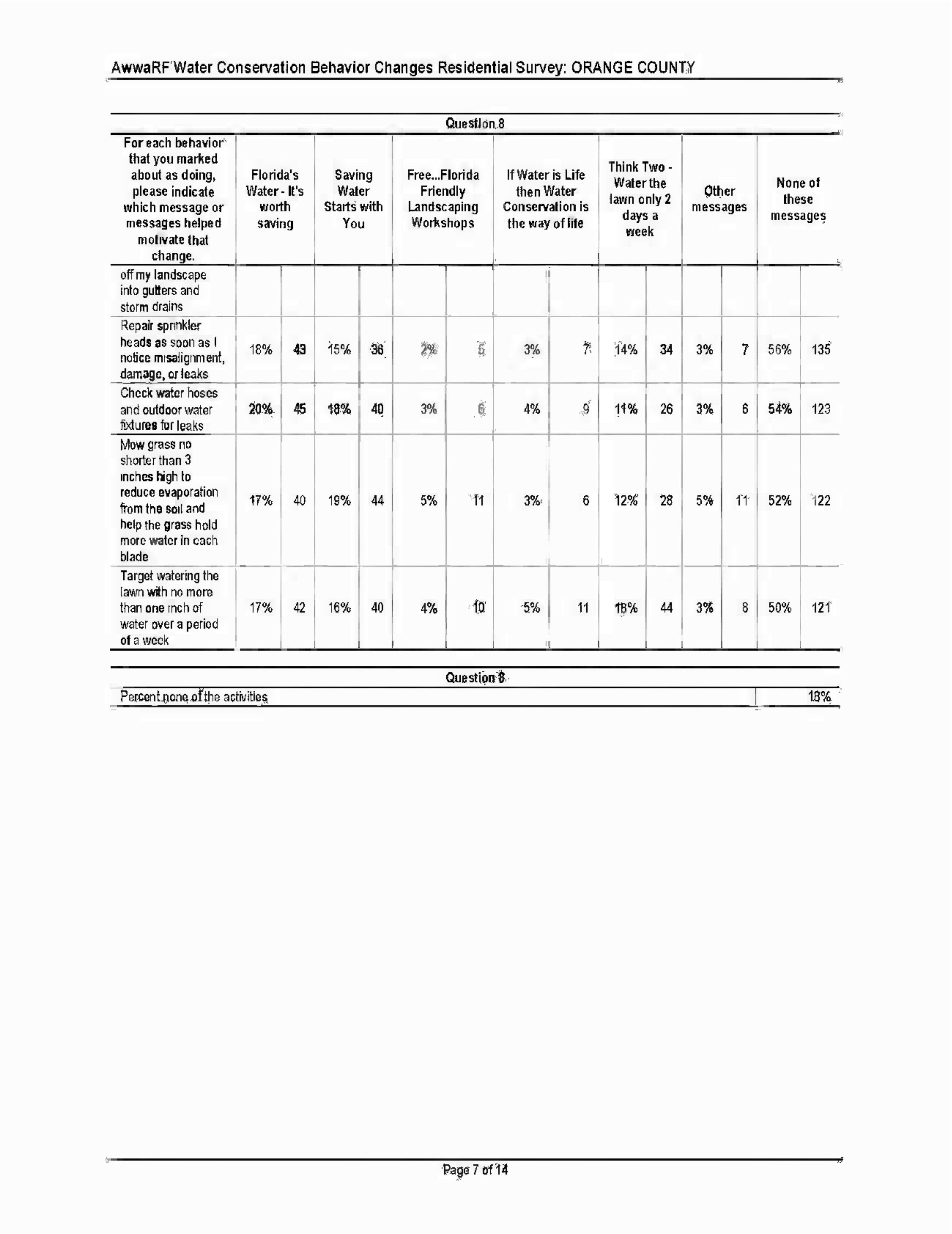


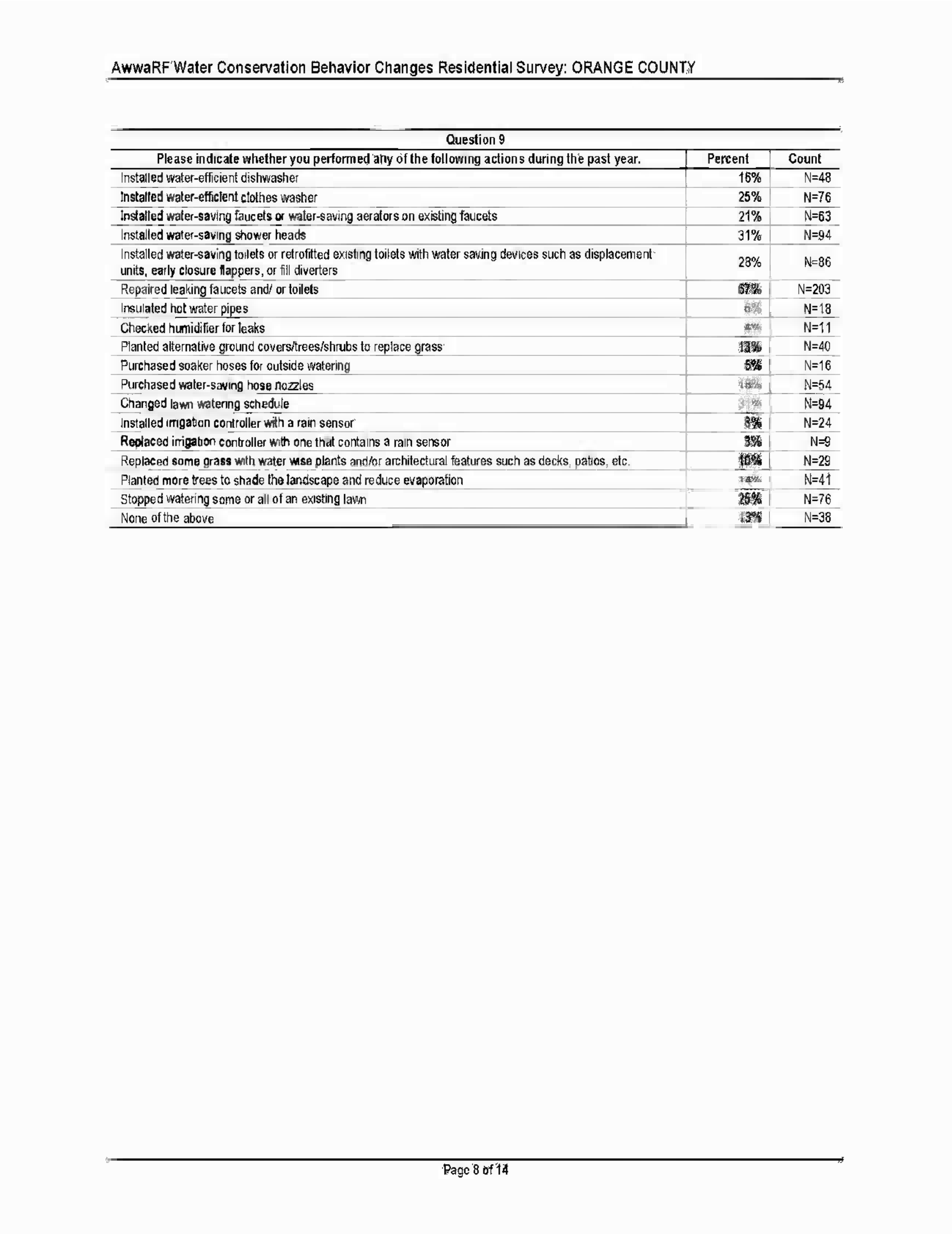
AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 8

For each behavior that you marked about as doing, please indicate which message or messages helped motivate that change.	Florida's Water - It's worth saving		Saving Water Starts with You		Free...Florida Friendly Landscaping Workshops		If Water is Life then Water Conservation is the way of life		Think Two - Water the lawn only 2 days a week		Other messages		None of these messages	
off my landscape into gutters and storm drains														
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	18%	43	15%	36	2%	5	3%	7	14%	34	3%	7	56%	135
Check water hoses and outdoor water fixtures for leaks	20%	45	18%	40	3%	6	4%	9	11%	26	3%	6	54%	123
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	17%	40	19%	44	5%	11	3%	6	12%	28	5%	11	52%	122
Target watering the lawn with no more than one inch of water over a period of a week	17%	42	16%	40	4%	10	5%	11	18%	44	3%	8	50%	121

Question 8

Percent none of the activities	18%



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 9		
Please indicate whether you performed any of the following actions during the past year.	Percent	Count
Installed water-efficient dishwasher	16%	N=48
Installed water-efficient clothes washer	25%	N=76
Installed water-saving faucets or water-saving aerators on existing faucets	21%	N=63
Installed water-saving shower heads	31%	N=94
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	28%	N=86
Repaired leaking faucets and/ or toilets	67%	N=203
Insulated hot water pipes	6%	N=18
Checked humidifier for leaks	4%	N=11
Planted alternative ground covers/trees/shrubs to replace grass	13%	N=40
Purchased soaker hoses for outside watering	5%	N=16
Purchased water-saving hose nozzles	18%	N=54
Changed lawn watering schedule	31%	N=94
Installed irrigation controller with a rain sensor	8%	N=24
Replaced irrigation controller with one that contains a rain sensor	3%	N=9
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	10%	N=29
Planted more trees to shade the landscape and reduce evaporation	14%	N=41
Stopped watering some or all of an existing lawn	25%	N=76
None of the above	13%	N=38

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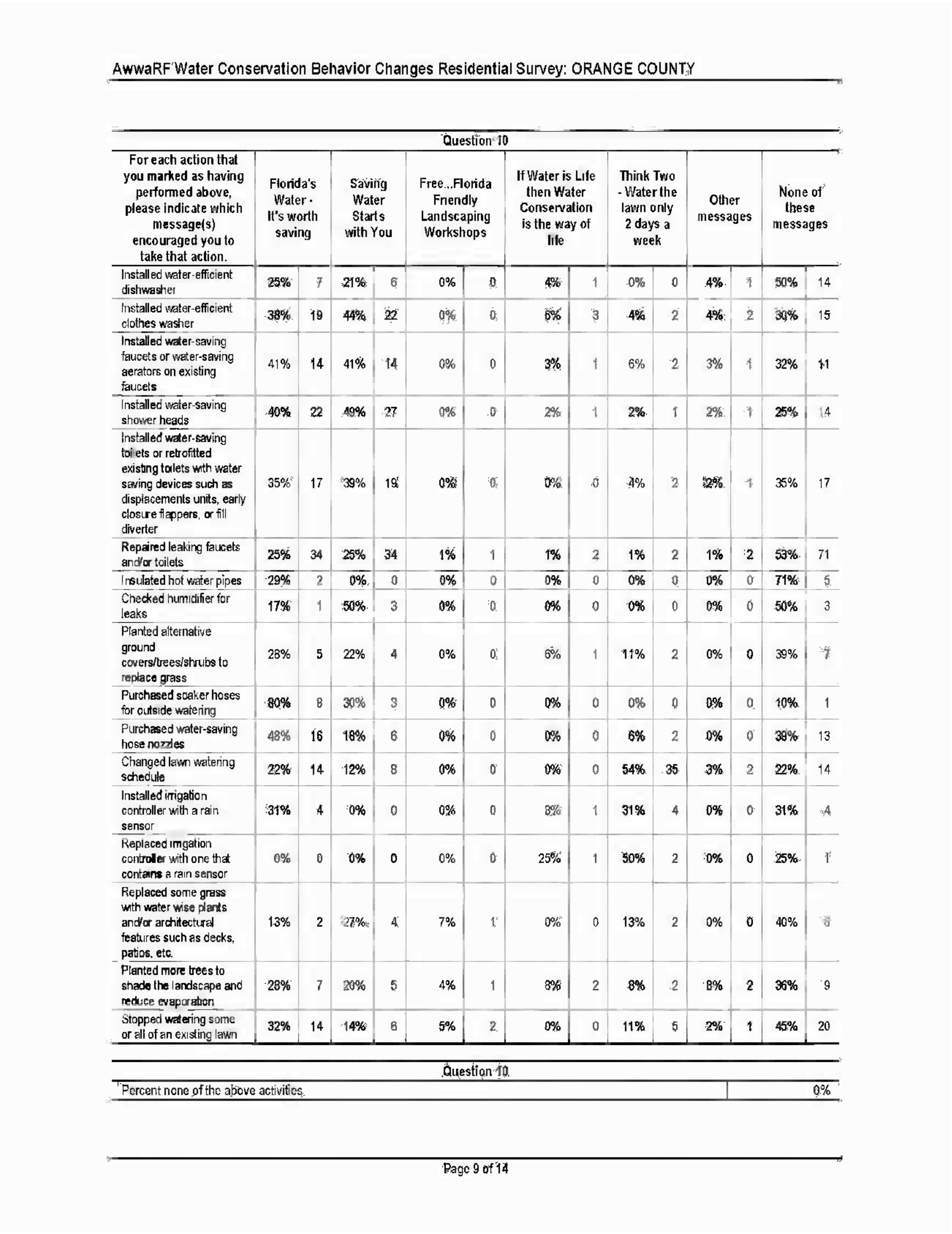

AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 10

For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action.	Florida's Water - It's worth saving		Saving Water Starts with You		Free...Florida Friendly Landscaping Workshops		If Water is Life then Water Conservation is the way of life		Think Two - Water the lawn only 2 days a week		Other messages		None of these messages	
Installed water-efficient dishwasher	25%	7	21%	6	0%	0	4%	1	0%	0	4%	1	50%	14
Installed water-efficient clothes washer	38%	19	44%	22	0%	0	6%	3	4%	2	4%	2	30%	15
Installed water-saving faucets or water-saving aerators on existing faucets	41%	14	41%	14	0%	0	3%	1	6%	2	3%	1	32%	11
Installed water-saving shower heads	40%	22	49%	27	0%	0	2%	1	2%	1	2%	1	25%	14
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	35%	17	39%	19	0%	0	0%	0	4%	2	2%	1	35%	17
Repaired leaking faucets and/or toilets	25%	34	25%	34	1%	1	1%	2	1%	2	1%	2	53%	71
Insulated hot water pipes	29%	2	0%	0	0%	0	0%	0	0%	0	0%	0	71%	5
Checked humidifier for leaks	17%	1	50%	3	0%	0	0%	0	0%	0	0%	0	50%	3
Planted alternative ground covers/trees/shrubs to replace grass	28%	5	22%	4	0%	0	6%	1	11%	2	0%	0	39%	7
Purchased soaker hoses for outside watering	80%	8	30%	3	0%	0	0%	0	0%	0	0%	0	10%	1
Purchased water-saving hose nozzles	48%	16	18%	6	0%	0	0%	0	6%	2	0%	0	39%	13
Changed lawn watering schedule	22%	14	12%	8	0%	0	0%	0	54%	35	3%	2	22%	14
Installed irrigation controller with a rain sensor	31%	4	0%	0	0%	0	8%	1	31%	4	0%	0	31%	4
Replaced irrigation controller with one that contains a rain sensor	0%	0	0%	0	0%	0	25%	1	50%	2	0%	0	25%	1
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	13%	2	27%	4	7%	1	0%	0	13%	2	0%	0	40%	6
Planted more trees to shade the landscape and reduce evaporation	28%	7	20%	5	4%	1	8%	2	8%	2	8%	2	36%	9
Stopped watering some or all of an existing lawn	32%	14	14%	6	5%	2	0%	0	11%	5	2%	1	45%	20

Question 10

Percent none of the above activities	0%

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AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 11

Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	6%	N=16
The utility offered it, but I did not participate	16%	N=42
The utility never offered one, but I would have participated if it did	60%	N=160
The utility never offered one, but I would not have participated anyway	18%	N=49
Total	100%	N=267

Question 12

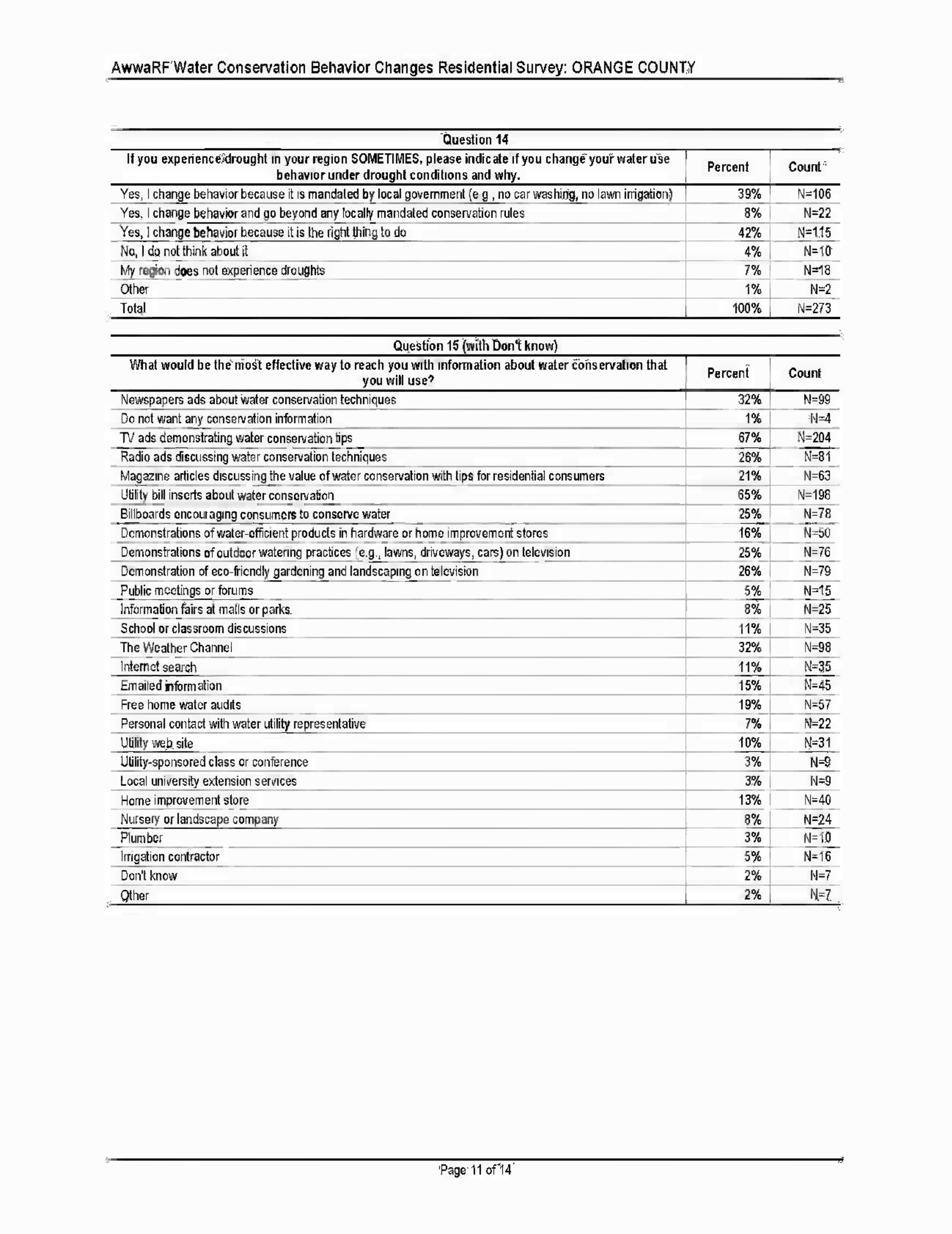
If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	87%	N=270
I am concerned about my family's health	33%	N=103
I am concerned about global climate change and how it may affect water supplies	51%	N=158
I am concerned about water availability	80%	N=248
I am concerned about a drought	58%	N=179
I am concerned about water restrictions	51%	N=157
I am concerned about the impact of water withdrawals on the environment	55%	N=170
I changed my behavior after reading a brochure insert with my water bill	12%	N=37
I changed my water usage after attending a workshop given by the water utility	0%	N=1
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	1%	N=4
I changed my water usage after seeing a television show about water conservation	12%	N=36
It is the right thing to do	80%	N=247
I do not know	0%	N=1
Other	4%	N=13
I do not conserve water	0%	N=0

Question 13 (with Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	1%	N=1
I do not have time	1%	N=1
I do not think about it	4%	N=5
I cannot afford to purchase and install water-saving fixtures	17%	N=22
I can afford to pay for as much water as I want or need	6%	N=7
I do not know	3%	N=4
I am already conserving as much as I am able	80%	N=101
Other	8%	N=10

Question 13 (without Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	1%	N=1
I do not have time	1%	N=1
I do not think about it	4%	N=5
I cannot afford to purchase and install water-saving fixtures	18%	N=22
I can afford to pay for as much water as I want or need	6%	N=7
I am already conserving as much as I am able	81%	N=101
Other	8%	N=10



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 14

If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	39%	N=106
Yes, I change behavior and go beyond any locally mandated conservation rules	8%	N=22
Yes, I change behavior because it is the right thing to do	42%	N=115
No, I do not think about it	4%	N=10
My region does not experience droughts	7%	N=18
Other	1%	N=2
Total	100%	N=273

Question 15 (with Don't know)

What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	32%	N=99
Do not want any conservation information	1%	N=4
TV ads demonstrating water conservation tips	67%	N=204
Radio ads discussing water conservation techniques	26%	N=81
Magazine articles discussing the value of water conservation with tips for residential consumers	21%	N=63
Utility bill inserts about water conservation	65%	N=198
Billboards encouraging consumers to conserve water	25%	N=78
Demonstrations of water-efficient products in hardware or home improvement stores	16%	N=50
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	25%	N=76
Demonstration of eco-friendly gardening and landscaping on television	26%	N=79
Public meetings or forums	5%	N=15
Information fairs at malls or parks	8%	N=25
School or classroom discussions	11%	N=35
The Weather Channel	32%	N=98
Internet search	11%	N=35
Emailed information	15%	N=45
Free home water audits	19%	N=57
Personal contact with water utility representative	7%	N=22
Utility web site	10%	N=31
Utility-sponsored class or conference	3%	N=9
Local university extension services	3%	N=9
Home improvement store	13%	N=40
Nursery or landscape company	8%	N=24
Plumber	3%	N=10
Irrigation contractor	5%	N=16
Don't know	2%	N=7
Other	2%	N=7

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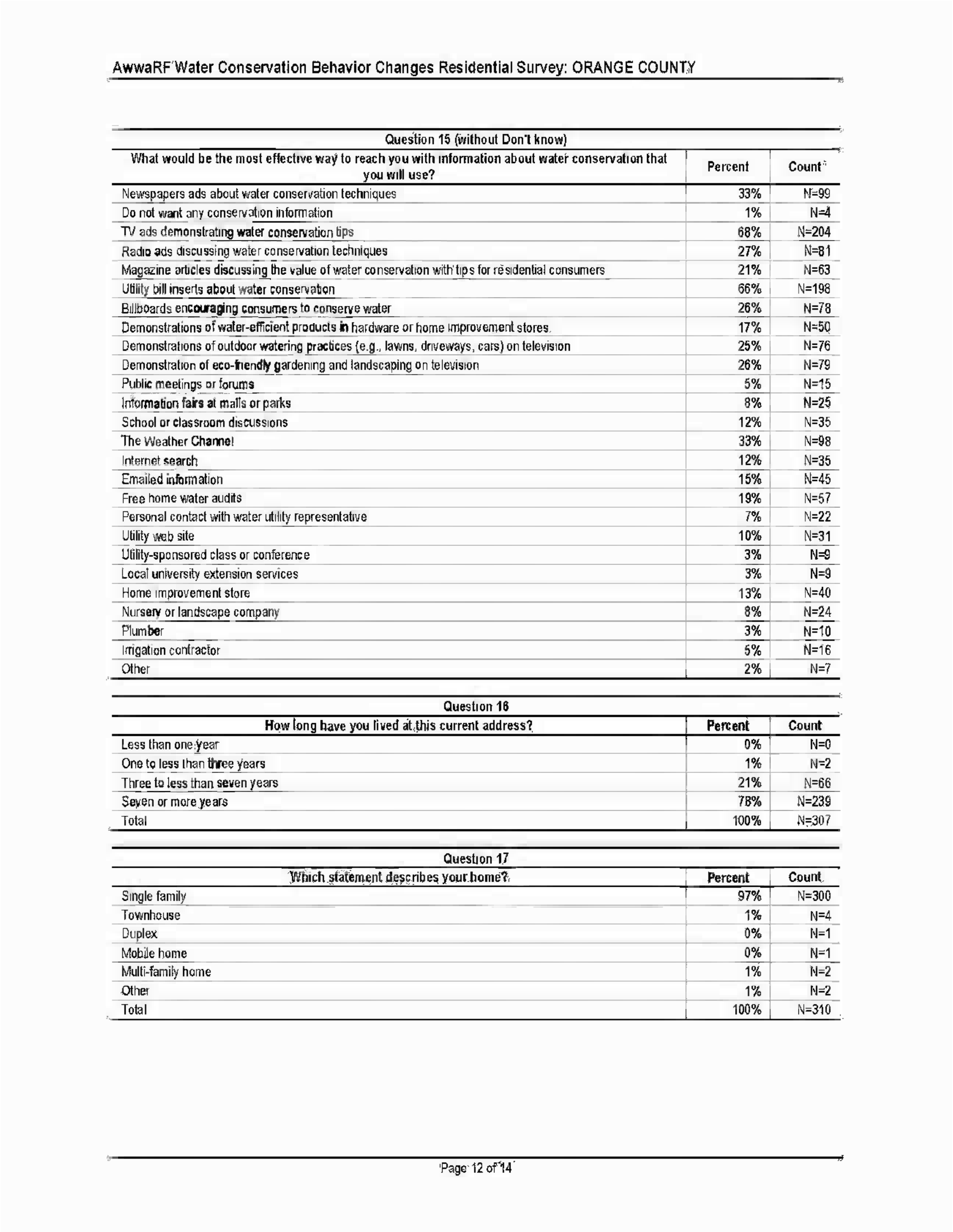
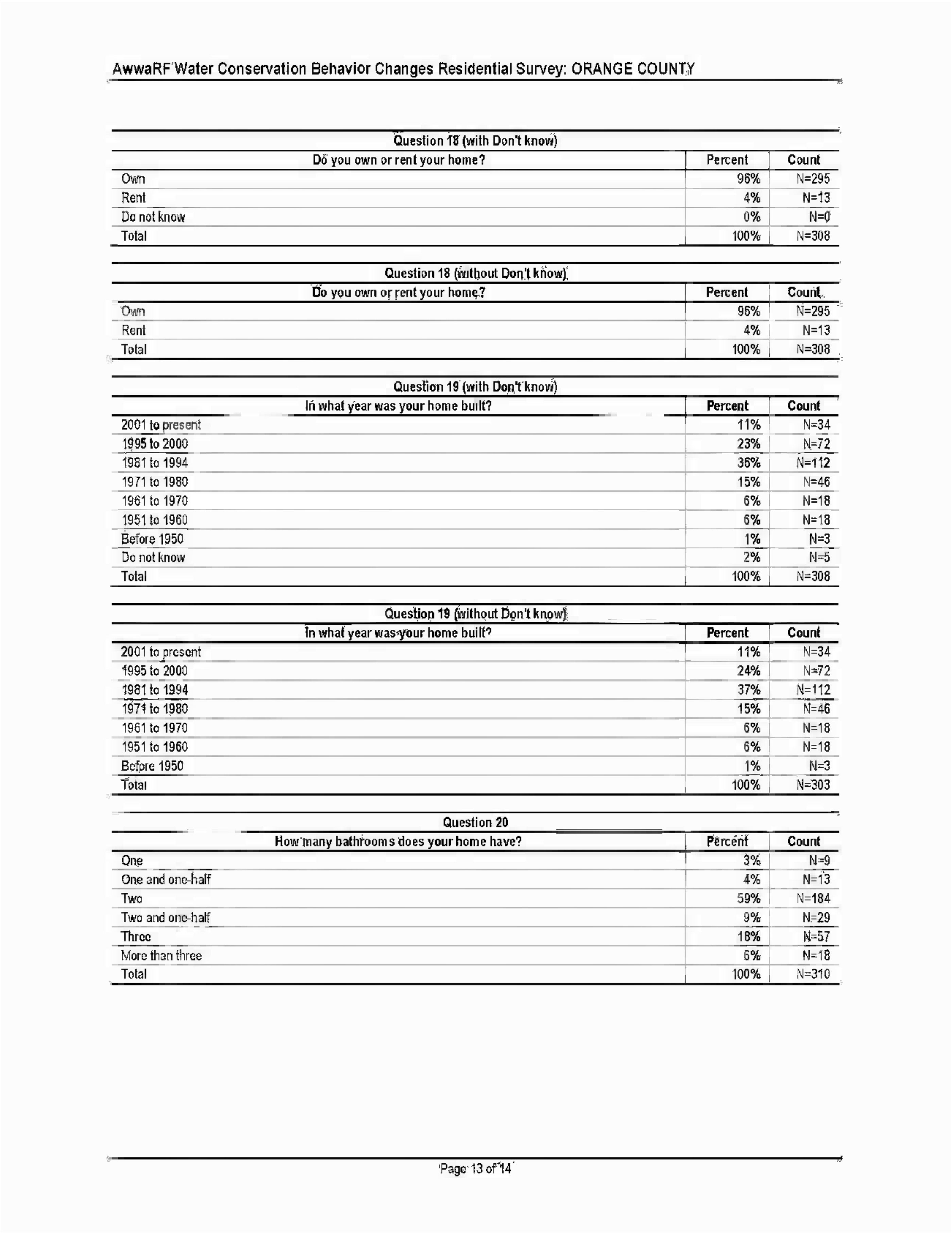


Question 15 (without Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	33%	N=99
Do not want any conservation information	1%	N=4
TV ads demonstrating water conservation tips	68%	N=204
Radio ads discussing water conservation techniques	27%	N=81
Magazine articles discussing the value of water conservation with tips for residential consumers	21%	N=63
Utility bill inserts about water conservation	66%	N=198
Billboards encouraging consumers to conserve water	26%	N=78
Demonstrations of water-efficient products in hardware or home improvement stores.	17%	N=50
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	25%	N=76
Demonstration of eco-friendly gardening and landscaping on television	26%	N=79
Public meetings or forums	5%	N=15
Information fairs at malls or parks	8%	N=25
School or classroom discussions	12%	N=35
The Weather Channel	33%	N=98
Internet search	12%	N=35
Emailed information	15%	N=45
Free home water audits	19%	N=57
Personal contact with water utility representative	7%	N=22
Utility web site	10%	N=31
Utility-sponsored class or conference	3%	N=9
Local university extension services	3%	N=9
Home improvement store	13%	N=40
Nursery or landscape company	8%	N=24
Plumber	3%	N=10
Irrigation contractor	5%	N=16
Other	2%	N=7

Question 16 How long have you lived at this current address?	Percent	Count
Less than one year	0%	N=0
One to less than three years	1%	N=2
Three to less than seven years	21%	N=66
Seven or more years	78%	N=239
Total	100%	N=307

Question 17 Which statement describes your home?	Percent	Count
Single family	97%	N=300
Townhouse	1%	N=4
Duplex	0%	N=1
Mobile home	0%	N=1
Multi-family home	1%	N=2
Other	1%	N=2
Total	100%	N=310



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 18 (with Don't know)

Do you own or rent your home?	Percent	Count
Own	96%	N=295
Rent	4%	N=13
Do not know	0%	N=0
Total	100%	N=308

Question 18 (without Don't know)

Do you own or rent your home?	Percent	Count
Own	96%	N=295
Rent	4%	N=13
Total	100%	N=308

Question 19 (with Don't know)

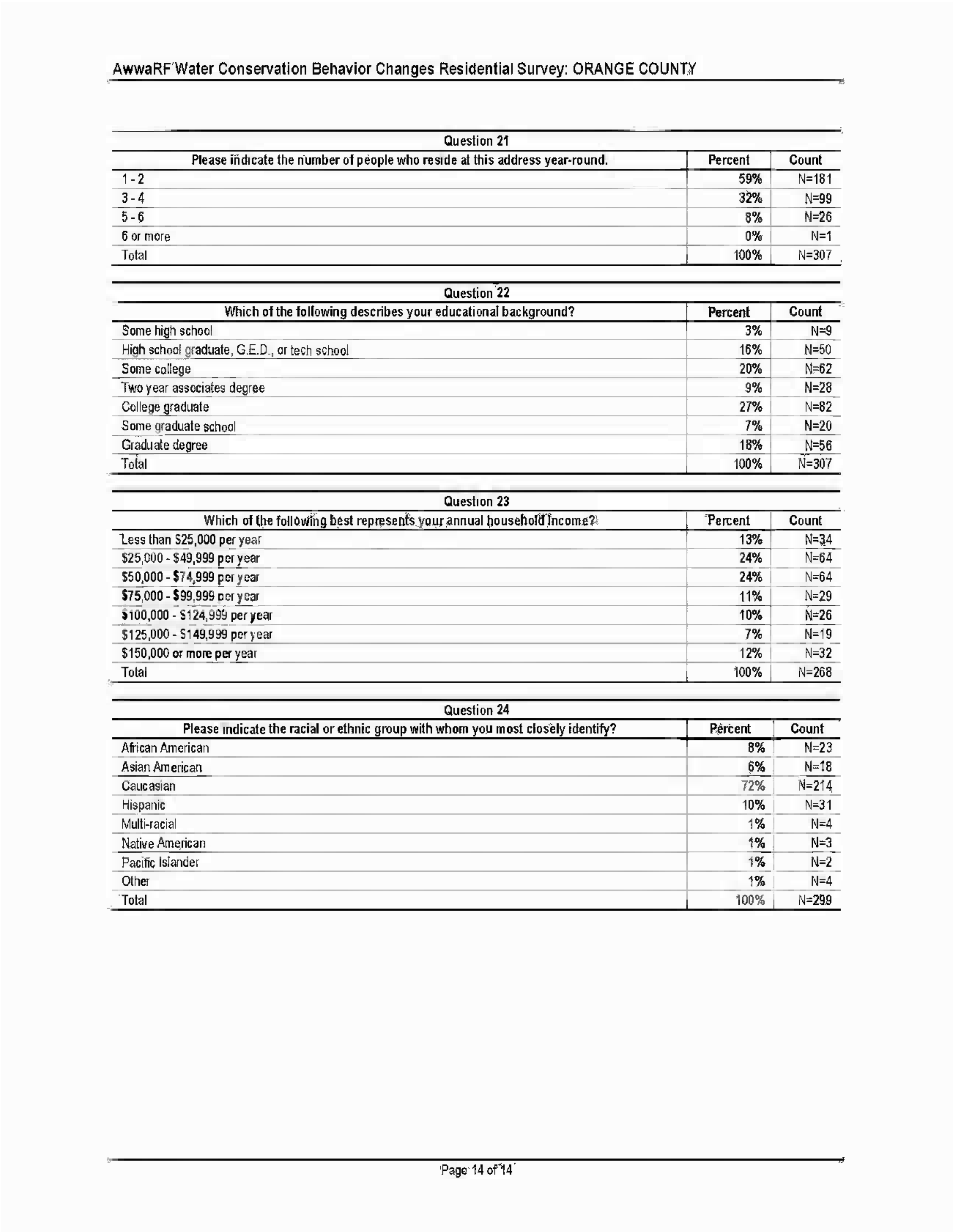
In what year was your home built?	Percent	Count
2001 to present	11%	N=34
1995 to 2000	23%	N=72
1981 to 1994	36%	N=112
1971 to 1980	15%	N=46
1961 to 1970	6%	N=18
1951 to 1960	6%	N=18
Before 1950	1%	N=3
Do not know	2%	N=5
Total	100%	N=308

Question 19 (without Don't know)

In what year was your home built?	Percent	Count
2001 to present	11%	N=34
1995 to 2000	24%	N=72
1981 to 1994	37%	N=112
1971 to 1980	15%	N=46
1961 to 1970	6%	N=18
1951 to 1960	6%	N=18
Before 1950	1%	N=3
Total	100%	N=303

Question 20

How many bathrooms does your home have?	Percent	Count
One	3%	N=9
One and one-half	4%	N=13
Two	59%	N=184
Two and one-half	9%	N=29
Three	18%	N=57
More than three	6%	N=18
Total	100%	N=310



AwwaRF Water Conservation Behavior Changes Residential Survey: ORANGE COUNTY

Question 21

Please indicate the number of people who reside at this address year-round.	Percent	Count
1 - 2	59%	N=181
3 - 4	32%	N=99
5 - 6	8%	N=26
6 or more	0%	N=1
Total	100%	N=307

Question 22

Which of the following describes your educational background?	Percent	Count
Some high school	3%	N=9
High school graduate, G.E.D., or tech school	16%	N=50
Some college	20%	N=62
Two year associates degree	9%	N=28
College graduate	27%	N=82
Some graduate school	7%	N=20
Graduate degree	18%	N=56
Total	100%	N=307

Question 23

Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	13%	N=34
$25,000 - $49,999 per year	24%	N=64
$50,000 - $74,999 per year	24%	N=64
$75,000 - $99,999 per year	11%	N=29
$100,000 - $124,999 per year	10%	N=26
$125,000 - $149,999 per year	7%	N=19
$150,000 or more per year	12%	N=32
Total	100%	N=268

Question 24

Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	8%	N=23
Asian American	6%	N=18
Caucasian	72%	N=214
Hispanic	10%	N=31
Multi-racial	1%	N=4
Native American	1%	N=3
Pacific Islander	1%	N=2
Other	1%	N=4
Total	100%	N=299

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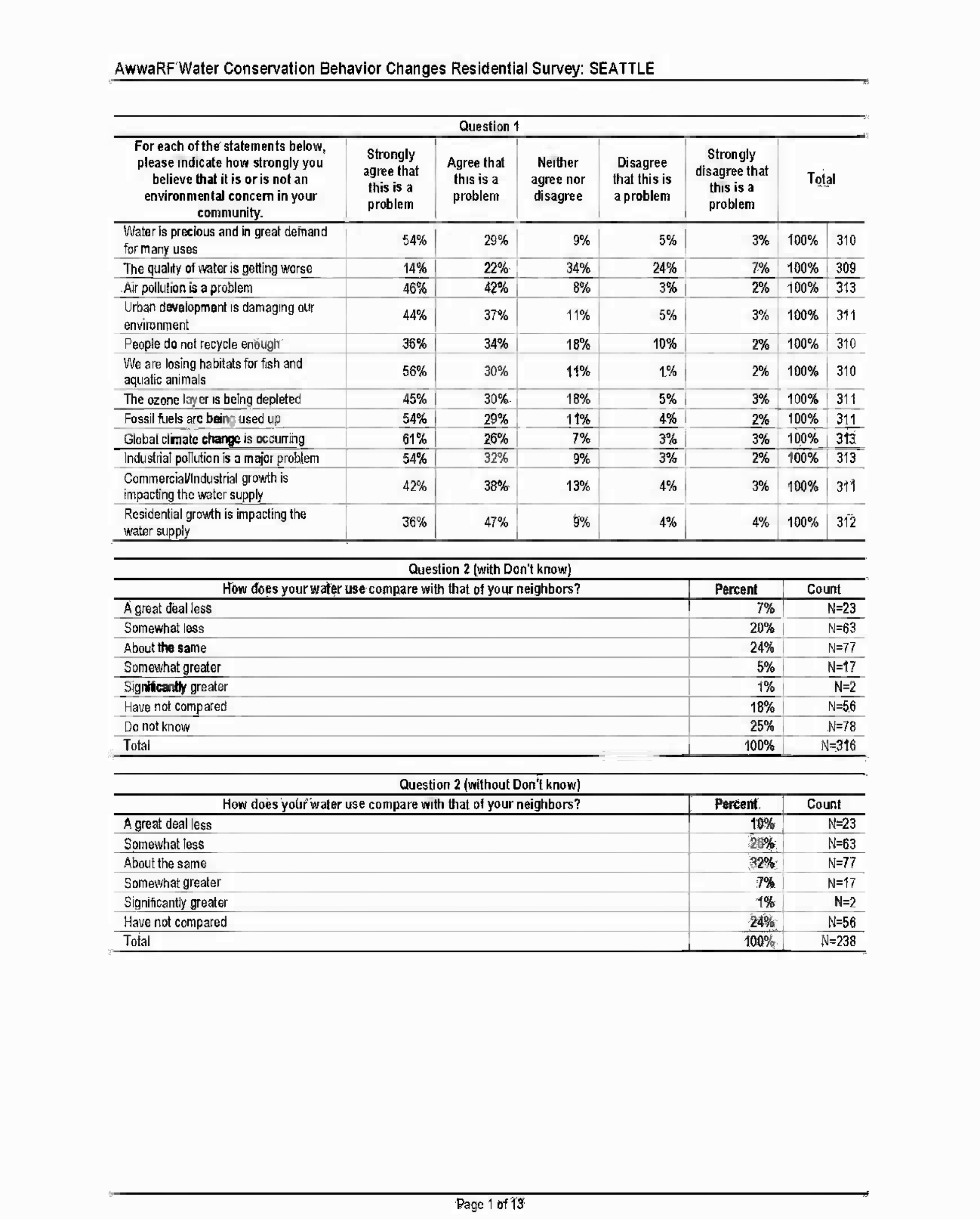
SEATTLE PUBLIC UTILITIES: ENUMERATED SURVEY RESPONSES



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 1

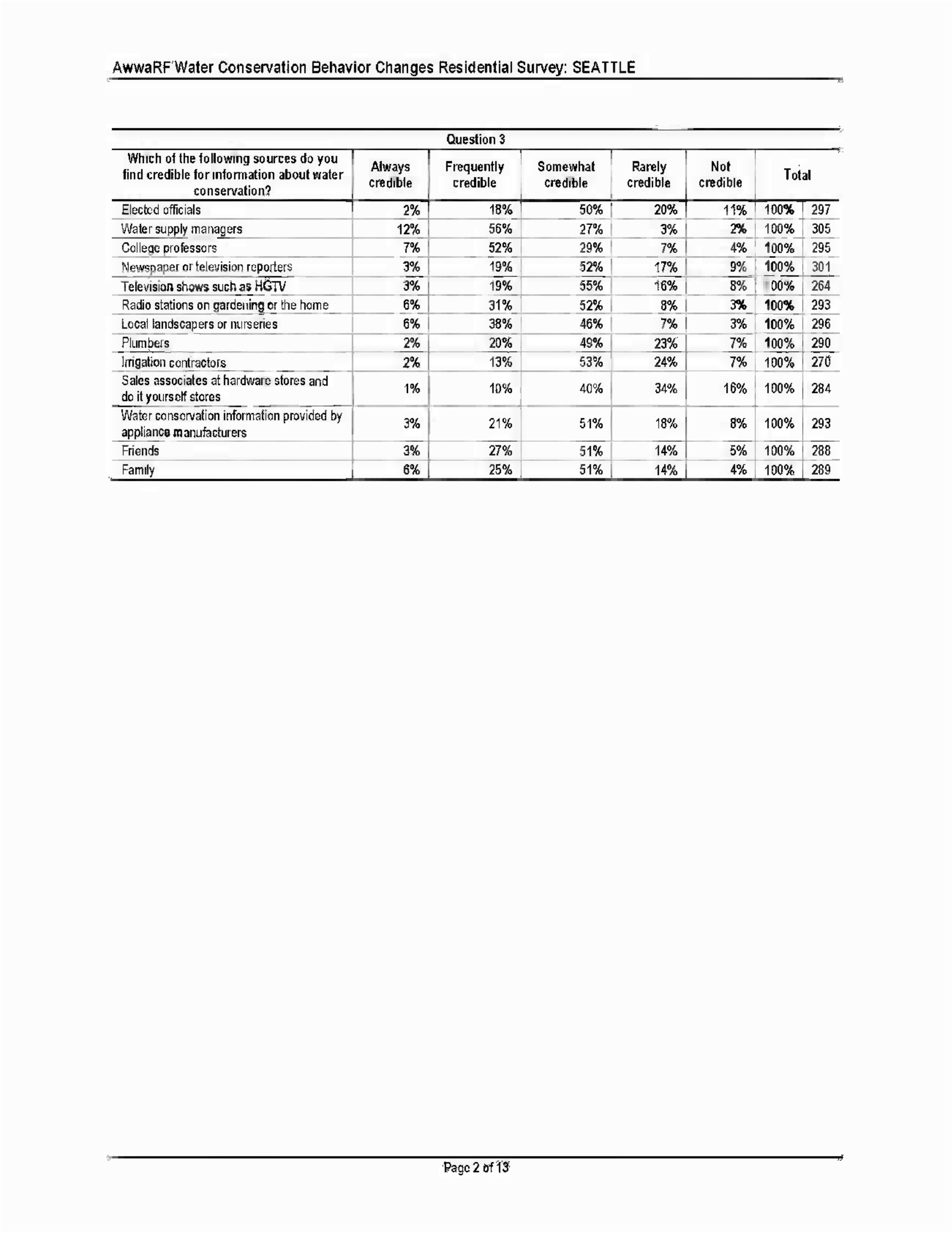
For each of the statements below, please indicate how strongly you believe that it is or is not an environmental concern in your community.	Strongly agree that this is a problem	Agree that this is a problem	Neither agree nor disagree	Disagree that this is a problem	Strongly disagree that this is a problem	Total	
Water is precious and in great demand for many uses	54%	29%	9%	5%	3%	100%	310
The quality of water is getting worse	14%	22%	34%	24%	7%	100%	309
Air pollution is a problem	46%	42%	8%	3%	2%	100%	313
Urban development is damaging our environment	44%	37%	11%	5%	3%	100%	311
People do not recycle enough	36%	34%	18%	10%	2%	100%	310
We are losing habitats for fish and aquatic animals	56%	30%	11%	1%	2%	100%	310
The ozone layer is being depleted	45%	30%	18%	5%	3%	100%	311
Fossil fuels are being used up	54%	29%	11%	4%	2%	100%	311
Global climate change is occurring	61%	26%	7%	3%	3%	100%	313
Industrial pollution is a major problem	54%	32%	9%	3%	2%	100%	313
Commercial/Industrial growth is impacting the water supply	42%	38%	13%	4%	3%	100%	311
Residential growth is impacting the water supply	36%	47%	9%	4%	4%	100%	312

Question 2 (with Don't know)

How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	7%	N=23
Somewhat less	20%	N=63
About the same	24%	N=77
Somewhat greater	5%	N=17
Significantly greater	1%	N=2
Have not compared	18%	N=56
Do not know	25%	N=78
Total	100%	N=316

Question 2 (without Don't know)

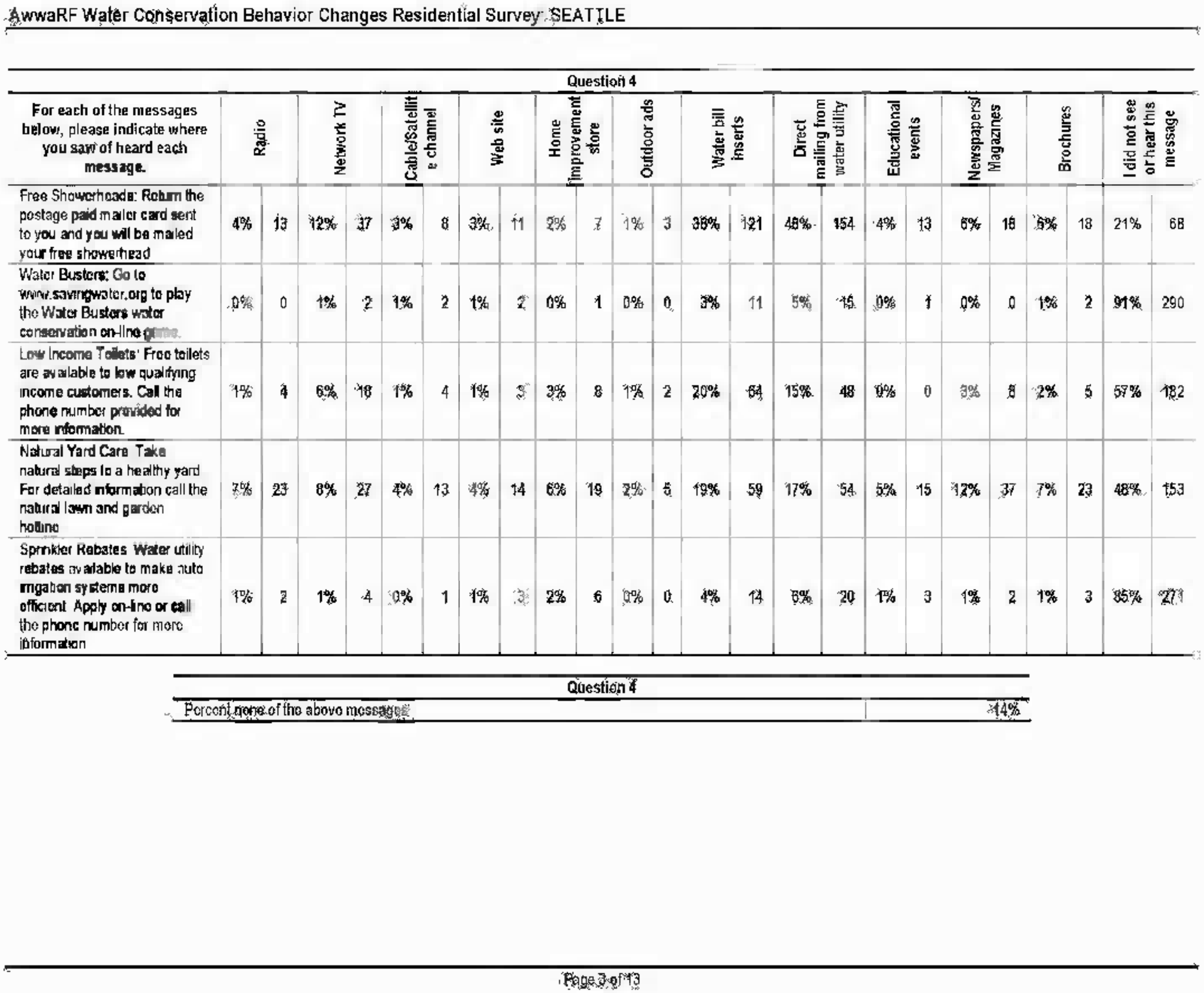
How does your water use compare with that of your neighbors?	Percent	Count
A great deal less	10%	N=23
Somewhat less	26%	N=63
About the same	32%	N=77
Somewhat greater	7%	N=17
Significantly greater	1%	N=2
Have not compared	24%	N=56
Total	100%	N=238



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 3

Which of the following sources do you find credible for information about water conservation?	Always credible	Frequently credible	Somewhat credible	Rarely credible	Not credible	Total	
Elected officials	2%	18%	50%	20%	11%	100%	297
Water supply managers	12%	56%	27%	3%	2%	100%	305
College professors	7%	52%	29%	7%	4%	100%	295
Newspaper or television reporters	3%	19%	52%	17%	9%	100%	301
Television shows such as HGTV	3%	19%	55%	16%	8%	100%	264
Radio stations on gardening or the home	6%	31%	52%	8%	3%	100%	293
Local landscapers or nurseries	6%	38%	46%	7%	3%	100%	296
Plumbers	2%	20%	49%	23%	7%	100%	290
Irrigation contractors	2%	13%	53%	24%	7%	100%	270
Sales associates at hardware stores and do it yourself stores	1%	10%	40%	34%	16%	100%	284
Water conservation information provided by appliance manufacturers	3%	21%	51%	18%	8%	100%	293
Friends	3%	27%	51%	14%	5%	100%	288
Family	6%	25%	51%	14%	4%	100%	289



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 4

For each of the messages below, please indicate where you saw of heard each message.	Radio		Network TV		Cable/Satellite channel		Web site		Home Improvement store		Outdoor ads		Water bill inserts		Direct mailing from water utility		Educational events		Newspapers/ Magazines		Brochures		I did not see or hear this message	
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead	4%	13	12%	37	3%	8	3%	11	2%	7	1%	3	38%	121	48%	154	4%	13	6%	18	6%	18	21%	68
Water Busters: Go to www.savingwater.org to play the Water Busters water conservation on-line game.	0%	0	1%	2	1%	2	1%	2	0%	1	0%	0	3%	11	5%	15	0%	1	0%	0	1%	2	91%	290
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	1%	4	6%	18	1%	4	1%	3	3%	8	1%	2	20%	64	15%	48	0%	0	3%	8	2%	5	57%	182
Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline	7%	23	8%	27	4%	13	4%	14	6%	19	2%	5	19%	59	17%	54	5%	15	12%	37	7%	23	48%	153
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information	1%	2	1%	4	0%	1	1%	3	2%	6	0%	0	4%	14	6%	20	1%	3	1%	2	1%	3	85%	271

	Question 4
Percent none of the above messages	14%

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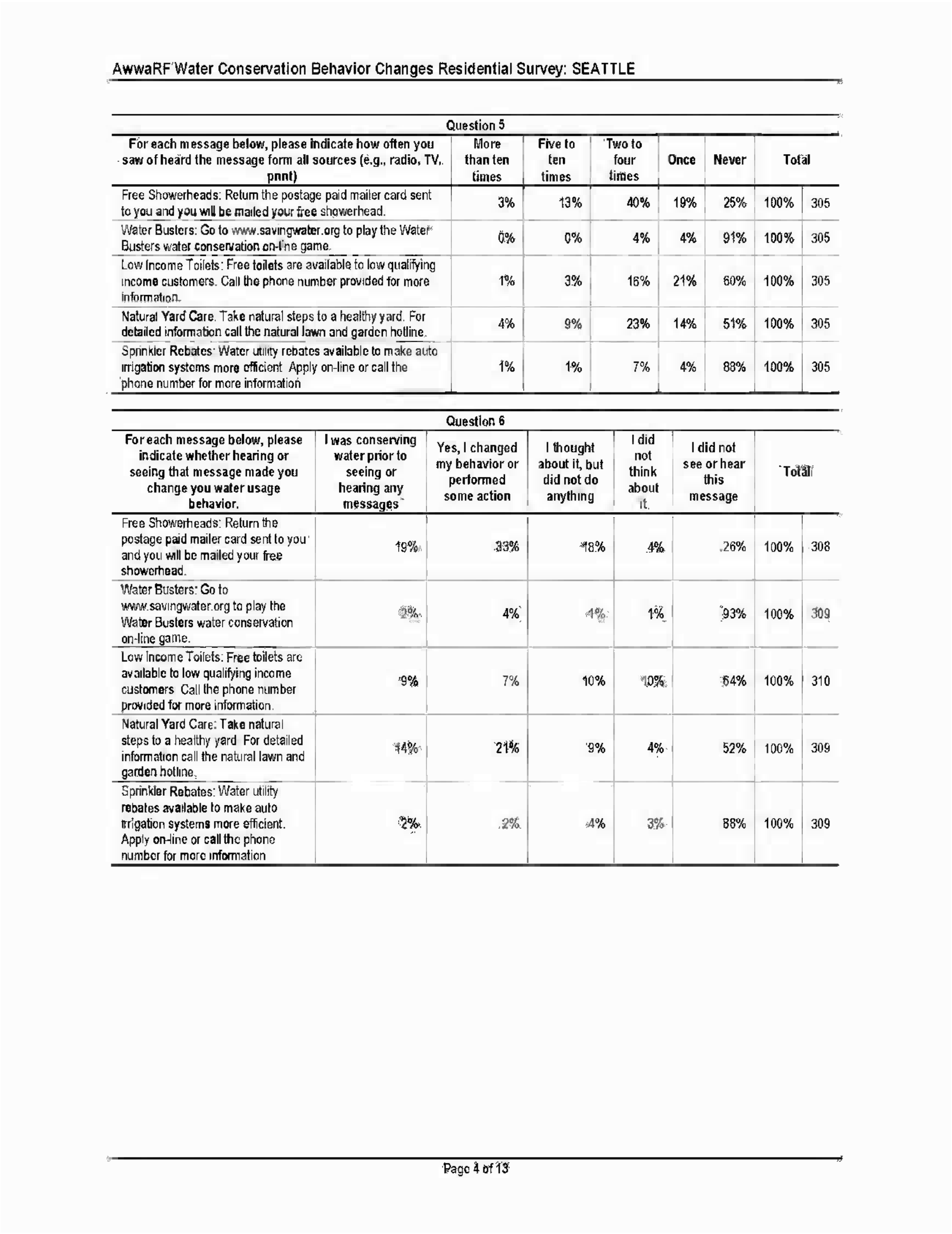


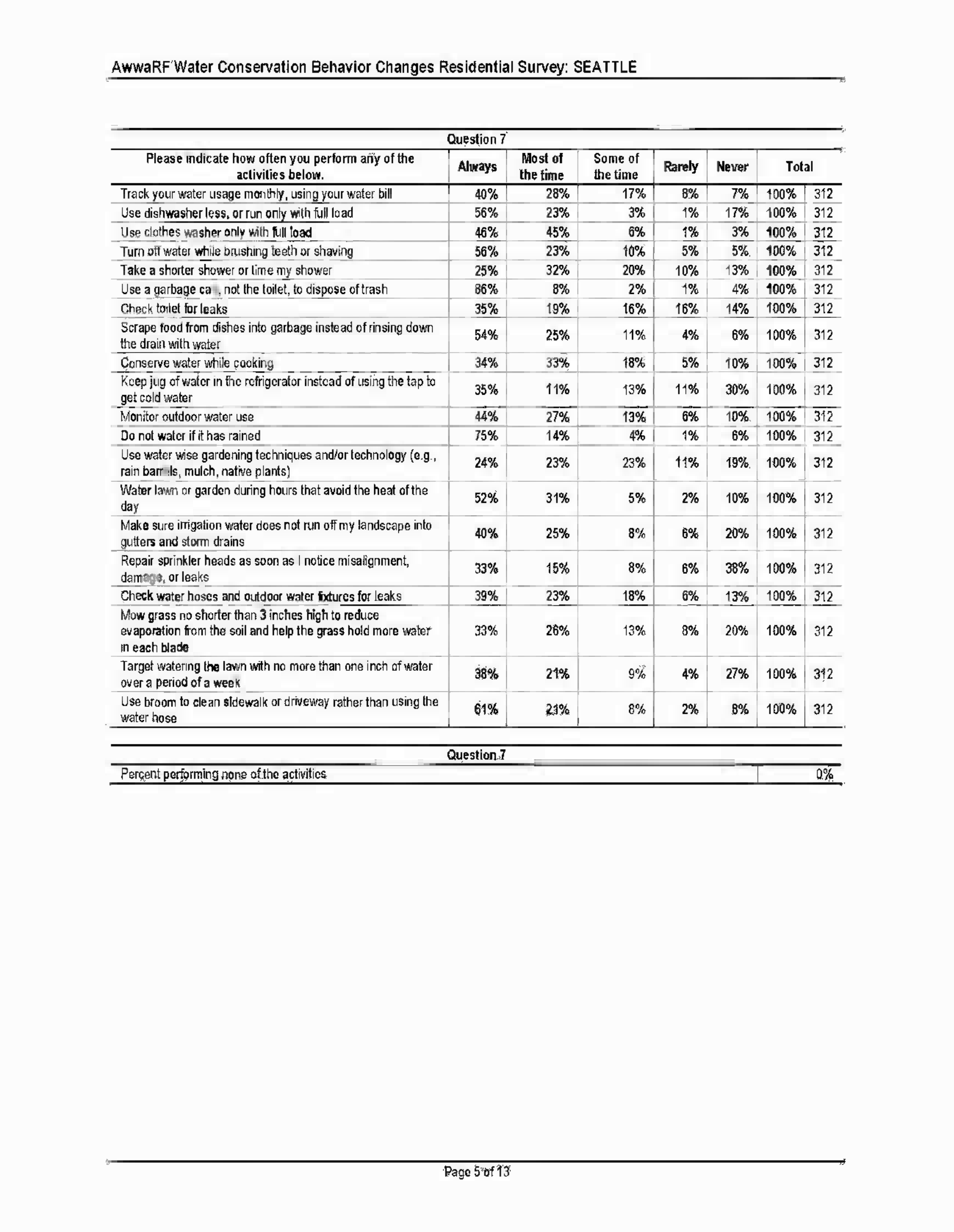
AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 5

For each message below, please indicate how often you saw of heard the message form all sources (e.g., radio, TV, pnnt)	More than ten times	Five to ten times	Two to four times	Once	Never	Total	
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead.	3%	13%	40%	19%	25%	100%	305
Water Busters: Go to www.savingwater.org to play the Water Busters water conservation on-line game.	0%	0%	4%	4%	91%	100%	305
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	1%	3%	16%	21%	60%	100%	305
Natural Yard Care. Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline.	4%	9%	23%	14%	51%	100%	305
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information	1%	1%	7%	4%	88%	100%	305

Question 6

For each message below, please indicate whether hearing or seeing that message made you change you water usage behavior.	I was conserving water prior to seeing or hearing any messages	Yes, I changed my behavior or performed some action	I thought about it, but did not do anything	I did not think about it.	I did not see or hear this message	Total	
Free Showerheads: Return the postage paid mailer card sent to you and you will be mailed your free showerhead.	19%	33%	18%	4%	26%	100%	308
Water Busters: Go to www.savingwater.org to play the Water Busters water conservation on-line game.	2%	4%	4%	1%	93%	100%	309
Low Income Toilets: Free toilets are available to low qualifying income customers. Call the phone number provided for more information.	9%	7%	10%	10%	64%	100%	310
Natural Yard Care: Take natural steps to a healthy yard. For detailed information call the natural lawn and garden hotline.	14%	21%	9%	4%	52%	100%	309
Sprinkler Rebates: Water utility rebates available to make auto irrigation systems more efficient. Apply on-line or call the phone number for more information	2%	2%	4%	3%	88%	100%	309



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 7

Please indicate how often you perform any of the activities below.	Always	Most of the time	Some of the time	Rarely	Never	Total	
Track your water usage monthly, using your water bill	40%	28%	17%	8%	7%	100%	312
Use dishwasher less, or run only with full load	56%	23%	3%	1%	17%	100%	312
Use clothes washer only with full load	46%	45%	6%	1%	3%	100%	312
Turn off water while brushing teeth or shaving	56%	23%	10%	5%	5%	100%	312
Take a shorter shower or time my shower	25%	32%	20%	10%	13%	100%	312
Use a garbage can, not the toilet, to dispose of trash	86%	8%	2%	1%	4%	100%	312
Check toilet for leaks	35%	19%	16%	16%	14%	100%	312
Scrape food from dishes into garbage instead of rinsing down the drain with water	54%	25%	11%	4%	6%	100%	312
Conserve water while cooking	34%	33%	18%	5%	10%	100%	312
Keep jug of water in the refrigerator instead of using the tap to get cold water	35%	11%	13%	11%	30%	100%	312
Monitor outdoor water use	44%	27%	13%	6%	10%	100%	312
Do not water if it has rained	75%	14%	4%	1%	6%	100%	312
Use water wise gardening techniques and/or technology (e.g., rain barrels, mulch, native plants)	24%	23%	23%	11%	19%	100%	312
Water lawn or garden during hours that avoid the heat of the day	52%	31%	5%	2%	10%	100%	312
Make sure irrigation water does not run off my landscape into gutters and storm drains	40%	25%	8%	6%	20%	100%	312
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	33%	15%	8%	6%	38%	100%	312
Check water hoses and outdoor water fixtures for leaks	39%	23%	18%	6%	13%	100%	312
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	33%	26%	13%	8%	20%	100%	312
Target watering the lawn with no more than one inch of water over a period of a week	38%	21%	9%	4%	27%	100%	312
Use broom to clean sidewalk or driveway rather than using the water hose	61%	21%	8%	2%	8%	100%	312

Question 7

Percent performing none of the activities	0%

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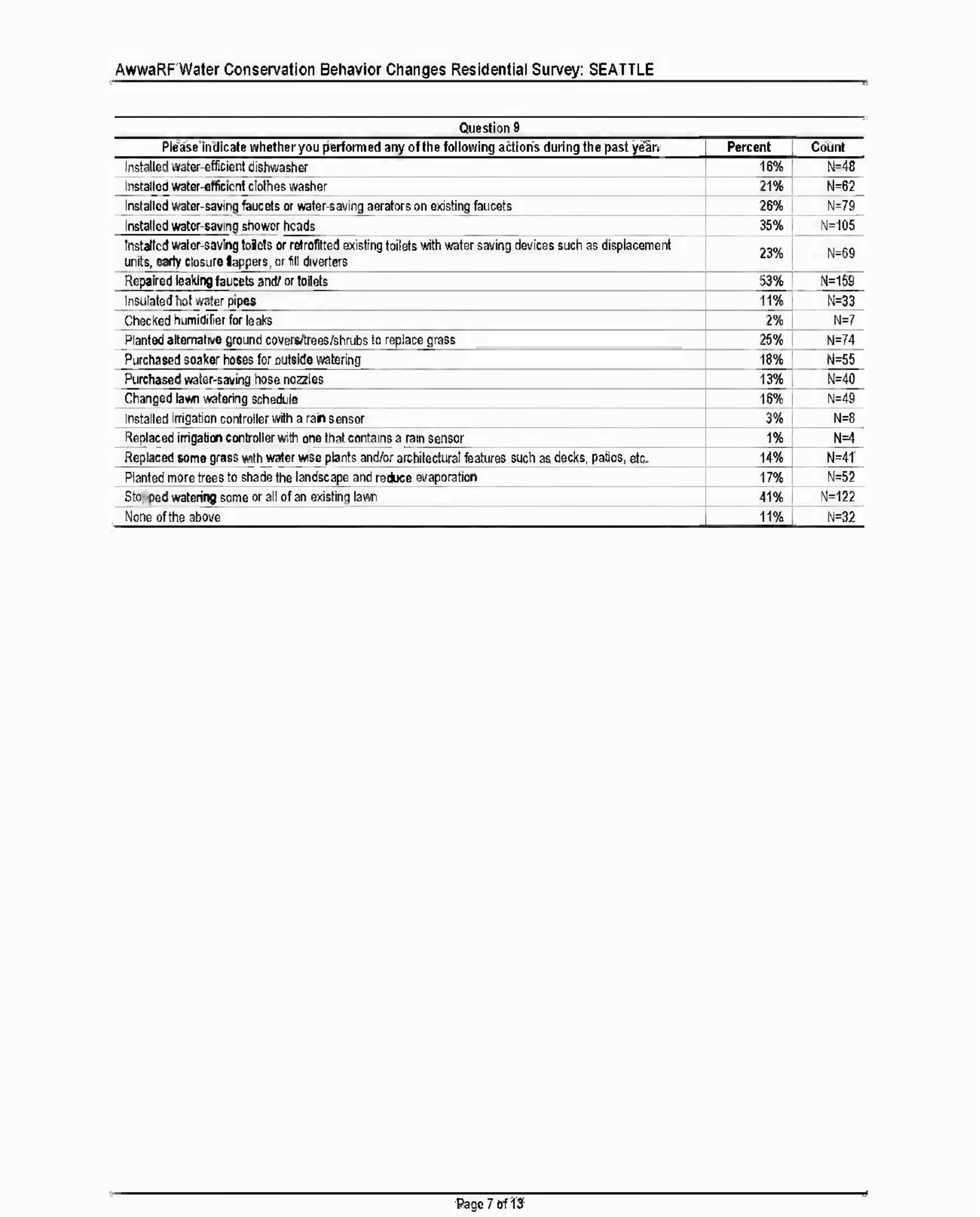
AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

	Question 8													
For each behavior that you marked above, please indicate which message or messages helped motivate that change.	Free Showerheads		Water Busters		Low Income Toilets		Natural Yard Care		Sprinkler Rebates		Other messages		None of these messages	
Track your water usage monthly using your water bill	8%	19	1%	2	1%	3	5%	12	1%	2	18%	44	74%	179
Use dishwasher less, or run only with full load	1%	2	0%	0	0%	0	1%	2	0%	1	23%	56	76%	185
Use clothes washer only with full load	1%	2	2%	5	0%	1	0%	1	0%	1	30%	69	66%	153
Turn off water while brushing teeth or shaving	1%	3	2%	4	0%	0	0%	1	0%	1	31%	70	67%	153
Take a shorter shower or time my shower	10%	25	1%	3	0%	1	0%	1	1%	2	25%	59	64%	154
Use a garbage can, not the toilet, to dispose of trash	1%	3	1%	2	0%	0	2%	4	0%	1	23%	53	73%	165
Check toilet for leaks	2%	4	1%	3	2%	5	0%	1	0%	1	19%	45	75%	176
Scrape food from dishes into garbage instead of rinsing down the drain with water	0%	0	1%	3	0%	0	1%	2	0%	1	24%	54	74%	167
Conserve water while cooking	0%	1	1%	3	0%	0	0%	1	0%	1	19%	42	79%	180
Keep jug of water in the refrigerator instead of using the tap to get cold water	0%	0	1%	2	0%	0	0%	1	0%	1	13%	31	86%	211
Monitor outdoor water use	0%	1	1%	2	0%	0	7%	17	2%	4	22%	51	70%	164
Do not water if it has rained	0%	1	1%	2	0%	0	9%	21	1%	3	19%	43	71%	159
Use water wise gardening techniques and/ or technology (e.g., rain barrels, mulch, native plants)	0%	1	1%	2	0%	0	17%	41	1%	2	21%	51	63%	155
Water lawn or garden during hours that avoid the heat of the day	0%	1	1%	2	0%	1	13%	30	1%	3	23%	53	64%	150
Make sure irrigation water does not run off my landscape into gutters and storm drains	0%	0	1%	2	0%	0	7%	17	1%	2	18%	42	75%	180
Repair sprinkler heads as soon as I notice misalignment, damage, or leaks	0%	0	0%	0	0%	0	3%	7	0%	1	10%	25	87%	218
Check water hoses and outdoor water fixtures for leaks	0%	0	0%	1	0%	0	4%	9	1%	2	18%	40	77%	176
Mow grass no shorter than 3 inches high to reduce evaporation from the soil and help the grass hold more water in each blade	0%	0	1%	2	0%	0	14%	34	1%	3	19%	45	67%	162
Target watering the lawn with no more than one inch of water over a period of a week	0%	0	0%	0	0%	0	8%	21	1%	3	17%	42	74%	183
Use broom to clean sidewalk or driveway rather than using the water hose	0%	0	0%	1	0%	0	4%	9	0%	1	20%	47	75%	175

	Question 8
Percent none of the activities	21%



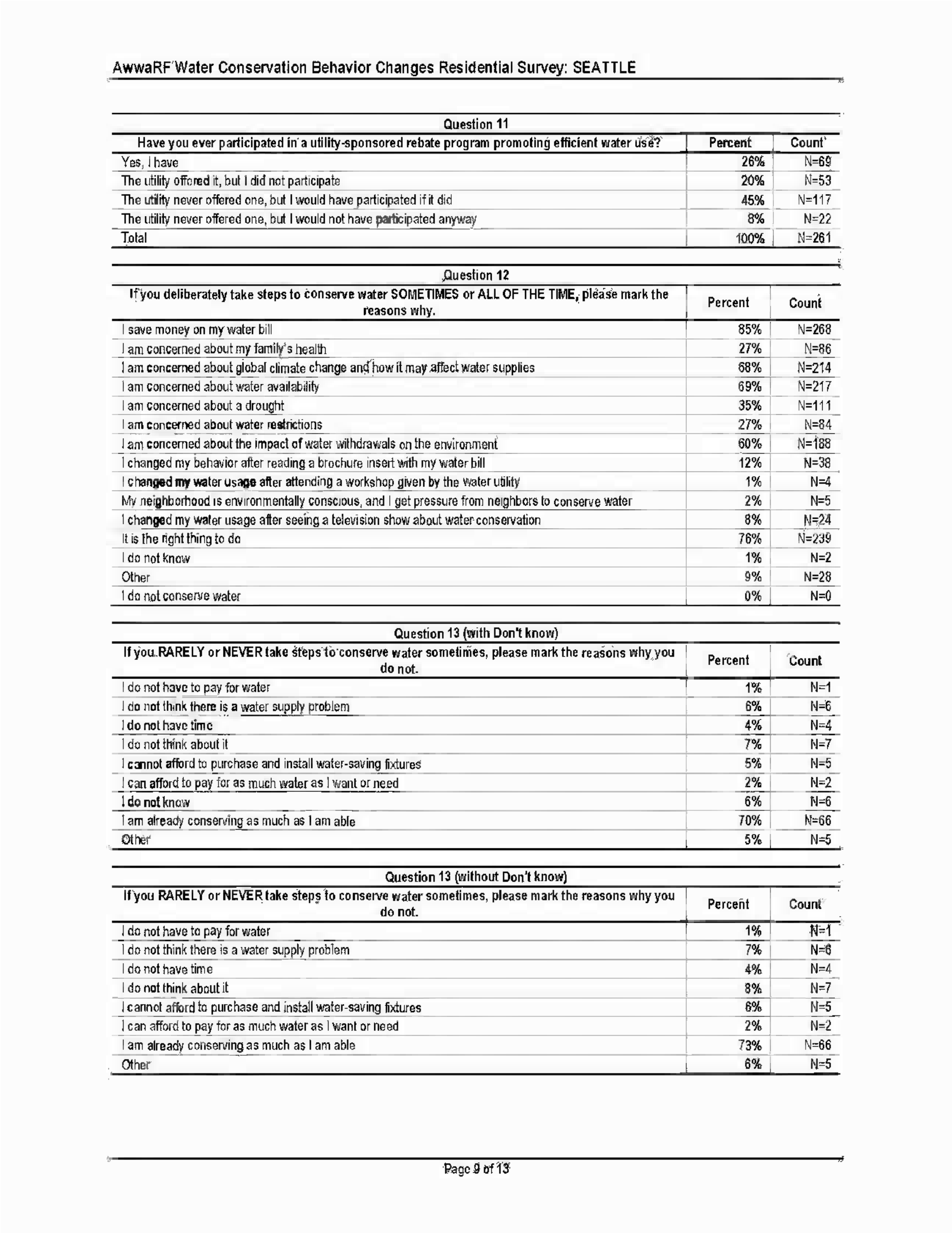
AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 9

Please indicate whether you performed any of the following actions during the past year.	Percent	Count
Installed water-efficient dishwasher	16%	N=48
Installed water-efficient clothes washer	21%	N=62
Installed water-saving faucets or water-saving aerators on existing faucets	26%	N=79
Installed water-saving shower heads	35%	N=105
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacement units, early closure flappers, or fill diverters	23%	N=69
Repaired leaking faucets and/ or toilets	53%	N=159
Insulated hot water pipes	11%	N=33
Checked humidifier for leaks	2%	N=7
Planted alternative ground covers/trees/shrubs to replace grass	25%	N=74
Purchased soaker hoses for outside watering	18%	N=55
Purchased water-saving hose nozzles	13%	N=40
Changed lawn watering schedule	16%	N=49
Installed irrigation controller with a rain sensor	3%	N=8
Replaced irrigation controller with one that contains a rain sensor	1%	N=4
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	14%	N=41
Planted more trees to shade the landscape and reduce evaporation	17%	N=52
Stopped watering some or all of an existing lawn	41%	N=122
None of the above	11%	N=32

	Question 10													
For each action that you marked as having performed above, please indicate which message(s) encouraged you to take that action.	Free Showerheads		Water Busters		Low Income Toilets		Natural Yard Care		Sprinkler Rebates		Other messages		None of these messages	
Installed water-efficient dishwasher	0%	0	0%	0	3%	1	0%	0	0%	0	27%	8	70%	21
Installed water-efficient clothes washer	0%	0	7%	3	2%	1	0%	0	0%	0	51%	21	41%	17
Installed water-saving faucets or water-saving aerators on existing faucets	34%	18	2%	1	2%	1	2%	1	0%	0	28%	15	34%	18
Installed water-saving shower heads	71%	54	1%	1	1%	1	0%	0	0%	0	14%	11	16%	12
Installed water-saving toilets or retrofitted existing toilets with water saving devices such as displacements units, early closure flappers, or fill diverter	2%	1	4%	2	8%	4	0%	0	0%	0	40%	20	46%	23
Repaired leaking faucets and/or toilets	2%	2	3%	3	4%	4	1%	1	0%	0	21%	22	70%	73
Insulated hot water pipes	5%	1	0%	0	5%	1	0%	0	0%	0	36%	8	55%	12
Checked humidifier for leaks	0%	0	0%	0	33%	1	0%	0	0%	0	67%	2	0%	0
Planted alternative ground covers/trees/shrubs to replace grass	0%	0	2%	1	2%	1	31%	16	0%	0	20%	10	53%	27
Purchased soaker hoses for outside watering	0%	0	0%	0	0%	0	26%	10	0%	0	26%	10	53%	20
Purchased water-saving hose nozzles	0%	0	4%	1	4%	1	28%	7	0%	0	28%	7	44%	11
Changed lawn watering schedule	0%	0	6%	2	3%	1	15%	5	0%	0	21%	7	56%	19
Installed irrigation controller with a rain sensor	0%	0	0%	0	17%	1	17%	1	0%	0	17%	1	50%	3
Replaced irrigation controller with one that contains a rain sensor	0%	0	0%	0	0%	0	0%	0	0%	0	100%	2	0%	0
Replaced some grass with water wise plants and/or architectural features such as decks, patios, etc.	0%	0	5%	1	0%	0	27%	6	0%	0	32%	7	45%	10
Planted more trees to shade the landscape and reduce evaporation	0%	0	3%	1	3%	1	21%	8	5%	2	18%	7	55%	21
Stopped watering some or all of an existing lawn	0%	0	3%	2	1%	1	17%	13	1%	1	24%	18	55%	41

	Question 10
Percent none of the above activities	0%



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 11

Have you ever participated in a utility-sponsored rebate program promoting efficient water use?	Percent	Count
Yes, I have	26%	N=69
The utility offered it, but I did not participate	20%	N=53
The utility never offered one, but I would have participated if it did	45%	N=117
The utility never offered one, but I would not have participated anyway	8%	N=22
Total	100%	N=261

Question 12

If you deliberately take steps to conserve water SOMETIMES or ALL OF THE TIME, please mark the reasons why.	Percent	Count
I save money on my water bill	85%	N=268
I am concerned about my family's health	27%	N=86
I am concerned about global climate change and how it may affect water supplies	68%	N=214
I am concerned about water availability	69%	N=217
I am concerned about a drought	35%	N=111
I am concerned about water restrictions	27%	N=84
I am concerned about the impact of water withdrawals on the environment	60%	N=188
I changed my behavior after reading a brochure insert with my water bill	12%	N=38
I changed my water usage after attending a workshop given by the water utility	1%	N=4
My neighborhood is environmentally conscious, and I get pressure from neighbors to conserve water	2%	N=5
I changed my water usage after seeing a television show about water conservation	8%	N=24
It is the right thing to do	76%	N=239
I do not know	1%	N=2
Other	9%	N=28
I do not conserve water	0%	N=0

Question 13 (with Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	6%	N=6
I do not have time	4%	N=4
I do not think about it	7%	N=7
I cannot afford to purchase and install water-saving fixtures	5%	N=5
I can afford to pay for as much water as I want or need	2%	N=2
I do not know	6%	N=6
I am already conserving as much as I am able	70%	N=66
Other	5%	N=5

Question 13 (without Don't know)

If you RARELY or NEVER take steps to conserve water sometimes, please mark the reasons why you do not.	Percent	Count
I do not have to pay for water	1%	N=1
I do not think there is a water supply problem	7%	N=6
I do not have time	4%	N=4
I do not think about it	8%	N=7
I cannot afford to purchase and install water-saving fixtures	6%	N=5
I can afford to pay for as much water as I want or need	2%	N=2
I am already conserving as much as I am able	73%	N=66
Other	6%	N=5

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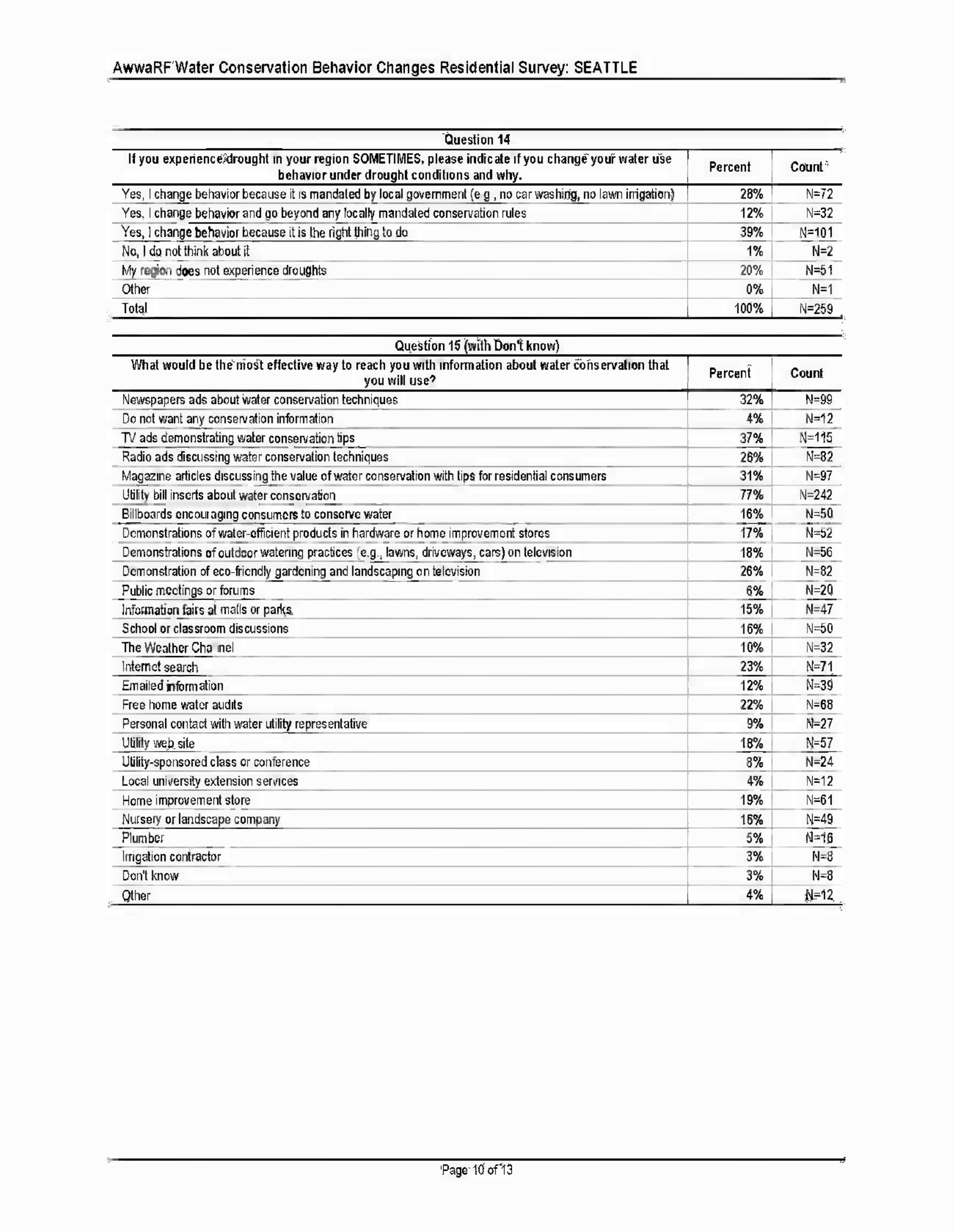

AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 14 If you experience drought in your region SOMETIMES, please indicate if you change your water use behavior under drought conditions and why.	Percent	Count
Yes, I change behavior because it is mandated by local government (e.g., no car washing, no lawn irrigation)	28%	N=72
Yes, I change behavior and go beyond any locally mandated conservation rules	12%	N=32
Yes, I change behavior because it is the right thing to do	39%	N=101
No, I do not think about it	1%	N=2
My region does not experience droughts	20%	N=51
Other	0%	N=1
Total	100%	N=259

Question 15 (with Don't know) What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	32%	N=99
Do not want any conservation information	4%	N=12
TV ads demonstrating water conservation tips	37%	N=115
Radio ads discussing water conservation techniques	26%	N=82
Magazine articles discussing the value of water conservation with tips for residential consumers	31%	N=97
Utility bill inserts about water conservation	77%	N=242
Billboards encouraging consumers to conserve water	16%	N=50
Demonstrations of water-efficient products in hardware or home improvement stores	17%	N=52
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	18%	N=56
Demonstration of eco-friendly gardening and landscaping on television	26%	N=82
Public meetings or forums	6%	N=20
Information fairs at malls or parks	15%	N=47
School or classroom discussions	16%	N=50
The Weather Channel	10%	N=32
Internet search	23%	N=71
Emailed information	12%	N=39
Free home water audits	22%	N=68
Personal contact with water utility representative	9%	N=27
Utility web site	18%	N=57
Utility-sponsored class or conference	8%	N=24
Local university extension services	4%	N=12
Home improvement store	19%	N=61
Nursery or landscape company	16%	N=49
Plumber	5%	N=16
Irrigation contractor	3%	N=8
Don't know	3%	N=8
Other	4%	N=12

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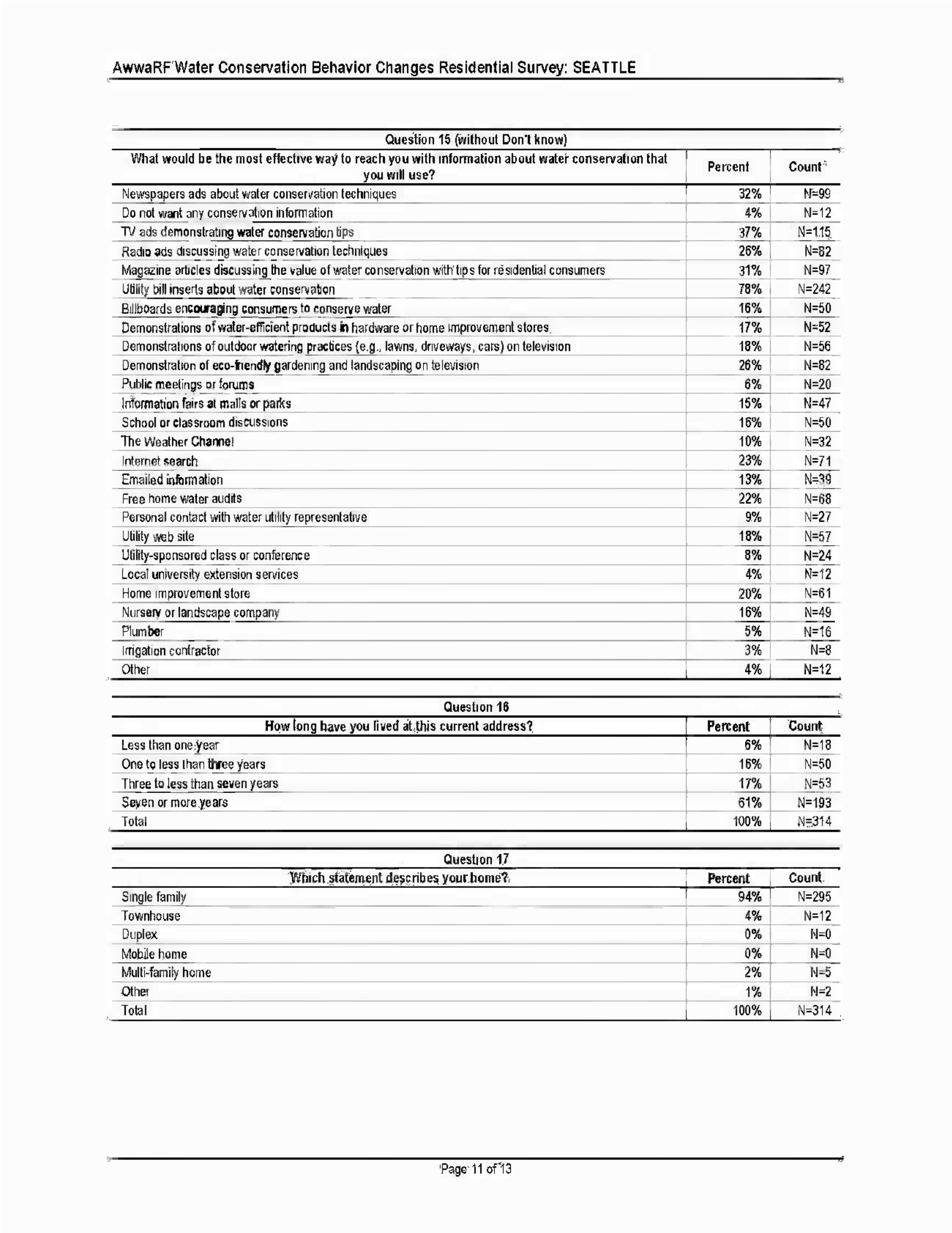


AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 15 (without Don't know)

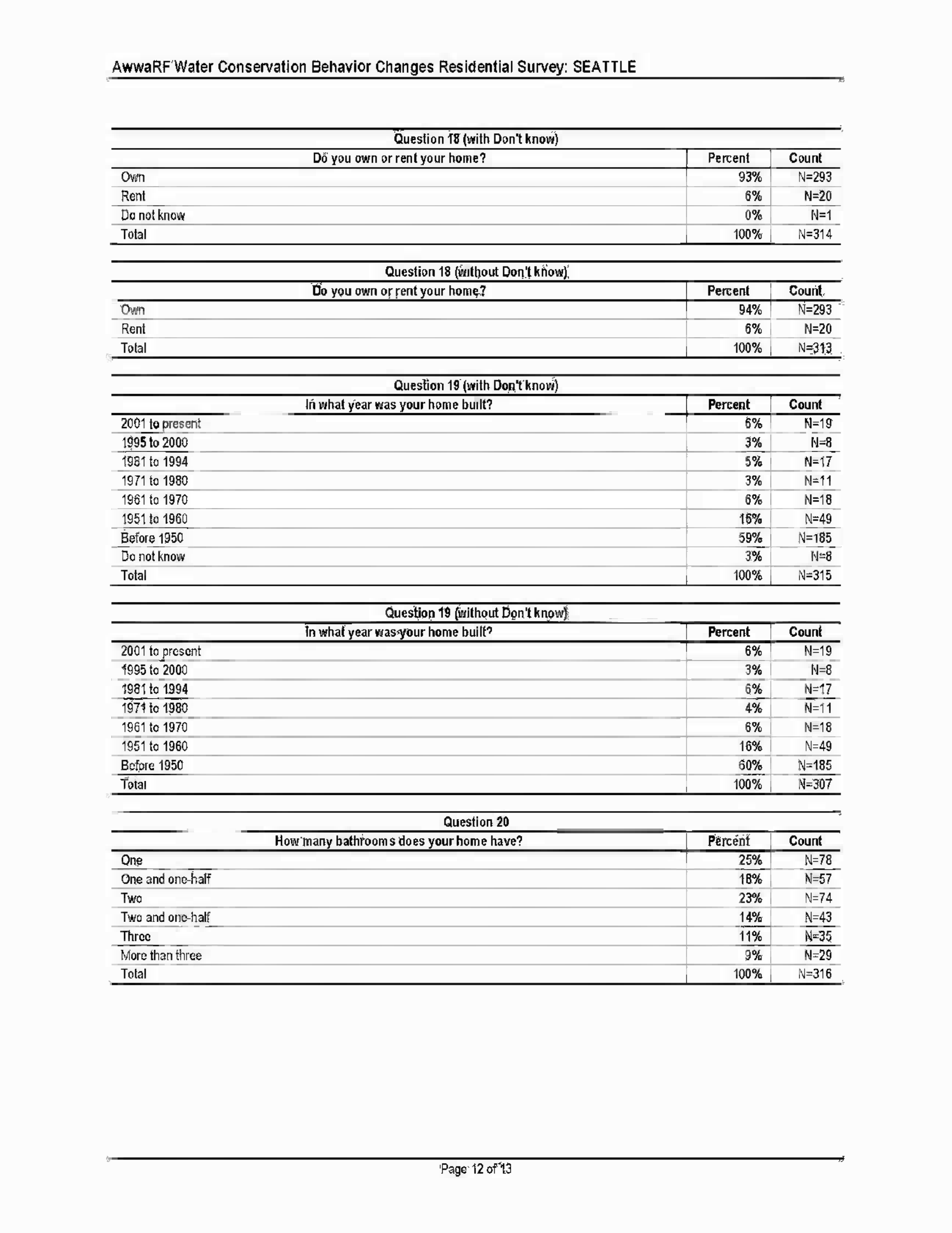
What would be the most effective way to reach you with information about water conservation that you will use?	Percent	Count
Newspapers ads about water conservation techniques	32%	N=99
Do not want any conservation information	4%	N=12
TV ads demonstrating water conservation tips	37%	N=115
Radio ads discussing water conservation techniques	26%	N=82
Magazine articles discussing the value of water conservation with tips for residential consumers	31%	N=97
Utility bill inserts about water conservation	78%	N=242
Billboards encouraging consumers to conserve water	16%	N=50
Demonstrations of water-efficient products in hardware or home improvement stores	17%	N=52
Demonstrations of outdoor watering practices (e.g., lawns, driveways, cars) on television	18%	N=56
Demonstration of eco-friendly gardening and landscaping on television	26%	N=82
Public meetings or forums	6%	N=20
Information fairs at malls or parks	15%	N=47
School or classroom discussions	16%	N=50
The Weather Channel	10%	N=32
Internet search	23%	N=71
Emailed information	13%	N=39
Free home water audits	22%	N=68
Personal contact with water utility representative	9%	N=27
Utility web site	18%	N=57
Utility-sponsored class or conference	8%	N=24
Local university extension services	4%	N=12
Home improvement store	20%	N=61
Nursery or landscape company	16%	N=49
Plumber	5%	N=16
Irrigation contractor	3%	N=8
Other	4%	N=12

Question 16

How long have you lived at this current address?	Percent	Count
Less than one year	6%	N=18
One to less than three years	16%	N=50
Three to less than seven years	17%	N=53
Seven or more years	61%	N=193
Total	100%	N=314

Question 17

Which statement describes your home?	Percent	Count
Single family	94%	N=295
Townhouse	4%	N=12
Duplex	0%	N=0
Mobile home	0%	N=0
Multi-family home	2%	N=5
Other	1%	N=2
Total	100%	N=314



Question 18 (with Don't know)

Do you own or rent your home?	Percent	Count
Own	93%	N=293
Rent	6%	N=20
Do not know	0%	N=1
Total	100%	N=314

Question 18 (without Don't know)

Do you own or rent your home?	Percent	Count
Own	94%	N=293
Rent	6%	N=20
Total	100%	N=313

Question 19 (with Don't know)

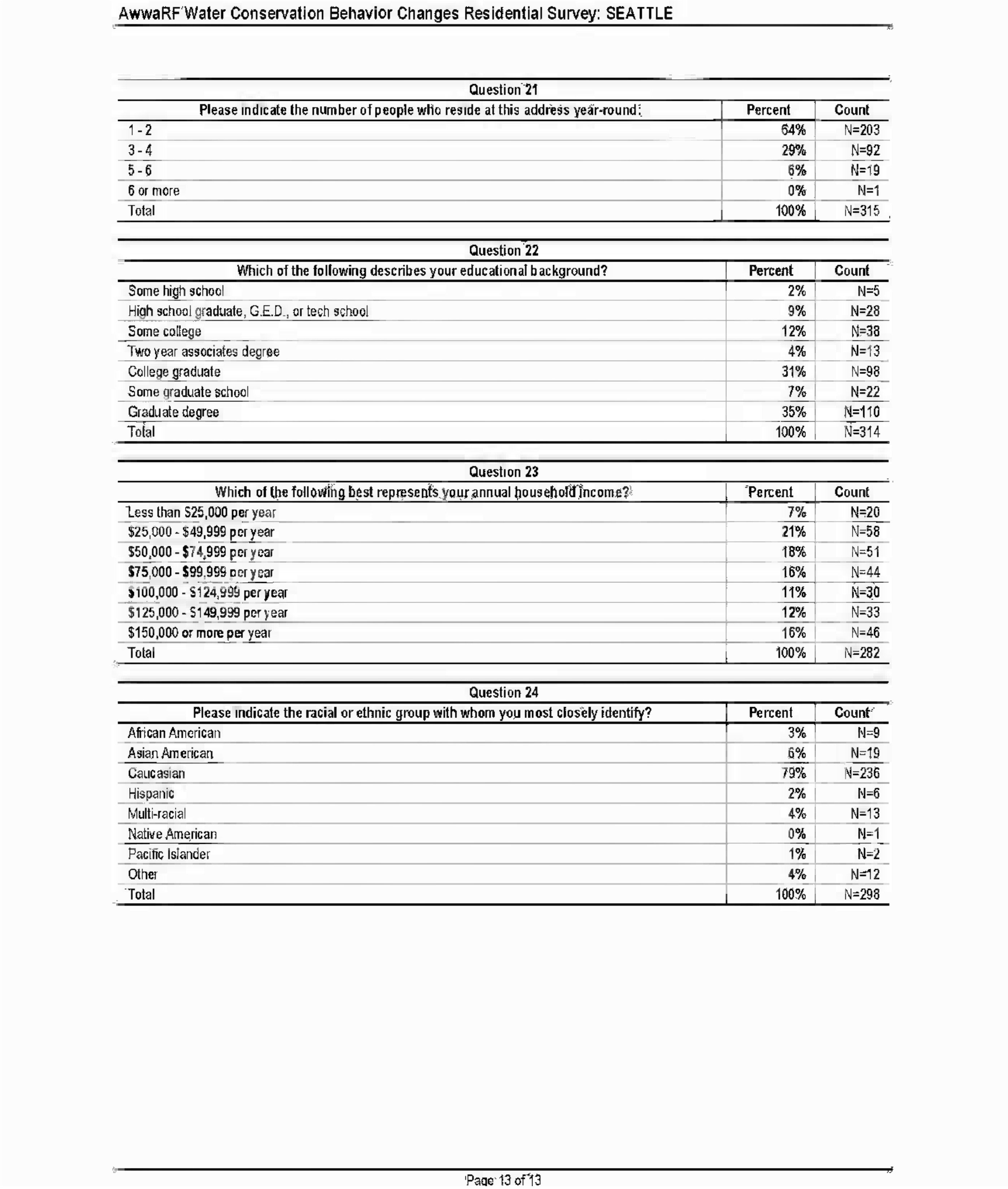
In what year was your home built?	Percent	Count
2001 to present	6%	N=19
1995 to 2000	3%	N=8
1981 to 1994	5%	N=17
1971 to 1980	3%	N=11
1961 to 1970	6%	N=18
1951 to 1960	16%	N=49
Before 1950	59%	N=185
Do not know	3%	N=8
Total	100%	N=315

Question 19 (without Don't know)

In what year was your home built?	Percent	Count
2001 to present	6%	N=19
1995 to 2000	3%	N=8
1981 to 1994	6%	N=17
1971 to 1980	4%	N=11
1961 to 1970	6%	N=18
1951 to 1960	16%	N=49
Before 1950	60%	N=185
Total	100%	N=307

Question 20

How many bathrooms does your home have?	Percent	Count
One	25%	N=78
One and one-half	18%	N=57
Two	23%	N=74
Two and one-half	14%	N=43
Three	11%	N=35
More than three	9%	N=29
Total	100%	N=316



AwwaRF Water Conservation Behavior Changes Residential Survey: SEATTLE

Question 21

Please indicate the number of people who reside at this address year-round:	Percent	Count
1 - 2	64%	N=203
3 - 4	29%	N=92
5 - 6	6%	N=19
6 or more	0%	N=1
Total	100%	N=315

Question 22

Which of the following describes your educational background?	Percent	Count
Some high school	2%	N=5
High school graduate, G.E.D., or tech school	9%	N=28
Some college	12%	N=38
Two year associates degree	4%	N=13
College graduate	31%	N=98
Some graduate school	7%	N=22
Graduate degree	35%	N=110
Total	100%	N=314

Question 23

Which of the following best represents your annual household income?	Percent	Count
Less than $25,000 per year	7%	N=20
$25,000 - $49,999 per year	21%	N=58
$50,000 - $74,999 per year	18%	N=51
$75,000 - $99,999 per year	16%	N=44
$100,000 - $124,999 per year	11%	N=30
$125,000 - $149,999 per year	12%	N=33
$150,000 or more per year	16%	N=46
Total	100%	N=282

Question 24

Please indicate the racial or ethnic group with whom you most closely identify?	Percent	Count
African American	3%	N=9
Asian American	6%	N=19
Caucasian	79%	N=236
Hispanic	2%	N=6
Multi-racial	4%	N=13
Native American	0%	N=1
Pacific Islander	1%	N=2
Other	4%	N=12
Total	100%	N=298

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APPENDIX E:
RANGE OF COMMUNICATION STRATEGIES AND TACTICS USED BY WATER UTILITIES

Water Use it Wisely (Phoenix, AZ)	
Communications Strategy	
Audience (Demographics, geopolitical factors, housing factors, family factors)	Education Tools/Materials
• Arizonan Homeowners who garden, landscape, water their yards • Age: 30 years and up • Youth	1. **Xeriscape**: The Seven Principles of Xeriscape Design teach homeowners to landscape an attractive, yet water-wise, yard. 2**. Time Period**: Homeowners are being targeted throughout the month of April because this is the time when most homeowners excessive amounts of water to tend their yards. 3. **Partners**: Lowe's retail store hosts clinics that demonstrate the many ways homeowners can save water in their homes and landscape. "How-To Clinics" Schedule: • April 2; "Lower your water bill" • April 9; "Plant to attract hummingbirds & butterflies" • April 16; "Plant, stake and grow trees & shrubs" • April 23; "Select an irrigation timer" • April 30; "Summerize your landscape"
• Arizonan Homeowners who garden, landscape, water their yards • Age: 30 years and up • Youth	Landscape watering guidelines
• Arizonan Homeowners who garden, landscape, water their yards • Age: 30 years and up • Youth	"100 Water-Saving Tips" Tips are divided into the regions where U.S. homeowners reside. Simple, everyday tips are provided, based on indoor or outdoor water-usage and activity.
• Arizonan Homeowners who garden, landscape, water their yards • Age: 30 years and up • Youth	Provide a list of Low Water-Use Plants for Arizona This list of plants educates gardeners/homeowners on how they can still garden and landscape using low water-use plants to conserve water,
Children	Provide Kids Activity Pages in Water Conservation Guide

Children	Provide educational tools, such as games on the web site: www.wateruseitwisely.com. • "Tip Tank" • "Water Wisdom and Games"
Water Use it Wisely (Tempe, Ariz.)	
Communications Strategy	
Homeowners	The Complete Guide to Home Water Management
Homeowners	Landscape Plants for the Arizona Desert: Guide to Growing More than 200 Low-Water-Use Plants
Homeowners	Xeriscape guides
Homeowners	1. "Desert Lawn Care" brochure Tips on mowing, de-thatching, watering, fertilizing, aerating
Homeowners	1. "Multifamily Toilet Rebate Program" brochure "Since 1991, the City of Tempe has had a Toilet Rebate Program in effect for single family residential homes that replace high water use toilets with more conserving ultra low-flow toilets. The City has offered a rebate of 50% of the purchase price of an ultra low-flow toilet up to $75.00 for each toilet replaced."
Homeowners	1. "Water-Wise Landscaping in the Arizona Desert" CD ROM
Homeowners	"Southwestern Landscaping: A Practical Environmental Approach" book
Homeowners	"Landscape Watering by the Numbers: A Guide for the Arizona Desert" booklet
Business and Industry	1. "Water Efficiency Incentives for Business and Industry" brochure "The City of Tempe is offering, to Industrial and Commercial water customers in the Tempe Water Service Area, grants to install water-saving technologies."
Youth– Ages 5-10 years	"Sponge Blob Round Pants" Workbook for Grades K-5
Youth – Ages 5-10 years	"The Adventures of Freckles, The Ware-Saving Ogre" Workbook for Grades K-5
Youth – Ages 5-10 years	1. "The Arizona Water Savers Olympics 2000 Workbook." This workbook teaches children in grades K-5 how to conserve water in their home. Small acts, such as filling the bathtub half-full or less, are reinforced through fill-in-the-blank puzzles, word searches, and water trivia.
Hispanic Homeowners	1. "Nuestro Bello Desierto": • A calendar of gardening/water conservation tips specific to that month's climate

Not specified	1. Advertising/Communications: Giveaways: • “Water – Use It Wisely” magnet • “Landscape Watering Guidelines” table • “Make It a Rule to Conserve Water” ruler
Program Evaluation	
Awareness	According to the Summary Report, 84% of Arizonans recognize the “Water –Use It Wisely” campaign with aid. Very few focus groups recognized the name without aid.
Attitude	Residents surveyed who were aware and knowledgeable of WUIW also seemed to be attuned to various, specific water conservation programs, such as those sponsored by Desert Botanical Garden. These same respondents were more likely to report conserving for the “right” community-based reasons (e.g., they were more likely to give “altruistic” reasons for why they saved water).
Impact	Households who are aware of and knowledgeable about WUIW did not have lower water use than residents who did not report knowing about WUIW.
Source	“Water Conservation Awareness, Attitudes and Behaviors: Arizona Municipal Water Users Association, 2007”
Water Use It Wisely (Durham, NC)	
Communications Strategy	
Homeowners	1. Public Outreach Events • Conservation staff members participate in numerous community events throughout the year, ranging from art and community festivals to neighborhood block parties. • Host “Conservation Station” events to promote showerhead exchange/sale and rain barrels. 2. Exclusively from WUIW: • Program logo on most promotional items (such as rain gauges, pencils, tattoos, banners, stress balls, mascot, notepads, etc.). • Brochures with practical conservation tips. • Television ads – running on local government station for several years; running on local NBC affiliate starting June 2007. • Web banners. 3. Southeast regional landscaping guide teaching Xeriscape principles with the “Water – Use It Wisely” look and feel.

Homeowners (cont.)	4. Website: http://www.durhamnc.gov/departments/wm/water_cons.cfm • Durham utilizes the website to promote conservation, including general conservation tips, plus simple leak repair information. • The City's conservation ordinance is available online. • Daily updates are made regarding the status of our reservoirs, including historical graphs and links to stream gauging data. 5. Miscellaneous: • News Releases – the Department issues news releases related to conservation and relevant conservation issues (such as restrictions) when needed. • When space permits, conservation information and tips are included in the annual water quality report, which is mailed to every postal customer in Durham. • Citizen's Newsletter – includes occasional tips and information regarding upcoming events. Distributed with customers' bills. • The Department participates with other City departments in the EnviroStars program to help provide "greening" information to business customers. Water Conservation is one of four major components of the Program.
Youth – Elementary school children (K-5)	1. Education Programs • Conservation staff members provide educational programs to local schools on a request basis. Most presentations are provided to students in elementary schools. • The Department hosts an annual water festival to educate 4th grade students on the value of water and water conservation.
Seattle 1%	
Communications Strategy	
	Overall Messaging: • Conservation awareness supporting recruitment of residential and commercial customers • Targeted marketing • Collaboration with Puget Sound regional water utilities Festivals
Audience: Residential-Indoor	1. WashWise rebates • Multi-family toilet rebates • Building owner and operator targeting

Audience: Residential-Indoor (cont.)	2. Behavior messaging • Collaboration with energy utilities • Program recruiting through media, mailings 3. Promotion of Flush Star toilet performance
Audience: Residential-Landscape	• Irrigation system efficiency rebates • Aesthetic-oriented media campaign • Regional sales events • Retailer partnerships (nurseries & home & garden centers) • Technical materials • High peak-users targeting
Audience: Commercial (process, domestic)	• Small and large business targeting • Restaurant targeting and other users of inefficient pre-rinse spray heads • Project recognition through BEST awards program • Outreach to chambers of commerce and other business groups through Resource Venture • Technical assistance, assessments, workshops • Financial incentives (custom projects & standard rebates) • Bonus incentives to increase specific measure participation • Targeted promotion through vendors, trade groups, agencies • End-use metering wherever possible to build cost-effective conservation recommendations
Audience: Commercial-Landscape	• Assessments, workshops and technical assistance • Financial incentives (custom projects and set rebates) • Targeted recruiting and promotion • Market transformation by establishing and building vendor and contractor relationships
Audience: Youth	• Educator training and resources • Classroom and take-home materials • Educational TV PSA for kids • Interactive activities
Audience: Residential-Homeowners	“Saving Water Partnership” Web Site: http://savingwater.org/outside_watering.htm Lists information on how to prevent over-watering and water-saving landscaping tools

Program Evaluation	
	2005 Annual Report Goals and Objectives of the Regional 1% Program: • "The long-term goal of the 1% Program is to keep water demand at the end of 2010 the same level as it was in 2000, despite growth in population and economic activity." • The 2005 1% Program fixture and equipment rebate programs for residential and commercial customers expanded upon 2004 efforts and customer contacts. • Rebates were re-tooled in some instances, new incentives were introduced, and new utility partnerships were formed to leverage resources and increase services to customers. • 1% Program outreach and technical assistance was expanded for large and small commercial customers, and for vendors and contractors. • Marketing strategies to increase rebates and long-term conservation behaviors focused on target recruitment of different types of customers for specific conservation programs. These strategies employed mass media, direct mailings, new program materials, new web and hotline resources, seminars and workshops, agency and trade association partnerships and a host of targeted promotions.
Calgary: "30-in-30"	
Communications Strategy	
Audience: • Residential • Commercial • Municipal • Industrial	1. Seven recordings of PSAs are included in this CD: • Advises homeowners to use a Frisbee to measure the amount of water used to water lawn with sprinklers. • Advises homeowners to leave the grass 3 inches high because grass at this length can shade itself, preventing burned grass and, consequently, less water used to water the burned grass. • Advises homeowners to use rain barrels to capture rain and use rain water when gardening and landscaping. • Advises homeowners to water their lawns in first thing in the morning to conserve water. • Last 3 recordings are 30-second radio commercials advising homeowners why leaky toilets waste water and how to take care of leaky toilets. Taglines: • "Stop the Waste, Take the Leaky Toilet Test" • "Fill a Frisbee, Free a River"

Audience (cont): • Residential • Commercial • Municipal • Industrial	2. Goal: To use the same amount of water Calgary households and residents remove today from the river in 2033. To do this they need to reduce per capita water consumption by 30 percent over 30 years. This would allow them to accommodate Calgary’s projected population growth – to 1.5 million, using the same amount of water they use today. 3. Action Plan: The City’s Water Efficiency Plan outlines how all audiences can contribute to achieving sustainable water use. The City’s many water conservation programs are successfully contributing to measurable reductions in water demand. 4. Metrics: The City has thre indicators to measure how far it has have come along with its goal: Universal water metering 1. Per capita demand 2. Peak-day demand 3. Non-revenue water
Program Evaluation	
	1. “Water Conservation Survey: Summer 2006” Key Findings: • “67% of residents recalled the Summer 2006 outdoor water conservation advertising consistent with recall levels reported for Summer 2004 (65%).” • “The three key Summer 2006 Water Conservation campaign messages were the most commonly reported respondent actions undertaken as a result of the campaign. This indicates that the campaign was effective at impacting the water conservation behaviours of those exposed to it.” • In addition to high levels of recall, the three key campaign messages were the actions most commonly practiced by respondents as a result of learning of them through the campaign.

JEA: Building Community (Jacksonville, Fla.)	
Communication Strategy	
Audience: Households, families	“Is Your Grass Thirsty?” pamphlet: • Promotes saving water as a family project • Provides a layout of how to save water by dividing a yard into different zones and keeping time of how long each zone is watered “Water Conservation Tips” online: • Recommends using ENERGY STAR appliances to save water Waterwise Florida Landscape: • Written for residents, homeowners, landscapers “…to Promote Water Conservation Using the Principles of Xeriscape”
	Collateral Materials: 1. “Saving Water Indoors” brochure: • Targets and informs homeowners how they can save water throughout their home (in the bathroom, kitchen, from faucets, while doing laundry). 2. “Saving Water Outdoors” brochure: • Sequel to “Saving Water Indoors” brochure, demonstrating ways for homeowners to conserve water while landscaping and through irrigation. 3. JEA magnet: “Is Your Grass Thirsty?”: • Refers homeowners and residents to www.jea.com and the LawnSmart team for those having problems with lawn watering. 4. “The Ins and Outs of Home Energy Conservation” brochure: • JEA promotes how to save energy and has a tip on how to save water by sealing leaks 5. “When Less is More” pamphlet: • Water-and money-saving tips for a homeowner’s lawn Promotes LawnSmart 6. “Is Your Lawn-Watering Knowledge All Wet?” pamphlet: • Provides lawn care (watering and fertilizing) tips “The Right Plant in the Right Place Makes ‘Cents’” pamphlet: • Informs consumers (homeowners) how to save money by buying and planting plants that are drought-tolerant 7. “How Green is Your Garden?” pamphlet: • Provides lawn and garden tips to homeowners and promotes two different workshops taking place in Jacksonville

	8. “How to Save Energy & Water at Home” booklet: - Informs homeowners how to save energy and water throughout different areas of their home in detail with cost tables and figures, check-lists, and other how-to’s
Program Evaluation	
	“2006 Annual Water Quality Report and Water Conservation Guide” Written for Jacksonville residents to inform them of their source of water, their public water system, water conservation tips for indoor and outdoor use.
Region of Durham, Ontario, Canada Program	
Communications Strategy	
Audience: Homeowners, households in Durham, specifically those who garden and landscape	“Household Guide to Water Efficiency” “…guide to new gardening and landscaping ideas, water and energy saving appliances and practices, and a host of other water wise measures and equipment for use both in and around [the] home.” This guide informs homeowners residing in Durham, Ontario about the Importance of Water, Durham’s Water System, Water Billing and Metering System, Water Efficiency in Your Home, and Creating Water Efficient Lawns & Gardens. Web site: http://www.region.durham.on.ca/waterefficiency/ The City has a page with information on Water Efficiency. It includes: - an electronic copy of “Household Guide to Water Efficiency” - “Introduction to Water Efficiency” - “Saving Water Indoors” In this section, they include a pie chart that breaks down water usage indoors. They also include a table for “Potential Savings” for a family of 2, 4, and 6. These illustrations promote education and understanding to residential households to conserve water with statistics they can relate to and directly benefit from. “Saving Water Outdoors”: - Focuses on how to gauge water usage during the summer, since most households use the most amount of water to garden and landscape during the summer.

	"Water-Efficient Gardening": To promote water-efficient gardening, the Durham Region built a garden at Regional Headquarters in 1998. It closed in June of 2003 due to the construction of the new Regional Headquarters building. A new Water Efficient Garden is in the planning stages for the new facility which is slated to open in 2005. "Replacing Inefficient Toilets: Durham's Subsidy Programs": • Replacing inefficient toilets has been a priority of the Region of Durham's for the past 10 years. • Did you know that toilets account for approximately 45 percent of the total indoor water use? Older toilets use between 13 and 20 litres per flush, while water efficient toilets use between four and six liters. New homes have been equipped with the standard six-litre toilet since 1996. • Between 1996 and 2003, the Region replaced close to 9,000 toilets in the townships of Uxbridge, Scugog and Brock. Shopping for a Six-Litre Toilet. • Provides advice homeowners shopping for toilets, which types are most water-efficient based on toilet age "Water and Energy Efficient Demonstration Community": • The Water and Energy Efficient Demonstration Community is located in the Tribute Communities' Hamlet development in the Town of Ajax. • The objective of the community is to demonstrate how to make new homes more water and energy efficient. • This Project is a partnership between Durham Region, Tribute Communities, Federation of Canadian Municipalities and Natural Resources Canada. • Three Studies and Projects are listed on the web site: http://www.region.durham.on.ca/works.asp?nr=/departments/works/studies.htm&setFooter=/includes/worksFooter.txt

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ABBREVIATIONS

4P's	four principles
AMWUA	Arizona Municipal Water Users Association
ANOVA	Analysis of variance
AWWA	American Water Works Association
CBSM	Community-based social marketing
COOLER	Presence of an Evaporative Cooler
CUWCC	California Urban Water Conservation Council
EPAct	Energy Policy Act
gpcd	gallons per capita per day
HECW	Presence of High-Efficiency Clothes Washer
HonUB	Presence of a Hot Tub
HS	Household Size
HSQFT	House Area
HSYR	Year House Built
INC	Household Income
kgal	kilogallon
LOTSIZE	Size of Lot
MGD	million gallons per day
MPW	Marginal Price of Water
PAC	Project Advisory Committee
POOL	Presence of Swimming Pools
Q_{annual}	annual per household water use
$Q_{min\ month}$	minimum monthly per household water use
RENT	Rental Status
REUWS	Residential End Uses of Water Study
S	percent seasonal use
SE	Standard Error
SPRINK	Presence of an In-Ground Spinkler System
SPU	Seattle Public Utilities
SWP	Saving Water Partnership

TREAT	Presence of Home Water Treatment
ULFT	Presence of ULF Toilets
ULS	Presence of Low-Flow Showers
SJWMD	St. John's Water Management District

Water Conservation: Customer Behavior and Effective Communications

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Instructions

http://www.ehow.com/how_2311291_calculate-rainfall-harvesting.html

1. How to Calculate Rainfall for Harvesting

1

The first thing to do is to figure the area of the structure. Begin by using the measuring tape, and measure your roof from one eave to the next. You can do this on the ground because it doesn't matter whether your roof is flat or sloped. So let's say the measurement is 30 feet X 50

2

You now have the measurements necessary to find the square footage of your roof.Multiply 30 feet times 50 feet. That's 1,500 square feet. And that is your catchment area. Write that down.

3

Now, check the rain gauge. For simplicity, let's say that it rained one inch. Write down the

4

An inch of rainfall on a square foot of surface area yields .623 gallons.

5

Now, multiply .623 gallons by the number of surface square feet. In this case it would be 30 feet X 50 feet= 1,500 square feet X 1 inch X .623 gallons per square foot per inch of rainfall.

6

Let's say instead it rained 2.5 inches. Then the calculation would read 30 feet X 50 feet=1,500 square feet X 2.5 inches X .623 gallons per square foot per inch of rainfall.The total number of

Read more: How to Calculate Rainfall for Harvesting | eHow.com
http://www.ehow.com/how_2311291_calculate-rainfall-harvesting.html#ixzz27bUO1JT9

http://www.fmlink.com/article.cgi?type=Sustainability&title=Natural%20Landscaping%20and%20Artificial%20Turf%3A%20Achieving%20Water%20Use%20and%20Pesticide%20Reduction&pub=BuildingGreen&id=40602&mod

How to calculate dry weather runoff

Irrigation on lawn is for every 1000 square feet, 10,000 gallons of water in summer. (Assume annual use is 30,000 gallons per 1000 square feet.)

Artificial turf on football field is a 2 million gallon annual savings

Stormwater Calcultions

1. Football field including end zones	57,600
2. Add for soccer field	20,000
3. Track assuming 20 ft wide by 1 mile length	105,600
4. Add softball field	40,000
5. Add Baseball field	95,000
6. Total Area	318,200
7. Gallons per square foot for every inch of rainfall	0.6230
8. For one inch rainfall, gallons for total area.	198,238.60
9. LA Civic Center average annual precip (inches)	14.41
10. Mt. Wilson average annual precip (iches)	34.58
11. Mid-way between rainfall.	24.50
12. Total Estimated Gallons of Captured Rainfall	**4,855,855**
13. Total Estimated Acre-feet of Captured Rainfall	**14.90**

Dry Weather Runoff Calculations

1. Football field including end zones	57,600
2. Add for soccer field	20,000
3. Track assuming 20 ft wide by 1 mile length	105,600
4. Add softball field	40,000
5. Add Baseball field	95,000
6. Total Area	318,200
6. Gallons per 1000 feet per year for lawn	9,546,000
7. Annual savings for football team	7,546,000
8. Estimated annual acre-feet of dry weather runoff	23.16

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Office of the General Manager

January 3, 2012

Ms. Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Dear Ms. Jazmadarian: NINA

Support of the Foothill Regional Water Recycling Project

The Metropolitan Water District of Southern California (Metropolitan) supports Foothill Municipal Water District's recycling project. Foothill's project would help diversify Southern California's water resource portfolio and provide a new, local water supply that will help increase the water supply reliability for Southern California's 19 million people and nearly $1 trillion economy.

Metropolitan's Integrated Resources Plan recognizes that local resource development is an important component of the strategy to deal with future uncertainty. Our region may face potential climate change impacts, uncertain imported supplies, or potential disruption due to earthquakes. Foothill's recycled water project can help increase the pool of supplies available to mitigate these future challenges and would be an important local asset which will help improve supply reliability within our region.

Metropolitan has a long history of supporting local resource development. Since 1982, Metropolitan has been implementing programs to provide financial assistance to member agencies for developing local water supplies. Currently, Metropolitan has contracts with member agencies to provide financial assistance to 62 recycling projects and 22 groundwater recovery projects. The LRP continues to be open for new project applications and Foothill's water recycling project may be a good fit for assistance under this ongoing program.

Should you require assistance, or have any questions about Metropolitan's supporting programs, please contact Mr. Robert Harding of my staff at (213) 217-6582 or via e-mail at bharding@Metropolitanh2o.com.

Very truly yours,

Jeffrey Kightlinger
General Manager

WPH:tt

700 N. Alameda Street, Los Angeles, California 90012 • Mailing Address: Box 54153, Los Angeles, California 90054-0153 • Telephone (213) 217-6000

RAYMOND BASIN
MANAGEMENT
BOARD

November 16, 2010

City of Alhambra

City of Arcadia

California-American
Water Company

East Pasadena
Water Company

H.E. Huntington Library
and Art Gallery

Kinneloa Irrigation
District

La Cañada Irrigation
District

Las Flores Water
Company

Lincoln Avenue
Water Company

Pasadena Cemetery
Association

City of Pasadena

Rubio Cañon Land and
Water Association

San Gabriel County
Water District

City of Sierra Madre

Sunny Slope
Water Company

Valley Water Company

Ms. Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Interest in Using Recycled Water

Dear Ms. Jazmadarian:

The Raymond Basin Management Board, which serves as Watermaster for the Raymond Basin understands that the Facilities Planning Study Grant requires letters of interest from potential recycled water customers. This letter serves to indicate the Raymond Basin Management Board's interest in acquiring up to 600 AF of recycled water from Foothill Municipal Water District to increase basin levels in the Pasadena Subarea. We understand that the recycled water would be recharged into the Raymond Basin (Pasadena Subarea) at the Eaton Canyon Spreading Grounds. This recharge would help offset the declining water levels and reduce dependence on imported surface water supplies.

The Recycled Water Feasibility Study should answer many of the questions associated with the development of recycled water in Raymond Basin including quantity and estimated cost. We look forward to reviewing the draft of that study and further quantifying the amount that Raymond Basin Management Board would be interested in purchasing.

If you have any questions, please call me at (626) 815-1300.

Sincerely,

Anthony C. Zampiello
Executive Officer

725 North Azusa Avenue • Azusa, CA 91702 • 626.815.1300 • Fax 626.815.1303
http://www.raymondbasin.org

VALLEY WATER COMPANY
4524 HAMPTON ROAD
P.O. BOX 706
LA CAÑADA FLINTRIDGE, CA 91012
PHONE: (818) 790-5516 FAX: (818) 790-6019

November 24, 2010

Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

RE: Interest in Recycled Water

Dear Ms. Jazmadarian,

Valley Water Company (Valley) understands that the Recycled Water Feasibility Study (Feasibility Study) Grant requires a letter of interest from potential recycled water customers. This letter serves as Valley's "interest" in acquiring recycled water from Foothill Municipal Water District (Foothill) and does not constitute contractual obligation to acquire any recycled water from Foothill.

Based on historic system demands and potential for additional production rights through basin recharge, Valley is interested in acquiring about 400 acre-feet of recycled water from Foothill, neglecting current recycled water development ambiguity.

The Feasibility Study will answer many of the questions associated with the development of recycled water, including quantity and estimated cost. Valley looks forward to reviewing the draft Feasibility Study for further consideration.

If you have any questions, please feel free to call me.

Sincerely,

Bob Fan
General Manager

LINCOLN AVENUE
WATER COMPANY
serving Altadena since
1896

564 WEST HARRIET STREET
ALTADENA, CALIFORNIA 91001-4571
(626) 798-9101
FAX (626) 798-9446

The mission of the Lincoln Avenue Water Company is to reliably provide to its customers and shareholders high quality water, service, and maintenance of the Company's resources in an environmentally and fiscally responsible manner.

November 23, 2010

Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Dear Nina:

Interest in Using Recycled Water

Lincoln Avenue Water Company (Lincoln) understands that the Facilities Planning Study Grant requires letters of interest from potential recycled water customers. This letter serves as Lincoln's interest in participating in this program. We understand that Foothill may recharge the recycled water into the Raymond Basin. This recharge would count as additional production rights and may be purchased by Lincoln for potable use. Lincoln would be interested in purchasing up to 250 AF of these additional production rights.

The Recycled Water Feasibility Study will answer many of the questions associated with the development of recycled water in the service area including quantity and estimated cost. We look forward to reviewing the draft of that study and further quantifying the amount that Lincoln would be interested in purchasing.

If you have any questions, please call me at (626) 798-9101.

Sincerely,
Lincoln Avenue Water Company

Robert J. Hayward
General Manager

Rubio Cañon
Land and Water Association
583 E. SACRAMENTO STREET, ALTADENA, CA 91001-3023 (626) 797-0509 • FAX (626) 797-0520

RECEIVED
NOV 29 2010
By

November 22, 2010

Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Dear Nina:

Interest in Using Recycled Water

Rubio Canon Land & Water Association (Rubio) understands that the Facilities Planning Study Grant requires letters of interest from potential recycled water customers. This letter serves as Rubio's interest in acquiring up to zero AF of recycled water directly from Foothill Municipal Water District to serve to its larger customers for irrigation purposes. We understand that Foothill may also recharge the recycled water into the Raymond Basin. This recharge would count as additional production rights and may be purchased by Rubio for potable use. Rubio would be interested in purchasing up to 250 AF of these additional production rights.

The Recycled Water Feasibility Study will answer many of the questions associated with the development of recycled water in the service area including quantity and estimated cost. We look forward to reviewing the draft of that study and further quantifying the amount that Rubio would be interested in purchasing.

If you have any questions, please call me at (626) 797-0509 ex. 205.

Sincerely,

Lillian Woods

Lillian Woods
Director of Operations

La Cañada United
Methodist Church
open hearts open minds open doors

November 26, 2012

Mrs. Nina Jazmadarian
General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Dear Nina:

We understand that Foothill Municipal Water District (FMWD) would like to build a membrane bioreactor (MBR) plant to recycle wastewater and recharge it using infiltration galleries under the athletic fields at La Canada High School. A promising site for constructing the MBR plant is on church property, near the 210 freeway exit ramp which was used for staging the construction of sewers in La Canada. This letter serves to inform those interested that we are proceeding with negotiations with FMWD.

Additionally, FMWD may conduct infiltration tests at the corner of the Church property near the intersection of Oak Grove Drive and Berkshire Place. It is anticipated that three tests would occur. Please coordinate with Mr. Bruce Bell on the date and time of the test to insure no interference with Church activities.

If you have any questions, please contact me.

Sincerely,

Bob Kemmerer
President, Board of Trustees
La Canada United Methodist Church

MAILING ADDRESS : P.O. Box 667, La Canada Flintridge, CA 91012 • CHURCH LOCATION : 104 Berkshire Place, La Cañada Flintridge, CA 91011
PH: (818) 790-3605 • FAX: (818) 790-4531 • www.lcumc.com

WATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

STEPHEN R. MAGUIN
Chief Engineer and General Manager

May 26, 2011

File No. 31-370-40.4A

Ms. Nina Jazmadarian, General Manager
Foothill Municipal Water District
4536 Hampton Road
La Canada Flintridge, CA 91011

Dear Ms. Jazmadarian:

Foothill Municipal Water District Facilities Planning Study

This letter is in support of the Foothill Municipal Water District's project to analyze the feasibility of building a membrane bioreactor plant in the Arroyo Seco area to treat raw wastewater to a water quality suitable for groundwater recharge. The Los Angeles County Sanitation Districts (Sanitation Districts) have been, and will continue to, provide both technical and regulatory expertise in support of the project described above.

Expanding the use of recycled water supplies is of great importance to the Sanitation Districts, and we appreciate the Foothill Municipal Water District's efforts in this regard. We look forward to continuing our work with you to maximize the beneficial use of recycled water.

Very truly yours,

Stephen R. Maguin

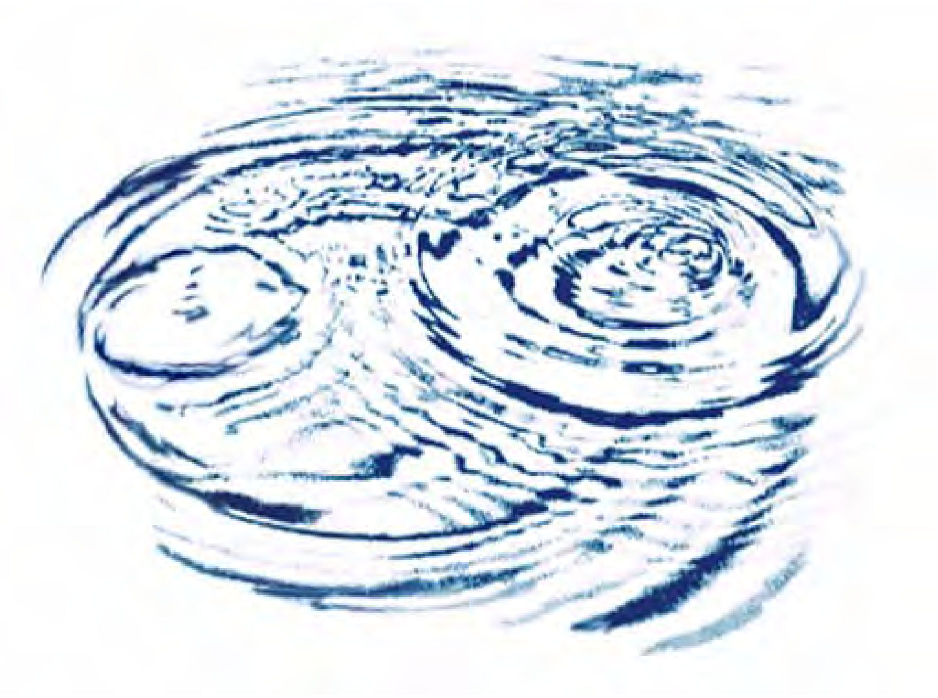
Ray Tremblay
Assistant Department Head
Technical Services

RT:JN

FOOTHILL MUNICIPAL WATER DISTRICT

WATER RESOURCES PLAN ALTERNATIVES SCREENING REPORT

JANUARY 2009



Stetson Engineers Inc.

861 Village Oaks Drive, Covina, California 91724
Phone: (626) 967-6202, Fax: (626) 331-7065

Covina, CA Bakersfield, CA San Rafael, CA Centennial, CO Mesa, AZ

Table of Contents

SECTION 1 - INTRODUCTION

Foothill Municipal Water District (FMWD) currently provides member agencies with treated imported water supplied by Metropolitan Water District of Southern California (MWD). The member agencies within FMWD's service area include:

1) Crescenta Valley Water District (Crescenta Valley)
2) Kinneloa Irrigation District (Kinneloa)
3) La Cañada Irrigation District (La Cañada)
4) Las Flores Water Company (Las Flores)
5) Lincoln Avenue Water Company (Lincoln)
6) Mesa Crest Water Company (Mesa Crest)
7) Rubio Canon Land and Water Association (Rubio)
8) Valley Water Company (Valley)

FMWD receives water delivered by MWD through MWD's 116-inch-diameter Upper Feeder at turnout FM-1 located at the vicinity of Seco Street and Rosemont Avenue in Pasadena near the Rose Bowl. The turnout is nominally designed to deliver 40 cubic feet per second (cfs).

A second MWD connection for FMWD, discussed in Section 3 below, was proposed in FMWD's Master Plan to improve current and future water supply reliability. Current and future water demands from member agency are also discussed below.

This briefing paper has been prepared to provide basic data and a framework for a conceptual level screening of water supply alternatives to determine whether a second MWD connection, or an alternative water supply option, best meets the water reliability needs of FMWD and its member agencies. It is anticipated this briefing paper will be used by FMWD and its member agencies to identify two or three water supply alternatives that will then be studied in detail in the next phase of this process.

Water supply alternatives discussed in this briefing paper include:

- Groundwater
- Recycled Water
- San Gabriel Valley Municipal Water District/Raymond Basin Feeder
- Conservation
- Partnerships with Other Agencies / Transfers
- Interconnections
- Debris Basins

The discussions for each alternative will include a brief description of the water supply source and a review of cost, quantity, reliability, environmental issues, energy use, and green house gas considerations. Based on discussion with member agencies regarding environmental issues, this briefing paper did not review the use of additional tunnels and surface water diversions as an alternate source of water supply due to the potentially limited amount of additional water that may be available and the significant resistance anticipated to potential projects from permitting and resource agencies.

SECTION 2 - MEMBER AGENCY WATER DEMANDS

The average, minimum, and maximum total water demands, in acre-feet per year (AFY) over the past five years (calendar years 2003 to 2007) are provided in Table 2-1 for each member agency. The average, minimum, and maximum water demands from FMWD for each member agency are also provided.

Table 2-1 Historical Water Demands (AFY)

		Local Water Supplies	FMWD Deliveries	Agency Retail Demands
Foothill Municipal Water District	**5 Yr Average**	9,488.1	12,652.6	21,170.3
	Min	8,128.4	11,836.0	20,553.7
	Max	10,662.9	14,236.9	22,330.4
Crescenta Valley Water District	**5 Yr Average**	3,101.6	2,447.4	5,549.0
	Min	2,602.5	1,714.6	5,323.6
	Max	3,609.0	3,132.9	5,735.4
Kinneloa Irrigation District	**5 Yr Average**	836.4	0.0	836.4
	Min	793.9	0.0	793.9
	Max	895.8	0.0	895.8
La Cañada Irrigation District	**5 Yr Average**	167.9	2,900.0	3,057.1
	Min	85.2	2,671.0	2,854.4
	Max	237.4	3,095.4	3,202.9
Las Flores Water Company	**5 Yr Average**	348.8	684.7	1,033.4
	Min	288.5	636.6	979.7
	Max	392.3	744.9	1,064.7
Lincoln Avenue Water Company	**5 Yr Average**	2,162.8	1,329.2	3,471.7
	Min	1,152.6	725.9	3,115.3
	Max	2,798.2	1,984.1	3,994.8
Mesa Crest Water Company	**5 Yr Average**	0.0	724.7	724.7
	Min	0.0	687.8	687.8
	Max	0.0	766.8	766.8
Rubio Canon Land & Water Assn.	**5 Yr Average**	1,508.8	1,061.3	2,467.8
	Min	1,399.8	859.9	2,287.7
	Max	1,578.7	1,169.0	2,686.1
Valley Water Company	**5 Yr Average**	1,361.8	3,482.1	4,007.0
	Min	1,094.4	3,115.0	3,726.9
	Max	1,614.4	3,767.1	4,243.4

Notes:

Agency water demands provided by FMWD and Kinneloa between calendar years 2003 and 2007

Kinneloa Irrigation data based on customer sales and leaking, flushing, and operation adjustments

Table 2-2 provides the average local water supply for each member agency as an annual quantity, in acre-feet (AF), and as a percentage of total local water supplies. The table also shows annual average FMWD deliveries to each member agency as an annual quantity and as a percentage of total FWD deliveries.

Table 2-2 Member Agency Water Supply Percentages

	Local Water Demands		FMWD Demands	
Water Agency	**Quantity (AF)**	**Percent of Total Local Water (%)**	**Quantity (AF)**	**Percent of Total FMWD Deliveries (%)**
Crescenta Valley Water District	3,101.6	32.7%	2,447.4	19.4%
Kinneloa Irrigation District	836.4	8.8%	0.0	0.0%
La Cañada Irrigation District	167.9	1.8%	2,900.0	23.0%
Las Flores Water Company	348.8	3.7%	684.7	5.4%
Lincoln Avenue Water Company	2,162.8	22.8%	1,329.2	10.5%
Mesa Crest Water Company	0.0	0.0%	724.7	5.7%
Rubio Land & Water Association	1,508.8	15.9%	1,061.3	8.4%
Valley Water Company	1,361.8	14.4%	3,482.1	27.6%
Total	9,488.1	100.0%	12,629.4	100.0%

Note: Quantities based on five year average (calendar years 2003 to 2007)

The projected future average annual water demands for each member agency are provided in Table 2-3.

Table 2-3 **Member Agency Water Demand Projections (AFY)**

	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand	Demand from FMWD	Demand from FMWD
	2010		2015		2020	2025
Crescenta Valley Water District	2,275	5,625	2,310	5,661	3,144	3,463
Kinneloa Irrigation District	0	NA	300	NA	300	300
La Cañada Irrigation District	2,958	3,130	3,129	3,302	3,328	3,453
Las Flores Water Company	586	975	589	978	802	813
Lincoln Avenue Water Company	2,271	3,030	2,348	3,107	1,643	1,687
Mesa Crest Water Company	708	708	728	728	787	808
Rubio Canon Land & Water Association	1,150	2,487	1,155	2,493	1,306	1,323
Valley Water Company	3,826	4,623	4,048	4,845	3,658	3,718
Total	13,774	20,578	14,607	21,114	14,968	15,565

Notes:

NA = Not Available

2010 and 2015 demands from "FMWD Master Plan", November 2007, and from Kinneloa Irrigation District

2020 and 2025 demands from FMWD 2005 UWMP and from Kinneloa Irrigation District

2010 and 2015 demands from Master Plan are less than demands from UWMP

A statewide plan to reduce water consumption by 20 percent by the year 2020 is being proposed and is discussed in Section 7 - Conservation

The Local Agency Formation Commission for the County of Los Angeles (LAFCO) recently prepared a municipal service review to analyze service area overlaps and revisions for Crescenta, La Cañada, and the City of Glendale. No immediate changes have resulted from this review. Any future changes to the service areas of Crescenta and La Cañada may result in revisions to water demands within FMWD’s service area.

SECTION 3 - SECOND MWD CONNECTION

A second MWD connection would provide water supply reliability and flexibility to FMWD's member agencies. A second MWD connection on the East Valley Feeder would allow FMWD to continue to receive imported treated water from MWD during scheduled or unscheduled outages on the Upper Feeder.

A second MWD connection would require the construction of approximately 27,000 feet of 24-inch transmission main, a 1,700 horsepower pumping plant, a 1 MG terminal reservoir, 3,200 ft of 18-inch looping connection to La Cañada's reservoir facilities, and an interconnection between La Cañada and Mesa Crest. This proposed MWD connection would provide an estimated 15.7 cfs in imported water supplies from an alternative source to FM-1. The total cost for the facilities associated with the proposed connection is estimated to total $19.8 million.

Cost

Based on a 30-year period at 6 percent interest, the annualized cost for the second MWD connection is approximately $1.44 million per year. Operations and maintenance (O&M) costs have been assumed at approximately $0.4 million per year. Additionally, the cost to purchase MWD water would need to be incorporated into any cost comparisons of this connection with other supplies. A simple projection of MWD Tier 1 water rates for the next 30 years is shown in Table 3-1. These rates assume that the current rate structure will be maintained. Please note that in addition to the Tier 1 water rate, FMWD agencies pay the readiness-to-serve charge, the capacity charge and at times the Tier 2 rate as well as the Foothill costs.

Table 3-1 Projected MWD Water Rates

	CY 2009	**CY 2010**	**CY 2011**	**CY 2012**	**CY 2013**	**CY 2014**	**CY 2015**	**CY 2016**	**CY 2017**	**CY 2018**
Tier 1	$ 579	$ 701	$ 785	$ 832	$ 865	$ 900	$ 936	$ 973	$ 1,012	$ 1,052
Assumed Percentage Increase		21%	12%	6%	4%	4%	4%	4%	4%	4%
	CY 2019	**CY 2020**	**CY 2021**	**CY 2022**	**CY 2023**	**CY 2024**	**CY 2025**	**CY 2026**	**CY 2027**	**CY 2028**
Tier 1	$ 1,095	$ 1,138	$ 1,184	$ 1,231	$ 1,280	$ 1,332	$ 1,385	$ 1,440	$ 1,498	$ 1,558
Assumed Percentage Increase	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
	CY 2029	**CY 2030**	**CY 2031**	**CY 2032**	**CY 2033**	**CY 2034**	**CY 2035**	**CY 2036**	**CY 2037**	**CY 2038**
Tier 1	$ 1,620	$ 1,685	$ 1,752	$ 1,822	$ 1,895	$ 1,971	$ 2,050	$ 2,132	$ 2,217	$ 2,306
Assumed Percentage Increase	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

The reasoning for a second connection has been that it is needed for shutdowns on the Upper Feeder or for an emergency. During the past ten years, FMWD's service connection on the Upper Feeder has been out of service a total of 13 days or 0.4 percent of the time. None of these shutdowns has been an emergency shutdown. Assuming that FMWD would have taken flows of 15 cfs normally without these shutdowns, total water taken during these days would have been 387 AF or an average of 39 AFY over the ten year period. If the second connection is only used for shutdowns and assuming the same shutdown scenario, the cost rate for the second MWD connection is approximately $47,584 per AF (or ($1.44 million + $0.4 million) per year / 39 AFY). The MWD water rate and other applicable charges would need to be added to this figure.

Another issue is the power costs associated with the second connection. The current lift from FMWD's Arroyo Pumping Plant to Crescenta Valley reservoirs is about 750 feet. The lift for this second connection is approximately 1,100 feet. The power rate to boost 15.7 cfs water is approximately $190 per AF compared to the current $124 per AF for that reservoir zone. Based on the power cost, and the projected cost for MWD Tier 1 of $579 per AF in calendar year 2009, the cost rate for any water lifted from the second connection would be approximately $769 per AF for FMWD. Foothill's costs and other rates and charges would need to be applied when selling this water to the member agencies.

In some instances, MWD will be able to provide water to service connection FM-1 during a shutdown on the Upper Feeder. MWD is able to move water from the Santa Monica Feeder to the Upper Feeder. This amount can range from 10 to 20 cfs depending upon demands on the Santa Monica Feeder as well as if Pasadena requests water at its service connection P-5. However, if MWD does a complete shutdown of the Upper Feeder that impacts the area around FM-1 or Eagle Rock, no water will be available from the Santa Monica Feeder. The next complete shut down will likely be when MWD is rehabilitating the gates at Eagle Rock Tower. At that time, MWD will not be able to provide water to FMWD.

Reliability

The second MWD connection would eliminate complete dependence on the Upper Feeder for FMWD's imported water deliveries. This would be an increase in reliability during planned and unplanned shutdowns of FMWD's existing facilities. However, since FMWD member agencies on the east side of FMWD's service area will not be able to receive water from the second MWD connection, it will not completely relieve dependence on FMWD's existing facilities.

The second MWD connection would not change FMWD's current level of dependence on the long term reliability of MWD water. The reliability of MWD's water supply sources has always been subject to variations in hydrology in the Colorado River watershed and the State Water Project. More recently the effects of global climate change and potential impacts on current and future pumping operations from the State Water Project due to fishery protection measures in the Sacramento-San Joaquin Bay-Delta have created a much greater level of uncertainty regarding MWD's ability to always meet firm water demands in the future. Recent preliminary analysis of restrictions on pumping operations in the Bay-Delta indicate that MWD may be putting water into its storage programs far less often in the future and withdrawing water from storage and seeking other sources of supply far more often. Although there is no comprehensive current evaluation of MWD reliability, it appears it is now less reliable than it was only a short while ago. The reliability of MWD to meet firm demands has not been fully quantified at this time. The reliability of MWD supply compared to other available water supply sources can only be qualitatively compared and the benefit of having diversification of risks to reliability provided by having alternative sources of supply should be considered.

Institutional Issues

A large portion of the pipeline for the secondary connection is outside of FMWD's service area. MWD's policy is that MWD provides service to an agency's service area and it is the agency's responsibility for capital costs from that point. It is not likely that MWD will be willing to pay for this portion of the pipeline since recent connections with new pipelines have been predicated on not enough capacity being available from existing facilities.

Environmental Issues

There do not appear to be significant environmental issues associated with the proposed second MWD connection. The proposed connection includes construction of pipeline on existing streets. Water deliveries would likely go to meet municipal and industrial demands. Only typical construction related impacts are expected.

Energy Use and Greenhouse Gases

Construction and O&M of the proposed facilities may require moderate energy use and contribute to greenhouse gases. The lift of approximately 1,100 feet to pump this water to the service area is greater than the current lift of 736 feet to pump this water into the service area. Thus more energy will be required for pumping water through the second MWD connection.

Pros to Second Connection

A second connection provides a second source of water to portions of FMWD's service area. It would be greatly beneficial should there be a complete shutdown of the Upper Feeder or a combination of failures on the Upper Feeder and Santa Monica Feeder.

Cons to Second Connection

A second connection does not increase supply reliability during a drought or regulatory shortage. The capital costs of a second connection and the unit cost for water provided by the second connection are considerable. Energy use and impacts to greenhouse gas emissions are also more. In addition to the capital costs and power costs, FMWD will still need to take water from MWD at the rates that MWD has in effect at the time of delivery.

SECTION 4 - GROUNDWATER

Member agencies produce groundwater from two groundwater basins: the Raymond Basin and the Verdugo Basin. Groundwater production from each of the basins is discussed in this section.

Raymond Basin

The Raymond Basin is a groundwater basin of approximately 40 square miles that extends from La Cañada and the San Rafael hills to the west, the San Gabriel Mountain foothills to the north, the Santa Anita Canyon to the east, and the Raymond fault to the south. The groundwater basin is recharged by the Arroyo Seco, a tributary to the Los Angeles River, and by Eaton Wash, Santa Anita Wash, and other streams in the San Gabriel River watershed. Pumping rights to the Raymond Basin are adjudicated and are managed by the Raymond Basin Management Board. Sixteen parties have rights to pump from the Raymond Basin, which is separated into three major subareas: the Monk Hill Subarea, the Pasadena Subarea, and the Santa Anita Subarea. The Raymond Basin Judgment adjudicated groundwater rights based on a long-term average yield of the Raymond Basin. The Judgment allows a party to exceed its Decreed Right by no more than 10 percent, which will be deducted from the following year’s total allowable extraction. Conversely, a party is not allowed to carryover more than 10 percent of its Decreed Right to a subsequent year.

In addition to Decreed Rights, each party has the right to spread diverted surface water and recapture up to 80 percent from groundwater wells located in the Monk Hill Subarea and the Pasadena Subarea

Six of eight FMWD member agencies have water rights in the Raymond Basin, including Valley, Rubio, Lincoln, Las Flores, La Cañada, and Kinneloa. Valley, Rubio, Lincoln, Las Flores, and La Cañada produce groundwater from the Monk Hill Subarea while Kinneloa produces groundwater from the Pasadena Subarea.

Decreed rights for each of FMWD’s member agencies are provided below. The average, minimum, and maximum allowable extractions and water production over the past ten years (fiscal years 1997/98 to 2006/07) are provided in Table 4-1 for each member agency in the Monk Hill Subarea and the totals for all Monk Hill producers and in Table 4-2 for Kinneloa’s pumping in the Pasadena Subarea and the totals for all the Pasadena Subarea producers.

Table 4-1 Member Agency Extractions in the Monk Hill Subarea (AFY)

		"Decreed Right 1955"	Net Leases	Allowable Extraction	Amount Extracted	Balance
Valley Water Company	**10 Yr Avg**	797.0	32.6	1,414.5	1,345.9	68.6
	Min	797.0	19.9	1,230.5	1,150.8	24.3
	Max	797.0	48.9	1,558.3	1,478.6	79.7
Rubio Canon Land & Water Assn.	**10 Yr Avg**	1,221.0	0.0	1,406.6	1,351.1	55.6
	Min	1,221.0	0.0	1,198.0	1,090.8	(66.4)
	Max	1,221.0	0.0	1,595.3	1,491.6	122.1
Lincoln Ave Water Company	**10 Yr Avg**	567.0	665.9	1,443.5	1,453.9	(10.3)
	Min	567.0	0.0	889.7	833.0	(273.5)
	Max	567.0	2,000.0	2,678.3	2,951.8	56.7
Las Flores Water Company	**10 Yr Avg**	249.0	(60.0)	309.7	297.4	12.3
	Min	249.0	(175.0)	188.3	181.7	0.0
	Max	249.0	0.0	419.0	419.0	24.9
La Cañada Irrigation District	**10 Yr Avg**	100.0	0.0	108.1	104.6	3.5
	Min	100.0	0.0	15.6	15.6	0.0
	Max	100.0	0.0	176.0	176.0	10.0
Monk Hill Subarea	**10 Yr Avg**	7,489.0	0.0	7,553.0	7,014.3	538.6
	Min	7,489.0	0.0	4,740.6	4,070.4	252.6
	Max	7,489.0	0.0	11,157.9	10,710.9	712.9

Table 4-2 Member Agency Extractions in the Pasadena Subarea (AFY)

		"Decreed Right 1955"	Net Leases	Allowable Extraction	Amount Extracted	Balance
Kinneloa Irrigation District	**10 Yr Avg**	516.0	(25.0)	653.1	660.9	(7.8)
	Min	516.0	(300.0)	431.1	379.5	(51.6)
	Max	516.0	150.0	930.3	930.0	51.6
Pasadena Subarea	**10 Yr Avg**	17,843.0	0.0	21,845.9	20,646.0	1,199.9
	Min	17,843.0	0.0	16,959.7	15,991.3	(340.8)
	Max	17,843.0	0.0	23,819.4	24,124.1	2,695.8

Member agencies are currently producing essentially the total amount of groundwater allowed under their existing water rights. The only opportunity to increase the use of groundwater is to increase recharge of water to the basin. Increasing the amount of diverted surface water recharged in the basin or introducing new sources of groundwater recharge (such as recycled water and imported surface water) may allow member agencies to produce additional water over their Decreed Rights. Sources of additional groundwater recharge supplies are discussed in other sections of this Briefing Paper.

It may be possible to significantly reduce dependence on FMWD facilities for a planned shut down or a short term emergency shut down by maximizing production from member agencies' existing groundwater wells and constructing additional wells for use during emergencies. Some member agencies have underutilized groundwater production capacity. Any unused groundwater from a member agency with capacity in excess of their demands could be delivered to other member agencies through existing interconnections, available FMWD's facilities, and/or proposed interconnections (See Section 9 - Interconnections). Additional groundwater pumping capacity will also be needed and is discussed below. Upon completion of repairs or maintenance to FMWD facilities, member agencies would rely on FMWD for water supply if full use of groundwater production capacity exhausts member agencies' water rights.

Member agencies on the west side of FMWD's service area (such as Valley and La Cañada) may be able to maximize groundwater production for deliveries to others, however, water quality concerns may limit the ability to utilize existing groundwater production capacity in this area. Valley has four groundwater wells with a combined capacity of over 4,000 gallons per minute (gpm) (with 797 AFY of groundwater rights). Based on the November 2007 FMWD Master Plan, the total well capacity may only be sufficient to meet Valley's average demands without deliveries from FMWD. La Cañada has two groundwater wells with a combined capacity of approximately 1,250 gpm (with 100 AFY of groundwater rights). However, La Cañada currently relies on FMWD for over 90 percent of its total water supplies. Based on the well capacities of Valley and La Cañada, additional groundwater well capacity may be needed to provide sufficient water to other member agencies during emergency or planned shutdowns of FMWD facilities.

Member agencies on the east side of FMWD's service area (such as Lincoln, and Rubio) may be able to maximize groundwater production for deliveries to others. Lincoln has two groundwater wells with a combined capacity of Approximately 2,000 gpm (with 567 AFY of groundwater rights). Rubio has two groundwater wells with a combined capacity of approximately 2,750 gpm (with 1,221 AFY of groundwater rights). Although Rubio may have additional well capacity to provide water to others on a short term basis, additional groundwater well capacity may be needed to provide sufficient water to other member agencies during emergency or planned shutdowns of FMWD facilities.

If water quality concerns limit the ability to utilize Valley's and other member agency wells to supply water to other member agencies during a planned or emergency shutdown of FMWD's facilities it may be possible to construct new wells to provide emergency supplies for short periods in Las Flores' and Cresenta Valley's service areas with much less likelihood of water quality concerns.

The Foothill Conjunctive Use Project (CUP) will allow MWD to store up to 9,000 AF of available imported water in the Monk Hill Subarea of the Raymond Basin for subsequent withdrawal of up to 3,000 AFY during emergencies and droughts. Storing imported water in the groundwater basin would be accomplished through in-lieu deliveries to FMWD member agencies and injection.

Imported water deliveries taken on an in-lieu basis will be delivered at each member agency's treated water connection and credited to a storage account. The cost of water deliveries are deferred as no charges for these in-lieu deliveries are made at the time of delivery from MWD. However, when MWD requires the water to be produced during emergencies and droughts, produced groundwater will be invoiced at the current MWD treated water rate. Groundwater pumping costs will be reimbursed by MWD. Agencies that have participated in this type of storage approach include La Cañada, Valley, and Rubio.

There may not currently be storage capacity available in the Monk Hill Subarea to expand the CUP. However, Pasadena plans to significantly increase pumping in the Monk Hill Subarea when a new groundwater treatment plant is complete. Expansion of the CUP may be possible when Pasadena increases it's pumping.

Reliability

Some of the member agencies rely on groundwater treatment (and blending) to remove contamination to allow them to maintain groundwater production and serve the water to their customers. The spread of contamination may impact the ability of member agencies to produce their entire Decreed Rights in the future which may reduce the reliability of a portion of the groundwater supply if suitable additional treatment cannot be implemented.

During a July 2008 meeting of the Pasadena Subarea Safe Yield Sub-Committee of the Raymond Basin Management Board, several items were agreed upon, including the following:

- Current groundwater production in the Pasadena Subarea is greater than natural recovery "Safe Yield"
- At some point overall production must be curtailed to reverse the declining levels until supplemental water for recharge is made available
- Long-term Supplemental water deliveries (replenishment) will be required if production levels are to continue at 1955 Decreed Right levels
- The Long-term Storage Program should be suspended as soon as possible

The Sub-Committee agreed that while most producers would have difficulty meeting current demands if production were reduced to required levels all at once, a phased reduction in water production along with other management practices would be the most desirable approach. It appears there may be temporary, phased reduction in groundwater production at some time in the future. This should be considered when evaluating future water supply alternatives.

Lincoln operates a groundwater treatment facility as part of a cleanup effort to remove perchlorate and VOCs from groundwater in the Jet Propulsion Laboratory area. Lincoln leases approximately 1,000 AFY of groundwater rights from the City of Pasadena (Pasadena) in order to have adequate water rights to be able to continuously operate the treatment facility to support groundwater cleanup objectives for the groundwater basin. Pasadena is planning to construct a similar groundwater treatment facility. As a result, Pasadena may produce groundwater rights which would have been leased to Lincoln in the past. In anticipation of not being able to lease water rights from Pasadena in the future, and to continue operations at Lincoln's treatment facility, Lincoln has requested the Raymond Basin Management Board transfer a portion of the water rights held in Pasadena's Long Term Storage Account to Lincoln to purchase and use. If the transfer of rights from Pasadena's Long Term Storage Account is not accomplished, or if some other source of water rights does not become available to Lincoln, Lincoln may have to reduce its groundwater production by up to 1,000 AFY at some time in the future.

Verdugo Basin

The Verdugo Basin is a groundwater basin of approximately 5,000 acres located in the Crescenta Valley between the San Gabriel Mountains and the Verdugo Mountains.

The Basin was adjudicated in 1979 and two municipal producers, the City of Glendale

(Glendale) and Crescenta Valley Water District (Crescenta Valley), possess all production rights. Crescenta Valley has a right to produce 3,294 AFY and Glendale has a right to produce 3,856 AFY in the Verdugo Basin.

Excess pumping within the Verdugo Basin by either party is allowed as long as the total yield of 7,150 acre-feet annually is not exceeded. Over the past several years, Crescenta Valley has exceeded its Verdugo Basin pumping right. However, Glendale has not exercised all of its rights so Crescenta Valley has compensated Glendale for the over-pumping which encroaches on Glendale's rights. Glendale has never pumped its full water right from the Verdugo Basin. Glendale's pumping has been limited due to lack of well capacity. Pump tests from recently drilled pilot wells indicate low production capacities. Glendale also operates the Glendale Water Treatment Plant, designed to remove volatile organic compounds from groundwater produced by its wells, and the Verdugo Park Water Treatment Plant, designed to remove turbidity and bacteria.

Based on Glendale's 2005 UWMP, projected water production from 2010 to 2025 by Glendale from the Verdugo Basin is 2,300 AFY (or 1,556 AFY less than Glendale's production rights). However, the Upper Los Angeles River Area (ULARA) Watermaster's Groundwater Pumping and Spreading Plan, prepared July 2007, projects that Glendale will produce its entire Verdugo Basin pumping right of 3,856 AFY by water year 2008-09. The ULARA Plan indicates Glendale has been studying and evaluating various alternatives to increase pumping capacity. However, as discussed above, pump tests from recently drilled pilot wells indicate low production capacities. Since Glendale has so far been unsuccessful in adding well capacity it maybe possible that Crescenta Valley may continue to use Glendale's Verdugo Basin water rights and compensate Glendale over the short-term future. Crescenta Valley might also be able to negotiate a long-term agreement to use Glendale's unused production rights if Glendale does not anticipate the ability to add well capacity.

The only opportunity to increase the use of groundwater is to increase recharge of water to the Verdugo basin. Increasing the amount of diverted surface water recharged in the basin or introducing new sources of groundwater recharge (such as debris basin recharge) may allow Crescenta Valley to produce additional water over its pumping rights. However, the ability to spread and extract groundwater would need approval of the ULARA Watermaster and meet all required conditions. Sources of additional groundwater recharge supplies are discussed in other sections of this Briefing Paper.

Reliability

Although nitrate contamination is widespread in the basin, Crescenta Valley reduces nitrate levels through groundwater treatment and blending with treated and/or imported water supplies. Additional nitrate treatment may be needed if Crescenta Valley's pumping rights are increased by recharge of supplemental water. However, methyl tert-butyl ether (MTBE) contamination has caused a temporary shutdown of one of

Crescenta Valley's wells. Crescenta Valley is planning to install granular activated carbon treatment to remove MTBE from the groundwater.

Crescenta Valley can currently extract a portion of Glendale's pumping rights to the Verdugo Basin, with compensation to Glendale. Although this arrangement may continue in the short-term, Glendale may in the future pump its entire right to the Verdugo Basin, which would reduce the amount groundwater available to Crescenta Valley.

Cost

Groundwater that is of good quality can typically be produced at cheaper costs than purchasing water from MWD. The cost is typically the cost of power to pump the groundwater, the cost of O&M (typically a minimal amount), and the cost of the chlorine needed to treat the water before putting into the distribution system.

The problem with costs arises when water is of poor quality and must be treated prior to introduction into the distribution system. Treatment can often add a significant cost in the form of the capital needed for treatment, resin or chemicals that are needed, O&M including power costs, and also brine or sludge disposal. As an example, the cost to install a 5,000 gpm nitrate treatment (regenerative ion exchange) to remove nitrate contamination was recently estimated at approximately $5 million in capital costs (equipment, site work, brine discharge connection, and electrical) and $0.8 million per year in O&M (brine disposal and salt). These costs need to be compared on a case-by-case basis with MWD's water rates along with the risk each agency is willing to take on reliability when deciding on treatment.

Institutional Issues

FMWD is not part of either the Verdugo Basin or Raymond Basin adjudications. Thus, should it decide to pursue any projects that impact either basin such as the current conjunctive use project in the Raymond Basin, it must partner with the appropriate Watermaster and overlying producers.

Environmental Issues

There are currently no environmental issues connected with pumping groundwater from wells that exist. Typically new wells have not been a major cause of concern.

Energy Use and Greenhouse Gases

Typically, the amount of energy used to pump water of good quality is low compared to importing water. Treatment adds a higher level of energy usage.

Pros to Groundwater

There are several pros to groundwater. These include the low cost of producing good quality groundwater and the low use of energy compared to importing water. From a reliability standpoint, those producers in the Monk Hill Subarea at this point have not been impacted by the lower groundwater levels that are in evidence in the Pasadena Subarea. Thus, groundwater provides a high degree of reliability. Additionally, the groundwater basins act as reservoirs that can be called upon during a shutdown or emergency. The limiting factors to these “reservoirs” are production capability due to either not enough wells or water quality concerns and water rights.

Cons to Groundwater

FMWD is not a party to either the Raymond Basin or San Fernando adjudications. Thus, FMWD has no direct rights to the groundwater basins either for storage or production. Any groundwater program such as the Foothill Conjunctive Use Project (described above) will require coordination with the local producers and Watermasters of the respective basins.

Additionally, FMWD is considered a consecutive distribution system and received a Very Small System Waiver allowing it to circumvent extensive water quality testing. Should groundwater be introduced into FMWD’s system, this waiver would no longer be applicable and extensive water quality testing would need to be performed costing FMWD a significant amount of money. Additionally, the operators would likely need to receive higher levels of treatment certifications than currently required. The only exception is during an emergency, FMWD would be able to take groundwater into its distribution system for a short period of time. Any program that on a regular basis introduces groundwater into FMWD’s system would need to consider these costs versus the benefits.

SECTION 5 – RECYCLED WATER

Recycled water use can alleviate the amount of imported water supplies required by FMWD's member agencies. Recycled water in FMWD's service area can be used for nonpotable purposes, such as landscape, public parks, and golf course irrigation. Recycled water can also be used for groundwater recharge through spreading or injection into the groundwater aquifer to enhance ground water supplies.

Construction of a wastewater treatment facility (scalping plant) can be used to treat wastewater and deliver recycled water within FMWD's service area. FMWD's member agencies may also consider participating in a larger treatment plant to create a regional recycled water recharge project that might include all groundwater producers in the Raymond Basin.

Potential Available Wastewater Quantities

According to the City of La Cañada Flintridge (La Cañada Flintridge) staff, the peak ultimate wastewater discharges from the La Cañada Flintridge area are projected at approximately 14 MGD. Based on a wastewater peaking factor of 3.5, the ultimate average wastewater discharge is approximately 4 MGD. A majority of wastewater generated within the La Cañada Flintridge area overlaps the service areas of Valley, Crescenta, and La Cañada.

The potential quantity of wastewater generated can also be estimated based on projected population. According to FMWD's 2005 UWMP, the population within FMWD's service area will increase from 87,671 (in 2010) to 94,482 (in 2025). Based on a wastewater generation factor of 80 gallons per day per capita (Metcalf & Eddy, Wastewater Engineering), the projected amount of wastewater within FMWD's service area is approximately 7.0 MDG (in 2010) to 7.6 MGD (in 2025).

Potential Recycled Water Users

Based on discussions with FMWD's member agency staff, FMWD's "Preliminary Reclamation Assessment" (May 1996), and Crescenta's "Final Recycled Water Feasibility Study" (April 2004), potential large recycled water users were identified, including the following:

	Potential User	Potential Recycled Water Use
1.	Various CalTrans medians	Up to 52 AFY per median
2.	Two Strikes Park (LA County Parks)	23.6 AFY
3.	Flintridge Riding Club	34.6 AFY
4.	La Cañada Unified School District	60.8 AFY
5.	Descanso Gardens Guild	25.0 AFY
6.	Farnsworth County Park	30.0 AFY
7.	Loma Alta County Park	37.4 AFY
8.	Charles White County Park	15.2 AFY
9.	Mountain View Cemetery	91.0 AFY
10.	La Cañada-Flintridge Golf Course	59.9 AFY

A map showing the location of these potential recycled water users is shown in Figure 5-1.

Potential Wastewater Treatment Plant

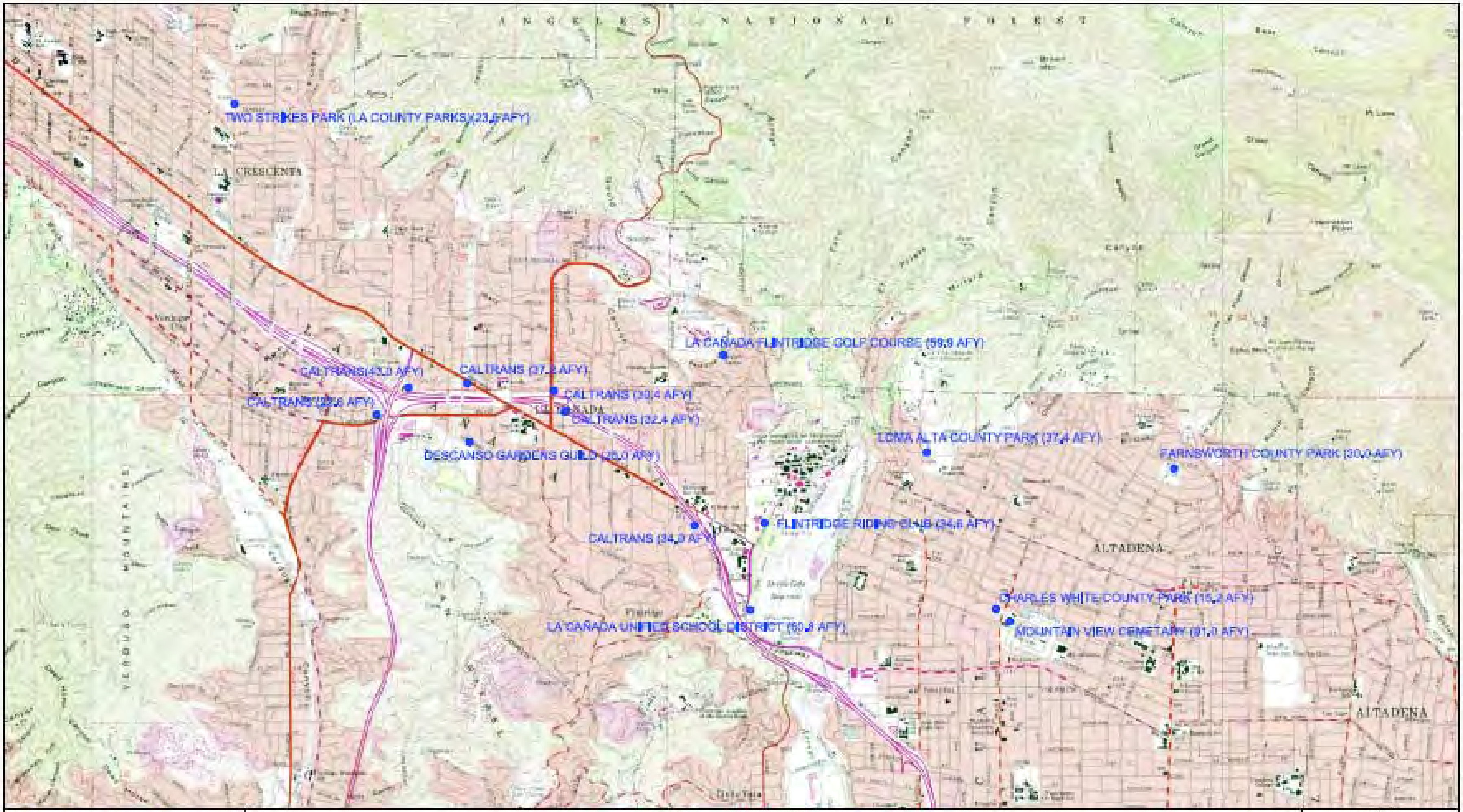
Title 22 of the California Code of Regulations provides the standards for levels of treatment and types of uses for recycled water. Membrane Bioreactor package treatment plants (MBR Plants) produce recycled water that meet Title 22 standards for irrigation and groundwater recharge by spreading. The use of MBR plants has been assumed for this evaluation of the use of recycled water.

Based on discussions with FMWD's member agency staff, the following potential sites for a wastewater treatment plant were identified:

1. La Cañada Flintridge Golf Course
2. Pasadena Surface Water Treatment
3. Oak Grove Park
4. Mayor's Park
5. Lyon's Dr / Castle Rd intersection
6. East of Alta Canada / South of Olive Lane

A map showing the location of these potential wastewater plants is shown in Figure 5-2.

It has been assumed the capacity of a proposed treatment plant will be designed to meet the peak hour demands of all potential recycled water irrigation users. The peak hour flow has been assumed to be 3 times the maximum day demand. The maximum day demand has been assumed to be 2.5 the average day demand.



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2651 W Guadalupe Rd., Suite A209
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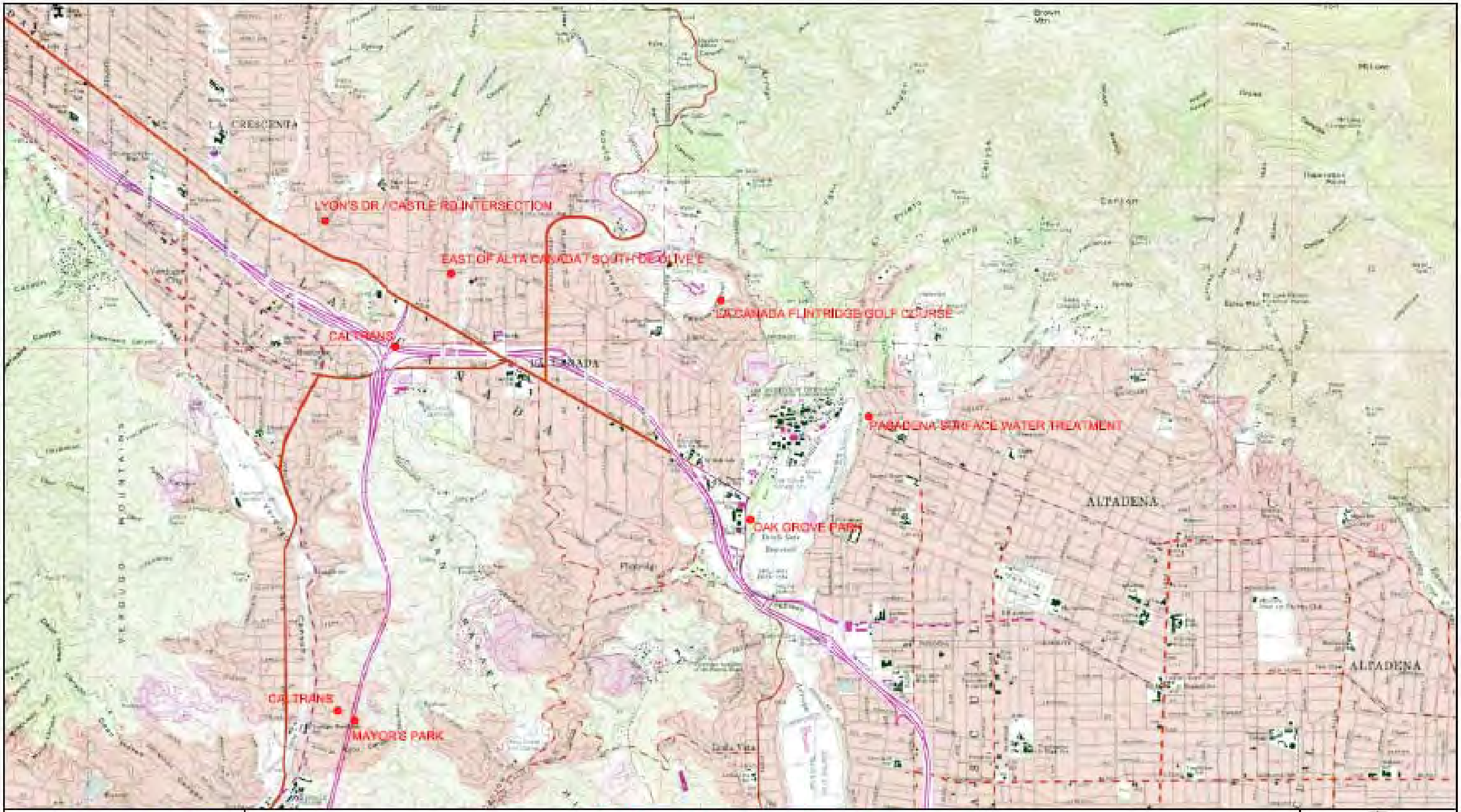
FOOTHILL MUNICIPAL WATER DISTRICT

POTENTIAL RECYCLED WATER USERS

FIGURE 5-1



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FOOTHILL MUNICIPAL WATER DISTRICT

POTENTIAL RECYCLED WATER TREATMENT SITES

NORTH

APPROX. SCALE :
1,500' 0 1,500'

FIGURE 5-2

Recycled Water Costs

The cost to provide recycled water to potential irrigation users within the Monk Hill Subarea was estimated using potential users located within close proximity to one another to minimize distribution pipeline costs. Two scenarios were analyzed, including: (Scenario 1) with four CalTrans sites near the 210 Freeway and Descanso Gardens; and (Scenario 2) with six CalTrans sites near the 210 Freeway, Descanso Gardens, Flintridge Riding Club, and the La Cañada Unified School District. The treatment plant sizes were 1.0 MGD in Scenario 1 and 2.0 MGD in Scenario 2. These scenarios were created as examples of small recycled water projects, also referred to as scalping plants, which might be implemented. Additional opportunities, such as a scalping plant to supply recycled water to the Charles White County Park and the Mountain View Cemetery exist within FMWD. In addition, a more detail recycled water study might be able to optimize the location of the plant, the irrigation customers to be served, and the size of the plant to achieve some reduction in cost

The treatment plants in both scenarios were sized to meet peak hour demands for potential irrigation users. It was assumed that recycled water that was not delivered to potential irrigation users would be delivered to the Arroyo Seco Spreading Grounds for groundwater recharge.

The total capital costs for a treatment plant and infrastructure (pipeline and boosters) is approximately $15.2 million for Scenario 1 and approximately $27.4 million for Scenario 2. Based on a 30-year period at 6 percent interest, the annualized costs are $1.1 million per year for Scenario 1 and $1.99 million for Scenario 2. Pumping and treatment O&M costs were estimated at approximately $0.9 million per year for Scenario 1 and approximately $1.5 million for Scenario 2. Additional information regarding recycled water facility cost estimates are provided in Appendix A.

The total recycled water use by potential irrigation users under Scenario 1 is 162 AFY, with the remaining 960 AFY flowing to the Arroyo Seco Spreading Grounds for recharge. The total cost of recycled water for Scenario 1 is approximately $1,750 per AF.

The total recycled water use by potential irrigation users under Scenario 2 is 320 AFY, with the remaining 800 AFY flowing to the Arroyo Seco Spreading Grounds for recharge. The total cost of recycled water for Scenario 2 is approximately $1,560 per AF.

The use of recycled water as a source of recharge water at the Arroyo Seco Spreading Grounds was also analyzed (Scenario 3). The treatment plant size for Scenario 3 is 4 MGD, which is sized to represent a regional groundwater recharge project for the Monk Hill Subarea of the Raymond Basin. The total capital costs for a treatment plant and infrastructure (pipeline and boosters) is approximately $40 million for Scenario 3. Based on a 30-year period at 6 percent interest, the annualized cost is approximately

$2.9 million per year. Pumping and treatment O&M costs were estimated at approximately $2.4 million per year. Approximately 3,360 AFY of recycled water would be provided to the Arroyo Seco Spreading Grounds for recharge, assuming the spreading grounds would be unavailable 25 percent of the time due to spreading of stormwater runoff, maintenance activities, and vector control considerations. The total cost of recycled water for Scenario 3 is approximately $1,580 per AF. A larger treatment plant or an additional treatment plant could be considered with groundwater producers in the Pasadena subarea to create a larger basin-wide project in the Raymond Basin.

Reliability

Recycled water use can alleviate the amount of imported water supplies required by FMWD's member agencies. The use of recycled water supplies for irrigation and for groundwater recharge to obtain additional groundwater rights can provide alternate sources of supply during planned or unplanned shutdown of FMWD's facilities. The use of recycled water supplies can also provide alternate sources of supply during periods of MWD delivery shortages.

Construction of a scalping plant or regional wastewater plant may reduce the amount of wastewater flow that would have been treated by existing downstream treatment plants. Coordination and cooperation with the Sanitation Districts of Los Angeles County would be required to implement a recycled water project.

Groundwater recharge of recycled water may allow member agencies to pump groundwater in excess of their existing pumping rights. However, member agencies may need to add well capacity to extract this additional groundwater. In addition, member agencies may need to add treatment if groundwater contamination is present.

Institutional Issues

Coordination with multiple entities will be required for a recycled water project. These will likely include the Sanitation Districts of Los Angeles County, CalTrans, Los Angeles County Parks and Recreation, Raymond Basin Watermaster and the City of Pasadena. Use of land (such as the Arroyo Seco Spreading Grounds and Pasadena Surface Water Treatment) owned by the City of Pasadena, which is in development of their own recycled water system, may also need to be resolved.

Spreading of recycled water in the Arroyo Seco Spreading Grounds for groundwater recharge may require a review of the impact on the US Environmental Protection Agency's (USEPA) Record of Decision regarding groundwater contamination in the vicinity.

Environmental Issues

The Regional Water Quality Control Board and California Department of Public Health criteria to avoid degradation of basin water quality would have to be met.

There may be opposition to placement of a wastewater treatment plant from nearby residents due to concerns about possible odors, aesthetic impacts, and noise from plant operations.

Water Quality Considerations

Groundwater recharge projects must meet the groundwater basin water quality objectives established by the Regional Water Quality Control Board, Los Angeles Region and the Raymond Basin Management Board's Criteria for the Delivery of Supplemental Water. The MBR Plants generally produce very high quality recycled water, however, additional water quality and treatment review would be required to determine the characteristics of the recycled water from these projects to review compliance with the specific water quality requirements for recharge in the Raymond Basin.

Energy Use and Greenhouse Gases

The operation of a proposed wastewater treatment plant to produce recycled water would require energy usage that may continuously contribute to greenhouse gases. However, operation of a proposed wastewater treatment plant would offset the need to treat the wastewater elsewhere, so implementation of a recycled water project to reuse the treated water might be considered to have no net increase in greenhouse gas emissions. Additionally, there would be reduced demands for MWD imported water and the pumping associated with moving that water on the State Water Project or Colorado River Aqueduct.

Pros to Recycled Water

Recycled water is actually "new" water that is added to supplies. The scalping plants would be in FMWD's service area offering greater reliability. By using the recycled water to recharge the groundwater basin, a greater degree of reliability on the potable side of demands is created. The costs of recycled water are cheaper than most other supplies that are available to FMWD. Once the capital facilities of the recycled water project have been paid off, there will be a drop in the rate for the water as only O&M and rehabilitation costs will apply. Comparing recycled water costs to projected MWD water costs in Table 3-1, recycled water will be cheaper for FMWD around calendar year 2028 or calendar year 2031 depending on the scenario chosen.

Cons to Recycled Water

One of the areas that will need to be addressed is the “not in my backyard” issue that arises from recycled water plants. Considerable outreach as well as good planning/siting must be performed before any project can move forward. Recycled water can only be used for nonpotable purposes. To increase reliability, recycled water needs to be spread and the appropriate production facilities must be in place for use during an emergency or shutdown.

SECTION 6 – SAN GABRIEL AND RAYMOND BASIN FEEDER

FMWD's member agencies are currently producing essentially the total amount of groundwater allowed under their existing water rights. As discussed in Section 4 (Groundwater), the only opportunity to increase the use of groundwater is to increase recharge of water to the basins. Increasing the amount of groundwater recharge, such as additional imported surface water discussed below, may allow member agencies to produce additional water over their existing water rights.

Increasing the availability of replenishment water can enhance spreading operations and extraction potential in the Raymond Basin. A potential source of additional spreading water is untreated, imported water delivered though San Gabriel Valley Municipal Water District's (SGVMWD) Devil Canyon-Azusa Pipeline, which begins at the State Water Project's (SWP) Devil Canyon afterbay and currently terminates in the City of Azusa. SGVMWD's untreated imported water facilities are used to deliver water for groundwater recharge and to make power approximately four to six months of each year (primarily in the summer) at the San Dimas hydroelectric facility. During those times, little or no water can be delivered westerly in the pipeline. The Foothill Water Coalition (FWC), which includes FMWD, is pursuing a program that would include construction of a pipeline extension from the Devil Canyon-Azusa Pipeline to deliver water from the terminus (City of Azusa) to the Raymond Basin (San Gabriel and Raymond Basin Feeder). The FWC and the Army Corps of Engineers will initiate a conceptual level study of the San Gabriel and Raymond Basin Feeder and other water supply reliability projects in the next few weeks.

To help ensure the availability of sufficient water supplies, a pipeline interconnection (Alosta Connection) between the Devil Canyon-Azusa Pipeline and MWD's facilities would need to be constructed. The cost to construct the Alosta Connection is estimated at $2.3 million. The annual cost at a repayment rate of 6 percent over 30 years is approximately $170,000 per year.

The Devil Canyon-Azusa Pipeline could be extended into the Raymond Basin to provide replenishment water. Phase 1 would provide water to the Santa Anita and Sierra Madre Spreading Grounds, located in the Santa Anita Subarea. Phase 2 would provide water to the Eaton Wash Spreading Grounds, located in the Pasadena Subarea, which may benefit Kinneloa. Phase 3 would provide water to the Arroyo Seco Spreading Grounds, located in the Monk Hill Subarea where the remainder of FMWD's member agencies with water rights produce groundwater. The capital cost of the Phase 1, 2 and 3 extension is about $31,300,000, including the Alosta Connection. The annual repayment over 30 years at 6 percent interest is approximately $2.29 million per year.

Although there have been no studies to determine the amount of potential deliveries from the proposed San Gabriel and Raymond Basin Feeder, for the purposes of this Briefing Paper, it has been assumed the water will be delivered to the four spreading grounds associated with Phases 1, 2 and 3. The recharge rate of the Arroyo Seco represents approximately 40 percent of the total recharge rate of all four spreading grounds. Based on deliveries to the Arroyo Seco Spreading Grounds at 40 percent of the total cost, the Monk Hill Subarea users would need to pay approximately $12.5 million, or $0.9 million per year. Since the Monk Hill Subarea users are located within Phase 3 of the proposed San Gabriel and Raymond Basin Feeder, additional infrastructure and pumping costs associated with Phases 1 and 2 may be necessary.

Phase 3 of the proposed San Gabriel and Raymond Basin Feeder is still very conceptual at this time. A potential alternative has recently been suggested to the original proposal for a pipeline that would deliver imported water from the Eaton Canyon area to the Arroyo Seco. The concept of retaining stormwater for a longer period behind Devil’s Gate Dam and pumping water through existing storm drains and some new pipelines to the Eaton Canyon Spreading Grounds has been proposed. This concept may allow delivery of imported water from the Phase 2 extension of the San Gabriel and Raymond Basin Feeder to the Arroyo Seco Spreading Grounds through the same network of storm drains and new pipelines. A preliminary feasibility study to be conducted jointly by the FWC and the Army Corps of Engineers will evaluate these options and as well as potential improvements to the Arroyo Seco Spreading Grounds that could result in the recharge of more storm water and provide more spreading capacity for recycled water if a recycled water project is developed.

Reliability

The current preliminary planned capacity of the Alosta Connection is approximately 30 cfs. The current percolation rate of the Arroyo Seco Spreading Grounds is approximately 18 cfs. Based on a 40 percent allocation discussed above, the Arroyo Seco Spreading Grounds could receive approximately 12 cfs from the proposed San Gabriel and Raymond Basin Feeder. Although there have been no studies to determine the amount of potential deliveries from the proposed San Gabriel and Raymond Basin Feeder, the Arroyo Seco Spreading Grounds should have sufficient capacity to percolate this assumed rate of delivery.

If member agencies with existing water rights can produce more groundwater, it would make capacity in FMWD’s pipeline available to member agencies without water rights. Increased groundwater pumping would also increase the local supply of water that might be shared among member agencies during a planned or unplanned shut down of FMWD’s facilities.

Delivery of imported water through the proposed San Gabriel and Raymond Basin Feeder project would increase the amount of groundwater available for recharge which may allow member agencies to produce additional water over their existing water rights. These additional water rights may allow member agencies to continue providing reliable water supplies during planned and unplanned shutdowns of FMWD facilities.

Although groundwater recharge of imported water may allow member agencies to pump groundwater in excess of their existing pumping rights, member agencies may need to add well capacity to extract this additional groundwater. In addition, member agencies may need to add treatment if groundwater contamination is present.

Cost

MWD has historically provided water for groundwater recharge at the untreated replenishment water rate (currently $258 per AF). However deliveries of this type of water are not guaranteed. According to recent discussions with MWD on availability, untreated replenishment water may be available only three out of the ten years in the immediate future and approximately five out of ten years in the future if some improvements to the Bay-Delta System are in place, easing current court ordered pumping restrictions. Based on MWD's estimated reliability, and assuming for this discussion replenishment water is available for three months of the year when it is available, a 12 cfs allocation to the Arroyo Seco Spreading Grounds is equivalent to annual average replenishment of approximately 430 AFY to 720 AFY from MWD. MWD may also be able to provide more reliable full service untreated water for recharge at Tier 1 (currently $351 per AF) or Tier 2 (currently $449 per AF) rates. MWD is currently reviewing whether full service Tier 1 and Tier 2 untreated water can be provided for recharge. Based on MWD's untreated replenishment water rate, FMWD will need to pay approximately $1,250 per AF ($258 per AF + ($0.9 million per year / 720 AFY)) to $2,350 per AF ($258 per AF + ($0.9 million per year / 430 AFY)) for water delivered to the Arroyo Seco Spreading Grounds.

Water delivered through the proposed San Gabriel and Raymond Basin Feeder may also be delivered directly to member agencies. However, there would be significant additional infrastructure costs, including a surface water treatment plant, pipelines, and booster stations.

Institutional Issues

FMWD will need to coordinate with the FWC, Pasadena and MWD for successful completion of the project.

Spreading of imported water in the Arroyo Seco Spreading Grounds for groundwater recharge may require a review of the impact on the USEPA's Record of Decision regarding groundwater contamination in the vicinity.

Environmental Issues

There do not appear to be significant environmental issues associated with the proposed San Gabriel and Raymond Basin Feeder project, however there may be some moderate issues involved in crossing Eaton Canyon and possible constructing the pipeline in the Arroyo Seco Canyon. The Alosta Connection would be constructed within the existing San Dimas Wash area. The San Gabriel and Raymond Basin Feeder would be constructed on existing streets. Water deliveries would recharge into an existing spreading basin. Only typical construction related impacts are expected.

Energy Use and Greenhouse Gases

Construction and operations of the proposed San Gabriel and Raymond Basin Feeder and Alosta Connection may require moderate energy use and contribute to greenhouse gases in addition to the energy used to move water on the State Water Project.

Pros

As discussed above, if member agencies with existing water rights can produce more groundwater, it would make capacity in FMWD's pipeline available to member agencies without water rights. Increased groundwater pumping may also significantly increase the local supply of water that might be shared among member agencies during a planned or unplanned shut down of FMWD's facilities.

Cons

The FWC is comprised of many agencies interested in the extension of the San Gabriel and Raymond Basin Feeder. However, most of the agencies benefit from Phase 1 and 2 of the extension. For FMWD only Kinneloa benefits from Phase 2 of the extension. None of FMWD's other member agencies have a direct benefit. Most of the agencies benefiting from Phase 1 and 2 will not benefit from Phase 3. The FWC agreement stipulates that FMWD will share costs equally with the other agencies. The question arises if Phase 3 is not constructed and FMWD has paid costs equally with other agencies, what has FMWD gained from its participation? Additionally, the availability of MWD replenishment water is not guaranteed. There are also possibilities of revising the program which may impact operations.

SECTION 7 - CONSERVATION

Implementation of conservation measures within FMWD's service area can reduce the water demands on local and imported water supplies. Conservation measures can be grouped into two general categories: (1) "hardware" devices or equipment and (2) behavior or management practices. The implementation of comprehensive conservation programs to reduce long-term water demands typically includes both hardware- and behavior-driven measures. Although the two types of measures require different levels of effort, both are required to meet conservation goals. For example, outdoor water conservation programs include ongoing landscape management practices (such as shorter lawn watering times) and one-time hardware measures (such as turf replacement and improved irrigation system controllers).

Conservation Methods

The 2005 FMWD UWMP provides descriptions of several water conservation programs, or Best Management Practices (BMPs), that are currently being practiced within FMWD's service area. These BMPs include "Residential Plumbing Retrofit", "Large Landscape Conservation Programs and Incentives", "High-Efficiency Washing Machine Rebate Programs", "Public Information Programs", and "Conservation Pricing." The UWMP did not include information on the effectiveness or amount of water savings from these current conservation measures.

During the recent process to develop MWD's Water Shortage Allocation Plan MWD estimated the current total water savings from active and passive conservation measures within FMWD to be approximately 1,600 AFY. MWD has developed a methodology to estimate future potential water conservation savings within the MWD service area from active conservation programs, price induced savings, and code based savings. Projections for FMWD's service area from MWD's methodology were not available for this evaluation, however they may be available for future evaluations of potential water conservations savings. Based on discussions with the member agencies it appears there is the potential for additional water conservation savings from price induced programs, fixture rebates, and public education programs. Reduction in outdoor water use may represent the potential for significant water savings in some portions of FMWD's service area, although achieving those savings may be difficult. Some conservation measures (such as rate structures and irrigation controller rebates) may need to be combined with significant public education efforts for the programs to be successful. FMWD has also kicked off the Foothill Water Conservation Corps in an effort to develop conservation and public education further.

MWD (through the http://www.bewaterwise.com/ website), offers rebates for purchase and installation of high efficiency clothes washers ($135 to $400), high efficiency toilets ($30 to $100), weather-based irrigation controllers ($80 to $200), and synthetic turf

($0.30 to $0.80 per square foot). These devices can produce significant water savings. For example, high efficiency clothes washers can use up to 50 percent less water than standard clothes washers. High efficiency toilets can use up to 20 percent less water than standard toilets, and weather-based irrigation controllers can reduce typical household water use by as much as 10 percent.

Use of tiered water rates alone may not be effective for achieving conservation savings in some areas. Implementation of a water budget allocation system with tiered billing rates (or budget-based rate structure) may be a more successful method to encourage conservation. A budget-based rate structure estimates the amount of water use for each household and business by taking into account how many people are using water at the location and how much irrigation is required for the lot. When customers use more water than needed, they are given progressively expensive penalties (i.e. double or triple the normal rate, or more).

Implementation of budget-based rates requires significant up-front administrative costs for setup. In addition, it is a major undertaking to educate water customers to adapt to the new rate system. Use of water budget-based rate structures is not common due to the cost and effort required for implementation. Irvine Ranch Water District (IRWD), which switched to tiered budget-based rates in the early 1990s, saw a 61 percent reduction in average landscaping water use between 1992 and 2005. In addition, while the average water use in Orange County is 190 gallons per day (gpd) per person, IRWD customers use only 90 gpd per person.

According to IRWD's "Residential Runoff Reduction (R3) Study", prepared July 2004, weather-based irrigation controllers, which regulate landscape water use, resulted in water savings of 41 gpd in typical residential settings, or approximately 10 percent of total household water use, and 545 gpd for larger dedicated landscape irrigation accounts.

According to IRWD's "Is System Pressure Reduction a Valuable Water Conservation Tool?", prepared February 2003, a reduction in system pressure can significantly reduce residential water consumption, especially irrigation, without causing any significant costs in terms of increased customer complaints. In one of the treatment neighborhoods analyzed where pressure was reduced significantly by 17.6 percent, single-family consumption declined by 1.9 percent overall, and by 4.1 percent among those residences with greater-than-average landscapes.

Governor Schwarzenegger has proposed a plan to achieve a 20 percent reduction in per capita water use statewide by the year 2020. In March 2008 the State Water Resources Control Board organized the 20x2020 Agency Team to develop a plan to achieve a 20 percent reduction in per capita urban water use throughout California by 2020. The plan is anticipated for completion by the end of 2008. The plan, in conjunction with supporting legislation, may mandate water demand reductions through conservation. Since these proposals are preliminary they have not been incorporated in the water demand projections presented in this briefing paper, however, these proposals emphasize the need for water conservation measures described herein.

Reliability

Based on the “Handbook of Water Use and Conservation”, prepared by Amy Vickers in 2001, hardware measures are generally more reliable than behavior driven measures in achieving long-term water savings. Hardware measures typically need to be installed only once and do not require an ongoing effort to maintain water savings. For example, installation of a low-volume 1.6 gallon per flush (gpf) toilet to replace a leaking 3.5 gpf fixture will save considerable amounts of water over an operational life of at least 20 years without any additional effort beyond normal maintenance. In contrast, educating people to adopt low-water-use or native landscaping and irrigation practices, though essential to conserving outdoor water use, requires considerable time. In addition, ongoing reminders are necessary if these irrigation practices are to be maintained.

Costs

The cost effectiveness of conservation programs vary greatly. Water conservation savings and program costs reported for IRWD’s early programs, including implementation of a tiered budget-based rate structure, irrigation workshops, water audits, and water saving fixture rebates showed average costs of approximately $75 per acre foot of water saved in year 2008 dollars. These low costs were probably greatly influenced by the large amount of inefficient water use that existed prior to these programs because there had not been any significant conservation efforts. The costs reflect what at the time were easily attainable water savings. Achieving greater levels of conservation after these programs are implemented becomes progressively more difficult and more expensive.

Documentation available on the City of Santa Monica’s Ultra Low Toilet Retrofit Program shows costs of approximately $312 per acre foot of water savings in year 2008 dollars.

Environmental Issues

There do not appear to be any environmental issues associated with conservation measures. Installation of conservation saving devices would replace existing lower efficiency devices. Implementation of conservation programs would reduce water usage.

Energy Use and Greenhouse Gases

High efficiency devices, such as high efficiency clothes washers, use less energy. The implementation of conservation programs, such as a rebate program for high efficiency clothes washers, may reduce energy use throughout FMWD's service area, and reduce the amount of greenhouse gases.

Pros

Conservation can reduce the amount of water demands from local and imported water supplies. Conservation can be beneficial to member agencies which rely heavily on imported water supplies provided by FMWD during periods of MWD water shortages.

Cons

Conservation cannot act as independent sources of water supply and must be used in conjunction with other projects to increase reliability for member agencies during planned/unplanned shutdowns of FMWD facilities.

SECTION 8 – PARTNERSHIPS WITH OTHER AGENCIES/TRANSFERS

FMWD can obtain a new source of water supply by participation in the development of local resources with another agency. For discussion purposes, ocean desalination was chosen as the project for further analysis. FMWD can either enter into a take or pay contract to become a customer of a new ocean desalination plant, or FMWD can participate in funding the plant and obtain capacity as a project partner. It would be unfeasible to create the infrastructure for direct delivery of desalinated ocean water to FMWD's service area, but FMWD could exchange the desalinated ocean water with MWD for delivery of a like amount of water to FMWD.

An example of such a project is Poseidon Resources' proposed ocean water desalination plant along Carlsbad State Beach which received final approval from the California Coastal Commission in August 2008. The proposed $300 million plant will provide approximately 50 MGD of desalinated ocean waste. There are nine local water agencies in San Diego County which have already contracted to purchase the entire output of the proposed plant.

Reliability

Participation in an ocean desalination program does not result in new infrastructure for delivery of water to FMWD's service area and therefore does not increase the reliability of supply for FMWD during either a planned or an emergency shutdown of FMWD's facilities. Desalinated water would increase the reliability of FMWD's water supplies during a hydrological or regulatory shortage that reduced MWD's ability to provide water.

Through participation in an ocean desalination program, FMWD could exchange desalinated ocean water with MWD for delivery of exchanged water to FMWD. However, if MWD were to implement the recently approved, Shortage Allocation Plan during periods of water shortage. The benefit of participating in an ocean desalination program to protect FMWD against required shortage reductions would vary depending on the level of shortage called by MWD.

MWD's Shortage Allocation Plan includes two alternative calculations of the shortage allocation to each member agency to allow impacts on retail costumers and the local economy to be considered. The allocation method that would apply to FMWD is the Wholesale Minimum Allocation. The Wholesale Minimum Allocation calls for FMWD to reduce its MWD use by one and one-half times the shortage level declared by MWD. For example, if MWD declares a Level 2 or a 10 percent shortage. FMWD would be allocated 15 percent (10 percent x 1½) less than its base allocation. Table 6-1 and Table 6-2 present examples for two different shortage levels to illustrate the varying degree of protection participation in an ocean desalination program would provide FMWD at two different shortage levels under MWD's Shortage Allocation Plan.

These examples assume water supplies for FMWD, without participation in an ocean desalination program, consist of 9,000 AFY of local supplies and 12,000 AFY of MWD supplies and for comparison that FMWD would participate in an ocean desalination program to obtain 5,000 AFY, which would change FMWD's breakdown of water supplies to 14,000 AFY of local supplies and 7,000 AFY of MWD supplies.

Table 8-1 shows the reduction in MWD water use required for a 10 percent and a 40 percent shortage level, without participation in an ocean desalination program.

Table 8-1 Reductions in MWD Deliveries (No Participation in a Desalination Program)

Without Shortage Allocation					
FMWD Imported Water Allocation	12,000	AF	12,000	AF	[A]
FMWD Other Supplies	9,000	AF	9,000	AF	
Total	21,000	AF	21,000	AF	
With Shortage Allocation					
MWD Shortage Level	10%		40%		
MWD Wholesale Reduction	15%		60%		
FMWD Imported Water Allocation	10,200	AF	4,800	AF	[B]
FMWD Other Supplies	9,000	AF	9,000	AF	
Total	**19,200**	**AF**	**13,800**	**AF**	
(Reduction in Imported Water Allocation)	**1,800**	**AF**	**7,200**	**AF**	**[A] - [B]**

Table 8-2 shows the reduction in MWD water use required for a 10 percent and a 40 percent shortage level, assuming participation in an ocean desalination program for 5,000 AFY.

Table 8-2 Reductions in MWD Deliveries (5,000 AFY Participation in a Desalination Program)

Without Shortage Allocation			
FMWD Imported Water Allocation	7,000 AF	7,000 AF	[C]
FMWD Other Supplies	14,000 AF	14,000 AF	
Total	21,000 AF	21,000 AF	
With Shortage Allocation			
MWD Shortage Level	10%	40%	
MWD Wholesale Reduction	15%	60%	
FMWD Imported Water Allocation	5,950 AF	2,800 AF	[D]
FMWD Other Supplies	14,000 AF	14,000 AF	
Total	**19,950 AF**	**16,800 AF**	
(Reduction in Imported Water Allocation)	**1,050 AF**	**4,200 AF**	**[C] - [D]**

The tables show that for the assumed circumstances, at a 10 percent shortage level, FMWD would have to reduce its MWD water purchase by 1,800 AFY without participation in an ocean desalination program, but FMWD would only have to reduce its MWD water purchase by 1,050 AFY with participation in an ocean desalination program.

The tables also show that for the assumed circumstances at a 40 percent shortage level, FMWD would have to reduce its MWD water purchases by 7,200 AFY without participation in an ocean desalination program, but FMWD would only have to reduce its MWD water purchase by 4,200 AFY with participation in an ocean desalination program.

Costs

A feasibility report produced for the proposed Dana Point Desalination Project in 2007 estimated the total cost of desalinated water would be $1,584 per AF. The Monterey Peninsula Water Management District's evaluation of desalination project costs in 2008 estimated costs ranging from $1,520 to $2,920 per AF for projects with a capacity from 7.5 MGD to 20 MDG.

FMWD’s participation in a desalination plant would reduce the amount of overall imported water used, and therefore reduce the amount of imported water reductions imposed by MWD. According to available information regarding MWD’s water shortage allocation plan, MWD’s member agencies would need to pay the base rate and a penalty for any water exceeding imported water delivery allocations. The current planned penalty is two to four times the Tier 2 rate (or approximately $898 to $1,796 per AF). As discussed above, the cost to construct and operate a desalination plant may range from $1,520 to $2,920 per AF. Since penalties would be occasional and desalination costs would be continuous, desalination costs are significantly more than drought penalties under the current water shortage allocation plan.

However, MWD’s rates continue to increase and developing a partnership with an agency where water is transferred to FMWD on a regular basis may be beneficial when comparing costs. A decision to partner with another entity on a local resource development project would need to be made on a case-by-case basis depending on the cost of the project and projected MWD rates.

Institutional Issues

Any partnering where supplies are exchanged on paper rather than physically moved through MWD’s distribution system will require either modifications to MWD’s Tier 1 contract for FMWD and the partnering agency or adding service connection FM-1 as a point of delivery to the partnering agency for “in-lieu” deliveries of Tier 1 water. Should MWD not be willing to accept either option or another creative option, FMWD would need to pay the wheeling rate to move the water it has paid to have developed.

Spot transfers are also an option from Northern or Central California and even possibly entities along the Colorado River which can be wheeled through MWD’s system. However, this past year, MWD has had difficulties obtaining transfers and the cost has been higher than originally anticipated. The Governor’s Drought Water Bank has been established and there is a preference that entities go through the Bank to purchase water. One requirement of the Bank is that entities be in a 20 percent reduction mode to qualify for a transfer. Additionally, should FMWD pursue transfers on its own, it is competing against MWD and likely raising the price of the transfer water. At this point, it is not recommended that FMWD pursue this type of transfer.

Environmental Issues

Depending on the project, environmental issues may vary. For this example, there are significant environmental issues associated with an ocean desalination plant, such as marine and aquatic life impacts. Approval of the construction and operation of an ocean desalination facility may include an extensive permitting process through various federal, state, and local agencies.

Energy Use and Greenhouse Gases

Depending on the project, energy use and greenhouse gas emissions will vary. For this example, the operation of an ocean desalination plant is an energy intensive process and may continuously contribute to greenhouse gases.

Pros

Partnering with another agency will allow FMWD to obtain more supply reliability and in the long-run may lower the costs of water in comparison to purchasing from MWD.

Cons

Partnering with another entity does not solve the reliability issue during shutdowns and emergencies since MWD's distribution system will need to be used to move the water to FMWD.

SECTION 9 - INTERCONNECTIONS

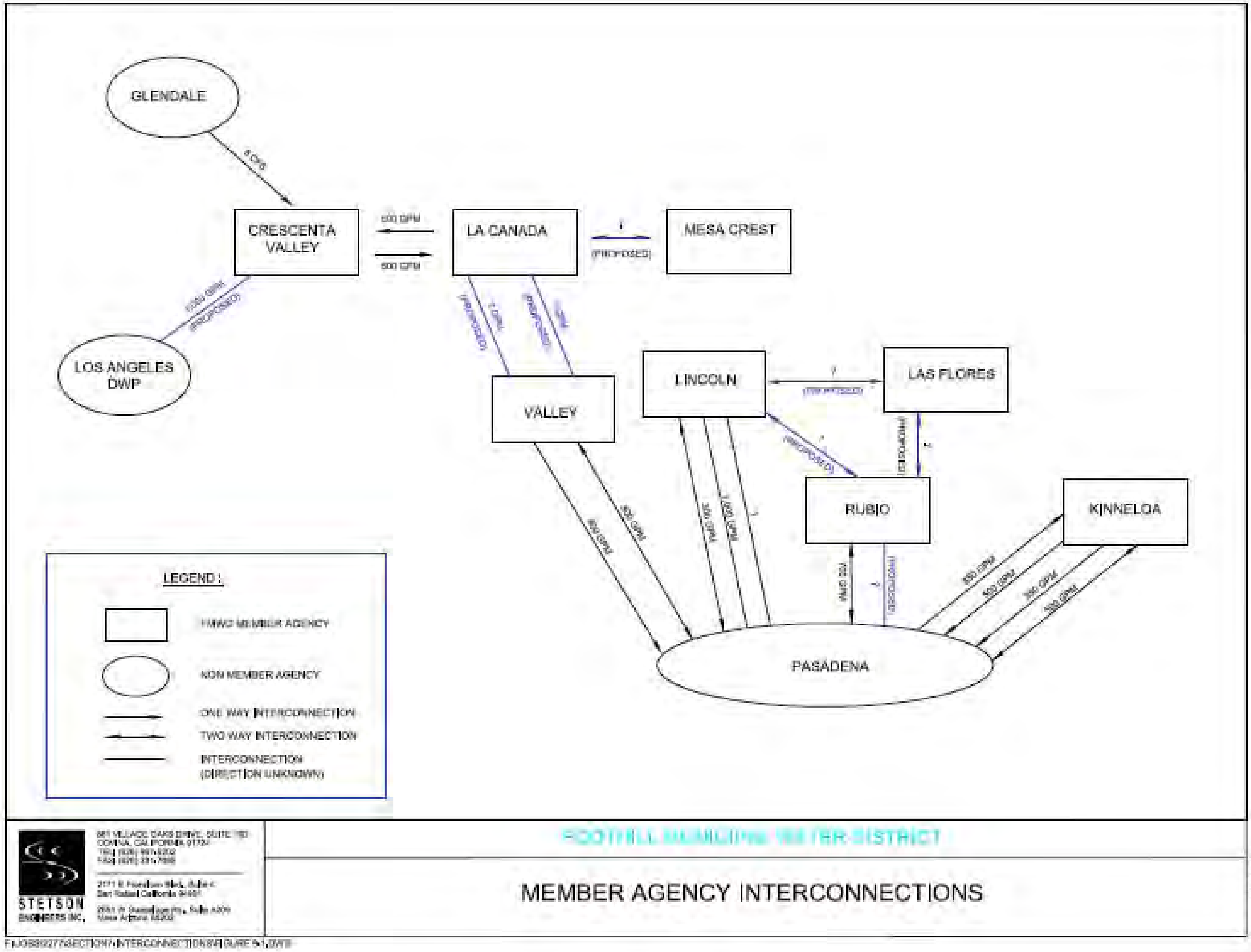
Emergency interconnections are distribution system connections between water purveyors for use during critical situations where one system is temporarily unable to provide sufficient potable water to meet minimum health and/or fire protection needs. An emergency interconnection will allow a water purveyor to continue serving water during critical situations such as local water supply shortages as a result of earthquakes, fires, prolonged power outages, and droughts. FMWD member agencies can increase water supply reliability by constructing additional proposed future emergency interconnection with other agencies.

FMWD has two emergency water interconnections with the City of Pasadena. One can provide a flow of 10 cfs to FMWD. The second connection provides water to Pasadena. In addition, FMWD's member agencies have interconnections with one another and outside agencies, as shown in Figure 9-1.

Proposed Interconnections

Additional interconnections will increase water supply reliability for the member agencies during emergency situations or planned/unplanned shutdowns of imported water supplies delivered through FMWD facilities. Proposed interconnections were identified through discussion with FMWD member agency staff and from the 2007 FMWD Master Plan. These proposed interconnections within FMWD's service area are also shown in Figure 9-1.

A recently completed interconnection between Crescenta and Los Angeles Department of Water and Power (LADWP) will allow Crescenta to obtain up to 1,000 gpm during emergency situations. However, LADWP staff has indicated the interconnection with Crescenta is located near the edge of LADWP's service area and it is unlikely any significant additional capacity is available for interconnections between Crescenta and LADWP without significant improvements to LADWP's system.



FOOTHILL MUNICIPAL WATER DISTRICT

MEMBER AGENCY INTERCONNECTIONS

FIGURE 9-1

Reliability

Interconnections increase reliability of member agencies during emergency situations or planned/unplanned shutdowns of imported water supplies.

Interconnections with multiple agencies can be beneficial to member agencies which rely heavily on imported water supplies provided by FMWD. However, interconnections cannot act as independent sources of water supply and must be used in conjunction with conservation and other projects to increase reliability for member agencies during planned/unplanned shutdowns of FMWD facilities.

The proposed interconnections (indicated by member agencies' staff and the 2007 FMWD Master Plan) between La Cañada and Mesa Crest, La Cañada and Valley, Lincoln and Las Flores, Las Flores and Rubio, Rubio and Pasadena, and Rubio and Lincoln will increase FMWD member agency reliability during a planned shutdown of FMWD's imported water facilities.

In addition to the previously identified proposed interconnections, this Briefing Paper recommends the capacity of Crescenta's existing interconnection to La Cañada may need to be increased, or an additional interconnection may be needed. La Cañada, which relies on a relatively large amount of imported water supplies, can currently obtain some water from Crescenta Valley during a shutdown of FMWD's existing MWD interconnection. Crescenta Valley has recently constructed a 5 cfs interconnection with Glendale, and will be able to obtain up to 1,000 gpm with a new interconnection with LADWP. These interconnections, along with Crescenta Valley's groundwater wells in the Verdugo Basin, may allow Crescenta Valley to provide some additional water to La Cañada to increase reliability during planned or unplanned shutdowns of FMWD's system.

This Briefing Paper also recommends that an interconnection between Mesa Crest and La Cañada may increase reliability. Mesa Crest, which is entirely dependent on imported water supplies, has proposed an interconnection with La Cañada to obtain some water during a shutdown of FMWD's existing MWD interconnection.

Valley has an 800 gpm interconnection from Pasadena, has recently completed an interconnection with La Cañada and has proposed another interconnection with La Cañada. These interconnections, along with Valley's groundwater production wells, may allow Valley to provide some additional water to La Cañada to increase reliability.

Existing and proposed interconnections can increase reliability during planned shutdowns of FMWD's system. However, based on discussion with member agencies, interconnections will not provide sufficient supplies during extended shutdowns and emergency periods for member agencies which significantly depend on imported water supplies.

Costs

Costs depend on the location of the connection and the amount of piping and other appurtenant facilities needed to construct the interconnection.

Environmental Issues

There do not appear to be significant environmental issues associated with the installation of new interconnections. Interconnections would be installed on existing streets.

Energy Use and Greenhouse Gases

There does not appear to be any significant energy use or contribution to greenhouse gases associated with the installation of new interconnections.

Pros

In many instances, an interconnection is a cost-efficient method of increasing reliability during a shutdown or emergencies. In addition to the previously identified proposed interconnections, Crescenta’s existing interconnection to La Cañada may need to be increased, or an additional interconnection may be needed, and a new interconnection between Mesa Crest and La Cañada may increase reliability.

Cons

Not enough capacity has been identified through interconnections to sustain agencies during an extended shutdown or emergency. For the most part, service from an interconnection would be secondary to the needs of the agency providing the water. If the agency does not need the water or has enough capacity to provide the water during a shutdown or emergency, then it will. Otherwise, the agency receiving the water has no benefits from the interconnection.

SECTION 10 – DEBRIS BASINS

Debris basins are typically located at the mouth of canyons where rainfall runoff is concentrated and as a result, are potential areas to capture and retain runoff for groundwater recharge. By modifying existing debris basins into recharge basins, these basins can retain and recharge water which otherwise would flow to the ocean.

Geomatrix's "Final Report Verdugo Basin Groundwater Recharge, Storage, and Conjunctive Use Feasibility Study", prepared May 2005, analyzed the use of debris basins for groundwater recharge. Debris basins reviewed include the Verdugo Debris Basin and the Pickens and Dunsmuir Debris Basins based on large tributary areas and flows. Proposed increased maintenance for these debris basins and outlet structures included removal of debris, the regrading of berms, and scarification of the basin bottom which will require heavy construction equipment and debris hauling. The Geomatrix report used a percolation rate of 1 foot per day along with hydrologic data on monthly average rainfall capture and percentage (75 percent) usable area for recharge to model the expected recharge volumes for the debris basins.

Based on information from the Geomatrix report, the recharge capacity of debris basins within the Raymond Basin can be estimated for this conceptual level screening of water supply sources. A simple analysis of six existing debris basins (including Bigbrier, Cooks, Gould, Upper Gould, Halls, and Lincoln) located in the Monk Hill Subarea of the Raymond Basin was conducted to determine the possible volumes that could be recharged. The analysis also makes use of data developed in the Los Angeles County Department of Public Works "Hydrologic Report" of 1992-1993 regarding sizes and capacities of the six basins. Although the hydrologic data used for the Geomatrix Report is not available for the analysis of the Monk Hill Subarea basins, assumptions were made to prorate the extra days of retention based on the relative sizes of the surface areas of the debris basins. Based on these assumptions, the estimated average recharge for the six debris basins analyzed is approximately 30 AFY per debris basin in the Raymond Basin.

Reliability

Debris basins can provide additional recharge water into the Raymond Basin, which may increase the amount of Decreed Rights for FMWD member agencies. This additional water may provide increased reliability to member agencies during planned and unplanned shutdowns of FMWD facilities. However, this additional water may not be sufficient to act as an independent source of water supply and must be used in conjunction with conservation and other projects to increase reliability for member agencies during planned/unplanned shutdowns of FMWD facilities. In addition, similar to spreading diverted surface water, member agencies may only be able to recapture up to 80 percent water recharged from the debris basins.

Although the debris basins can be maintained to allow increased recharge, there are no available studies to determine the ability to produce water recharged in these areas. Additional studies would be required to determine how much net water would be saved as a result of maintenance. Safe yield studies to determine the impact of groundwater recharge from the debris basins into the Raymond Basin may also be required.

Groundwater recharge of debris basin water may allow member agencies to pump groundwater in excess of their existing pumping rights. However, member agencies may need to add well capacity to extract this additional groundwater. In addition, member agencies may need to add treatment if groundwater contamination is present.

Costs

Proposed improvements to the Verdugo Debris Basin were estimated by Geomatrix to cost $300,000 with an annual O&M cost of $242,000. Proposed improvements to the Pickens and Dunsmuir Debris Basins were estimated by Geomatrix to cost a total of $308,000 with an annual total O&M cost of $352,000. On average, the total annualized cost (6 percent over 30 years) for improvements plus annual maintenance costs per debris basin is approximately $320,000 per year. Based on an annual average yield of approximately 30 AFY per debris basin in the Raymond Basin, the estimated cost of water recharged by improved debris basins is approximately $10,700 per AF. Based on an estimated recharge rate of 30 AFY per debris basin in the Raymond Basin, and assuming 15 debris basins within the Monk Hill Subarea can be improved, the total Raymond Basin recharge capacity from debris basins is potentially 450 AFY.

The Geomatrix report indicates a recharge capacity of the Verdugo Debris Basin (into the Verdugo Basin) of approximately 430 AFY and a recharge capacity of the Pickens and Dunsmuir Debris Basins (into the Verdugo Basin) of approximately 110 AFY. The debris basins in the Verdugo Basin can recharge more water per basin than the debris basins in Raymond Basin due to their larger sizes and their location. In addition, the Verdugo Debris Basin allows capture of some residential runoff in addition to runoff from unimproved hill sides. The greater yield of the debris basins in the Verdugo Basin results in costs per acre foot of water recharged lower than in the Raymond Basin. The estimated cost of water recharged by the improved Verdugo Basin debris basins ranges from approximately $750 per AF to $2,900 per AF.

Institutional Issues

Coordination will be required with Los Angeles County Department of Public Works, the Watermasters of the respective groundwater basins, California Department of Fish and Game (DFG) and United States Fish and Wildlife Service (USFW).

Environmental Issues

The proposed maintenance of the debris basins may be regulated by environmental permits from the DFG and USFW. In addition, maintenance requires ponding of surface water in existing debris basins; creating potential wildlife habitat and increased vegetation growth. The proposed maintenance also includes more-frequent grading and clearing of vegetation on debris basin bottoms and sides than currently occurs. As a result, the permitting requirements will include modifications to the existing maintenance permits issued by DFG, which currently limits the maintenance within the debris basins to protect established wildlife and vegetation. The permits limit maintenance activities to specific agreed-upon areas and timing. Additionally, debris accumulation must meet a certain threshold before it can be removed.

Energy Use and Greenhouse Gases

On-going maintenance of debris basins will lead to removal of debris and cleanup of debris basins on an annual basis. The hauling of debris may contribute to greenhouse gases.

Pros

The expansion of the use of the debris basins will increase the recharge of the groundwater basins and yield from those groundwater basins. The debris basins overlying the Verdugo Basin may be more cost effective to develop and have less environmental constraints.

Cons

The costs for expansion of the debris basins overlying the Raymond Basin is high. There may be significant environmental issues associated with the modification and maintenance of the debris basins .

SECTION 11 - SUMMARY

At the March 24, 2008 meeting, FMWD's Board developed the following matrix to preliminarily rate the various resource alternatives.

Weighting	1	0.9	0.9	1	0.8	
	Emergency Reliability	**Rate Mitigation**	**Reliability of Infrastructure**	**Supply Shortage (Drought)**	**Other Challenges**	**Priority**
Recycled Water	3		4	6	5	16.6
Groundwater	6		5	5	2	17.1
Transfers	1		1	4	3	8.3
San Gabriel Pipeline	4		2	1.5	1	8.1
Conservation	2		3	3	6	12.5
Interties	5		6	1.5	4	15.1

The resource alternative is shown in the first column on the left. The second from the top row reflects the various needs that FMWD would like addressed with the resource alternative. "Emergency Reliability" is for emergency outages on both the imported water system and on FMWD's system. The "Rate Mitigation" category was not completed but means in comparison to MWD's rates, which alternatively provides for lower costs and/or rates. "Reliability of Infrastructure" is for overall operational reliability, versatility and for flexibility during replacement of pipelines and other infrastructure. "Supply Shortage" is based on imported water supply shortages where more reliability would occur with the development of a particular supply alternative. "Other Challenges" is challenges such as institutional, legal, environmental, etc. Each category is ranked from 1 through 6 with number 1 being the lowest in meeting the category requirement and number 6 being the highest. The weighting of each need is shown on the top row above the need. The total of the ranking and weighting is shown in the column furthest to the right.

Stetson has modified or added additional water resources and further broken down the categories. Based on review of the alternative water supplies discussed in this Briefing Paper, Stetson has revised some of the preliminary ratings in the matrix above. A summary of the project alternatives, including costs and potential yields for each project, is provided below to facilitate the screening process. In addition, preliminary scorings for environmental issues and reliability have been included. Consideration should be given at the workshop to weighing all the criteria.

Weighting	1	0.9	0.9	1	1	0.9	0.8	
	Emergency Reliability	**Rate Mitigation**	**Reliability of Infrastructure**	**Supply Shortage (Drought)**	**Environmental Impacts**	**Energy Use Greenhouse Gases**	**Other Challenges**	**Priority**
Second MWD Interconnection	3	1	3	1	4	2	3	15.8
Recycled Water	4	5	4	6	3	3	5	27.8
Groundwater	6	3	5	5	5	4	2	28.4
Partnering/Transfers (Desalination)	1	4	1	5	3	3	3	18.6
San Gabriel Pipeline	4	2	3	1	3	2	1	15.1
Conservation	2	4	2	3	6	6	5	25.8
Interties	4	5	4	1	5	4	4	24.9
Debris Basins	3	4	2	3	3	5	2	20.5

The rankings in red are those that Stetson has added or changed as a recommendation. Based on these rankings, there is no one solution to the problem. However, there are some water resource alternatives that rise to the top for more detailed evaluation, including:

1. Developing recycled water for reliability due to a drought or regulatory event. The development of recycled water will require partnership and coordination with several entities but will increase the reliability of Foothill's agencies significantly. Public outreach will also need to be done to ensure the successful completion of project(s). It appears that over time, recycled water will be cheaper than Metropolitan water.

2. Developing facilities to optimize groundwater resources for shutdowns and emergencies. This development of additional facilities would need to be done working with member agencies. Ideally additional well capacity could be added in either the Monk Hill Basin or the Verdugo Basin where water quality meets California Department of Public Health (CDPH) standards. During a shutdown or emergency, this water would be put into Foothill's distribution system and delivered to those agencies that need water. The water could be the retail agencies adjudicated rights that are produced from the well or could be an exchange of water that is pre-stored or returned through imported water deliveries once the emergency or shutdown is over. This operation would need to be vetted through CDPH to ensure that it meets their requirements without adding significant costs to FMWD operations and water quality testing.

   In addition retail agencies should look into additional well capacity and also wellhead treatment for contaminants so that an agency can sustain a shutdown or emergency outage. Because of brine disposal issues, bioremediation should be reviewed as an appropriate treatment. There should be an investigation of whether it would be more advantageous for Foothill to spearhead the treatment of groundwater and work on a contractual basis with retail agencies to operate the system(s).

3. Developing more interconnections or increasing the size of interconnections so that agencies may sustain a shutdown or emergency outage for a short length of time. Look into adding another interconnection with Pasadena for emergencies.

4. Increasing conservation for supply reliability. This would entail developing a process for FMWD and the retail agencies to provide outreach and funding for more conservation. The funding could be developed through identifying grants for conservation and partnering with Metropolitan.

If sufficient funds for evaluating additional alternatives are available, the following options might also provide water supply reliability benefits:

1. Explore partnerships with other agencies or water transfers on a case-by-case basis as they arise to determine if the opportunity increases FMWD's reliability at a reasonable cost.

2. Supporting Crescenta Valley in any efforts to modify debris basins in the Verdugo Basin to recharge storm water.

Additionally, the following recommendations are made:

1. Although the San Gabriel Valley Pipeline Phase III project should not be pursued, the Raymond Basin Watermaster has put into the FWC study being performed with the Army Corps of Engineers the feasibility of expanding the capacity at the Arroyo Spreading Grounds. FMWD should support this aspect of the study and negotiate with the Watermaster and the City of Pasadena on this process recognizing that the Monk Hill Producers are paying for the San Gabriel Valley Pipeline project through their groundwater assessments.

2. The second connection due to costs and inadequate benefits should be dropped from further consideration.

The Board at its workshop in October 2008 had an opportunity to revisit the rankings and make its own decisions on the values assigned to each water resource alternative/need. They agreed with the rankings provided by Stetson. Additionally, the Board agreed with the recommendations as listed above. In November 2008, the Board directed staff to:

1. Proceed with a study for FMWD interconnections with the City of Pasadena.
2. Hire John Morris to assist in applying for a State Water Resources Control Board planning grant for recycled water, and
3. Meet with member agencies to continue to refine the concept of introducing groundwater into FMWD's distribution system.

The Board felt that at this point, FMWD should wait to proceed with developing a formal conservation program until the results of the 20X2010 process and a region-wide conservation program to be possibly developed by Los Angeles County Integrated Regional Water Management Plan are known. However, it continues to support conservation through FMWD efforts with the FWCC and the member agencies.

Additionally, FMWD's member agencies felt that they would be able to develop interconnections without the need of any further studies and will proceed in that direction as opportunities occur.

Appendix A

Reclaimed Water Facility Cost Estimates

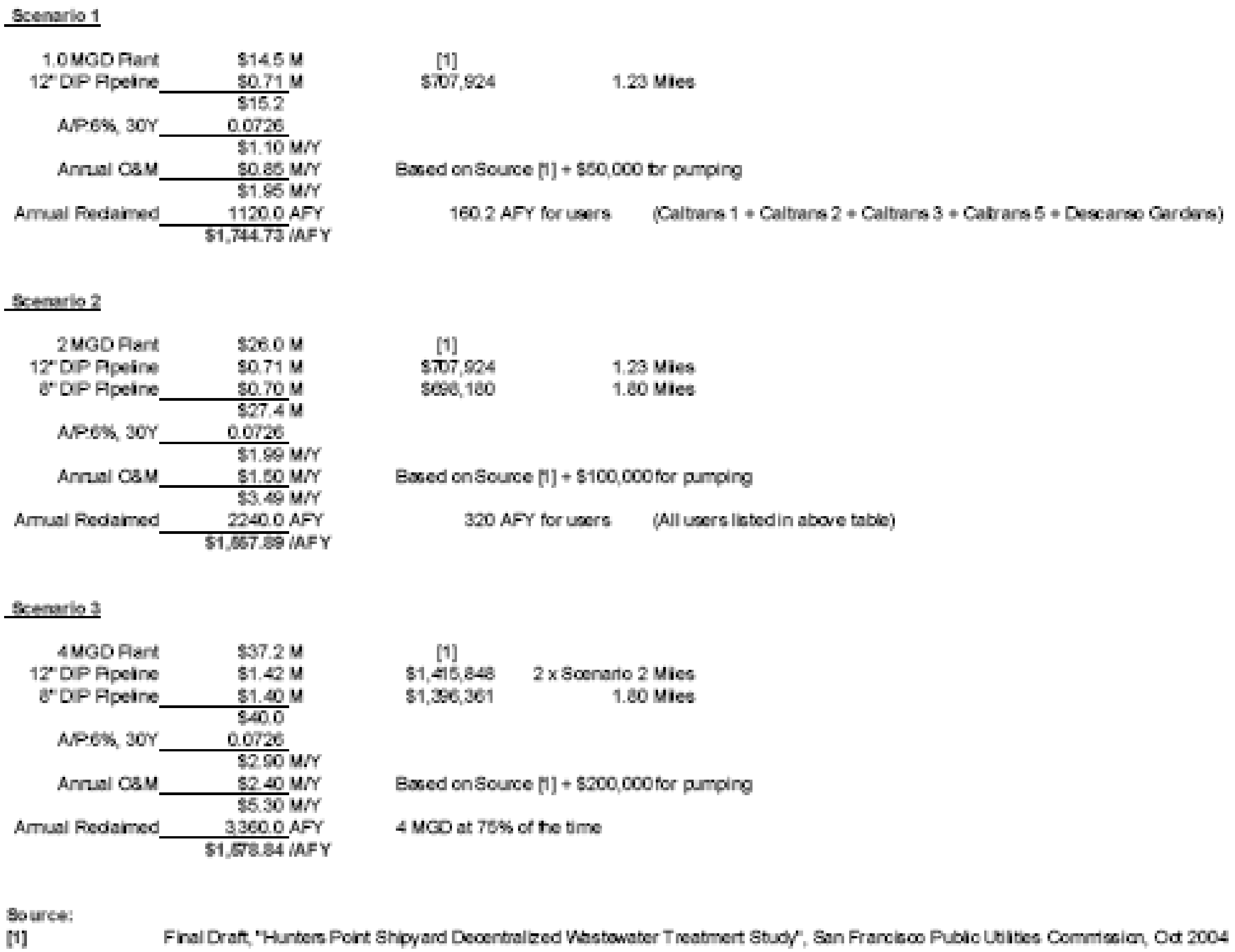
RAYMOND BASIN - MONK HILL SUBAREA
Reclaimed Water Facility Cost Estimates

Basin Name	Peak Flowrate (MGD)	Average Flowrate (MGD)	Average Flowrate (AFY)	
District 2	1.86	0.531	596	
District 3B	1.35	0.386	432	
TOTALS	3.210	0.917	1,028	
Users				
Caltrans 1	0.151	0.020	22.6	
Caltrans 2	0.288	0.038	43.0	
Caltrans 3	0.249	0.033	37.2	
Caltrans 4	0.203	0.027	30.4	
Caltrans 5	0.217	0.029	32.4	
Caltrans 6	0.227	0.030	34.0	
Descanso Gardens	0.167	0.022	25.0	
Flintridge Riding Club	0.231	0.031	34.6	
La Canada USD	0.407	0.054	60.8	8
TOTALS	2.141	0.285	320.0	

Interceptor peak = 3.5 average flow
(per Metcalf & Eddy)

ADD x 2.5 = MDD
MDD x 3 = MPH
(per Arcadia Recycled Water Report)

	Trenching	Pipe	Bedding	Demolition	Resurface	Disposal	Misc Costs	Project Burden	
	G 1030 807-13	33 11 13.15	G 1030 815	02 41 13.17-5050	32 11 23.23	0100; 32 1			
8" DIP	$4.87	$34.02	$2.86	$2.53	$13.63	$1.00	$5.00	15%	$73.49 /LF $388,041 /Mile
	Trenching	Pipe	Bedding	Demolition	Resurface	Disposal	Misc		
	G 1030 807-14	33 11 13.15	G 1030 815	02 41 13.17-5050	32 11 23.23	0100; 32 12	16.13-0200,-0480		
12" DIP	$10.45	$46.98	$7.47	$3.38	$18.18	$1.25	$7.00	15%	$108.91 /LF $575,062 /Mile



Scenario 1

1.0 MGD Plant	$14.5 M	[1]		
12" DIP Pipeline	$0.71 M	$707,924	1.23 Miles	
	$15.2			
A/P.6%, 30Y	0.0726			
	$1.10 M/Y			
Annual O&M	$0.85 M/Y	Based on Source [1] + $50,000 for pumping		
	$1.95 M/Y			
Annual Reclaimed	1120.0 AFY	160.2 AFY for users		(Caltrans 1 + Caltrans 2 + Caltrans 3 + Caltrans 5 + Descanso Gardens)
	$1,744.73 /AFY			

Scenario 2

2 MGD Plant	$26.0 M	[1]		
12" DIP Pipeline	$0.71 M	$707,924	1.23 Miles	
8" DIP Pipeline	$0.70 M	$698,180	1.80 Miles	
	$27.4 M			
A/P.6%, 30Y	0.0726			
	$1.99 M/Y			
Annual O&M	$1.50 M/Y	Based on Source [1] + $100,000 for pumping		
	$3.49 M/Y			
Annual Reclaimed	2240.0 AFY	320 AFY for users		(All users listed in above table)
	$1,557.89 /AFY			

Scenario 3

4 MGD Plant	$37.2 M	[1]	
12" DIP Pipeline	$1.42 M	$1,415,848	2 x Scenario 2 Miles
8" DIP Pipeline	$1.40 M	$1,396,361	1.80 Miles
	$40.0		
A/P.6%, 30Y	0.0726		
	$2.90 M/Y		
Annual O&M	$2.40 M/Y	Based on Source [1] + $200,000 for pumping	
	$5.30 M/Y		
Annual Reclaimed	3,360.0 AFY	4 MGD at 75% of the time	
	$1,578.84 /AFY		

Source:

[1] Final Draft, "Hunters Point Shipyard Decentralized Wastewater Treatment Study", San Francisco Public Utilities Commission, Oct 2004

WATER RECYCLING FACILITIES PLANNING/PROJECT REPORT

FOOTHILL MUNICIPAL WATER DISTRICT

January 27, 2012

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LIST OF ABBREVIATIONS

AF – acre-foot or acre-feet
AFY - acre-feet per year
Avg - Average
BMPs - Best Management Practices
Ccf – hundred cubic feet
CDPH - California Department of Public Health
CECs- Emerging Constituents/Constituents of Emerging Concern
Cf – cubic feet
cfs - cubic feet per second
CMLC - cement mortar lined and coated
Crescenta Valley – Crescenta Valley Water District
CTC - carbon tetrachloride
CVWD – Crescenta Valley Water District
Dep - deposit
Ea - Each
Eff. - effective
FHCUP - Foothill Conjunctive Use Project
FMWD – Foothill Municipal Water District
FY – fiscal year
Glendale - City of Glendale
gpm - gallons per minute
GWP - City of Glendale Water & Power
IRP - Integrated Water Resources Plan
JPL - Jet Propulsion Laboratory
JWPCP - Joint Water Pollution Control Plant
KID – Kinneloa Irrigation District
Kinneloa – Kinneloa Irrigation District
La Cañada – La Cañada Irrigation District
LACSD - County Sanitation Districts of Los Angeles County
LAGWRP - Los Angeles-Glendale Water Reclamation Plant
LARWQCB - California Regional Water Quality Control Board, Los Angeles Region
Las Flores – Las Flores Water Company
LAWC – Lincoln Avenue Water Company
LCID – La Cañada Irrigation District
LFWC – Las Flores Water Company
Lincoln – Lincoln Avenue Water Company
MAF – million acre-feet
Max - Maximum
MCL - Maximum contaminant level

Mesa Crest – Mesa Crest Water Company
MG - million gallons
μg/l - micrograms per liter
mg/l - milligrams per liter
Min - Minimum
Mo - month
MUN - municipal supply
MWD – Metropolitan Water District of Southern California
NDMA - N-nitrosodimethylamine
NPDES - National Pollutant Discharge Elimination System
NTU - nephelometric turbidity units
O&M - Operations and Maintenance
Pasadena - City of Pasadena
PAYG - pay as you go
PCE - tetrachloroethylene
PPM - Parts per million
PUSD – Pasadena Unified School District
RCL&WA – Rubio Canon Land and Water Association
ROW – Rights-of-Way
RTS - Readiness-to-Serve charge
Rubio – Rubio Cañon Land and Water Association
RWC - Recycled Water Contribution
RWQCB - Regional Water Quality Control Board
SAT – Soil Aquifer Treatment
SJCWRP - San Jose Creek Water Reclamation Plant
SWRCB - State Water Resources Control Board
TAF - thousand acre-feet
TCE - trichloroethylene
TDS - Total dissolved solids
TOC - total organic carbon
ULARA - Upper Los Angeles River Area
UV - Ultraviolet
Valley – Valley Water Company
VOCs - Volatile organic compounds
VPWTP - Verdugo Park Water Treatment Plant
VWC – Valley Water Company
Weymouth – F.E. Weymouth Treatment Plant
WNWRP - Whittier Narrows Water Reclamation Plant
WSDM - Water Surplus and Drought Management
Yr - Year

A. INTRODUCTION

A-1. Introduction

Foothill Municipal Water District (FMWD) was formed in 1952 for the purpose of enabling its various member agencies to obtain supplemental water from the Metropolitan Water District of Southern California (MWD). The current member agencies of FMWD include:

1) Crescenta Valley Water District (Crescenta Valley)
2) Kinneloa Irrigation District (Kinneloa)
3) La Cañada Irrigation District (La Cañada)
4) Las Flores Water Company (Las Flores)
5) Lincoln Avenue Water Company (Lincoln)
6) Mesa Crest Water Company (Mesa Crest)
7) Rubio Cañon Land and Water Association (Rubio)
8) Valley Water Company (Valley)

The FMWD service area and each of its retail agencies are shown on Figure A-1.

Prior to joining MWD, FMWD member agencies relied on local supplies, primarily groundwater from the Verdugo and Raymond basins, a small amount of surface runoff from local mountains to meet the water demands of their customers, and imported water through interconnections with the City of Pasadena. Approximately 60 percent of water demands within FMWD are now met with imported water. Drought and environmental constraints on pumping water from the Sacramento/San Joaquin Delta have led to what is anticipated to be a long term reduction in imported water supplies available to Southern California. In response to the potentially limited future supply of imported water and the relative cost of imported water, FMWD has developed a local water supply program to improve long-term water supply reliability to its service area including development of a recycled water program. FMWD has retained engineering, financial, and other consultants to evaluate the feasibility of developing up to three satellite recycled water facilities; one near the Arroyo area of its service area, one more towards the west side of its service area in the Verdugo Basin and the third towards the eastside of its service in the Eaton Canyon area. The recycled water will be used for irrigation of large landscapes, such as Caltrans freeway medians, parks and sports fields, as well as recharging groundwater basins.

This Water Recycling Facilities Planning/Project Report is being prepared to evaluate the feasibility of using recycled water to offset the use of imported water. This report, partially funded by a grant ($75,000) from the State Water Resources Control Board, addresses the Arroyo, Verdugo Basin, and Eaton Canyon areas of FMWD's recycled water program.

A-2. Study Area

The Study Area for this assessment is separated into three separate hydrologic areas: (1) the Verdugo Basin Study Area, (2) the Arroyo Study Area, and (3) Eaton Canyon Study Area. The Verdugo Basin Study Area includes the service areas of FMWD member agencies within the Verdugo Basin watershed, including Crescenta Valley and portions of La Cañada. The Arroyo Study Area includes the service areas of FMWD member agencies within the Monk Hill subarea of the Raymond Basin, including Las Flores, Lincoln, Mesa Crest, Rubio, Valley, and the remaining portions of La Cañada. The Eaton Canyon Study Area includes the service area of Kinneloa, located within the Pasadena subarea of the Raymond Basin. Figure A-2 shows the locations of the Verdugo Basin watershed and Raymond Basin. Additional discussion of these areas is provided in Section B. Figure A-3 shows the locations of the FMWD member agencies and their relationship to the study areas.

B. STUDY AREA CHARACTERISTICS

B-1. Hydrologic Features.

B-1.1 Raymond Basin

The Raymond Basin is located in Los Angeles County about 10 miles north-easterly of downtown Los Angeles. The Raymond Basin is a wedge shaped area in the northwesterly portion of the San Gabriel Valley and is bounded on the north by the San Gabriel Mountains, on the west by the San Rafael Hills and is separated from the Main San Gabriel Basin on the southeast by the Raymond Fault. The Raymond Basin is divided into an eastern unit, which is the Santa Anita subarea, and the Western unit which is the Pasadena subarea and the Monk Hill subarea. The locations of the Monk Hill subarea, which includes the Arroyo Study Area, and the Pasadena subarea, which includes the Eaton Canyon Study Area, are shown in Figure A-2. The surface area of the Raymond Basin is about 40.9 square miles. Average precipitation in the Basin was about 16.1 inches during fiscal year (FY) 2008-09 and about 24.6 inches during FY 2007-08, with a 50-year mean of about 23.8 inches. Figure B-1 shows the historic rainfall for water years 1989-90 through 2008-09 using data from the Descanso Gardens rainfall station (Station No. 1071B), which is representative of the Basin. The principal streams in the Raymond Basin are the Arroyo Seco, Eaton Wash and Santa Anita Wash. The Arroyo Seco flows to the Los Angeles River, while Eaton Wash and Santa Anita Wash flow to the Rio Hondo, a tributary of the San Gabriel River.

B-1.2 Verdugo Basin

The Verdugo Basin is a groundwater basin with a surface area of approximately 5,000 acres located in the Crescenta Valley between the San Gabriel Mountains and the Verdugo Mountains. The Verdugo Basin is shown in Figure A-2 and Figure A-4. The Verdugo Basin is relatively small in area and relatively steeply sloping. MWD's "2007 Groundwater Assessment Study" indicates historic annual precipitation between 1949 and 2003 in the Verdugo Basin has ranged from 8.95 inches to 55.16 inches, with a long-term average of 23.37 inches.

B-2. Groundwater Basins (including quantities extracted by all users, natural and artificial recharges, losses by evapotranspiration, inflow and outflow of basins, and safe yield or overdraft).

B-2.1 **Raymond Basin**

The Raymond Basin is a groundwater basin with a surface area of approximately 40 square miles that extends from La Cañada Flintridge and the San Rafael Hills to the west, the San Gabriel Mountain foothills to the north, the Santa Anita Canyon to the east, and the Raymond Fault to the south. The western area of the Raymond Basin, which includes the Arroyo Study Area, is shown in Figure A-2. The groundwater basin is recharged by the Arroyo Seco, a tributary to the Los Angeles River, and by Eaton Wash, Santa Anita Wash, and other streams in the San Gabriel River watershed. Pumping rights to the Raymond Basin are adjudicated and are managed by the Raymond Basin Management Board. Sixteen parties have rights to pump from the Raymond Basin, which is separated into three major subareas: the Monk Hill Subarea, the Pasadena Subarea, and the Santa Anita Subarea.

Decreed rights for each of FMWD’s member agencies and the average, minimum, and maximum allowable extractions and water production over the ten year period from FY 2001-02 to FY 2010-11 are provided in Table B-1 for each member agency in the Monk Hill Subarea. Totals are provided in Table B-2 for Kinneloa’s pumping in the Pasadena Subarea.

Table B-1 Member Agency Extractions in the Monk Hill Subarea (Acre-feet per Year (AFY))

		"Decreed Right 1955"	Net Leases	Allowable Extraction	Amount Extracted	Balance
La Cañada Irrigation District	10 Yr Avg [1]	100.0	(10.7)	108.1	103.7	4.5
	Min	100.0	(75.0)	15.6	15.6	0.0
	Max	100.0	0.0	273.6	273.6	10.0
Las Flores Water Company	10 Yr Avg [1]	249.0	(18.1)	324.6	318.0	6.7
	Min	249.0	(125.0)	204.3	192.7	0.0
	Max	249.0	0.0	419.0	419.0	24.9
Lincoln Ave Water Company	10 Yr Avg [1]	567.0	877.2	1,624.2	1,633.6	(9.4)
	Min	567.0	0.0	793.1	761.5	(273.5)
	Max	567.0	2,000.0	2,678.3	2,951.8	56.7
Rubio Cañon Land & Water Assn.	10 Yr Avg [1]	1,221.0	0.0	1,442.2	1,373.4	68.8
	Min	1,221.0	0.0	1,212.9	1,090.8	(19.8)
	Max	1,221.0	0.0	1,688.1	1,661.7	122.1
Valley Water Company	10 Yr Avg [1]	797.0	30.5	1,292.4	1,244.9	47.6
	Min	797.0	(28.2)	909.8	909.8	0.0
	Max	797.0	48.9	1,558.3	1,478.6	79.7
Monk Hill Subarea	10 Yr Avg [1]	7,489.0	0.0	6,331.8	5,164.5	1,167.3
	Min	7,489.0	0.0	4,740.6	3,863.8	252.6
	Max	7,489.0	0.0	8,651.3	7,270.4	3,132.5

[1] 10-Year period from FY2001-02 to FY 2010-11

Table B-2 Member Agency Extractions in the Pasadena Subarea (AFY)

		"Decreed Right 1955"	Net Leases	Allowable Extraction [2]	Amount Extracted	Balance
Kinneloa Irrigation District	10 Yr Avg [1]	516.0	51.5	648.9	623.0	25.9
	Min	516.0	0.0	431.1	379.5	(43.4)
	Max	516.0	150.0	930.3	930.0	51.6
Pasadena Subarea	10 Yr Avg [1]	17,843.0	0.0	21,510.7	19,055.7	2,455.0
	Min	17,843.0	0.0	19,318.2	15,622.7	666.4
	Max	17,843.0	0.0	23,819.4	21,873.0	4,533.6

[1] 10-Year period from FY2001-02 to FY 2010-11

[2] Includes phased reduction for Decreed Rights to Pasadena Subarea beginning FY 2009-10

Natural recharge of groundwater occurs through infiltration and percolation of rainfall and surface runoff. Based on the 1954 “Report of Referee” for the Raymond Basin, the amount of water entering the Raymond Basin from precipitation, inflow from mountains, and inflow from hills was approximately 67,890 AFY over a 17 year average. The amount of water entering the Monk Hill subarea from precipitation, inflow from mountains, and inflow from hills was approximately 21,990 AFY over a 17 year average. MWD’s “2007 Groundwater Assessment Study” indicates the Raymond Basin has a storage capacity of approximately 1.37 million acre-feet (MAF) with a natural safe yield of approximately 30,622 AFY (Monk Hill: 7,487 AFY; Pasadena: 17,843 AFY; Santa Anita: 5,290 AFY). Approximately one percent of groundwater in the Raymond Basin flows into the Main San Gabriel Basin.

In addition to the natural recharge listed above, artificial recharge occurs in the Raymond Basin through the use of imported water. Until May 2007, MWD made water available at discounted rates to agencies for replenishment of the groundwater basins. Because of three years of drought in Northern California, nine years on the Colorado River watershed and a decision by a Federal Judge that restricted pumping in the

Sacramento—San Joaquin Delta due to the diminishing population of the Delta Smelt, MWD ceased offering discounted water rates for replenishment water. In June 2011, discounted deliveries began again until the end of the calendar year. The program is undergoing a refinement process as to future availability. The two methods used by FMWD retail agencies to take deliveries of this water are injection and in-lieu replenishment. This water is kept in storage for times when replenishment deliveries are not available. The water is also used to shift imported water deliveries from peak demand summer periods to lower winter periods thereby reducing the need to construct more infrastructure to meet peaking needs.

Also, in February 2003, FMWD entered into a conjunctive use agreement (FHCUP) with MWD where MWD delivers water to FMWD for storage by the retail agencies in the Raymond Basin when supplies are plentiful and calls on FMWD's retail agencies to produce that water when supplies are short. FMWD pays for the water when the water is called at the existing MWD rates. In exchange for the ability to cycle water in the basin, MWD agreed to finance the construction of facilities to assist in delivering water to the area. The facility construction was completed in 2008.

MWD had delivered some water prior to the completion of construction and asked that the water be extracted from the groundwater basin. As of this writing, most of the water has been extracted from the groundwater basin.

B-2.2 **Verdugo Basin**

The Verdugo Basin was adjudicated in 1979 and two municipal producers, the City of Glendale (Glendale) and Crescenta Valley, possess all production rights. Crescenta Valley has a right to produce 3,294 AFY and Glendale has a right to produce 3,856 AFY in the Verdugo Basin. The Verdugo Basin is one of four Upper Los Angeles River Area (ULARA) basins included in the 1979 groundwater adjudication, commonly called the San Fernando Judgment. Production rights for Crescenta Valley in the Verdugo Basin and the average, minimum, and maximum water production over the ten year period from FY 2001-01 to FY 2010-11 are provided in Table B-3.

Table B-3 Member Agency Extractions in the Verdugo Basin (AFY)

		Production Rights	Amount Extracted
Crescenta Valley [1]	10 Yr Avg	3,294	3,068
	Min	3,294	2,609
	Max	3,294	3,687
Verdugo Basin [1], [2]	10 Yr Avg	7,150.00	5,137
	Min	7,150.00	4,194
	Max	7,150.00	6,013

[1] Crescenta Valley production obtained from Crescenta Valley

[2] City of Glendale production obtained from City of Glendale

During the past two decades, Crescenta Valley has exceeded its Verdugo Basin pumping right. Glendale has never pumped its full water right from the Verdugo Basin. Glendale’s pumping has been limited due to lack of well capacity and water quality problems. Pump tests from recently drilled pilot wells indicate low production capacities. Glendale also operates the Glendale Water Treatment Plant, designed to remove volatile organic compounds from groundwater produced by its wells, and the Verdugo Park Water Treatment Plant, designed to remove turbidity and bacteria. Crescenta Valley also treats groundwater at its Glenwood ion exchange facility.

The only opportunity to increase the use of groundwater is to increase the artificial recharge of water to the Verdugo basin. Introducing new sources of water for groundwater recharge, such as recycled water and stormwater, may allow Crescenta Valley to produce additional water over its pumping rights. However, the ability to spread and extract groundwater would need approval of the ULARA Watermaster and meet all required conditions.

MWD's "2007 Groundwater Assessment Study" indicates the Verdugo Basin has a storage capacity of approximately 160,000 AF with a safe yield of approximately 7,150 AFY which is equivalent to the total production rights. Groundwater from the Verdugo Basin outflows into the San Fernando Basin to the west. In addition, an average of 300 to 400 AFY of underflow is estimated to pass from the Verdugo Basin into the Raymond Basin. Although, recharge spreading basins currently do not exist in the Verdugo Basin, modifications to existing debris basins are being considered to retain water and increase recharge rates.

B-3. Water Quality - Groundwater and Surface Water.

B-3.1 **Raymond Basin**

Raymond Basin groundwater quality data is summarized in Kinneloa's 2008 Annual Consumer Confidence Report, La Cañada's 2008 Annual Drinking Water Quality Report, Las Flores' 2008 Annual Consumer Confidence Report, Lincoln's 2008 Consumer Confidence Report, Rubio's 2008 Water Quality Report, and Valley's 2009 Consumer Confidence Report (See Appendix A). Groundwater is generally of good quality and Total Dissolved Solids (TDS) concentrations range from 200 parts per million (ppm) to 400 ppm in Kinneloa, 270 ppm to 550 ppm in La Cañada, approximately 430 ppm in Las Flores, 335 ppm to 340 ppm in Lincoln, 320 ppm to 410 ppm in Rubio, and 660 ppm to 830 ppm in Valley, with a secondary Maximum Contaminant Level (MCL) of 1,000 ppm. Specific water quality issues are discussed below.

Volatile organic compounds (VOCs) have been detected in several areas in the Raymond Basin, particularly in the vicinity of the Arroyo Seco. VOCs such as tetrachloroethylene (PCE) have been detected above the primary MCL of 5 micrograms per liter (μg/l) in Las Flores' Well No. 2 (maximum concentration of 14 μg/l during October 2003); and Valley's Wells No. 2 (maximum concentration of 10 μg/l during May 2001) and No. 3 (maximum concentration of 6 μg/l during June 2002). VOCs such as trichloroethylene (TCE) have been detected above the MCL of 5 μg/l in Lincoln's Well

No. 5 (maximum concentration of 79 μg/l during August 1986). VOCs such as carbon tetrachloride (CTC) have been detected above the MCL of 0.5 μg/l in Lincoln's Wells No. 3 (maximum concentration of 2.2 μg/l during August 2008) and No. 5 (maximum concentration of 2.1 μg/l during December 1986). These contaminants may have originated from the nearby Jet Propulsion Laboratory (JPL) Superfund site, or former dry cleaning sites and unsewered areas in La Cañada Flintridge, based on a review of the Remedial Investigation Addendum Work Plan[1] for the JPL site. Lincoln is able to serve water using Granular Activated Carbon treatment facilities. VOCs have not been detected at Las Flores' well for the last eight months; Las Flores' Granular Activated Carbon treatment facilities have been out of service for two years.

Perchlorate has been detected in several Raymond Basin wells and several monitoring wells in the vicinity of the JPL Superfund site. Perchlorate has been detected above the MCL of 6 μg/l in Las Flores' Well No. 2 (maximum concentration of 8.8 μg/l during November 2007), and Lincoln's Well No. 3 (maximum concentration of 16.7 μg/l during August 1997) and Well No. 5 (maximum concentration of 7 μg/l during September 1997). Lincoln is able to serve water through anion exchange resins and blending with FMWD imported water supplies. Las Flores is able to serve water through blending with FMWD imported water supplies.

High fluoride concentrations have been detected in the foothill areas and high nitrate concentrations have been detected in the Monk Hill Subarea and Pasadena Subarea. Fluoride has been detected above its MCL of 2 milligrams per liter (mg/l) in Kinneloa's Wilcox Well (recent concentration of 2.3 mg/l during August 2009). Nitrate has been detected above the MCL of 45 mg/l in both of La Cañada's wells, Las Flores' Well No. 2, and all four of Valley's wells. Kinneloa is able to serve water through blending with other

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[1] *Final Operable Unit 3, Remedial Investigation (RI) Addendum Work Plan (Pasadena Sampling Plan [PSP]-2004-1), National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California*. Prepared for National Aeronautics and Space Administration, Management Office, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, California 91109. Prepared by Battelle Environmental Restoration Department, 505 King Avenue, Columbus, Ohio 43201. November 2004.

local water supplies. La Cañada, Las Flores, and Valley are able to serve water through blending with imported water supplies.

FMWD also provides its member agencies within the western unit of the Raymond Basin with imported surface water supplies. FMWD receives imported water supplies from MWD's F.E. Weymouth Treatment Plant (Weymouth). Water quality data from Weymouth is provided in Appendix B and meets all California Department of Public Health (CDPH) water quality standards.

B-3.2 **Verdugo Basin**

Verdugo Basin groundwater quality data is summarized in the City of Glendale Water & Power (GWP) 2008 Water Quality Report and the Crescenta Valley's 2008 Annual Water Quality Report (See Appendix A). Groundwater in Verdugo Basin contains high concentrations of nitrate resulting in treatment of the groundwater. In addition to treatment, purchased surface water from MWD's Weymouth Treatment Plant is blended with groundwater from the Verdugo Basin to further lower concentrations of contaminants. TDS is reported below the MCL of 1,000 mg/l and ranges from approximately 210 to 786 mg/l. Specific water quality concerns within the basin are addressed below.

Nitrate has historically been the only constituent of concern within Verdugo Basin, primarily caused by agricultural activities and leaking septic systems in the La Crescenta area (Glendale, 2006). Nitrate values within the GWP Glorietta Wells 3, 4 and 6 range from approximately 26 to 51 mg/l[2], which are above the MCL of 45 mg/l. Nitrate values for groundwater delivered to the Verdugo Park Water Treatment Plant (VPWTP), which consist of Verdugo Wells A and B, as well as with groundwater from a

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[2] Values represent constituent levels prior to blending with purchased SWP water from the MWD Weymouth Plant.

horizontal infiltration system range from 14 to 20 mg/l, which are below the MCL. During water year 2008/09 approximately 530 AF were treated.

Nitrate values for Crescenta Valley's groundwater ranges from 36 to 61 mg/l, which are above the MCL. Crescenta Valley currently pumps from five wells (6, 8, 10, 12 and 14). Groundwater from these wells is treated for nitrate at the Glenwood Ion Exchange Nitrate Removal Facility, which treated approximately 459 AF in Water Year 2008/09. Additionally, groundwater pumped from Wells 1, 5, 9 and 11 is blended with imported water in order to reduce the concentration of nitrate.

VOCs have been recently detected within the basin at levels above the detection limit. The source of VOCs is from leaking underground storage tanks containing gasoline and/or from gas station spills at the surface. In August of 2006 MTBE was detected at Crescenta Valley Well 7 at a concentration of 29 μg/l, exceeding the MCL of 13 μg/l. As a result, Crescenta Valley ceased production from this well. A sampling event in October 2006 showed the concentration of MTBE had risen to 50 μg/l in Well 7. However, in October 2007, the MTBE concentration dropped to 0.5 μg/l. Crescenta Valley reported in its 2008 annual groundwater report that MTBE concentrations in their active Verdugo Basin wells ranged from 0 to 14 μg/l. Additionally, PCE concentrations ranged from nondetect to 6.7 μg/l, with the higher concentrations exceeding the MCL of 5 μg/l. MTBE and PCE concentrations within the GWP Glorietta Wells have not been found to exceed the corresponding MCLs.

FMWD provides Crescenta Valley imported surface water supplies. As previously noted, FMWD receives imported water supplies from Weymouth. Water quality data from MWD's Weymouth Treatment Plant is provided in Appendix B and meets all CDPH water quality standards.

B-4. Land Use and Land Use Trends.

Information on existing land use was obtained from the Los Angeles County General Plan (December 2008) and the City of La Cañada Flintridge's "Land Use Element, City of La Cañada Flintridge", adopted November 15, 1993. Information on projected land use within the Study Areas was obtained from the Los Angeles County General Plan 2035, Public Review Draft, April 2011 and the City of La Cañada Flintridge General Plan (Vision 2030), Public Draft, December 2010. These reports do not provide a break down of land use information that is an exact correlation with the Study Areas. The information from these reports that most closely match the Study Area boundaries has been used below to describe existing use and land use trends.

The Los Angeles County General Plan (December 2008) provides information on the Eaton Canyon Study Area and portions of the Verdugo Basin Study Area and Arroyo Study Area. Relevant portions of the Los Angeles County General Plan (December 2008) are provided in Appendix C.1. The City of La Cañada Flintridge's "Land Use Element" provides information on portions of the Verdugo Basin Study Area and Arroyo Study Area. Relevant portions of the City of La Cañada Flintridge's "Land Use Element" are provided in Appendix C.3.

The Los Angeles County General Plan 2035 provides information on the Eaton Canyon Study Area and portions of the Verdugo Basin Study Area and Arroyo Study Area through the year 2035. Relevant portions of the Los Angeles County General Plan 2035, Public Review Draft are provided in Appendix C.2. The City of La Cañada Flintridge's General Plan (Vision 2030), provides information on portions of the Verdugo Basin Study Area and Arroyo Study Area through the year 2030. Relevant portions of the City of La Cañada Flintridge General Plan (Vision 2030), Public Draft are provided in Appendix C.4.

B-4.1 **Verdugo Basin Study Area**

As discussed previously, the Verdugo Basin Study Area includes Crescenta Valley and portions of La Cañada. Crescenta Valley is located in unincorporated areas of Los Angeles County (La Crescenta-Montrose area) and La Cañada is located in the City of La Cañada Flintridge. Figure B-2 shows the location of these areas.

Land use in the service area of Crescenta Valley (La Crescenta-Montrose area) is approximately 60 per cent residential, with rural land comprising approximately 20 percent of the service area, land for public use/parks comprising approximately 10 percent of the service area, land for transportation corridor comprising approximately 5 percent of the service area, and land use for commercial/industrial comprising approximately 5 per cent of the service area. Land use maps from the Los Angeles County General Plan are provided in Appendix C. Crescenta Valley's service area is experiencing densification of its housing structures (i.e., conversion of single-family dwellings to multi-unit residences).

Land use in the service area of La Cañada is over 70 per cent residential, with open space/public land comprising approximately 25 per cent of the service area, and commercial (community planned development) comprising less than 5 per cent of the service area. Portions of the Land Use Element are provided in Appendix C. A significant portion of La Cañada's service area has been undergoing conversion from smaller homes to larger homes (mansionization).

B-4.2 **Arroyo Study Area**

As discussed previously, the Arroyo Study Area includes Valley, Mesa Crest, and portions of La Cañada. La Cañada, Valley, and Mesa Crest are located in the City of La Cañada Flintridge. Figure B-2 shows the location of the City of La Cañada Flintridge. The Arroyo Study Area also includes Las Flores, Lincoln, and Rubio, located in unincorporated areas of Los Angeles County (Altadena). Figure B-2 also shows the location of the Altadena area.

Land use in the service area of La Cañada is over 70 per cent residential, with open space/public land comprising approximately 25 per cent of the service area, and commercial (community planned development) comprising less than 5 per cent of the service area. A significant portion of La Cañada's service area has been undergoing conversion from smaller homes to larger homes (mansionization).

Land use in the service area of Valley is over 60 per cent residential, with open space/public land comprising approximately 25 percent of the service area, land for the "Downtown Plan" comprising approximately 10 per cent of the service area, and commercial (community planned development) comprising less than 5 per cent of the service area. Some conversions from smaller homes to larger homes (mansionization) are occurring in Valley's service area.

Land use in the service area of Mesa Crest is approximately 60 percent residential, with open space/public land comprising approximately 40 percent of the service area. The Mesa Crest service area has experienced many home remodeling expansions.

Land use in the service area of Las Flores is approximately 95 percent residential and 5 percent open space/public land. The Las Flores service area is currently experiencing minimal or no conversion to multi-unit dwellings.

Land use in the service area of Lincoln is approximately 50 percent residential, with rural land comprising approximately 25 per cent of the service area, and open space/public/other use comprising approximately 25 percent of the service area. There is no significant land available in Lincoln's service area for large scale development and the housing density has remained relatively stable.

Land use in the service area of Rubio is approximately 75 percent residential, with approximately 15 percent rural/other use, and approximately 10 percent open space/public. Rubio's service area has remained stable with essentially no growth.

B-4.3 **Eaton Canyon Study Area**

As discussed previously, the Eaton Canyon Study Area includes Kinneloa, located in portions of the unincorporated areas of Los Angeles County (Altadena) and portions of the City of Pasadena. Figure B-2 shows the location of the City of Pasadena and Altadena area.

Land use in the service area of Kinneloa is approximately 55 percent residential, with approximately 45 percent open space/other use.

B-4.4 **Land Use Trends**

Table B-4 provides a summary of existing land use within the Study Areas. Table B-5 provides a summary of projected land use within the Study Areas over the next 20 to 25 years. Based on the existing and projected land use information, there is a slight projected increase in residential land use within the Study Areas. In addition, there are slight decreases in projected commercial/industrial and public/institutional (e.g. schools, churches, government buildings) land uses. In general, an increase in residential land use results in an increased amount of wastewater available for treatment and reuse as recycled water (See Section D). It is not anticipated the slight decrease in public/institutional land use would reduce the recycled water demands that have been identified for the proposed projects.

Table B-4 Existing Land Use in Study Area (Acres)

	Crescenta Area [1], [2]	Altadena Area [1], [2]	Kinneloa Area [1]	La Cañada Flintridge [2]	Total
Residential	1,454	3,033	517	3,088	8,092
Commercial / Light Industrial	190	62	0	63	315
Public / Institutional	66	70	0	781	917
Open Space / Recreational / Forest	560	515	435	938	2,448
Other				755	755
Total	2,270	3,680	952	5,625	12,527

[1] Based on Los Angeles County GIS Land Use Maps
[2] Land Use Element, City of La Cañada Flintridge, Adopted November 15, 1993

Table B-5 Projected Land Use in Study Area (Acres)

	Crescenta Area [1], [2]	Altadena Area [1], [2]	Kinneloa Area [1]	La Cañada Flintridge [2]	Total
Residential	1,454	3,002	548	3,397	8,401
Commercial / Light Industrial	210	62	0	20	292
Public / Institutional	66	95	0	269	430
Open Space / Recreational / Forest	540	521	404	985	2,450
Other				117	117
				.	
Total	2,270	3,680	952	4,788	11,690

[1] Based on Los Angeles County General Plan 2035, Public Review Draft, April 2011
[2] City of La Cañada Flintridge General Plan (Vision 2030), Public Draft, December 2010

B-5. Population Projections of Study Area.

Populations within the Study Areas were projected using 2010 population data provided by retail agencies. These same projections are in FMWD's 2010 Regional Urban Water Management Plan update. Table B-6 provides combined population projections for the three Study Areas. Populations are estimated to increase from approximately 87,880 (current) to approximately 102,000 (in the year 2035). The population is estimated to grow at a rate of approximately 0.5% per year and assumes an outside boundary for planning purposes. This is lower than other projections by the Department of Finance and Southern California Association of Governments. The FMWD area is fully developed and limited growth is occurring with single family housing converting to multi-family housing. Once the economic turndown recovers, some of this limited slow growth should continue. These projections will also be refined as the 2010 census numbers are analyzed and new modeling is performed.

Table B-6 Combined Population Projections of Study Areas

	Population					
Agency	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Crescenta Valley	35,000	36,423	37,903	39,444	41,047	42,715
Kinneloa	1,450	1,475	1,500	1,510	1,520	1,525
La Cañada	9,300	9,450	9,600	9,750	9,900	10,050
Las Flores	4,500	4,614	4,730	4,850	4,972	5,098
Lincoln	16,126	16,533	16,951	17,379	17,818	18,263
Mesa Crest	2,000	2,051	2,102	2,155	2,210	2,266
Rubio	9,600	9,842	10,091	10,346	10,607	10,875
Valley	9,900	10,150	10,406	10,669	10,938	11,211
Total FMWD	87,876	90,538	93,283	96,103	99,012	102,003

B-6. Beneficial Uses (of receiving waters and degree of use, portion of flow that is effluent).

Both local groundwater and local surface water are used for municipal supply (MUN). At this point in time there are no effluent discharges to receiving waters, either surface or groundwater, within the study area. Should the feasibility study recommend the development of groundwater recharge with effluent, it is anticipated that the amount of effluent that would be recharged into any of the basins in any given year would be less than five percent of the annual safe yield of that basin.

C. WATER SUPPLY CHARACTERISTICS AND FACILITIES

C-1. Description of All Wholesale and Retail Entities.

C-1.1 FMWD

FMWD is an MWD member agency delivering imported water supplies from the Colorado River into its approximate 22 square mile service area, including the City of La Cañada Flintridge and unincorporated Los Angeles County areas of La Crescenta and Altadena. FMWD's service area includes eight retail Member Agencies that individually receive varying amounts of imported water deliveries annually ranging from 0 to 100 percent of the source of supply. The Arroyo Seco generally separates FMWD's service area into the western portion and the eastern portion. The western portion of FMWD's service area includes Crescenta Valley, La Cañada, Valley, and Mesa Crest which are located adjacent to each other. The eastern portion of FMWD's service area includes Lincoln, Las Flores, Rubio, and Kinneloa. Imported water supplies from FMWD are not currently served to Kinneloa Irrigation District.

Retail water agencies within the Verdugo Basin Study Area include Crescenta Valley and portions of La Cañada. Retail water agencies within the Arroyo Study Area include Las Flores, Lincoln, Mesa Crest, Rubio, Valley, and the remaining portions of La Cañada. The retail water agency within the Eaton Canyon Study Area is Kinneloa. The service areas for these agencies were previously depicted in Figure A-3.

C-1.2 Crescenta Valley Water District

Crescenta Valley produces water from groundwater wells, receives imported water supplies from FMWD, and obtains a minor amount of local tunnel water. Crescenta Valley serves portions of the cities of Glendale and La Cañada Flintridge and unincorporated areas of La Crescenta and Montrose. Crescenta Valley's service area is adjacent to the City of Glendale on the south and west, and La Cañada on the east, with its northern boundary adjoining Angeles National Forest. Crescenta Valley, which is the largest retail member agency of FMWD, has approximately 8,100 service connections.

C-1.3 **Kinneloa Irrigation District**

Kinneloa serves unincorporated portions of Los Angeles County (Altadena) and portions of the City of Pasadena. Kinneloa obtains its water supply from groundwater pumping and tunnel production supplying surface runoff. Kinneloa's service area is located on the eastern edge of FMWD's service area, extending onto the slopes of the San Gabriel Mountains and surrounded by the City of Pasadena on three sides. Kinneloa has approximately 600 service connections.

C-1.4 **La Cañada Irrigation District**

La Cañada serves portions of the City of La Cañada Flintridge and unincorporated areas of Los Angeles County (Montrose). La Cañada obtains its water supply primarily from imported water supplies from FMWD, with the remaining sources of supply from surface water and groundwater. The service area of La Cañada is primarily located north of Interstate Freeway 210, extending to Ocean View Boulevard to the west, approximately Gould Avenue to the east, and south of the Angeles National Forest to the north. La Cañada has approximately 2,900 service connections.

C-1.5 **Las Flores Water Company**

Las Flores is a non-profit mutual water company that serves unincorporated portions of Los Angeles County (Altadena). Las Flores obtains its water supply from groundwater and imported water supplies from FMWD. Las Flores is located between Lincoln and Rubio. Las Flores has approximately 1,500 service connections.

C-1.6 **Lincoln Avenue Water Company**

Lincoln is a non-profit mutual water company that serves customers in unincorporated portions of Los Angeles County (Altadena). Lincoln obtains its water supply from groundwater, local surface water, and imported water supplies from FMWD. Lincoln has approximately 4,400 service connections.

C-1.7 **Mesa Crest Water Company**

Mesa Crest is an investor-owned water utility that serves customers in the northeastern portion of FMWD's western portion service area in the area of the La Cañada Flintridge golf course. Mesa Crest obtains its water supply solely from imported water supplies from FMWD. Mesa Crest has approximately 700 service connections.

C-1.8 **Rubio Cañon Land and Water Association**

Rubio is a non-profit mutual water company that serves unincorporated portions of Los Angeles County north of Pasadena (Altadena). Rubio obtains its water supply from groundwater from the Raymond Basin and imported water supplies from FMWD. Rubio has approximately 3,100 service connections.

C-1.9 **Valley Water Company**

Valley is a non-profit mutual water company that serves the City of La Cañada Flintridge. Valley obtains its water supply primarily from imported water supplies from FMWD, with the remaining supply sources from groundwater. Valley's service area is approximately 2,400 acres in the City of La Cañada Flintridge. Valley has approximately 3,600 service connections.

C-2. Sources of Water for Study Area and Major Facilities (including costs, subsidies, and customer prices).

The water supply sources within the Verdugo Basin Study Area and the Arroyo Study Area include imported surface water from FMWD and groundwater.

FMWD currently receives water delivered by MWD through MWD's 116-inch-diameter Upper Feeder at turnout FM-1 located in the vicinity of Seco Street and Rosemont

Avenue in Pasadena near the Rose Bowl. The turnout is nominally designed to deliver 40 cubic feet per second (cfs). A schematic showing FMWD's distribution system, including transmission lines, service connections, reservoirs, and pumps stations, is provided in Figure C-1. A further discussion of these facilities is provided in Section C-3.

FMWD's member agencies within the Verdugo Basin Study Area, Arroyo Study Area, and Eaton Canyon Study Area include Crescenta Valley, Kinneloa, La Cañada, Las Flores, Lincoln, Mesa Crest, Rubio, and Valley. Each of these agencies has its own distribution pipelines, connection(s) with FMWD (except Kinneloa), storage reservoirs, and emergency interconnection with other agencies (except Las Flores and Mesa Crest). Each member agency has groundwater production wells except Mesa Crest. Kinneloa, Crescenta Valley, and La Cañada also have tunnel water supply. La Cañada's tunnel supply was damaged by mudslides and repaired. Lincoln has local surface water supply collected from Millard Canyon. The pipes for this supply were damaged by the Station Fire. Lincoln is in the process of repairing these pipes. Mesa Crest's service area receives recycled water from County Sanitation Districts of Los Angeles County's (LACSD) La Cañada Water Reclamation Plant for golf course irrigation. A further discussion of these facilities is provided in Section C-3.

FMWD's water rate for Tier 1 water (effective January 1, 2011) is $744 per AF. A series of charges are also invoiced to the agencies. Two charges are pass-through of MWD charges to FMWD: the readiness-to-serve charge and capacity charge. The Readiness-to-Serve (RTS) charge recovers a portion of MWD's principal and interest payments on non-tax supported debt service that has been or will be issued to fund capital improvements necessary to meet standby service needs and emergency storage. The Capacity Charge recovers MWD costs incurred to provide distribution capacity used to meet peak day demands. FMWD also has an administrative and operating charge and capital and rehabilitation charge. The administrative and operating charge recovers those costs associated with the administration, operation and maintenance of the District and its distribution system. The capital and rehabilitation charge recovers those costs associated with the capital improvements necessary to continue meeting demand through both the existing potable system and new infrastructure both potable and nonpotable. Energy costs to pump water from FMWD's connection with MWD near the Rose Bowl are passed through based on water deliveries and energy usage to each agency. A copy of the portion of FMWD's Administrative Code detailing these charges is provided in Appendix D.

It is anticipated FMWD will generally pass-through MWD rate increases to its member agencies for imported water. MWD's rates for Tier 1 water are projected to increase annually to approximately $2,174 per AF by the year 2030 (see Table C-1). It is anticipated that the administrative and operating charge will typically increase based on the rate of inflation and the capital and rehabilitation charge will increase based on the projects identified to be completed if FMWD continues with PAYG (pay as you go) as the preferred payment option. It is anticipated that should FMWD obtain financing for capital projects, the capital and rehabilitation charge will be steadier rather than fluctuate as currently anticipated.

Table C-1 **Projected MWD Water Rate for Treated Full Service Tier 1**

Year	Projected MWD Rate for Treated Full Service Tier 1 ($/AF)
2010	$701
2015	$920
2020	$1,214
2025	$1,625
2030	$2,174

Source: MWD 2010 UWMP

Typical retail water rates in the Verdugo Basin Study Area, including Crescenta Valley and La Cañada, range from about $1,170 per AF to about $2,300 per AF depending on the amount of water used. Typical retail water rates in the Arroyo Study Area, including

Las Flores, Lincoln, Mesa Crest, Rubio, Valley, and La Cañada, range from about $910 per AF to about $2,300 per AF depending on the amount of water used. Typical retail water rates in the Eaton Canyon Study Area, including Kinneloa, range from about $1,400 per AF to about $1,780 per AF depending on the amount of water used. It is anticipated FMWD member agencies will generally increase the rate it charges its customers at a similar rate increase as FMWD. A table of agency rates is provided in Appendix E.

C-3. Capacities of Present Facilities and Existing Flows (including estimated years when capacities to be reached for major components such as water treatment plants, major transmission and storage facilities).

C-3.1 **Verdugo Basin Study Area**

The Verdugo Basin Study Area primarily includes the service areas of Crescenta Valley and portions of La Cañada.

Crescenta Valley obtains approximately 40 percent of its water supplies from imported water delivered from FMWD and approximately half of its water supplies from twelve groundwater wells located in the Verdugo Basin. Crescenta Valley provides service to its customers through eleven pressure zones and sixteen pumping stations. The elevation of the service area varies from approximately 1,200 feet to almost 3,000 feet above sea level. Crescenta Valley's distribution system contains seventeen storage reservoirs totaling 17.5 million gallons (MG). Crescenta Valley's imported water purchases during the last two decades have ranged from approximately 1,000 AFY to approximately 3,000 AFY. Crescenta Valley has connection capacity with FMWD of 8.85 cfs. Crescenta Valley also produces local tunnel water which yields, on the average, about 50 to 60 AFY. Crescenta Valley anticipates growth in its water demand will be met by additional purchases from FMWD. As discussed in Section B-3, Crescenta Valley operates the Glenwood Ion Exchange Nitrate Removal Facility which removes nitrate from groundwater from the Verdugo Basin. Water served by Crescenta Valley meets CDPH drinking water standards.

Crescenta Valley has several emergency interconnections with adjacent water suppliers. There is an interconnection with the City of Glendale for emergency use, with a capacity of five cfs. Crescenta Valley has an agreement and is planning to construct a new interconnection for emergency service purposes with the City of Los Angeles Department of Water and Power, with a planned delivery of about 2.2 cfs. There are two emergency interconnections with adjacent La Cañada, each rated at about one cfs, and each one-way in different directions.

La Cañada obtains about 90 percent of its water supply from imported water supplies delivered by FMWD, with the remaining supply sources from surface water from Pickens Canyon (approximately five percent) and groundwater from the Raymond Basin (approximately five percent). La Cañada produces from two infiltration tunnels in Pickens Canyon with a maximum combined capacity of about 300 gallons per minute (gpm). La Cañada produces groundwater from two wells located in the Raymond Basin (Monk Hill subarea) with capacities of 500 gpm and 750 gpm. La Cañada has seven storage tanks with a total capacity of just over six (6) MG. La Cañada receives imported water from connections of approximately 3.3 cfs and 3.6 cfs with FMWD. As indicated above, La Cañada has two interconnections with Crescenta Valley, each one-way and in different directions, each about one cfs. La Cañada has an emergency interconnection with Valley. La Cañada is considering a two way interconnection with Mesa Crest (6- or 8-inch).

C-3.2 **Arroyo Study Area**

The Arroyo Study Area includes the service areas of Las Flores, Lincoln, Mesa Crest, Rubio, and Valley, and portions of the service area of La Cañada. (A discussion of La Cañada’s sources of water supplies is included in the discussion of the Verdugo Basin Study Area above).

Las Flores obtains about 30 percent of its water supply from groundwater from the Raymond Basin and the remainder from imported water delivered by FMWD. Las Flores operates a 650 gpm well (Mountain View Well No. 2) for groundwater production. Las Flores' service area is divided into three pressure zones that are each served by pumping stations to maintain adequate pressure changes. The two highest pressure zones also have five reservoirs that provide a total storage capacity of 4.55 MG. Las Flores has a two-way interconnection with Rubio, and a proposed two-way interconnection with Lincoln.

Lincoln obtains its water supply from groundwater from the Monk Hill subarea of the Raymond Basin, local surface water, and imported water supplies from FMWD. Lincoln's service area includes eight pressure zones with four pumping stations containing 16 pumps with a total capacity of about 15,500 gpm. Lincoln's system includes 13 storage tanks with a total capacity of 11.44 MG. Lincoln operates Well No. 3 and Well No. 5, with capacities of 900 gpm and 1,100 gpm, respectively. Well No. 5 has been modified to allow Raymond Basin injection for long term storage for later extraction during periods of emergency and drought. Lincoln also obtains local surface water collected from Millard Canyon which is treated in a filtration plant that can produce up to about 700 gpm. Lincoln has one proposed interconnection with Rubio and one proposed interconnection with Las Flores, which can each inject or produce water. Lincoln also has three interconnections with the City of Pasadena, with one that is two-way (about 0.7 cfs), one with unknown flow direction (about 2.2 cfs), and the other one with unknown flow rate and direction.

Mesa Crest's sole source of water supply is imported water delivered by FMWD. Mesa Crest can receive 1.7 cfs (763 gpm) from FMWD. There are four pressure zones in the system with five reservoirs totaling 3.5 MG. Mesa Crest currently does not have any interconnections with adjacent water suppliers. As discussed above, La Cañada is considering a two-way interconnection with Mesa Crest (6- or 8-inch).

Rubio obtains its water supply from groundwater from the Raymond Basin imported water supplies from FMWD and surface water from Rubio Canyon. The Rubio system has four storage reservoirs totaling approximately 7.8 MG. Rubio has one 8-inch interconnection (about 1.6 cfs) with the City of Pasadena (two-way), one proposed additional interconnection with Pasadena, one two-way interconnection with Las Flores, and one proposed two-way interconnection with Lincoln.

Valley obtains approximately 70 per cent of its water supply from imported water supplies delivered by FMWD, with the remaining approximately 30 percent of its supply sources from groundwater production from the Raymond Basin. Valley operates four production wells, with a capacity of approximately 1,000 gpm each. Two of the four are operated primarily for groundwater production, while the other two wells are operated primarily for injection of imported water into the groundwater basin. (These later two wells can also be used for production). Valley serves its customers through five pressure zones and five reservoir sites totaling approximately 5.4 MG of storage. Valley has two emergency interconnections with the City of Pasadena (capacities of about 1.8 cfs each), with one two-way interconnection and another interconnection providing water only to the City of Pasadena. As indicated above, Valley has an emergency interconnection with La Cañada.

C-3.3 **Eaton Canyon Study Area**

The Eaton Canyon Study Area includes the service area of Kinneloa. Kinneloa obtains water supplies from groundwater pumping and tunnel production supplying surface runoff. Kinneloa operates two wells with capacities of approximately 800 gpm and 550 gpm. Kinneloa has ten reservoirs totaling approximately 4 MG of storage. Kinneloa has four interconnections with the City of Pasadena, consisting of a one-way connection from the City of Pasadena (about 1.9 cfs), two one-way connections to the City of Pasadena (about 0.8 cfs and 1.1 cfs), and one two-way connection (about 1.1 cfs).

C-3.4 **FMWD Facilities**

As indicated above, FMWD's service area is generally separated by the Arroyo Seco into a western portion and an eastern portion. The FMWD system provides imported water supplies to three service areas: Eastern (also named Altadena), Central (also named La Cañada), and Berkshire (also known as La Crescenta). Each service area includes two reservoirs, separately ranging in size from 1 to 1.4 MG. Imported water is supplied from MWD's 116-inch diameter Upper Feeder through a nominal 40 cfs connection (FM-1) located near the Rose Bowl (Seco Street and Rosemont Avenue). Imported water travels through approximately 6,500 feet of 39-inch cement mortar lined and coated (CMLC) steel pipeline to the main pumping plant P-1. From pumping plant P-1, the water is pumped to both the western portion and eastern portion of FMWD's service area. Figure C-1 shows a schematic of the FMWD distribution system, along with the transmission lines, reservoirs and member agency turnouts.

Pumping plant P-1 includes five (5) pumps delivering water to the western portion of FMWD's service area, where the Verdugo Basin Study Area and part of the Arroyo Study Area are located. These pumps include three 3,150 gpm pumps, one 3,545 gpm pump and one 1,655 gpm pump. Pumping plant P-1 also includes five (5) pumps delivering water to the eastern portion of FMWD's service area, where part of the Arroyo Study Area is located. The capacities of these pumps vary from 1,080 gpm to 2,025 gpm. The pumps at pumping plant P-1 have the ability to normally deliver 22.5 cfs to the western portion of FMWD's service area. The pumps at pumping plant P-1 also have the ability to normally deliver 12.5 cfs to the eastern portion of FMWD's service.

Pumping plant P-1 transmits water to the La Cañada Reservoirs utilizing approximately 1,000 feet of 36-inch, 8,000 feet of 30-inch and 3,500 feet of 24-inch diameter CMLC steel pipelines. The capacities of the two La Cañada Reservoirs are 1.2 MG and 1.0 MG. Pumping plant P-1 can also pump water through an 18,600 foot 24-inch extension to the La Crescenta reservoirs. Water is boosted through the Berkshire pumping plant along the route. There are four pumps (B-1 through B-4) in the Berkshire pumping plant, with two at 1,795 gpm, one at 1,935 gpm and the remaining unit a variable frequency drive. The motors associated with each pump are 300 horsepower each. The capacities of the two La Crescenta Reservoirs are each 1 MG.

Pumping plant P-1 transmits water to the eastern portion of FMWD's service area through an 11,800 foot 24-inch diameter CMLC steel pipeline with turnout service to Lincoln, Rubio, and Las Flores along the route. The capacities of the two Altadena Reservoirs are 1.4 MG and 1.2 MG.

FMWD has two interconnections with the City of Pasadena, with one 10 cfs connection delivering water to the FMWD's La Cañada Reservoirs from the City of Pasadena and the other interconnection at a Caltrans service yard on the eastern portion of FMWD's service area delivering water up to 3.5 cfs to the City of Pasadena. Recent tests have shown that Pasadena under certain conditions may be able to deliver water to FMWD at the Caltrans connection up to about four (4) cfs.

Based on FMWD not having four hours of potable water storage during a high demand peak period, the CDPH had recommended five years ago that another potable tank be constructed in the service area. Based on a current review of the system and plans to develop more recycled water in the service area, CDPH has indicated a willingness to retract that recommendation once the recycled water system is on-line.

C-4. Groundwater Management and Recharge, Overdraft Problems.

C-4.1 **Raymond Basin**

The Raymond Basin Judgment adjudicated groundwater rights based on a long-term average yield of the Raymond Basin. Due to recent multiple dry year conditions, the Raymond Basin Management Board has phased in a required 30 percent reduction for all Decreed Rights to the Pasadena Subarea over five years, beginning fiscal year 2009-10. The Judgment allows a party to exceed its Decreed Right by no more than 10 percent, which will be deducted from the following year's total allowable extraction. Conversely, a party is not allowed to carryover more than 10 percent of its Decreed Right to a subsequent year.

In addition to its Decreed Rights, the parties to the Raymond Basin Judgment have long-term storage accounts to store water within the Monk Hill and Pasadena Subareas. The storage accounts, created by the Raymond Basin Management Board, minimize the annual loss of Decreed rights due to non-pumping. As of June 30, 2009, Raymond Basin parties' allowable storage amount in the Pasadena Subarea account was capped at 27,016.5 AF.

Six of eight FMWD member agencies have water rights in the Raymond Basin, including Valley, Rubio, Lincoln, Las Flores, La Cañada, and Kinneloa. Valley, Rubio, Lincoln, Las Flores, and La Cañada produce groundwater from the Monk Hill Subarea. The 30% reduction in pumping does not impact these agencies since they are in the Monk Hill Subarea. Kinneloa produces groundwater from the Pasadena Subarea. It is able to offset the 30% reduction in pumping rights through use of surface water and when needed leasing unused production rights.

Decreed rights for each of FMWD's member agencies were provided in Table B-1. The average, minimum, and maximum allowable extractions and water production over the ten year period from FY 2001-02 to FY 2010-11 were also provided in Table B-1 for each member agency in the Monk Hill Subarea and the totals for all Monk Hill producers; and in Table B-2 for Kinneloa's pumping in the Pasadena Subarea and the totals for all the Pasadena Subarea producers.

In addition to these rights, agencies are able to artificially recharge the groundwater basin through the FHCUP and MWD's replenishment program when available. These programs are more fully described in Section B-2 above.

Member agencies are currently producing essentially the total amount of groundwater allowed under their existing water rights. The only opportunity to increase the use of groundwater is to increase recharge of water to the basin. Introducing new sources of groundwater recharge such as recycled water may allow member agencies to produce additional water over their Decreed Rights.

C-4.2 **Verdugo Basin**

The Verdugo Basin is managed by the Upper Los Angeles River Area (ULARA) Watermaster. In 1979, a court order established the City of Glendale (whose water rights are maintained by GWP) and Crescenta Valley the only two water-rights holders in the Verdugo Basin. Currently, there are a combined 17 production wells with an estimated total production volume of 7,400 AFY (Watermaster, 2010). GWP and Crescenta Valley currently have extraction rights of 3,856 AFY and 3,294 AFY respectively. However, due to water quality issues, a lack of production capabilities due to aging wells and a decline in the water table, extraction rights by GWP are not completely utilized. In 2005, GWP conducted a basin wide assessment to locate potential locations for future production wells in order to access their full extraction rights. In 2007 GWP began rehabilitation on the Foothill Well in hopes of expanding production capabilities within the Verdugo Basin. Additionally, in February 2009, GWP drilled a test borehole which is expected to produce 600 to 700 gpm, the completed well (Rockhaven Well) is anticipated to be in operation by early 2011 (See Figure A-4) (Watermaster 2010).

Table C-2 summarizes groundwater production within the Verdugo Basin over the last five fiscal years (to be consistent with available five-year data for historical water demands).

Table C-2 Verdugo Basin Extraction Volumes from Fiscal Years 2006-07 to 2010-11 (AFY)

	City of Glendale	Crescenta Valley	
2006-07	2,495.4	3,144	[1], [2]
2007-08	2,740.4	3,223	[1], [2]
2008-09	2,208.3	3,084	[1], [2]
2009-10	2,087.2	2,703	[1], [2]
2010-11	1,698.3	2,788	[1], [2]
Average Production	2,246	2,988	
Water Rights	3,856	3,294	

[1] City of Glendale production obtained from City of Glendale
[2] Crescenta Valley production obtained from Crescenta Valley

GWP currently operates five production wells within the Verdugo Basin, in addition to a horizontal infiltration system. As previously mentioned GWP is not completely utilizing its full groundwater extraction rights. Crescenta Valley currently operates twelve production wells within the Verdugo Basin[3]. During Water Year 2006/07, Crescenta Valley over-extracted by 12 AF without the permission of the Watermaster. Additionally in water years 2004/05 and 2005/06, Crescenta Valley extracted more than their assigned extraction right. In the past, GWP has allowed Crescenta Valley to over extract without compensation. However, Crescenta Valley and GWP are currently in the process of determining an agreement regarding compensation on overextraction. In water year 2008/09, Crescenta Valley under pumped their respective extraction rights by 337.5 AF.

Based on the ULARA Judgment the City of Los Angeles has the right to extract import return flows from Verdugo Basin but has never exercised this right.

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[3] Well 2 is only used for emergency supply and is not operated on a regular basis.

In November 2006, the Verdugo Basin MTBE Task Force was established to investigate and expedite the cleanup of MTBE in order to return Crescenta Valley's wells to full operational capacity.

Currently, there are no artificial groundwater recharge (i.e., surface spreading or injection) activities within Verdugo Basin. Crescenta Valley, through a California Department of Water Resources Assembly Bill (AB) 303 Local Groundwater Assistance Grant, has conducted a feasibility study to investigate the potential for recharging and storing groundwater in the Verdugo Basin and the feasibility of implementing a conjunctive use program.[4] The groundwater storage capacity of the Basin has been estimated by the Watermaster to be approximately 160,000 AF. Since Water Year 2007/08, the change in storage has increased approximately 1,186 AF.

C-5. Water Use Trends and Future Demands, Prices, and Costs

C-5.1 Historical Demands

The average, minimum, and maximum total water demands, in acre-feet per year (AFY) over the past five years (fiscal years 2006-07 to 2010-11) are provided in Table C-3 for each member agency. The average, minimum, and maximum water demands from FMWD for each member agency are also provided.

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[4] "Final Report, Verdugo Basin Groundwater Recharge, Storage, and Conjunctive Use Feasibility Study," prepared for Crescenta Valley Water District, prepared by Geomatrix, May 2005.

Table C-3 Historical Water Demands (AFY; Fiscal Years 2006-07 to 2010-11)

		Local Water Supplies	FMWD Deliveries	Agency Retail Demands
Foothill Municipal Water District	5 Yr Average	8,475.5	10,761.0	19,236.5
	Min	6,074.5	8,269.7	14,344.3
	Max	10,574.6	13,043.4	23,618.0
Crescenta Valley Water District	5 Yr Average	2,894.9	1,939.2	4,834.0
	Min	2,220.8	1,430.9	3,651.7
	Max	3,240.0	2,516.7	5,658.8
Kinneloa Irrigation District	5 Yr Average	660.3	0.0	660.3
	Min	549.5	0.0	549.5
	Max	930.3	0.0	930.3
La Cañada Irrigation District	5 Yr Average	101.4	2,596.5	2,697.9
	Min	36.1	1,950.3	1,986.5
	Max	138.1	3,152.4	3,263.8
Las Flores Water Company	5 Yr Average	323.6	573.4	897.1
	Min	264.2	408.8	673.0
	Max	358.2	741.2	1,099.4
Lincoln Avenue Water Company	5 Yr Average	2,025.2	1,323.9	3,349.1
	Min	895.1	878.4	2,227.8
	Max	3,016.5	1,737.3	4,450.9
Mesa Crest Water Company	5 Yr Average	0.0	672.5	672.5
	Min	0.0	516.7	516.7
	Max	0.0	774.3	774.3
Rubio Cañon Land & Water Assn.	5 Yr Average	1,479.6	773.8	2,253.3
	Min	1,095.7	346.2	1,746.1
	Max	1,709.0	1,045.6	2,701.5
Valley Water Company	5 Yr Average	990.4	2,881.7	3,872.2
	Min	767.2	1,925.3	2,692.5
	Max	1,307.2	3,987.9	5,295.1

Notes:

1. Data from FMWD and Raymond Basin Management Board (Kinneloa Irrigation District)

Table C-4 provides the average local water supply for each member agency as an annual quantity and as a percentage of total local water supplies. The table also shows annual average FMWD deliveries to each member agency as an annual quantity and as a percentage of total FWD deliveries.

Table C-4 **Member Agency Water Supply Percentages**

	Local Water Supplies		FMWD Purchases	
Water Agency	Quantity (AF)	Percent of Total Local Water (%)	Quantity (AF)	Percent of Total FMWD Deliveries (%)
Crescenta Valley Water District	2,894.9	34.2%	1,939.2	18.0%
Kinneloa Irrigation District	660.3	7.8%	0.0	0.0%
La Cañada Irrigation District	101.4	1.2%	2,596.5	24.1%
Las Flores Water Company	323.6	3.8%	573.4	5.3%
Lincoln Avenue Water Company	2,025.2	23.9%	1,323.9	12.3%
Mesa Crest Water Company	0.0	0.0%	672.5	6.2%
Rubio Land & Water Association	1,479.6	17.5%	773.8	7.2%
Valley Water Company	990.4	11.7%	2,881.7	26.8%
Total	8,475.5	100.0%	10,761.0	100.0%

Note: Quantities based on five year average (fiscal years 2006-07 to 2010-11)

C-5.2 **Projected Water Demands**

The projected future average annual water demands for each member agency are provided in Table C-5.

Table C-5 **Member Agency Water Demand Projections (AFY; Calendar Year)**

	2010		2015		2020		2025		2030		2035	
	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand	Demand from FMWD	Total System Demand
Crescenta Valley Water District	1542	4330	1,956	5,150	2,281	5,200	2,396	5,250	2,516	5,300	2,646	5,325
Kinneloa Irrigation District	0	587	-	700	-	700	-	700	-	700	-	700
La Cañada Irrigation District	2166	2278	2,863	2,921	2,935	2,995	3,010	3,071	3,085	3,148	3,163	3,228
Las Flores Water Company	478	764	706	900	724	800	742	850	761	900	780	900
Lincoln Avenue Water Company	1333	2228	1,934	2,609	2,000	2,675	2,068	2,743	2,137	2,812	2,208	2,883
Mesa Crest Water Company	593	593	732	732	750	750	769	769	788	788	808	808
Rubio Cañon Land & Water Association	346	1925	772	2,271	569	2,069	621	2,121	675	2,174	730	2,229
Valley Water Company	2350	3330	2,331	3,600	2,400	3,200	2,400	3,200	2,400	3,200	2,400	3,200
Total	8,808	16,033	11,294	18,883	11,659	18,389	12,006	18,704	12,362	19,022	12,735	19,273

Notes:

1) 2010 demands based on FY2010-11 data. 2015 to 2035 "Demand from FMWD" based on FMWD's 2010 Urban Water Management Plan, prepared June 2011. Crescenta Valley's 2015 to 2035 "Total System Demand" based on Crescenta Valley's "2010 Urban Water Management Plan, prepared June 2011. La Cañada Irrigation District's demands based on FMWD's demands approximately 98 percent of total system demands (per La Cañada Irrigation District). "Total System Demand" for remaining FMWD member agencies based on demand data provided by retail agencies.
2) Impacts of the recently passed Senate Bill 7 (SBX7_7) included in some projections. SBx7_7 requires a statewide reduction in water consumption of 10 percent by 2015 and 20 percent by the year 2020. Member agencies that have less than 3,000 connections and that supply no more than 3,000 AFY (Las Flores, Kinneloa and Mesa Crest) were excluded from the SBX7_7 calculations.

C-5.3 **Cost of Water - Groundwater**

Groundwater that is of good quality can typically be produced at cheaper costs than purchasing water from MWD. The cost is typically the cost of power to pump the groundwater, Operations and Maintenance (O&M) costs (typically a minimal amount), and the cost of the chlorine needed to treat the water before putting into the distribution system. The problem with costs arises when water is of poor quality and must be treated prior to introduction into the distribution system. Treatment can often add a significant cost in the form of the capital needed for treatment, resin or chemicals that are needed, O&M including power costs, and also brine or sludge disposal. As an example, the cost to install a 5,000 gpm nitrate treatment (regenerative ion exchange) to remove nitrate contamination was recently estimated at approximately $5 million in capital costs (equipment, site work, brine discharge connection, and electrical) and $0.8 million per year in O&M (brine disposal and salt). These costs need to be compared on a case-by case basis with MWD's water rates along with the risk each agency is willing to take on reliability when deciding on treatment.

C-5.4 **Cost of Water – Imported Water**

In addition to groundwater production, water agencies within the Verdugo Basin Study Area and Arroyo Study Area purchase imported water supplies from FMWD. FMWD purchases water from MWD at a rate of $744 per AF (calendar year 2011) for treated full service Tier 1 water.

It is anticipated FMWD will generally pass-through MWD rate increases to its member agencies for imported water. MWD's rates for Tier 1 water are projected to increase annual to approximately $2,174 per AF by the year 2030 (see Table C-1). It is anticipated that the administrative and operating charge will typically increase based on the rate of inflation and the capital and rehabilitation charge will increase based on the projects identified to be completed if FMWD continues with PAYG as the preferred payment option. It is anticipated that should FMWD obtain financing for capital projects, the capital and rehabilitation charge will be steadier rather than fluctuate as currently anticipated.

C-6. Quality of Water Supplies.

The quality of FMWD's imported water supply provided to water agencies and the quality of local water supplies within the Verdugo Basin Study Area, the Arroyo Study Area, and the Eaton Canyon Study Area are discussed in Section B-3.

C-7. Sources for Additional Water and Plans for New Facilities (for both the local entity and the wholesalers).

C-7.1 Conservation and Water-Use Efficiency

MWD

MWD[5] is aggressively pursuing water conservation in residential, commercial and industrial sectors through a variety of financial incentive-based approaches for water-saving devices. These have included high-efficiency clothes washers, high-efficiency toilets, weather-based irrigation controllers, rotary sprinkler nozzles, restaurant pre-rinse spray valves, medical equipment steam sterilizers, and cooling tower conductivity controllers. Intensive public outreach and education is carried out by MWD to encourage customers to save water and take advantage of rebates. This outreach, education and incentive payments are funded through the rates paid by its member agencies. Total incentive payments for FY 2007-08 were $18.1 million, which created 7,400 AF of new annual water savings. Combined with devices installed in prior years through MWD's Active Conservation Program, the total annual savings for FY 2008-09 is 120,000 AF.

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[5] Because FMWD's primary role has been to import water from MWD, it is appropriate to discuss some of MWD's sources for additional water and plans for new facilities as they relate to FMWD in this section as well as FMWD's and local entities' plans.

FMWD

FMWD has traditionally provided administration of MWD's water conservation programs to its local agencies. However in 2009 it began providing matching incentives for weather-based irrigation controllers and synthetic turf to achieve more participation locally. Consumer participation has been low and FMWD has revamped the program to achieve more consumer participation to encourage greater conservation in compliance with SBX7 7 goals. The program was changed to provide funding for rain barrels, turf removal and high efficiency toilets. Over $55,000 in incentives were provided the first year with almost 200 retail customers participating.

Additionally, in 2008, FMWD formed the Foothill Water Conservation Corps. The FWCC is made up of a group of volunteers that assist FMWD with various conservation events such as water fairs, school education, etc.

FMWD has also sponsored landscape classes offered through MWD in its service area. The classes have been well attended with interest by attendees and those on waiting lists for more classes.

Crescenta Valley

Crescenta Valley has had active conservation programs for many years within its service area. Currently it is employing a summer intern program as a means to educate the public on ways to conserve water. These interns patrol the Crescenta Valley service area daily noting addresses where water waste is occurring so that the employees may contact the resident regarding water-wise practices. Crescenta Valley has a Turf Rebate Program, promotes and supports MWD rebate programs, plans on the retrofit of some apartment buildings within Crescenta Valley boundaries and participates in and supports community events that span not only within the Crescenta Valley service area, but other districts as well. Additionally, Crescenta Valley is working with the cities of Burbank, Glendale, and Pasadena on a uniform message campaign to promote effective outdoor watering practices.

C-7.2 **Water Resource and System Planning**

MWD

The framework for regional water resource planning for MWD's service area is the Integrated Water Resources Plan (IRP), originally adopted by MWD's board in 1996. It was updated in 2004 and is currently being updated again in 2010. The IRP provided a diversified 20-year resource plan to balance locally-developed resources with imported supplies. It called for investments in water conservation, recycling, groundwater treatment, storage and transfers, and in return brought supply diversity and stability.

In 2007/2008 MWD compiled a five-year action plan to develop more local supplies to offset immediate impacts of the increased pumping restrictions in the Bay-Delta. Additionally, staff prepared an action plan for updating the IRP to maintain water supply reliability through 2035, as well as address emerging trends in demand and supply. This update is currently occurring.

In July 2009, MWD implemented the allocation portion of its Water Surplus and Drought Management (WSDM) Plan at a Level 2 with an overall regional reduction of 10%. (The WSDM Plan is a staged Plan which provides short-term planning strategies for managing MWD's portfolio of diverse water resource programs with the final stage being an allocation of resources.) The application of the water allocation portion of WSDM was rescinded in April 2011.

FMWD

Until 2007, when a decision by a Federal Judge severely restricted pumping in the Sacramento–San Joaquin Delta due to the diminishing population of the Delta Smelt, FMWD had served its member agencies with a main strategy of providing imported water supplies to supplement local resources based on the supply reliability developed through the IRP. However, based on the pumping restrictions, three years of drought in Northern California and eight years on the Colorado River watershed, it was apparent that in most years until a permanent fix is achieved for the Bay-Delta, there would be supply allocations from MWD. In response, FMWD's Board of Directors took action to reduce the impacts by initiating a long-term program to achieve increased independence from imported water supplies. This program includes increased conservation, use of recycled water and increased stormwater capture.

For FMWD, because of its dependence on imported water, the reduction in imported supplies from MWD under its WSDM Plan translated to about 15% although the regional shortage was 10%. FMWD mirrored for the most part the allocation from MWD to its member agencies using the same base period and methodology for allocating imported supplies. Depending on the mix of local supplies to imported supplies, member agencies have also passed through some type of allocation to retail customers.

C-7.3 **Future Facilities**

MWD

In December 2007, MWD and its member agencies completed a two-year Integrated Area Study that defined the future facilities needed to reliably deliver MWD's water supplies developed under the IRP. The process was designed to better coordinate local and regional infrastructure planning, clarify policy issues and evaluate alternative approaches to meet water demands over the next 50 years. The Integrated Area Study covered the region's four primary load areas, Central Pool, Riverside and San Diego, West Valley and San Bernardino. Except for the ozone retrofit at the F.E. Weymouth Treatment Plant, there is minimum impact of new facilities to FMWD.

FMWD

The majority of FMWD's infrastructure is about 60 years old. A capital improvement program and rehabilitation program for a five-year period was developed starting in 2009 (see Appendix F for most current five-year projection). For the existing distribution system, most of the program is for rehabilitation of existing facilities. However, as discussed previously, CDPH had recommended with its inspection five years ago that a new storage tank was needed to help meet peak demands. At the recent review of the system and plans for recycled water, CDPH has indicated a willingness to retract its recommendation for a new storage tank based on the development of recycled water within the service area. Additionally, a new emergency interconnection is being considered with the City of Glendale. This interconnection would supply water from MWD's Joseph Jensen Treatment Plant rather than Weymouth increasing reliability to the service area.

A major portion of the resources to be developed by FMWD is recycled water with some development of stormwater as it pertains to recycled water and to help member agencies with increased recharge and groundwater production.

The local agencies also have their own capital and rehabilitation programs. There are limited new facilities being constructed. Interconnections for emergency purposes have been identified and are being reviewed. These interconnections will be constructed as time and funding permit.

Crescenta Valley

In addition to the interconnections discussed above, Crescenta Valley is studying the recharge of the Verdugo Basin. As indicated in Section C-4 above, Crescenta Valley has conducted a feasibility study to investigate the potential for recharging and storing groundwater in the Verdugo Basin and the feasibility of implementing a conjunctive use program. That feasibility study concluded that recharge of precipitation runoff using infiltration galleries at Crescenta Valley County Park was the preferred alternative. Because of limited available land for development of new spreading areas, recharge is being considered at debris basins and also by constructing infiltration galleries adjacent to flood control channels.

La Cañada

La Cañada had plans for constructing a 2 million gallon reservoir on a site near the Angeles Forest. Due to the Station Fire the site has been compromised and La Cañada is now evaluating its alternatives.

Raymond Basin

The Los Angeles County Department of Public Works working with Raymond Basin is also reviewing the possibility of recharging stormwater in Eaton Wash. A pipeline would be constructed between Devil's Gate Dam in the Arroyo Study area and Eaton Wash spreading grounds in the Eaton Study area. Stormwater would be held behind Devil's Gate Dam and moved from that area using the pipeline to the Eaton Wash spreading grounds for recharge purposes. This spreading may help address the overdraft issue in the Pasadena subarea so that pumping rights no longer need to be reduced.

Pasadena is also considering construction of a pump back facility. A pipeline would be constructed from Devil's Gate Dam back up to Pasadena's spreading grounds in the Arroyo. Water would be held behind Devil's Gate Dam and pumped as capacity is available in Pasadena's spreading ponds for recharge into the Monk Hill subarea of the basin.

C-7.4 **Water Resources Data**

Figure C-2 displays the historical and estimated population served within MWD's service area since 1990. In 1990, the population served was approximately 15 million people. Since 1990, the population served has increased to nearly 19 million people. Demographic projections provided to MWD by regional planning agencies forecast additional increases in population, with an estimated 22 million people by the year 2030.

Figure C-3 displays the historical and estimated water sales within MWD's service area since 1990. In 1990, water sales reached record-high levels of more than 2.5 MAF. Since 1990, water sales have ranged between 1.5 and 2.5 MAF. The projections of water sales through the year 2030 range from 1.5 to more than 2.9 MAF. The wide range in MWD water sales, both historically and into the future, is attributed to varying weather conditions, and the production of locally-supplied water.

MWD anticipates meeting these increasing demands through a variety of their water resource programs. Additional retail level conservation is anticipated in response to the

“20 x 2020” conservation legislation and is expected to ramp up to 200,000 AF of demand reduction by 2020. Additional local resources, supported by the MWD Local Resources Program (LRP) are expected to grow by 16 thousand acre-feet (TAF) beginning in 2015 and reaching 46 TAF by 2025. In addition to these local measures, MWD is planning on a Delta Fix coming on line before 2025 which will significantly improve the reliability of SWP supplies. Continuing management of MWD’s storage portfolio along with selected transfers will also be used to meet the regions’ wholesale water need. A detailed presentation of the projected demands and supply capability is included as Appendix G. Appendix G includes a series of Tables presenting MWD’s plans for supplying supplemental water to the region under several hydrologic scenarios in five year increments out to the year 2035. Also presented are In-Region Storage Capabilities, California Aqueduct Capabilities and Colorado River Aqueduct Capabilities projected out to 2035. Finally, a near term projection of MWD Rates and Charges is included. These data are included to demonstrate the planning that has occurred to ensure the reliability of the imported water supplies for the region.

The MWD capital improvement plan is anticipated to continue averaging approximately $400 million per year for the foreseeable future. Figure C-4 depicts a breakdown of the next several years of capital expenditures for different improvement projects. The most significant capital improvements of concern to FMWD are the completion of the oxidation retrofit program at the Weymouth Treatment Plant, which is expected by 2015, and the completion of the Delta Fix.

D. WASTEWATER CHARACTERISTICS AND FACILITIES

D-1. Description of Entities.

The majority of the wastewater service in Los Angeles County is provided by either the City of Los Angeles through their Hyperion System or by the LACSD through their Joint Outfall System (JOS). FMWD straddles these two service areas and therefore, any local satellite project will impact downstream facilities in one or both of these systems to some degree. These facilities are described in the following paragraphs.

D-1.1 **Los Angeles County Sanitation Districts**

The LACSD are a confederation of 23 separate Districts working cooperatively to meet the water pollution control and solid waste management needs of approximately 5.7million people in Los Angeles County. The LACSD, which provide wastewater services within the FMWD service area, are Districts 16 (Pasadena), 17 (Altadena), 28 (the area of La Cañada Flintridge surrounding the La Cañada Country Club), and 34 (the remainder of La Cañada Flintridge). Of these Districts, only District 28 provides local wastewater treatment. The locations of these Districts are provided in Figure D-1.

The District 28 Water Reclamation Plant (also known as the La Cañada Water Reclamation Plant) is a secondary wastewater treatment plant with a capacity of 200,000 gallons per day. The plant provides wastewater treatment for the residential area around the country club and presently treats about 100,000 gallons per day. The treated effluent is discharged into ponds at the country club and is then pumped and used for irrigation of the fairways and greens. Disinfected secondary effluent meets the regulatory requirements for controlled access golf course irrigation and some landscape irrigation.

The 100,000 gallons per day of effluent are adequate to meet the irrigation needs in the cooler months although Mesa Crest provides supplemental water to the ponds during the warmer summer months.

D-1.2 **City of Los Angeles Department of Public Works and City of Glendale**

The Cities of Los Angeles and Glendale co-own the Los Angeles-Glendale Water Reclamation Plant (LAGWRP), with the City of Los Angeles' Bureau of Sanitation operating and maintaining the plant. The LAGWRP provides wastewater services to Eastern San Fernando Valley including the Glendale-Burbank-La Crescenta area. Crescenta Valley's service area and a small portion of La Cañada's service area are serviced by the LAGWRP. LAGWRP is located outside of FMWD's service area. It is a part of the City of Los Angeles' wastewater system which is depicted in Figure D-2.

D-1.3 **Crescenta Valley Water District Collection System**

Crescenta Valley constructed a wastewater collection system for its entire service area in the early 1980s under the Clean Water Grant Program. The collection system includes the far western part of La Cañada Flintridge as its tributary by gravity. Specifically, Ocean View Avenue and the YMCA on Foothill Boulevard are included within the Crescenta Valley system. Figure D-3 depicts the Crescenta Valley collection system which flows to LAGWRP through a separate trunk sewer.

D-1.4 **City of La Cañada Flintridge Sewering Program**

Until recently, the residential areas of La Cañada Flintridge have not had access to municipal sewer services. The Foothill Trunk Sewer (Figure D-4), which serves the business district, was constructed by the LACSD in 1996. The City is working through a long-range master plan to provide sewer services to all remaining properties. Initially, the City defined Master Plan Areas for the purposes of approval and development of collection systems in a logical manner. These areas are depicted on Figure D-5

Sewer Master Plan Area 1, constructed as Assessment District 98-1, was completed in 1999. Sewer Master Plan Area 2, constructed as Assessment District 02-1 was completed in summer 2005. Sewer Master Plan Areas 3A & 3B, constructed as Assessment District 04-1 were completed in June 2008. In its continuing efforts, the City's goal is to expand and improve the Citywide wastewater collection and transmission system for the future Sewer Project Areas 4, 5 and 6 (Figure D-6). The assessment ballot for Sewer Project Areas 5, 6E, and 6J were defeated by a two-to-one vote in October, 2009.

The Foothill Trunk Sewer is maintained by the LACSD. Sewer mains in Areas 1, 2, and 3 are maintained by the Los Angeles County Department of Public Works under contract with the City.

D-2. Description of Major Facilities (including capacities, present flows, plans for new facilities, description of treatment processes, design criteria).

Wastewater from the Arroyo and Eaton Canyon Study Areas are primarily treated at LACSD's San Jose Creek Water Reclamation Plant (SJCWRP) and Whittier Narrows Water Reclamation Plant (WNWRP). Wastewater from part of the Verdugo Basin Study Area (Crescenta Valley's service area and a small portion of La Cañada's service area) is treated at the LAGWRP. The SJCWRP and WNWRP are located approximately 15 miles from the Study Areas, while the LAGWRP is located approximately 7 miles from the Study Areas. Effluent from these plants is not proposed to be used for FWMD's recycled water program due to the infrastructure and transportation costs to bring it to the study area. There is a small existing wastewater treatment plant in the Arroyo Study Area treating wastewater from approximately 425 homes and the La Cañada Flintridge Country Club, which is referred to as the La Cañada Water Reclamation Plant. LACSD's trunk sewers are used to deliver wastewater from the portion of the Study Areas generally east of Windsor Avenue/Arroyo Boulevard to the SJCWRP, located in unincorporated Los Angeles County near the City of Whittier, and the portion of the Study Areas generally west of Windsor Avenue/Arroyo Boulevard to the WNWRP, located in the City of El Monte. The North Outfall Sewer delivers wastewater from applicable portions of the Verdugo Basin Study Area to LAGWRP located in the City of Los Angeles. The location of LACSD's main trunk lines and wastewater treatment plants were provided in Figure D-1. The location of the LAGWRP and main trunk lines were provided in Figure D-2. Descriptions of the SJCWRP, WNWRP, and LAGWRP are provided below to provide information on the current regional wastewater facilities treating wastewater from the Study Areas.

D-2.1 **San Jose Creek Water Reclamation Plant**

SJCWRP provides primary, secondary, and tertiary treatment with a treatment capacity of 100 million gallons per day (MGD), serving a population of approximately one million people. The treatment process is shown in Appendix H. As shown in Appendix H, influent wastewater from LACSD's trunk sewer enters primary settling tanks where solids are removed and returned for further treatment at LACSD's Joint Water Pollution Control Plant (JWPCP). After the primary settling tanks, wastewater containing dissolved and suspended materials (mostly organic) receives secondary treatment in aeration tanks and secondary settling tanks. In the aeration tanks, oxygen is added to promote degradation of the biological content of wastewater by microorganisms. After the aeration tanks, wastewater enters secondary settling tanks where the microorganisms clump together and settle to the bottom as activated sludge, where they are removed and recycled back into the treatment process. Waste activated sludge is discharged to LACSD's trunk sewer for further treatment at LACSD's JWPCP. After secondary treatment, wastewater receives tertiary treatment with gravity filters consisting of layers of anthracite coal, sand, and gravel to remove any remaining suspended materials from the water. The reclaimed water is then disinfected with chlorine to remove harmful bacteria and viruses. After disinfection, any remaining chlorine in the reclaimed water is removed using sulfur dioxide to protect aquatic life in the receiving environment.

SJCWRP treated approximately 76,830 AF of wastewater during FY 2009-10. Of this total, approximately 49,290 AF was discharged into spreading grounds or delivered for direct use (including irrigation of parks, schools, and greenbelts). Unused reclaimed water was discharged to the San Gabriel River.

D-2.2 **Whittier Narrows Water Reclamation Plant**

WNWRP provides primary, secondary, and tertiary treatment for up to 15 MGD of wastewater, serving a population of approximately 150,000 people. Capacity is currently available at the plant as approximately 4.7 MGD was treated in FY 2009-10 and 6 MGD was treated in FY 2008-09. The treatment process is shown in Appendix H. As shown in Appendix H, influent wastewater from LACSD's trunk sewer enters primary settling tanks where solids are removed and returned for further treatment at LACSD's JWPCP. After the primary settling tanks, wastewater containing dissolved and suspended materials (mostly organic) receives secondary treatment in aeration tanks and secondary settling tanks. In the aeration tanks, oxygen is added to promote degradation of the biological content of wastewater by microorganisms. After the aeration tanks, wastewater enters secondary settling tanks where the microorganisms clump together and settle to the bottom as activated sludge, where they are removed and recycled back into the treatment process. Waste activated sludge is discharged to LACSD's trunk sewer for further treatment at LACSD's JWPCP. After secondary treatment, wastewater receives tertiary treatment with gravity filters consisting of layers of anthracite coal, sand, and gravel to remove any remaining suspended materials from the water. The reclaimed water is then disinfected with sodium hypochlorite to remove harmful bacteria and viruses. (The WNWRP will be switching over to UV in the near future for disinfection.) After disinfection, any remaining chlorine in the reclaimed water is removed using sodium bisulfite to protect aquatic life in the receiving environment.

WNWRP treated approximately 5,300 AF of wastewater during FY 2009-10. Of this total, approximately 5,300 AF was discharged into spreading grounds or delivered for direct use (including irrigation of parks, schools, and greenbelts).

D-2.3 **Los Angeles-Glendale Water Reclamation Plant**

LAGWRP provides primary, secondary, and tertiary treatment of approximately 20 MGD of wastewater. The treatment process is shown in Appendix H. As shown in Appendix H, influent wastewater from the North Outfall Sewer enters the headworks/barscreens where solids (such as branches, plastics, and rags) and grit (sand, rocks, and small debris) are removed, as part of the preliminary treatment. After the preliminary treatment, the wastewater travels through the influent pumping facility and enters the primary treatment where the solids (sludge) settle to the bottom of the primary tanks. The primary sludge from the tanks is returned to the main sewer where it is sent to the City of Los Angeles' Hyperion Treatment Plant for further processing. Wastewater from the primary treatment tanks flows by gravity to the secondary treatment system where bacteria are added to the aeration tanks for the nitrification-denitrification process. In the aeration tanks, oxygen is added to speed up the bacteria's rate of decomposition. From the aeration tanks, the wastewater with activated sludge flows to the secondary clarifying tanks to allow settling of the activated sludge by gravity. A portion of the settled activated sludge is returned to the aeration tanks to maintain biological equilibrium in the aeration tanks, while the remaining portion is discharged to the sewer where it flows to the Hyperion Treatment Plant for further processing. After secondary treatment, the wastewater enters the tertiary treatment to allow any remaining solids to be removed by the dual-bed or tetra denite sand filters. After tertiary treatment, the wastewater is disinfected using sodium hypochlorite to remove any remaining pathogens or disease-carrying organisms. After disinfection, the wastewater is dechlorinated using sodium bisulfite to protect fish and other aquatic life in the receiving environment. The treated water is reclaimed or discharged into the Los Angeles River.

Approximately 4.5 MGD of the processed wastewater are used for reclaimed purposes by the City of Los Angeles Department of Public Works and the City of Glendale. Reclaimed uses include utilization at the plant for treatment processes and landscape irrigation; cooling water for the Glendale Steam Power Plant; and irrigation at Griffith

Park, freeway landscaping, local cemeteries, and nearby golf courses. Unused reclaimed water is discharged into the Los Angeles River.

D-2.4 La Cañada Water Reclamation Plant

The La Cañada Water Reclamation Plant, located in the City of La Cañada Flintridge, treats wastewater generated from a small area (the La Cañada Flintridge Country Club and approximately 425 homes) within the Study Areas. As discussed previously, the La Cañada Water Reclamation Plant provides secondary treatment of 200,000 gallons per day of wastewater. The treatment process is shown in Appendix H. As shown in Appendix H, influent wastewater goes through bar screens and comminutors where large objects are removed by the bar screens and shredded/reduced in size by the comminutors. Wastewater then enters aeration tanks where oxygen is added to promote degradation of the biological content of wastewater by microorganisms. After the aeration tanks, wastewater enters secondary settling tanks where the microorganisms clump together and settle to the bottom, where they are removed and recycled back into the treatment process. Waste sludge is discharged to LACSD’s trunk sewer, which then flows towards the JWPCP. The secondary effluent is disinfected with chlorine prior to discharge to the four lakes on the Country Club golf course.

The La Cañada Water Reclamation Plant treated approximately 110 AF of wastewater during FY 2009-10, all of which was discharged into the lakes.

D-2.5 Groundwater Reliability Improvement Program (GRIP) Project

The Water Replenishment District of Southern California and LACSD are developing the proposed GRIP Project that will provide up to 21,000 AFY of advanced treated recycled water within the Central Basin through advanced treatment of effluent from the SJCWRP. A conceptual design report of the GRIP Project was completed in May 2009.

D-3. Water Quality of Effluent and any Seasonal Variation.

Recycled water quality produced from the SJCWRP and WNWRP was obtained from LACSD's "Status Report on Recycled Water Fiscal Year 2009-10" and is provided in Appendix I; however, it should be noted that these treatment plants are outside of the Study Areas for this report and effluent from these plants is not proposed to be a source of recycled water for the proposed projects. Mean, minimum, and maximum water quality concentrations during the sampling period are included. LACSD discharge, reuse, and recharge requirements are discussed in Section D-4.

Recycled water quality produced from the LAGWRP was obtained from LAGWRP's "Annual Waste Discharge Requirements for Title 22 Recycled Water Monitoring Report 2009" and is provided in Appendix J. It should be noted that LAGWRP is outside of the Study Areas for this report and effluent from this plant is not proposed to be a source of recycled water for the proposed projects. However, studies have been conducted to bring LAGWRP effluent to the Study Areas. The proposed use of LAGWRP effluent in the Study Areas will be discussed in a later section of this report. Discharge, reuse, and recharge requirements for the LAGWRP are discussed in Section D-4.

Recycled water quality from the GRIP Project is discussed in the Conceptual Level Study.[6] According to the Conceptual Level Study, compounds in the SJCWRP effluent that exceed current regulatory standards for groundwater recharge may be adequately removed using the treatment processes considered as part of the proposed treatment train for the GRIP Advanced Water Treatment Plant. The regulatory standards reviewed in the Conceptual Level Study include the Regional Water Quality Control Board's (RWQCB) discharge requirements under the National Pollutant Discharge Elimination System (NPDES) program, including the California Toxics Rule that regulates certain toxic pollutants; CDPH's draft regulation for Groundwater Recharge

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[6] *Groundwater Reliability Improvement Program (GRIP), Conceptual Level Study*. Prepared by MWH. Prepared for Upper San Gabriel Valley Municipal Water District, Water Replenishment District of Southern California, and Sanitation Districts of Los Angeles County. Draft Final. May 1, 2009.

Reuse for recharge of recycled water into the groundwater; and, although not applicable, the California Office of Environmental Health Hazard Assessment Public Health Goals as a basis for future regulatory standards that should be reviewed during the planning phase.

D-4. Additional Facilities Needed to Comply with Waste Discharge Requirements.

LACSD treatment facilities are subject to regulations administered by the RWQCB. LACSD treatment plants hold permits under the NPDES program, which must be renewed every five years. The LACSD treatment plants are subject to discharge, reuse, and recharge permits. LACSD will need to construct any facilities necessary to remain in compliance with these permits. Recycled water use from the San Jose Creek Water Reclamation Plant is permitted under the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) Order Nos. 87-50 and 97-072 for direct, non-potable applications, No. 91-100 for groundwater replenishment. Recycled water use from the Whittier Narrows Water Reclamation Plant is permitted under the LARWQCB Order Nos. 88-107 and 97-072 for direct, non-potable applications, No. 91-100 for groundwater replenishment. Recycled water use from the La Cañada Water Reclamation Plant is permitted under the LARWQCB Order No. 00-099.

The LAGWRP is subject to regulations administered by the RWQCB. The LAGWRP holds an NPDES permit that requires periodic renewal (current permit expires on November 13, 2011). The LAGWRP is subject to applicable discharge, reuse, and recharge permits. The Cities of Los Angeles and Glendale will need to construct any facilities necessary to remain in compliance with these permits. Reuse of recycled water from the LAGWRP is permitted under LARWQCB Order Nos. R4-2007-0006 and R4-2008-0040.

D-5. Sources of Industrial or Other Problem Constituents and Control Measures.

D-5.1 **County Sanitation Districts of Los Angeles County**

LACSD defines industrial wastewater as “all wastewater from any manufacturing, processing, institutional, commercial, or agricultural operation, or any operation where the wastewater discharged includes significant quantities of waste of non-human origin”. Based on Drinking Water Source Assessment and Protection Program reports, “Electrical/electronic manufacturing” industrial activities occur within Kinneloa; “Chemical/petroleum processing/storage” industrial activities occur within La Cañada and Valley; “Machine shops,” “Metal plating/finishing/fabricating,” “Plastics/synthetics producers,” and “Wood/pulp/paper processing and mills” industrial activities occur within Lincoln; and “Food processing” industrial activities occur within Rubio.

Companies that discharge industrial wastewater must comply with LACSD wastewater ordinance requirements, which include LACSD’s Industrial Wastewater Discharge Permit, Connection Fee, and Surcharge Programs. LACSD’s Industrial Wastewater Discharge Permit Program allows LACSD to regulate industrial wastewater dischargers that may be sources of industrial or other problem constituents. The Permit requires pretreatment of industrial wastewaters before discharge and restricts and prohibits discharge of certain wastewaters. The Permit application requires submittal of wastewater analysis results that include conventional pollutants such as chemical oxygen demand, suspended solids, total dissolved solids, pH, and toxic pollutants that may be present in the wastewater (e.g., heavy metals and organics). The Connection Fee Program requires all new LACSD users, as well as existing users that significantly increase the quantity or strength of their wastewater discharge, to pay a portion of the costs for providing additional conveyance, treatment, and disposal facilities. The Surcharge Program requires all industrial companies discharging to LACSD to pay a portion of the wastewater treatment and disposal costs.

D-5.2 **City of Los Angeles Department of Public Works**

The Industrial Waste Management (IWMD) Division within the Bureau of Sanitation of the City of Los Angeles Department of Public Works monitors, regulates, and controls industrial wastewater discharges to the City's wastewater collection and treatment system. The City of Los Angeles defines industrial wastewater as waste-bearing water other than domestic wastewater, which is generated from manufacturing, commercial or other operations not excluding household type operations performed at commercial establishments for or to support commercial purposes. Land use in the service areas of Crescenta Valley and La Cañada that are served by the LAGWRP includes a small area of industrial use.

Companies that discharge industrial wastewater must comply with Section 64.30 of the Los Angeles Municipal Code, Industrial Waste Control Ordinance, which includes the City of Los Angeles' industrial wastewater permit program. The industrial wastewater permit allows the City of Los Angeles to protect its sewer collection and treatment systems, and to prevent regulated toxic wastewater constituents from passing through to receiving waters and recovered bio-solids. As part of the permit application, an industrial waste inspector will inspect the facility, verify all information provided in the permit application is complete and accurate, and identify all wastewater generating processes, methods of wastewater conveyance, and pretreatment systems. In addition to the permit application fee, there is also an annual Inspection and Control Fee which all permitted Users must pay for the basic level of services such as inspection, sampling, inventory control, and reporting; and a Quality Surcharge Fee for discharged wastewater that contains organic waste and solids above domestic levels.

IWMD staff reviews and processes the permit application to establish discharge limitations, monitoring, and reporting requirements. Included in the permit are conditions, obligations, and responsibilities under which an industrial user is permitted to discharge industrial wastewater to the sewer system. Businesses classified as

Significant Industrial Users (SIUs) by the City of Los Angeles are subject to more stringent requirements than other types of businesses.

D-6. Existing Recycling (including users, quantities, contractual and pricing arrangements).

The La Cañada Water Reclamation Plant provides extended aeration secondary treatment for 200,000 gallons of wastewater per day (see flow diagram in Appendix H). The plant serves the La Cañada Flintridge Country Club and 425 surrounding homes, the location of which is depicted on Figure D-7. All of the disinfected, secondary effluent is put into the four lakes on the 105 acre Country Club golf course. Lake water (augmented by potable water during the summer) is used for landscape irrigation of the golf course as depicted on Figure D-8. All of the approximately 1.1 million gallons produced at the La Cañada Water Reclamation Plant during 2009 was used for landscape irrigation of the golf course and in storage reservoirs or landscape impoundments.

D-7. Existing Rights to Use of Treated Effluent after Discharge.

Once treated effluent is discharged to the environment it is subject to being appropriated through the water rights proceedings of the State Water Resources Control Board. While the wastewater, raw or treated, remains within pipes or treatment facilities, it is the property of the owner of the facilities. With regard to this planning effort, which does not envision any surface water discharge, the raw wastewater is therefore owned by La Cañada Flintridge, Crescenta Valley, or the Sanitation Districts of Los Angeles County depending on whose facilities contain it. Should FMWD select an alternative that included diversion of effluent from LAGWRP for use within FMWD, a separate agreement with Glendale may have to be negotiated for rights to the effluent.

D-8. Wastewater Flow Variations - Hourly and Seasonal.

Hourly wastewater flow variations within the Foothill Boulevard Main Trunk are depicted for MH 46 on Figure D-9, MH 61 on Figure D-10 and MH B-1442 on Figure D-11. These Manhole locations can be found on Figure D-4. MH B-1442 essentially represents the entire flow from La Cañada Flintridge. As may be noted, the total hourly flow varies from about 0.1cfs to about 2.5 cfs on a daily basis. The monthly and daily flow variations for 2009 for the Crescenta Valley collection system at the Elk Station are presented on Table D-1. It can be noted from these data that there is not much seasonal or daily variation in the wastewater flows and that a flow of 1.25 to 1.5 MGD can be expected on any given day. Seasonal variations in wastewater flow in the area are represented by Figure D-12 which depicts the flow at the La Cañada Plant flow over the 2009 year. This indicates that there is not a significant seasonal variation in flows but that there may be short term aberrations most likely driven by rainfall induced infiltration/inflow.

Table D-1 Wastewater Flows at Elk Station

Month	2009			
	MG per month	MG per day	MG min day	MG max day
January	51.68	1.67	1.54	1.80
February	46.66	1.67	1.57	1.91
March	51.10	1.65	1.57	1.88
April	47.12	1.57	1.41	1.73
May	49.40	1.59	1.51	1.72
June	47.15	1.57	1.51	1.65
July	46.85	1.51	1.45	1.59
August	44.60	1.44	1.31	1.52
September	42.63	1.42	1.20	1.58
October	44.47	1.43	1.23	1.64
November	41.71	1.39	1.26	1.52
December	46.48	1.50	1.27	1.85
Total Flow MG	559.86			
Monthly Average	46.65			

E. TREATMENT REQUIREMENTS FOR DISCHARGE AND REUSE

E-1. Required Water Qualities for Potential Uses

Water quality requirements of recycled water for beneficial use are based on the anticipated use. Examples of the water quality issues that may be of concern for the different anticipated uses are presented in Table E-1.

Table E-1 Water Quality Concerns for Anticipated Uses

Type of Use	Water Quality Issues
Landscape Irrigation	TDS Sulfate Chloride Boron Sodium Absorption Ratio
Cooling Tower Makeup	TDS Orthophosphate
Groundwater Recharge	TDS Sulfate Chloride Boron Total Organic Carbon Nitrogen Compounds

The water quality concerns for landscape irrigation are driven by the potential impacts that the water quality will have on the plant growth patterns particularly for salt sensitive species. For cooling tower makeup uses, the concerns are for the number of cycles between blowdowns and the potential for fouling within the cooling towers. The groundwater recharge issues relate to the existing water quality and what assimilative capacity exists to avoid any issues with the groundwater quality objectives established in Water Quality Control Plans adopted by the RWQCBs for watersheds.

E-2. Water Quality, Treatment, and Operational Requirements for Recycled Water Uses

E-2.1 Non-Potable Uses of Recycled Water

Treatment and water quality requirements for non-potable uses of recycled water are specified in *Water Recycling Criteria*, California Code of Regulations, Title 22, Division 4, Chapter 3. These requirements are depicted in Figure E-1 and are summarized in Table E-2.

Table E-2 California Water Recycling Criteria: Treatment and Quality Requirements for Nonpotable Uses of Reclaimed Water

Type of Use	**Total Coliform Limits**[a]	**Treatment Required**
Irrigation of fodder, fiber, and seed crops, orchards[b] and vineyards[b], processed food crops, nonfoodbearing trees, ornamental nursery stock[c], and sod farms; flushing sanitary sewers	None required	Secondary
Irrigation of pasture for milking animals, landscape areas[d], ornamental nursery stock and sod farms where public access is not restricted; landscape impoundments; industrial or commercial cooling water where no mist is created; nonstructural fire fighting; industrial boiler feed; soil compaction; dust control; cleaning roads, sidewalks, and outdoor areas	≤23/100 mL ≤240/100 mL in more than one sample in any 30-day period	Secondary Disinfection
Irrigation of food crops[b]; restricted recreational impoundments; fish hatcheries	≤2.2/100 mL ≤23/100 mL in more than one sample in any 30-day period	Secondary Disinfection

Irrigation of food crops[e] and open access landscape areas[f]; toilet and urinal flushing; industrial process water; decorative fountains; commercial laundries and car washes; snow-making; structural fire fighting; industrial or commercial cooling where mist is created	240/100 mL (maximum)	Secondary Coagulation[g] Filtration[h] Disinfection
Nonrestricted recreational impoundments	≤2.2/100 mL ≤23/100 mL in more than one sample in any 30-day period 240/100 mL (maximum)	Secondary Coagulation Clarification[i] Filtration[h] Disinfection

a. Based on running 7-day median.

b. No contact between reclaimed water and edible portion of crop.

c. No irrigation for at least 14 days prior to harvesting, sale, or allowing public access.

d. Cemeteries, freeway landscaping, restricted access golf courses, and other controlled access areas.

e. Contact between reclaimed water and edible portion of crop; includes edible root crops.

f. Parks, playgrounds, schoolyards, residential landscaping, unrestricted access golf courses, and other uncontrolled access irrigation areas.

g. Not required if the turbidity of the influent to the filters is continuously measured, does not exceed 5 nephelometric turbidity units (NTU) for more than 15 minutes and never exceeds 10 NTU, and there is capability to automatically activate chemical addition or divert the wastewater if the filter influent turbidity exceeds 5 NTU for more than 15 minutes.

h. The turbidity after filtration through filter media cannot exceed 2 NTU within any 24-hour period, 5 NTU more than 5% of the time within a 24-hour period, and 10 NTU at any time. The turbidity after filtration through a membrane process cannot exceed 0.2 NTU more than 5% of the time within any 24-hour period and 0.5 NTU at any time.

i. Not required if reclaimed water is monitored for enteric viruses, *Giardia*, and *Cryptosporidium*.

Source: State of California. 2000. Water Recycling Criteria. California Code of Regulations, Title 22, Division 4, Chapter 3. California Department of Public Health, Sacramento, California.

E-2.2 **Use Area Requirements**

Reclaimed water use area setback distance requirements include the following:

- No irrigation or impoundment of undisinfected reclaimed water within 150 feet (50 meters) of any domestic water supply well;
- No irrigation of disinfected secondary-treated reclaimed water within 100 feet (30 meters) of any domestic water supply well;
- No irrigation with tertiary-treated (secondary treatment, filtration, and disinfection) reclaimed water within 50 feet (15 meters) of any domestic water supply well unless special conditions are met, and no impoundment of tertiary-treated reclaimed water within 100 feet (30 meters) of any domestic water supply well;
- Only tertiary-treated reclaimed water can be sprayed within 100 feet (30 meters) of a residence or places where more than incidental exposure is likely.

Other use area controls include the following:

- Confinement of runoff to the reclaimed water use area unless otherwise authorized by the regulatory agency;
- Prohibition of reclaimed water spray, mist, or runoff in dwellings, designated outdoor eating areas, or food handling facilities;
- Protection of drinking water fountains against contact with reclaimed water;
- Signs (see Figure E-2) at sites using reclaimed water that are accessible to the public, although educational programs or other approaches to assure public notification may be acceptable to CDPH;
- Prohibition of hose bibbs on reclaimed water piping systems accessible to the public.

The reuse criteria require compliance with the CDPH cross-connection control regulations. They require that water systems serving residences through a dual water system that uses reclaimed water for landscape irrigation must, as a minimum, be protected by a double check valve assembly backflow preventer. The same requirement applies to a public water system in buildings using reclaimed water in a separate piping system within buildings for fire protection. A reduced pressure principle backflow prevention device is required as a minimum to protect the potable system at sites other than those mentioned above. An air gap separation is required where a public water system is used to supplement a reclaimed water supply.

Requirements pertaining to color-coding reclaimed water pipe are included in California's Health and Safety Code, which states, in part, that: "All pipes installed above or below ground, on and after June 1, 1993, that are designed to carry recycled water, shall be colored purple or distinctively wrapped with purple tape." The Health and Safety Code further states that purple pipe or tape is not required for pipes used for water delivered for agricultural use and at municipal or industrial facilities that have established a labeling or marking system for reclaimed water on their premises, as otherwise required by a local agency, that clearly distinguishes reclaimed water from potable water.

E-2.3 **Groundwater Recharge with Recycled Water**

FMWD anticipates that portions or all of the treated effluent from the proposed satellite plants might be used for groundwater recharge in either or both the Verdugo Basin and the Raymond Basin. The CDPH Drinking Water Program's thinking on the regulation of recharge of groundwater with recycled municipal wastewater was presented in draft regulations published in August 2008. These draft regulations outline the criteria under which a groundwater recharge program must operate including treatment, blending and retention time requirements. These criteria are also influenced by the method of groundwater recharge that is used. Figure E-3 depicts the two paths that may be used for recharge.

Regardless of which method is used for groundwater recharge, CDPH has draft regulations to address the control of pathogenic organisms. These regulations stipulate that the recharge water shall be disinfected tertiary recycled water as a minimum and that it shall be retained underground for a minimum of six months prior to extraction for use as a drinking water supply. The recharge program must demonstrate that the minimum retention time has been met by the use of a tracer study prior to the end of the third month of operation. Prior to that, one of the retention time calculations outlined in Table E-3 may be used to estimate retention time.

Table E-3 Methods to Determine Retention Time for Groundwater Recharge

Planning and Engineering Report Effort vs. Retention Time				
Method	**General Accuracy**	**General Level of Effort**	**Retention Time (months)**	**Safety Factor**
Formula (Darcy's)	Poor	Some information on aquifer	24	4
3-D Model	Fair	Lots of information on aquifer	12	2
Intrinsic Tracer	Better	Sampling of existing indicators	9	1.5
Added Tracer	Desired	Track added tracer	6	1.0

Source: California's Draft Criteria for Groundwater Recharge (as of 9/12/2008). Presentation to Water Reuse Inland Empire Chapter, July 14, 2009 by Heather Collins

The draft groundwater recharge criteria also indicate that the recycled water shall be of municipal wastewater origin, and that the agency shall have a pretreatment and pollutant source control program to maintain an inventory of compounds discharged into the collection system and to assess the fate of specified contaminants. The source control program shall also have an outreach program to help the users manage and minimize the discharge of contaminants to the collection system.

There are also proposed limits on the recycled water contribution as a percentage of the groundwater. These are calculated based on limiting the amount of total organic carbon (TOC). Table E-4 presents examples of how the contribution may be calculated. In addition, treatment processes are required for that portion of the recycled wastewater stream needing additional treatment to meet the TOC limit. This is typically done using reverse osmosis and advanced oxidation treatment equivalent to a 1.2 log N-nitrosodimethylamine (NDMA) reduction and a 0.5 log 1.4-dioxane reduction.

Table E-4 Recycled Water Contribution (RWC)

$\text{TOC max} = \frac{0.5\ \text{mg/L}}{\text{RWC}_{\text{proposed}}}$
Examples:
RWC = 10% or 0.10; TOC < 5.0 mg/L
RWC = 20% or 0.10; TOC < 2.5 mg/L
RWC = 35% or 0.10; TOC < 1.43 mg/L
RWC = 50% or 0.10; TOC < 1.0 mg/L
RWC = 75% or 0.10; TOC < 0.67 mg/L

Note: TOC is calculated on a 20 week average

Another way to help meet the RWC limits is through blending of the recycled water with another source of water. The water used for blending may consist of raw surface water, groundwater or stormwater. A source water evaluation for the water used for blending shall include a description of the water, delineation of the origin and extent of the water, susceptibility to contamination, identification of known or potential contaminants and an inventory of the potential sources of water contamination. The source of the water used for blending shall be monitored quarterly for nitrate and nitrite and there shall be a CDPH approved water quality monitoring plan for the purpose of demonstrating that the water meets specified primary MCLs and notification levels.

Monitoring wells shall be installed as a part of the recharge program at a location where the recharge water has been retained in the saturated zone for one to three months, but will take at least three months before reaching the nearest domestic water supply well and at an additional point or points between the application facility and the nearest downgradient domestic water supply well.

The required Title 22 Engineering Report identifying how the project will address the aforementioned issues will be prepared concurrently with the CEQA documents and facility designs. The report will then be submitted to the SWRCB for review and final approval.

E-3. Wastewater Discharge Requirements and Anticipated Changes in Requirements.

This study evaluates several alternatives for new upstream skimming plants which will withdraw raw wastewater from the existing collection system only during times when the reuse opportunities exist. It is anticipated the membrane bioreactors will be the treatment technology with the residuals being returned to the collection system for treatment. No discharge requirements currently exist and no discharges are anticipated from the proposed facilities other than for beneficial use.

E-4. Water Quality-Related Requirements of the RWQCB (to protect surface or groundwater from problems resulting from recycled water use).

E-4.1 **Statewide General Permit for Landscape Irrigation Uses of Municipal Recycled Water**

The RWQCB adopted the *"Statewide General Permit for Landscape Irrigation Uses of Municipal Recycled Water (General Permit – Water Quality Order No. 2009-0006-DWQ")*. In July 2009, the State Water Resources Control Board (SWRCB) adopted *"General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water (General Permit).* For those eligible, the General Permit allows the use of recycled water for landscape irrigation.[7] The General Permit facilitates the

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[7] Individually owned residences are not eligible for coverage under the General Permit. The RWQCBs will address individually owned residences on a case-by-case basis.

streamlining of the permitting process to reduce the overall costs normally incurred by the producer, distributors, and users of recycled water.

"Landscape Irrigation" uses include the following:

- Parks, greenbelts, and playgrounds
- School yards
- Athletic fields
- Golf courses
- Cemeteries
- Residential landscaping, common areas [7]
- Commercial landscaping, except eating areas
- Industrial landscaping, except eating areas
- Freeway, highway, and street landscaping.

To apply for coverage under the general permit, a project administrator must file a Notice of Intent (the form is available on the SWRCB website), providing a complete Operation and Maintenance Plan, and submitting the appropriate fee to the SWRCB. The SWRCB adopted Resolution No. 2009-0059 "*Approval of Certification Pursuant to the California Environmental Quality Act of the Mitigated Negative Declaration Covering General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water - Water Quality Order No. 2009-0006-DWQ,*" which satisfies the California Environmental Quality Act documentation for the those eligible under the General Permit. The General Permit is consistent with the "*Recycled Water Policy,*" State and Federal water quality laws, including the statewide water quality standards established by CDPH.

E-4.2 **Recycled Water Policy**

The Recycled Water Policy (adopted February 3, 2009) of the SWRCB provides direction to the RWQCBs, proponents of recycled water projects, and the public regarding the appropriate criteria to be used by the SWRCB and the RWQCBs in issuing permits for recycled water projects. The Recycled Water Policy describes permitting criteria that are intended to streamline the permitting of recycled water projects.

The SWRCB shares jurisdiction over the use of recycled water with the RWQCBs and CDPH. The RWQCBs are charged with protecting surface and groundwater resources and the issuance of permits that implement CDPH recommendations, the Recycled Water Policy, and applicable laws.

The Recycled Water Policy requires the development of regional or sub-regional salt and nutrient management plans, instead of addressing groundwater salt and nutrient control solely through individual recycled water projects. The salt and nutrient management plan for each basin/sub-basin is to be prepared by local water and wastewater entities, together with local salt/nutrient contributing stakeholders, who will fund locally-driven and controlled collaborative processes open to all stakeholders. The salt and nutrient management plans must be completed and proposed to the RWQCB within five years of the date of the Recycled Water Policy, unless extended by the RWQCB but in no case shall the period of completion exceed seven years. The salt and nutrient management plan must consider the inclusion of a significant stormwater use and recharge component because stormwater is typically lower in nutrients and salts, and can augment local water supplies. The following components must be included in each salt and nutrient management plan: (a) a basin/sub-basin wide monitoring plan, (b) a provision for annual monitoring of Emerging Constituents/Constituents of Emerging Concern (e.g., endocrine disrupters, personal care products or pharmaceuticals) (CECs), (c) water recycling and stormwater recharge/use goals and objectives, (d) salt and nutrient source identification, basin/sub-basin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients, (e) implementation measures to manage salt and nutrient loading in the basin on a sustainable basis, and (f) an antidegradation analysis.

The Recycled Water Policy addresses landscape irrigation projects that use recycled water, including the control of incidental runoff of recycled water. Landscape irrigation projects must include recycled water monitoring for CECs on an annual basis and priority pollutants on a twice annual basis, in addition to any other appropriate recycled water monitoring requirements. However, monitoring for CECs will not take effect until 18 months after the effective date of the Recycled Water Policy, unless requested by CDPH. Landscape irrigation projects that qualify for streamlined permitting are not required to include a project-specific receiving water and groundwater monitoring component unless required under the adopted salt and nutrient management plan. In addition, landscape irrigation projects that qualify for streamlined permitting and which are located within basins with salt and nutrient management plans in place may not require further antidegradation analysis.

The Recycled Water Policy also addresses recycled water groundwater recharge projects that must be reviewed and permitted on a site-specific basis. Recycled water groundwater recharge projects must comply with CDPH requirements for groundwater recharge projects. Recycled water groundwater recharge projects are required to implement a monitoring program for constituents of concern, and a monitoring program for CECs that is consistent with any actions by the SWRCB to address CECs, as described in the Recycled Water Policy (further discussed below). The recycled water groundwater recharge projects must include monitoring of recycled water for CECs on an annual basis and priority pollutants on a twice annual basis.

According to the Recycled Water Policy, the state of knowledge regarding CECs is incomplete. The Recycled Water Policy calls for the formation of an advisory panel (to be actively managed by the SWRCB) to address CECs as they relate to the use of recycled water, with a report to the SWRCB and CDPH within one year of the appointment of the panel. The advisory panel was formed in May 2009 and issued its final report to the SWRCB in June 2010.

E-4.3 **Los Angeles Regional Water Quality Control Board Basin Plan**

The LARWQCB Basin Plan[8] specifies water quality objectives which are "the allowable limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." Narrative or numerical water quality objectives applicable to all inland surface waters are provided in the LARWQCB Basin Plan (see Appendix K). Water quality objectives applicable to groundwaters are also provided in the LARWQCB Basin Plan (see Appendix K).

E-4.4 **Verdugo Basin**

Water quality related requirements to protect surface water and groundwater from use of recycled water in the Verdugo Basin is controlled by regulatory guidelines for application of recycled water on landscaped areas and regulatory guidelines which govern the use of recycled water for groundwater recharge. A description of the *"Recycled Water Policy"* recently adopted by the RWQCB is outlined above in the section entitled "Recycled Water Policy;" this policy would be applicable to Verdugo Basin. The following paragraphs indicate the regulatory guidance for use of recycled water for surface application and groundwater recharge for areas in the Verdugo Basin.

As stated in the "*Recycled Water Policy,*" the SWRCB finds that the use of water for irrigation may, regardless of its source, collectively affect groundwater quality over time. Therefore, consideration of recycled water use in the Verdugo Basin must include addressing requirements for surface application of recycled water as well as requirements for a groundwater recharge and reuse project.

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[8] *Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*, California Regional Water Quality Control Board, Los Angeles Region (4), Adopted June 13, 1994.

Water Quality objectives for the Verdugo Groundwater Basin are also specified by the LARWQCB Basin Plan. "Table 3-10. Water Quality Objectives for Selected Constituents in Regional Ground Waters" of the LARWQCB Basin Plan, lists water quality objectives applicable to regional groundwaters; water quality objectives for the Verdugo Basin are listed on page 3-20. Table E-5 below shows the water quality objectives for the Verdugo Basin as outlined in LARWQCB Basin Plan (see Appendix K).

Table E-5 Water Quality Objectives for Selected Constituents in Verdugo Basin

Verdugo Basin	**TDS (mg/l)**	**Sulfate (mg/l)**	**Chloride (mg/l)**	**Boron (mg/l)**
Verdugo Basin	600	150	100	0.5

E-4.5 **Raymond Basin**

Table E-6 shows the water quality objectives for selected constituents in inland surface waters of the Los Angeles River Watershed: above Figueroa Street, Rio Hondo above Santa Ana Freeway, Eaton Canyon Creek above Eaton Dam, and Arroyo Seco (above the spreading grounds). Table E-7 shows the water quality objectives for selected constituents in regional groundwaters for the Monk Hill sub-basin and Pasadena Area of the Raymond Basin.

Table E-6 Water Quality Objectives for Selected Constituents in Los Angeles River Watershed

Los Angeles River Watershed	**TDS (mg/l)**	**Sulfate (mg/l)**	**Chloride (mg/l)**
Above Figueroa Street	950	300	150
Rio Hondo above Santa Ana Freeway	750	300	150
Eaton Canyon Creek above Eaton Dam	250	30	10
Arroyo Seco (above spreading grounds)	300	40	15

Source: Table 3-8 of LARWQCB Basin Plan

Table E-7 Water Quality Objectives for Selected Constituents in Raymond Basin

Raymond Basin	TDS (mg/l)	Sulfate (mg/l)	Chloride (mg/l)	Boron (mg/l)
Monk Hill Sub-Basin	450	100	100	0.5
Pasadena Area	450	100	100	0.5

Source: Table 3-11 of LARWQCB Basin Plan

The Raymond Basin Management Board has developed a "Draft Criteria for Delivery of Supplemental Water."[9] The report established criteria to evaluate proposals for Supplemental Water recharge through which the Raymond Basin Management Board can manage both water supply and water quality, and advise regulatory agencies of those actions. The report provides a review of the three agencies responsible for setting guidelines and regulations associated with replenishing the groundwater in the Raymond Basin, i.e., Raymond Basin Management Board, RWQCB, and CDPH. The report summarized the CDPH Recycled Water Standards and RWQCB Basin Plan Objectives (see Appendix L).

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[9] *Draft Criteria for Delivery of Supplemental Water*, Raymond Basin Management Board, March 2006. Prepared by Stetson Engineers Inc.

F. RECYCLED WATER MARKET

F-1. Description of Market Assessment Procedures

The list of types of use for which recycled water is approved within California is continuing to grow as the value of wastewater recycling as a reliable water resource is being more widely recognized. The CDPH which is responsible for Title 22 of the California Administrative Code and which establishes wastewater recycling criteria is nearing the end of a multi-year process to update the regulations. Many agencies throughout the State of California have been looking for new areas to put recycled water to beneficial use rather than waste it. Historically, both the regulatory agencies and the agencies operating recycled water systems have addressed controlled irrigation use as the primary use for recycled water. More recently, both have recognized the safety and benefit of industrial uses such as process water and cooling tower makeup water, commercial uses such as flushing of toilets in commercial buildings, and widened irrigation uses such as for raw edible food crops and landscape irrigation under individual homeowner control. A number of MWD member agencies or sub-agencies have successfully implemented these types of uses in the recent past with the approval of the State and local regulatory agencies.

In a previous study to assess the potential recycled water users within FMWD (Preliminary Water Reclamation Assessment, MORRIS Water Resources Consultants, May, 1996), each of the retail member agencies was asked to provide information and usage records for irrigation or other large volume water users within their respective service areas. The information obtained was compared with that available from the previous studies prepared for the Cities of Glendale and Pasadena. As would be expected, the bulk of the identified users fall into landscape irrigation such as medians, freeway landscape, schools, cemeteries and parks. A number of churches were identified as large water users but it is doubtful that significant landscape exists on their properties so they were culled from the lists.

The information obtained from the FMWD member agencies with regard to potential recycled water users is summarized in Table F-1. The locations of these users are depicted on Figure F-1. The total identified potential demand within FMWD which could be converted to recycled water was slightly more than 900 AFY at that time.

ID	Na
LACSD	
23	La Canada
Las Flores Wat	
24	Farnsworth
Lincoln Avenue	
25	Camp Gro
26	Charles W
27	Children's
27	Children's
27	Children's
28	Elementary
29	Elementary
30	Elementary
31	Five Acres
32	Frank D
33	J. K. Bass
34	Jimmy Zon
35	L. A. Coun
36	L. A. Coun
37	Loma Alta
37	Loma Alta
37	Loma Alta
37	Loma Alta
38	Mountain V
39	Nuccio's N
40	Optimist B
41	Richard B

ID	N
42	The Sycam
Mesa Crest W	
43	Crescenta
44	La Canada
45	[illegible]
46	Starlight
47	Starlight
48	[illegible]
Rubio Canyon	
49	Eliot Mid
50	Scripps H
Valley Water Co	
51	Cal Trans
52	Cal Trans
53	Cal Trans
54	Cal Trans
55	Cal Trans
56	Cal Trans
57	Cal Trans
58	Cal Trans
59	City of La
60	City of La
61	City of La
62	City of La
63	City of La

ID	N
64	City of La
65	City of La
66	Descanso G
66	Descanso G
67	Flintridge
68	Flintridge
69	La Canada
69	La Canada
70	La Canada
71	St. Francis

Notes:

* Estimated base

** 91 AF of Ra

Multiple entries

The listing of a user does not necessarily mean that it would be economical to serve them or that they would have any interest, but only that a potential exists. Any refinement of that status would require further study and evaluation. As would be expected, the pattern of use exhibits a significant seasonality with the peak month representing 187 percent of the average. This is not atypical of most recycled water systems and must be accommodated for in the design of any distribution system as would the fact that most irrigation occurs in the evening or nighttime hours. With the vast majority of the potential users being for landscape irrigation, it is expected that the peak day will approximate twice the peak month rate and the peak hour may be an additional 2.5 times which would result in planning numbers of 3.7 times average for the peak day and 9.0 times average for the peak hour flows.

Due to the relatively small amount of raw wastewater available within the local collection system, it is expected that the users will be limited to those in relatively close proximity to the potential sites for the satellite plants. For these reasons, the listing of the specific users for the expected alternatives will be included in Section G along with the alternative descriptions and economic evaluations. In addition, additional uses will be investigated, particularly those that can expand the use beyond the seasonality of landscape irrigation. Both cooling tower makeup and groundwater recharge opportunities will be looked into and incorporated into the alternatives as appropriate.

G. PROJECT ALTERNATIVE ANALYSIS

G-1. Planning and Design Assumptions:

G-1.1 Delivery and System Pressure Criteria

The distribution systems are designed to provide a minimum pressure of 60 pounds per square inch (psi) for direct user connections. Spreading or injection connections are designed for a nominal 10 psi at the delivery point. The pipelines are sized to maintain a unit headloss below 6 feet per 1,000 feet.

G-1.2 Peak Delivery Criteria

The system alternatives are designed to meet the peak monthly flows from the treatment plant with augmentation from system reservoirs to cover the increases necessary for peak day and diurnal variations.

G-1.3 Storage Criteria

System storage is sized for one maximum day with the reservoir pad set at 130 feet above the elevation of the highest direct user. Access to potable water supplies will be made available to augment recycled water supplies, if needed, during peak demand months. For system alternatives which only deliver for spreading or injection, no system storage is anticipated.

G-1.4 Cost Basis: Cost Index, Discount Rate, Useful Lives, Etc.

All costs are calculated in 2011 dollars with a discount rate of 6 percent used for economic analyses. An inflation rate of 3 percent per year is used for future costs. The useful lives for mechanical and electrical equipment are assumed at 20 years, structures at 30 years, pipelines at 50 years, reservoirs and recharge facilities at 75 years and civil works at 100 years. The criteria used for the development of construction costs are presented in Table G-1 and those used for the development of operation and maintenance costs are in Table G-2.

Table G-1	**Facility Costing Criteria**				
PIPELINES:			-		
	Diameter		Cost/Foot		
	4"		$45		
	6"		$60		
	8"		$75		
	10"		$90		
	12"		$105		
			-		-
RESERVOIRS:					
	$0.75	per gallon of capacity			
PUMP STATIONS:					
	$3,000	per Horsepower of pumping capacity			
INFILTRATION GALLERIES:					
	$20,000	per acre			
LYSIMETERS:					
	$6,000	each			
MONITORING WELLS:					
	$250,000	each			
CONTINGENCY FACTOR:	30%				

Table G-2 Operation and Maintenance Costing Criteria

OPERATIONS:		
Pipelines:	0.5	days / month / 10,000 feet
Pump Stations:	2	days / month
Reservoirs:	0.5	days / month
Treatment:	0.5	days / week / 100,000 gal
MAINTENANCE		
Labor:		
Pipelines:	0.5	days / month / 10,000 feet
Pump Stations:	2	hours / month / 50 Hp
Treatment:	0.5	days / week / 100,000 gal
Reservoirs:	0.5	day / month
Spreading Basins:	1	day / month / acre
Parts:		
Pump Stations:	1.0%	of construction costs / year
Treatment:	1.0%	of construction costs / year
Materials:		
Pump Stations:	1.0%	of construction costs / year
Treatment:	1.0%	of construction costs / year
Reservoirs:	0.5%	of construction costs / year
UNIT RATES		
Labor:	$45	/hour
Power 2010 Ave.	$0.13	/kWh

G-1.5 **Rights-of-Way**

It is anticipated that most of the facilities that would be constructed would be in public Rights-of-Way (ROW). Much of this would be within local street ROW and some may be within Caltrans ROW for which an inter-agency agreement would be required. On some cases, new ROW may be required for the treatment facilities which may be handled through a lease or through purchase. An allowance for the costs of ROW is included within the economic analysis for each of the project alternatives.

G-1.6 **Planning Period**

The planning period for each of the alternative projects is based on the initial 20 years of operations. Assuming that the initial deliveries were made in 2014, thus the planning period would be through 2033.

G-2. Water Recycling Alternatives to be Evaluated

FMWD is considering up to 3 small scale satellite plants within different parts of its service area. Each plant could serve recycled water customers in relatively close proximity and/or deliver water for groundwater recharge. Direct reuse includes application of recycled water for landscape irrigation, cooling tower makeup water and carwash makeup water. For groundwater recharge, both direct spreading and the use of shallow infiltration galleries are possibilities.

G-2.1 **Treatment Alternatives**

Membrane bioreactors are planned as the primary treatment processes followed by ultraviolet (UV) disinfection. Additional treatment with reverse osmosis is not anticipated as groundwater recharge using injection wells is not being considered.

Alternatives also analyzed importing recycled water from areas outside of FMWD's service area for use. These are also more fully described below.

G-2.2 **Alternatives By Geography**

Alternatives have been developed for three different locations within FMWD, the Arroyo Seco area above Devil’s Gate Dam (the A series of alternatives), in the Verdugo Basin area on the West side of the District (the V Series of alternatives) and on the east side in the vicinity of the Eaton Wash Spreading Grounds (the E series of alternatives). The

Arroyo Seco location has 8 alternatives that were studied, the Verdugo Basin location has 6 alternatives that were studied and the Eaton Wash location has 3 alternatives that were studied.

The section below groups the alternatives by geographic location. It then provides for each alternative a table which summarizes the potential market for the recycled water, a table which lists the elements needed for construction of the alternative including pipeline length and diameter and booster sizing, the alternative's costs and a figure depicting the distribution system. Once the alternatives were developed and the users identified, the potential demands were updated from those presented in Table F-1 by adjusting for current water use based on meter records. All of the alternatives include conversions of existing uses that already have dedicated meters separate from the potable uses at the site or are for a new groundwater system. Any retrofit costs are expected to be nominal and will be covered by FMWD as a part of their project costs. FMWD plans on owning and anticipates contracting with a provider of wastewater/water operations services to operate and maintain any facilities that would be constructed as a result of this program.

Arroyo Seco Alternative

Alternative A-1 includes a 0.25 MGD satellite plant on Oak Grove Drive south of La Cañada High School which will serve landscape irrigation customers in the area. The wastewater will be extracted from the LACSD Joint Outfall B – Unit 6 in Oak Grove Drive at Berkshire with the residuals returned to the same sewer downstream of the extraction location. The potential users and their demands are presented in Table G-3 and the distribution system is depicted in Figure G-1. Figure G-2 the treatment plant layout. Table G-4 lists the elements included within Alternative A-1 and their estimated costs. System storage will be accommodated by using two storage tanks on the JPL property that are no longer needed for potable water purposes.

Table G-3 **Alternative A-1 and A-7 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
52	Caltrans	Irrigation	0.40	0.46	0.32	0.48	0.42	0.46	0.36	0.28	0.48	0.24	0.33	0.54	4.77
54	Caltrans	Irrigation	0.56	0.66	0.49	0.71	0.64	0.72	0.59	0.61	0.78	0.39	0.49	1.23	7.87
57	Caltrans	Irrigation	0.10	0.05	0.00	0.06	0.13	0.11	0.15	0.08	0.12	0.05	0.07	0.13	1.06
60	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.16
61	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04	0.04	0.02	0.01	0.01	0.24
67	Flintridge Prep	Irrigation	0.07	0.02	0.04	0.18	0.31	0.48	1.95	1.03	0.61	0.12	0.18	0.10	5.08
69	La Canada High School	Irrigation	0.68	0.74	1.03	1.43	1.98	3.30	3.48	5.70	2.65	3.10	0.00	1.22	25.31
71	St. Francis High School	Irrigation	0.16	0.08	0.14	0.21	0.32	0.33	0.36	0.46	0.31	0.34	0.27	0.18	3.18
Totals			**1.96**	**2.02**	**2.04**	**3.08**	**3.83**	**5.47**	**6.96**	**8.23**	**5.02**	**4.26**	**1.37**	**3.41**	**47.67**

Table G-4 **Alternative A-1 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
UV Disinfection	0.25	1	MGD	$ 150,000	$ 150,000
Booster	50	1	Hp	$ 3,000	$ 150,000
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
PVC Pipe	6"	7,800	Feet	$ 60.00	$ 468,000
Reservoir		Existing			$ -
Total					$ 2,652,200

Alternative A-2 is similar to Alternative A-1 but adds a groundwater recharge element with spreading basins along the west side of the Arroyo Seco near Hahamongna Watershed Park. The users are listed in Table G-5 and the distribution system is shown on Figure G-3. The system elements and their estimated costs are presented in Table G-6. The treatment facility will be the same as for Alternative A-1.

Table G-5 **Alternative A-2 and A-8 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total**
52	Caltrans	Irrigation	0.40	0.46	0.32	0.48	0.42	0.46	0.36	0.28	0.48	0.24	0.33	0.54	4.77
54	Caltrans	Irrigation	0.56	0.66	0.49	0.71	0.64	0.72	0.59	0.61	0.78	0.39	0.49	1.23	7.87
57	Caltrans	Irrigation	0.10	0.05	0.00	0.06	0.13	0.11	0.15	0.08	0.12	0.05	0.07	0.13	1.06
60	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.16
61	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04	0.04	0.02	0.01	0.01	0.24
67	Flintridge Prep	Irrigation	0.07	0.02	0.04	0.18	0.31	0.48	1.95	1.03	0.61	0.12	0.18	0.10	5.08
69	La Canada High School	Irrigation	0.68	0.74	1.03	1.43	1.98	3.30	3.48	5.70	2.65	3.10	0.00	1.22	25.31
71	St. Francis High School	Irrigation	0.16	0.08	0.14	0.21	0.32	0.33	0.36	0.46	0.31	0.34	0.27	0.18	3.18
	FMWD Spreading	Recharge	21.82	19.45	21.74	19.93	19.95	17.55	16.82	15.55	17.99	19.52	21.64	20.37	232.33
Totals			**23.78**	**21.48**	**23.78**	**23.01**	**23.78**	**23.01**	**23.78**	**23.78**	**23.01**	**23.78**	**23.01**	**23.78**	**280.00**

Table G-6 **Alternative A-2 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
UV Disinfection	0.25	1	MGD	$ 150,000	$ 150,000
Booster	50	1	Hp	$ 3,000	$ 150,000
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
PVC Pipe	6"	8,300	Feet	$ 60.00	$ 498,000
Reservoir		Existing			$ -
Basins		1.5	Acres	$ 100,000	$ 100,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 2,812,200

Alternative A-3 is again based on Alternative A-1 but with the addition of supplying cooling tower makeup water to JPL. Table G-7 lists the users while Figure G-4 depicts the system and Table G-8 lists the elements and their estimated costs. Again, the treatment facility is the same as with Alternative A-1.

Table G-7 **Alternative A-3 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total**
52	Caltrans	Irrigation	0.40	0.46	0.32	0.48	0.42	0.46	0.36	0.28	0.48	0.24	0.33	0.54	4.77
54	Caltrans	Irrigation	0.56	0.66	0.49	0.71	0.64	0.72	0.59	0.61	0.78	0.39	0.49	1.23	7.87
57	Caltrans	Irrigation	0.10	0.05	0.00	0.06	0.13	0.11	0.15	0.08	0.12	0.05	0.07	0.13	1.06
60	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.16
61	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04	0.04	0.02	0.01	0.01	0.24
67	Flintridge Prep	Irrigation	0.07	0.02	0.04	0.18	0.31	0.48	1.95	1.03	0.61	0.12	0.18	0.10	5.08
69	La Canada High School	Irrigation	0.68	0.74	1.03	1.43	1.98	3.30	3.48	5.70	2.65	3.10	0.00	1.22	25.31
71	St. Francis High School	Irrigation	0.16	0.08	0.14	0.21	0.32	0.33	0.36	0.46	0.31	0.34	0.27	0.18	3.18
	Jet Propulsion Lab	Cooling	6.07	5.87	5.73	5.89	8.32	10.03	10.94	13.56	13.98	13.70	10.22	8.26	112.58
Totals			**8.04**	**7.90**	**7.77**	**8.97**	**12.16**	**15.50**	**17.90**	**21.79**	**19.00**	**17.97**	**11.59**	**11.67**	**160.25**

Table G-8 **Alternative A-3 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
Booster	50	1	Hp	$ 150,000	$ 150,000
Booster	50	1	Hp	$3,000	$ 150,000
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
PVC Pipe	6"	7,800	Feet	$ 60.00	$ 468,000
Reservoir		Existing			$ -
Total					$ 2,652,200

Alternative A-4 is a combination of A-2 and A-3 with both spreading and cooling water makeup being added to the base Alternative A-1. Table G-9 presents the users and demands, Figure G-5 the system layout and Table G-10 the system elements and estimated costs. The treatment system is the same as with Alternative A-1.

Table G-9 **Alternative A-4 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total**
52	Caltrans	Irrigation	0.40	0.46	0.32	0.48	0.42	0.46	0.36	0.28	0.48	0.24	0.33	0.54	4.77
54	Caltrans	Irrigation	0.56	0.66	0.49	0.71	0.64	0.72	0.59	0.61	0.78	0.39	0.49	1.23	7.87
57	Caltrans	Irrigation	0.10	0.05	0.00	0.06	0.13	0.11	0.15	0.08	0.12	0.05	0.07	0.13	1.06
60	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.16
61	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04	0.04	0.02	0.01	0.01	0.24
67	Flintridge Prep	Irrigation	0.07	0.02	0.04	0.18	0.31	0.48	1.95	1.03	0.61	0.12	0.18	0.10	5.08
69	La Canada High School	Irrigation	0.68	0.74	1.03	1.43	1.98	3.30	3.48	5.70	2.65	3.10	0.00	1.22	25.31
71	St. Francis High School	Irrigation	0.16	0.08	0.14	0.21	0.32	0.33	0.36	0.46	0.31	0.34	0.27	0.18	3.18
	Jet Propulsion Lab	Cooling	6.07	5.87	5.73	5.89	8.32	10.03	10.94	13.56	13.98	13.70	10.22	8.26	112.58
	FMWD Spreading	Recharge	15.74	13.58	16.01	14.05	11.62	7.52	5.88	1.99	4.01	5.82	11.42	12.11	119.75
Totals			**23.78**	**21.48**	**23.78**	**23.01**	**23.78**	**23.01**	**23.78**	**23.78**	**23.01**	**23.78**	**23.01**	**23.78**	**280.00**

Table G-10 **Alternative A-4 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 50,000	$ 50,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 100,000	$ 100,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
UV Disinfection	0.25	1	MGD	$ 100,000	$ 100,000
Booster	50	1	Hp	$ 3,000	$ 150,000
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
PVC Pipe	6"	8,300	Feet	$ 60.00	$ 498,000
Reservoir		Existing			$ -
Basins		1.5	Acres	$ 100,000	$ 100,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 2,637,200

Similar to Alternative A-2 is Alternative A-5 but with the difference being that the groundwater recharge will be achieved by the use of shallow infiltration galleries. FMWD has approached Pasadena Unified School District (PUSD) with a plan to construct the infiltration galleries beneath the athletic fields north of John Muir High School. PUSD staff was receptive to negotiating terms for an agreement as long as construction and operation does not interfere with use of the field. The construction timeline of the MBR Plant will accommodate this request. The system users are listed in Table G-11, the layout on Figure G-6, the elements and cost estimates in Table G-12 and the treatment layout are the same as for A-1.

Table G-11 **Alternative A-5 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total**
52	Caltrans	Irrigation	0.40	0.46	0.32	0.48	0.42	0.46	0.36	0.28	0.48	0.24	0.33	0.54	4.77
54	Caltrans	Irrigation	0.56	0.66	0.49	0.71	0.64	0.72	0.59	0.61	0.78	0.39	0.49	1.23	7.87
57	Caltrans	Irrigation	0.10	0.05	0.00	0.06	0.13	0.11	0.15	0.08	0.12	0.05	0.07	0.13	1.06
60	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.16
61	La Canada Flintridge	Irrigation	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04	0.04	0.02	0.01	0.01	0.24
67	Flintridge Prep	Irrigation	0.07	0.02	0.04	0.18	0.31	0.48	1.95	1.03	0.61	0.12	0.18	0.10	5.08
69	La Canada High School	Irrigation	0.68	0.74	1.03	1.43	1.98	3.30	3.48	5.70	2.65	3.10	0.00	1.22	25.31
71	St. Francis High School	Irrigation	0.16	0.08	0.14	0.21	0.32	0.33	0.36	0.46	0.31	0.34	0.27	0.18	3.18
	Infiltration Galleries	Recharge	21.82	19.45	21.74	19.93	19.95	17.55	16.82	15.55	17.99	19.52	21.64	20.37	232.33
Totals			23.78	21.48	23.78	23.01	23.78	23.01	23.78	23.78	23.01	23.78	23.01	23.78	280.00

Table G-12 Alternative A-5 Elements

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
UV Disinfection	0.25	1	MGD	$ 200,000	$ 200,000
Booster	50	1	Hp	$ 3,000	$ 150,000
PVC Pipe	4"	7,300	Feet	$ 45.00	$ 328,500
PVC Pipe	6"	9,100	Feet	$ 60.00	$ 546,000
Reservoir		Existing			$ -
Infiltration Galleries		3	Acres	$ 20,000	$ 60,000
Lysimeters		5	each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 3,063,700

Alternative A-6 is based on only the recharge component of Alternative A-5. The users, system schematic and elements are presented in Table G-13, Figure G-7 and Table G-14 respectively. There is no change to the basic treatment layout.

Table G-13 **Alternative A-6 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	Infiltration Galleries	Recharge	24	21	24	23	24	23	24	24	23	24	23	24	280
Totals			24	21	24	23	24	23	24	24	23	24	23	24	280

Table G-14 **Alternative A-6 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
UV Disinfection	0.25	1	MGD	$ 150,000	$ 150,000
Booster	5	1	Hp	$ 3,000	$ 15,000
PVC Pipe	4"	4,300	Feet	$ 45.00	$ 193,500
Infiltration Galleries		3	Acres	$ 20,000	$ 60,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 2,197,700

The City of Pasadena is also investigating the feasibility of developing a recycled water system using their contractual entitlement to a portion of the City of Glendale's supply from the LAGWRP. The final two A series alternatives are based on using recycled water from Pasadena rather than building a new satellite plant. Alternative A-7 is the same as A-1 except for the source of supply. The users were previously listed on Table G-3, the system schematic is presented in Figure G-8 and the elements and estimated costs are in Table G-15. There is no new treatment facility. The recycled water would be purchased from the City of Pasadena at a cost of $1,500 per AF which will increase over time.

Table G-15 **Alternative A-7 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
Total					**$ 135,000**

Alternative A-8, the last of the A series alternatives, is the same as A-2 but with supply from Pasadena. The users were presented previously in Table G-5, the schematic is depicted in Figure G-9 and the elements and costs in Table G-16. Again there is no new treatment facility rather the water is purchased from the City of Pasadena at a cost of $1,500 per AF which will increase over time.

Table G-16 **Alternative A-8 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
PVC Pipe	4"	3,000	Feet	$ 45.00	$ 135,000
PVC Pipe	6"	500	Feet	$ 60.00	$ 30,000
Basins		1.5	Acres	$ 100,000	$ 100,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 295,000

Verdugo Basin Alternative

The first two Verdugo Basin alternatives consist of serving landscape users only. Alternative V-1 includes the development of a 0.25 MGD local satellite plant on the south side of the Foothill Freeway (I-210) just east of Briggs Avenue. The wastewater will be extracted from the CVWD sewer in Briggs Avenue at the I-210 Freeway with the return of the residuals at a location downstream of the extraction. Alternative V-2 envisions serving the same users but with the supply coming from the City of Glendale at a rate of $530 per AF which will increase over time. The users for both of these alternatives are listed in Table G-17. Figure G-10 presents the schematic for Alternative V-1, Figure G-11 the treatment plant layout and Figure G-12 the Alternative V-2 schematic with no treatment facility. Tables G-18 and G-19 present the elements and estimated costs for Alternative V-1 and V-2 respectively.

In addition, there are four other alternatives that include groundwater recharge that have also been evaluated. Alternative V-3 includes a 0.5 MGD MBR at the same location as Alternative V-1 and groundwater recharge through shallow infiltration galleries near the western edge of the Raymond Basin. The schematic is presented in Figure G-13 and the elements and costs in Table G-20. Alternative V-4 is the same as V-3 except it uses the City of Glendale as the source of supply for the recycled water. Alternative V-4 is depicted in Figure G-14 and the elements and costs in Table G-21. Alternatives V-5 and V-6 are modifications to Alternatives V-3 and V-4 respectively with the local users identified for Alternative V-1 being added to the infiltration galleries as users as is shown on Table G-22. Alternative V-5 is depicted in Figure G-15. Alternative V-6 is depicted in Figure G-16. Tables G-23 and G-24 present the elements of Alternative V-5 and Alternative V-6 respectively.

Table G-17 **Alternative V-1 and V-2 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total**
1	Caltrans	Irrigation	1.10	0.20	0.20	0.56	0.56	1.04	1.04	1.02	1.02	0.94	0.94	1.10	9.72
2	Caltrans	Irrigation	2.16	0.48	0.48	1.20	1.20	1.84	1.84	1.30	1.30	1.28	1.28	2.16	16.54
3	Caltrans	Irrigation	1.10	0.20	0.20	0.56	0.56	1.04	1.04	1.02	1.02	0.94	0.94	1.10	9.72
4	Caltrans	Irrigation	1.99	0.00	0.00	0.77	0.77	1.95	1.95	2.89	2.89	2.67	2.67	1.99	20.56
7	Crescenta Valley High School	Irrigation	0.01	0.00	0.00	0.02	0.02	0.10	0.10	0.04	0.04	0.02	0.02	0.01	0.38
8	Glenhaven Park	Irrigation	0.30	0.18	0.18	0.39	0.39	0.46	0.46	0.44	0.44	0.43	0.43	0.30	4.39
11	L.A. County Sheriffs Office	Irrigation	0.44	0.76	0.76	1.16	1.16	0.50	0.50	0.50	0.50	0.97	0.97	0.44	8.65
14	Caltrans	Irrigation	0.44	0.76	0.76	1.16	1.16	0.50	0.50	0.50	0.50	0.97	0.97	0.44	8.65
15	Caltrans	Irrigation	0.00	0.35	0.35	1.22	1.22	0.51	0.51	0.63	0.63	0.85	0.85	0.00	7.12
16	Car Wash	Car Wash	0.51	0.51	0.78	0.79	0.82	0.82	0.87	0.87	0.98	0.98	0.39	0.39	8.71
21	Briggs Plaza	Irrigation	0.16	0.16	0.19	0.19	0.23	0.23	0.28	0.28	0.31	0.31	0.12	0.12	2.58
Totals			**8.22**	**3.59**	**3.89**	**7.99**	**8.06**	**8.99**	**9.09**	**9.50**	**9.64**	**10.37**	**9.59**	**8.06**	**97.00**

Table G-18 **Alternative V-1 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 75,000	$ 75,000
Satellite Facility	0.25	1	L.S.	$ 150,000	$ 150,000
Structure		1	L.S.	$ 200,000	$ 200,000
MBR	0.25	1	MGD	$ 1,324,200	$ 1,324,200
Booster	40	1	Hp	$ 150,000	$ 150,000
Booster	40	1	Hp	$ 3,000	$ 120,000
PVC Pipe	4"	15,000	Feet	$ 45.00	$ 801,000
Reservoir	250,000	1	Gallons	$ 0.75	$ 187,500
Total					$ 2,582,700

Table G-19 **Alternative V-2 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Booster	50	1	Hp	$ 3,000	$ 150,000
PVC Pipe	4"	22,600	Feet	$ 45.00	$ 1,017,000
Reservoir	250,000	1	Gallons	$0.75	$ 187,500
Total					$ 1,204,500

Table G-20 Alternative V-3 Elements

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 112,500	$ 112,500
Satellite Facility	0.5	1	L.S.	$ 170,000	$ 170,000
Structure		1	L.S.	$ 300,000	$ 300,000
MBR	0.5	1	MGD	$ 1,944,600	$ 1,944,600
UV Disinfection	0.5	1	MGD	$ 225,000	$ 225,000
Booster	30	1	Hp	$ 3,000	$ 90,000
PVC Pipe	4"	1,000	Feet	$ 45.00	$ 45,000
PVC Pipe	6"	13,900	Feet	$ 60.00	$ 834,000
Infiltration Galleries		3.1	Acres	$ 20,000	$ 62,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 3,230,600

Table G-21 Alternative V-4 Elements

Item	Size	Quantity	Units	Unit Cost	Cost
PVC Pipe	6"	9,900	Feet	$ 60.00	$ 594,000
Infiltration Galleries		3.1	Acres	$ 20,000	$ 62,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well	Existing				$ -
Total					$ 686,000

Table G-22 Alternative V-5 and V-6 Users

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1	Caltrans	Irrigation	1.10	0.20	0.20	0.56	0.56	1.04	1.04	1.02	1.02	0.94	0.94	1.10	9.72
2	Caltrans	Irrigation	2.16	0.48	0.48	1.20	1.20	1.84	1.84	1.30	1.30	1.28	1.28	2.16	16.54
3	Caltrans	Irrigation	1.10	0.20	0.20	0.56	0.56	1.04	1.04	1.02	1.02	0.94	0.94	1.10	9.72
4	Caltrans	Irrigation	1.99	0.00	0.00	0.77	0.77	1.95	1.95	2.89	2.89	2.67	2.67	1.99	20.56
7	Crescenta Valley High School	Irrigation	0.01	0.00	0.00	0.02	0.02	0.10	0.10	0.04	0.04	0.02	0.02	0.01	0.38
8	Glenhaven Park	Irrigation	0.30	0.18	0.18	0.39	0.39	0.46	0.46	0.44	0.44	0.43	0.43	0.30	4.39
11	L.A. County Sheriffs Office	Irrigation	0.44	0.76	0.76	1.16	1.16	0.50	0.50	0.50	0.50	0.97	0.97	0.44	8.65
14	Caltrans	Irrigation	0.44	0.76	0.76	1.16	1.16	0.50	0.50	0.50	0.50	0.97	0.97	0.44	8.65
15	Caltrans	Irrigation	0.00	0.35	0.35	1.22	1.22	0.51	0.51	0.63	0.63	0.85	0.85	0.00	7.12
16	Car Wash	Car Wash	0.51	0.51	0.78	0.79	0.82	0.82	0.87	0.87	0.98	0.98	0.39	0.39	8.71
21	Briggs Plaza	Irrigation	0.16	0.16	0.19	0.19	0.23	0.23	0.28	0.28	0.31	0.31	0.12	0.12	2.58
	Infiltration Galleries		39.34	39.37	43.67	38.03	39.50	37.03	38.47	38.06	36.39	37.20	36.44	39.50	463.00
Totals			47.56	42.96	47.56	46.03	47.56	46.03	47.56	47.56	46.03	47.56	46.03	47.56	560.00

Table G-23 Alternative V-5 Elements

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 112,500	$ 112,500
Satellite Facility	0.5	1	L.S.	$ 170,000	$ 170,000
Structure		1	L.S.	$ 300,000	$ 300,000
MBR	0.5	1	MGD	$ 1,944,600	$ 1,944,600
UV Disinfection	0.5	1	MGD	$ 300,000	$ 300,000
Distribution Booster	40	1	Hp	$ 3,000	$ 120,000
PVC Pipe	4"	8,500	Feet	$ 45	$ 382,500
PVC Pipe	6"	10,500	Feet	$ 60.00	$ 630,000
Infiltration Gallery Booster	20	1	HP	$ 3,000	$ 60,000
Infiltration Galleries		3.1	Acres	$ 20,000	$ 62,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well		Existing			$ -
Reservoir	250,000	1	Gallons	$ 0.75	$ 187,500
Total					$ 3,716,600

Table G-24 Alternative V-6 Elements

Item	Size	Quantity	Units	Unit Cost	Cost
PVC Pipe	4"	19,400	Feet	$ 45.00	$ 873,000
PVC Pipe	6"	9,900	Feet	$ 60.00	$ 594,000
Distribution Booster	50	1	Hp	$ 3,000	$ 150,000
Infiltration Galleries		3.1	Acres	$ 20,000	$ 62,000
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well		Existing			$ -
Reservoir	250,000	1	Gallons	$ 0.75	$ 187,500
Total					$ 1,896,500

Eaton Wash Spreading Grounds Alternative

The final series of alternatives are those at the Eaton Wash Spreading grounds and involve a groundwater recharge program of 0.25 MGD with Alternative E-1 extracting of wastewater from LACSD Joint Outfall B – Unit 5 in Washington Boulevard immediately to the west of the spreading basins with the return of the residuals to the same sewer downstream of the point of extraction, Alternative E-2 doing the same spreading operation but with recycled water from the City of Pasadena and Alternative E-3 uses the multi-agency GRIP program as the source of the recycled water at a cost of $1,000 per AF which will increase over time. Since the time that Alternative E-3 was developed, the GRIP program has been modified and this alternative is no longer viable for the FMWD. Additionally, further analysis has shown the cost of recycled water that would be provided by GRIP to be substantially more than the $1000 per AF originally used in the alternative analysis. Table G-25 presents the flow data for the E series alternatives which is the same independent of the recycled water source. Figure G-17 presents a schematic showing the relationship of the trunk sewer and the satellite plant to the spreading basins and Figure G-18 is a preliminary layout of the satellite plant for Alternative E-1. The elements and costs for Alternative E-1 are presented in Table G-26. Alternative E-2 is depicted on Figure G-19 with the elements and estimated costs presented in Table G-27 and Alternative E-3 is shown on Figure G-20 with the elements and costs listed in Table G-28.

Table G-25 **Alternative E-1, E-2 and E-3 Users**

User No.	Customer	Type	Demand (Acre-Feet)												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	FMWD	Spreading	47.56	42.96	47.56	46.03	47.56	46.03	47.56	47.56	46.03	47.56	46.03	47.56	560.00
Totals			47.56	42.96	47.56	46.03	47.56	46.03	47.56	47.56	46.03	47.56	46.03	47.56	560.00

Table G-26 **Alternative E-1 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Site Work		1	L.S.	$ 112,500	$ 112,500
Satellite Facility	0.5	1	L.S.	$ 170,000	$ 170,000
Structure		1	L.S.	$ 300,000	$ 300,000
MBR	0.5	1	MGD	$ 1,944,600	$ 1,944,600
UV Disinfection	0.85	1	MGD	$ 300,000	$ 300,000
Booster	2	1	Hp	$ 3,000	$ 6,000
Basins		3	Acres	Existing	$ -
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well		1	Each	$ 250,000	$ 250,000
Total					$ 2,530,600

Table G-27 **Alternative E-2 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
PVC Pipe	6"	19,000	Feet	$ 60.00	$ 1,140,000
Basins		3	Acres	Existing	$ -
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well		1	Each	$ 250,000	$ 250,000
Total					$ 1,420,000

Table G-28 **Alternative E-3 Elements**

Item	Size	Quantity	Units	Unit Cost	Cost
Booster Station	150	1	Hp	$3,000	$ 450,000
PVC Pipe	6"	55,000	Feet	$ 60.00	$ 3,300,000
Basins		3	Acres	Existing	$ -
Lysimeters		5	Each	$ 6,000	$ 30,000
Monitoring Well		1	Each	$ 250,000	$ 250,000
Total					$ 4,030,000

G-3. Non-Recycled Water Alternatives

There is only one non-recycled water alternative for developing new water supplies within the service area. That alternative is the capture of more stormwater within the service area for recharge in the groundwater basins. The section below will discuss the various concepts that are being reviewed by groundwater entities within the service area.

G-3.1 **Debris Basins and Infiltration Galleries**

Debris basins are typically located at the mouth of canyons where rainfall runoff is concentrated and as a result, are potential areas to capture and retain runoff for groundwater recharge. By modifying existing debris basins into recharge basins, these basins can retain and recharge water which otherwise would flow to the ocean.

Use of debris basins for groundwater recharge has been analyzed by Geomatrix ("Final Report Verdugo Basin Groundwater Recharge, Storage, and Conjunctive Use Feasibility Study," prepared May 2005). Debris basins reviewed by Geomatrix include the Verdugo Debris Basin and the Pickens and Dunsmuir Debris Basins based on large tributary areas and flows. The recharge capacity of debris basins within the Raymond Basin (including Bigbrier, Cooks, Gould, Upper Gould, Halls, and Lincoln) located in the Monk Hill Subarea of the Raymond Basin has been reviewed ("Water Resources Plan, Alternatives Screening Report," prepared January 2009 by Stetson for FMWD).

Crescenta Valley is also pursuing grant funding to investigate the construction of infiltration galleries for recharge in the Verdugo Basin. It is anticipated that infiltration galleries could be placed along flood control channels, diverting flows into the galleries and recharging the basin. This operation would help increase the levels of the groundwater basin.

Although the debris basins and off channel infiltration galleries can be maintained to allow increased recharge, there are no available studies to determine the ability to produce water recharged in these areas. Additional studies would be required to determine how much net water would be saved as a result of maintenance. Safe yield studies to determine the impact of groundwater recharge from the debris basins into the Raymond Basin may also be required.

G-3.2 **Additional Spreading Grounds**

The City of Pasadena is exploring adding additional recharge ponds in the Arroyo for more stormwater capture and a possible pump back system where water would be held behind Devil's Gate Dam and pumped up to the recharge ponds. All agencies in the subbasin would benefit from these operations since basin levels would rise reducing pumping lift. However, because of limited available land and needs to set aside land for the environment and recreational use, the additional recharge ponds are limited in size and will not capture enough stormwater to significantly reduce dependence on imported water. Additionally, the Raymond Basin adjudication would need to be addressed regarding recharge of native waters.

G-3.3 **Devil's Gate Dam Water Transfer Project**

Los Angeles County Public Works is investigating a pump back system where water would be held behind Devil's Gate Dam and moved to the Eaton Canyon Spreading Grounds through the stormwater channels. This operation would help only one of the FMWD's retail agencies – Kinneloa. The reason is that the Raymond Basin is divided into three subbasins, the Monk Hill, Pasadena and Santa Anita. Water in the Monk Hill subbasin, on the Westside, spills into the Pasadena subbasin which then spills into the Santa Anita subbasin. However, water cannot move in the reverse direction. Five of FMWD's agencies have pumping rights and wells in the Monk Hill subbasin and only Kinneloa has rights and wells in the Pasadena subbasin. Mesa Crest has no pumping rights and Crescenta Valley's pumping rights are only in the Verdugo Basin. Additionally, the parties to the Pasadena subbasin adjudication are already in the second year of a voluntary program to reduce the basin pumping by 30 percent as it was found that the Basin was no longer able to meet the adjudicated levels of production. The recharge of both stormwater and recycled water in this area would assist in increasing basin levels and raise production to higher levels possibly back up to adjudicated rights.

These stormwater recharge projects are in conceptual stages at this time. However, should these projects proceed and even with conservation, the reduction in imported demands can be greater with the development of recycled water.

G-3.4 **Economic Costs of Non-Recycled Water Alternatives**

Debris Basins and Infiltration Galleries

Proposed improvements to the Verdugo Debris Basin were estimated by Geomatrix to cost $300,000 with an annual O&M cost of $242,000. Proposed improvements to the Pickens and Dunsmuir Debris Basins were estimated by Geomatrix to cost a total of $308,000 with an annual total O&M cost of $352,000. The estimated cost of water recharged by the improved Verdugo Basin debris basins ranges from approximately $750 per AF to $2,900 per AF.

The costs for expansion of the debris basins overlying the Raymond Basin are high. On average, the total annualized cost (6 percent over 30 years) for improvements plus annual maintenance costs per debris basin is approximately $320,000 per year. Based on an average yield of approximately 30 AFY per debris basin in the Raymond Basin, the estimated cost of water recharged by improved debris basins is approximately $10,700 per AF.

The cost of off channel infiltration galleries at Crescenta Valley Park were estimated at $1.7 million by Geomatrix and $3 million for flood channels from Dunsmuir, Shields-Eagle and Pickens debris basins. The estimated cost of water recharged through the off channel infiltration galleries ranges from approximately $420 per AF to $560 per AF.

Additional Spreading Ponds

The cost of installing additional recharge ponds in the Arroyo is estimated by the City of Pasadena Department of Water and Power as $440,000 for earthwork and $190,000 for piping. The new ponds would have a capacity of 14 cubic feet per second (cfs) which would increase the total spreading pond capacity in the Arroyo to 32 cfs or 62 acre feet per day.

Devil's Gate Dam Water Transfer Project

Los Angeles County Public Works estimates the costs for the Devil's Gate Dam Water Transfer Project to be between $12 and $16 million. The yield is expected to be between 2,300 and 4,200 acre-feet annually depending on hydrology.

G-4. Water Conservation/Reduction Analysis.

G-4.1 **Analysis**

FMWD has increased its conservation budget from $2,000 annually in fiscal year 2007-2008 to $27,500 annually starting in fiscal year 2010-11. (This budget was up to $50,000 in fiscal year 2010-11 due to water shortage conditions.) The money is used for various programs including rebates to customers to replace thirsty turf with California Friendly plants, highly efficient toilet rebates, rain barrel rebates and public outreach to encourage further conservation.

Implementation of conservation measures within FMWD's service area can reduce the water demands on local and imported water supplies. Conservation measures can be grouped into two general categories: (1) "hardware" devices or equipment and (2) behavior or management practices. The implementation of comprehensive conservation programs to reduce long-term water demands typically includes both hardware- and behavior-driven measures. Although the two types of measures require different levels of effort, both are required to meet conservation goals. For example, outdoor water conservation programs include ongoing landscape management practices (such as shorter lawn watering times) and one-time hardware measures (such as turf replacement and improved irrigation system controllers).

FMWD is a member of the California Urban Water Conservation Council. The 2010 FMWD UWMP provides descriptions of several water conservation programs, or Best Management Practices (BMPs), that are currently being practiced within FMWD's service area. These BMPs include "Residential Plumbing Retrofit," "Large Landscape Conservation Programs and Incentives," "High-Efficiency Washing Machine Rebate Programs," "Public Information Programs," and "Conservation Pricing."

During the recent process to develop MWD's Water Shortage Allocation Plan, MWD estimated the current total water savings from active and passive conservation measures within FMWD to be approximately 1,600 AFY. MWD has developed a methodology to estimate future potential water conservation savings within the MWD service area from active conservation programs, price induced savings, and code based savings. Projections for FMWD's service area from MWD's methodology were not available for this evaluation, however they may be available for future evaluations of potential water conservations savings. Based on discussions with the member agencies it appears there is the potential for additional water conservation savings from price induced programs, fixture rebates, and public education programs. However, reduction in outdoor water use may represent the potential for significant water savings in some portions of FMWD's service area since it is estimated that outdoor water use in some areas represents about 70-80% of total water use. Some conservation measures (such as rate structures and irrigation controller rebates) may need to be combined with significant public outreach efforts for the programs to be successful.

FMWD has also kicked off the Foothill Water Conservation Corps in an effort to develop conservation and public education further. The Corps represents volunteers in the community that help FMWD with conservation outreach such as manning booths at fairs and speaking at schools.

MWD (through the http://www.bewaterwise.com/ website) offers rebates for purchase and installation of high efficiency clothes washers (up to $85) weather-based irrigation controllers ($80 to $25 per station for more than 1 acre of landscape) and rotating sprinkler nozzles ($3 per nozzle for a minimum of 25 per application.) These devices can produce significant water savings. For example, high efficiency clothes washers can use up to 50 percent less water than standard clothes washers and weather-based irrigation controllers can reduce typical household water use by as much as 10 percent. In addition FMWD is offering its own rebates for rain barrels (up to $100 per barrel limit of 8 barrels), turf replacement ($1.00 per square foot up to $800) and high efficiency toilet (up to $50 per toilet maximum 4 toilets.)

FMWD also has a two-tiered rate commodity rate for water deliveries to its agencies. Retail agencies that use more than a certain amount pay a higher fee for that water.

The majority of agencies in the service area also have tiered rates for their customers. Use of tiered water rates alone may not be effective for achieving conservation savings in some areas. Implementation of a water budget allocation system with tiered billing rates (or budget-based rate structure) may be a more successful method to encourage conservation. A budget-based rate structure estimates the amount of water use for each household and business by taking into account how many people are using water at the location and how much irrigation is required for the lot. When customers use more water than needed, they are given progressively expensive penalties (i.e. double or triple the normal rate, or more).

In February 2008, the California Governor introduced a seven-part comprehensive plan for improving the Sacramento-San Joaquin Delta. A key component of the Governor's Delta plan was a goal to achieve 20 percent reduction in per capita water use statewide by the year 2020.

In March 2008, a 20x2020 Agency Team on Water Conservation was formed in response to the Governor's call for a statewide per capita savings.

In November 2009, Senate Bill 7 (SBX7-7; the Water Conservation Act of 2009) was enacted, requiring all water suppliers to increase water use efficiency. This legislation is divided into two sectors, urban water conservation and agricultural conservation. The urban provisions of SBX7-7 reflect the approach taken in the 20x2020 Water Conservation Plan discussed below. The legislation sets an overall goal of reducing per capita urban water use by 20 percent by December 31, 2020. The state shall make incremental progress towards this goal by reducing per capita water use by at least 10 percent by December 31, 2015. Highlights of this legislation are as follows:

- Each urban retail water supplier shall develop water use targets and an interim water use target by July 1, 2011.
- An urban retail water supplier shall include in its urban water management plan due July 2011, the baseline daily per capita water use, water use target, interim

water use target, and compliance daily per capita water use. DWR, through a public process and in consultation with the California Urban Water Conservation Council, shall develop technical methodologies and criteria for the consistent implementation of this part.

- DWR shall adopt regulations for implementation of the provisions relating to process water.
- A Commercial, Institutional, Industrial (CII) task force is to be established that will develop and implement urban best management practices for statewide water savings.
- Effective 2016, urban retail water suppliers who do not meet the water conservation requirements established by SBX7-7 are not eligible for State water grants or loans.

In February 2010, the “Final 20x2020 Water Conservation Plan” was released by the 20x2020 Agency Team. The 20x2020 Water Conservation Plan addresses only urban water use and conservation, and only potable water use. According to the 20x2020 Water Conservation Plan, non-potable recycled water was excluded in estimating the baseline per capita urban water use to give credit to agencies that have promoted recycled water in the past. The 20x2020 Water Conservation Plan recommends actions that will reduce per capita water use, not total urban water use, by 20 percent. Therefore, depending on the rate of population growth, total urban water use may never decrease and could eventually increase, even if all the recommendations in the 20x2020 Water Conservation Plan are successfully implemented.

Future water demands discussed in Section C-5 above assume compliance with the conservation requirements of SBX7-7.

G-4.2 **Impact on Recycling, if any**

As indicated above, conservation requirements of SBX7-7 impose a reduction in urban water use on a per capita basis, not total urban water use. As discussed in the 20x2020 Water Conservation Plan, depending on the rate of population growth, total urban water use may never decrease and could eventually increase, even if all the recommendations in the 20x2020 Water Conservation Plan are successfully implemented. In addition, future water conservation efforts will probably focus on reduction in residential irrigation and not indoor water use since a greater savings would likely be achieved there and the belief is that there has already been significant savings in indoor water use and likely a saturation point has been reached. Therefore, it is not anticipated water conservation requirements will lead to a reduction in the amount of wastewater available for recycling for this program in the future.

The 20x2020 Water Conservation Plan recommends the approach of considering recycling as a means to reduce use of potable water supplies. The approach counts recycling as a means to achieve a 20 percent reduction in potable water use and provides encouragement for recycled water use.

It is anticipated water conservation efforts will focus on residential water use and will not result in a significant reduction in the irrigation demands for the Public Agencies identified for the project alternatives.

G-4.3 **Recommendation**

FMWD should continue to support its member agencies' water conservation efforts through its own financial incentives and passing through financial incentives offered by MWD.

G-4.4 **Implementation**

Water conservation requirements mandated by SBX7-7 require implementation at the retail level by FMWD's member agencies.

G-5. No Project Alternative.

In the No Project Alternative, FMWD will continue to purchase imported water supplies from MWD. As discussed in Section C above, FMWD purchases water from MWD at a rate of $744 per AF (calendar year 2011) for treated full service Tier 1 water. As shown in Table C-1, MWD's rates for Tier 1 water are projected to increase annually to approximately $2,174 per AF by the year 2030.

As discussed in Section C, it is anticipated FMWD will generally pass-through MWD rate increases to its member agencies for imported water. It is anticipated that administrative and operating charges will typically increase based on the rate of inflation and capital and rehabilitation charges will increase based on the projects identified to be completed if FMWD continues with PAYG as the preferred payment option. It is anticipated that should FMWD obtain financing for capital projects, the capital and rehabilitation charge will be steadier rather than fluctuate as currently anticipated.

The reliability of MWD's imported water supplies will be affected by regulatory restrictions in the Delta that will prevent water agencies throughout the State from adequately replenishing their water reserves when wetter conditions return. MWD implemented its water allocation plan for the two consecutive years (July, 2009 through April, 2011) in response to the regulatory restrictions in the Delta. The well above normal snowpack in the Sierras enabled MWD to return to full service as well as to place significant quantities of surplus water into their storage accounts in 2011.

G-6. Comparison of Alternatives and Recommendation of Specific Alternative.

The economic analyses of Alternatives A-1 through 8, V-1 through 6, E-1 through 3 and the No Project alternative are presented in Tables G-29 through G-46. These economic evaluations are intended to determine the present worth of each alternative for comparative purposes. They are not intended for the development of alternative costs for rate setting purposes nor do they include any revenues from the sale of recycled water. Table G-47 presents a comparison of the present worth of all of the alternatives. A review of this table indicates that Alternative A-6 would be preferred for the Arroyo group, Alternative V-4 for the Verdugo group and Alternative E-1 for the Eaton Canyon group.

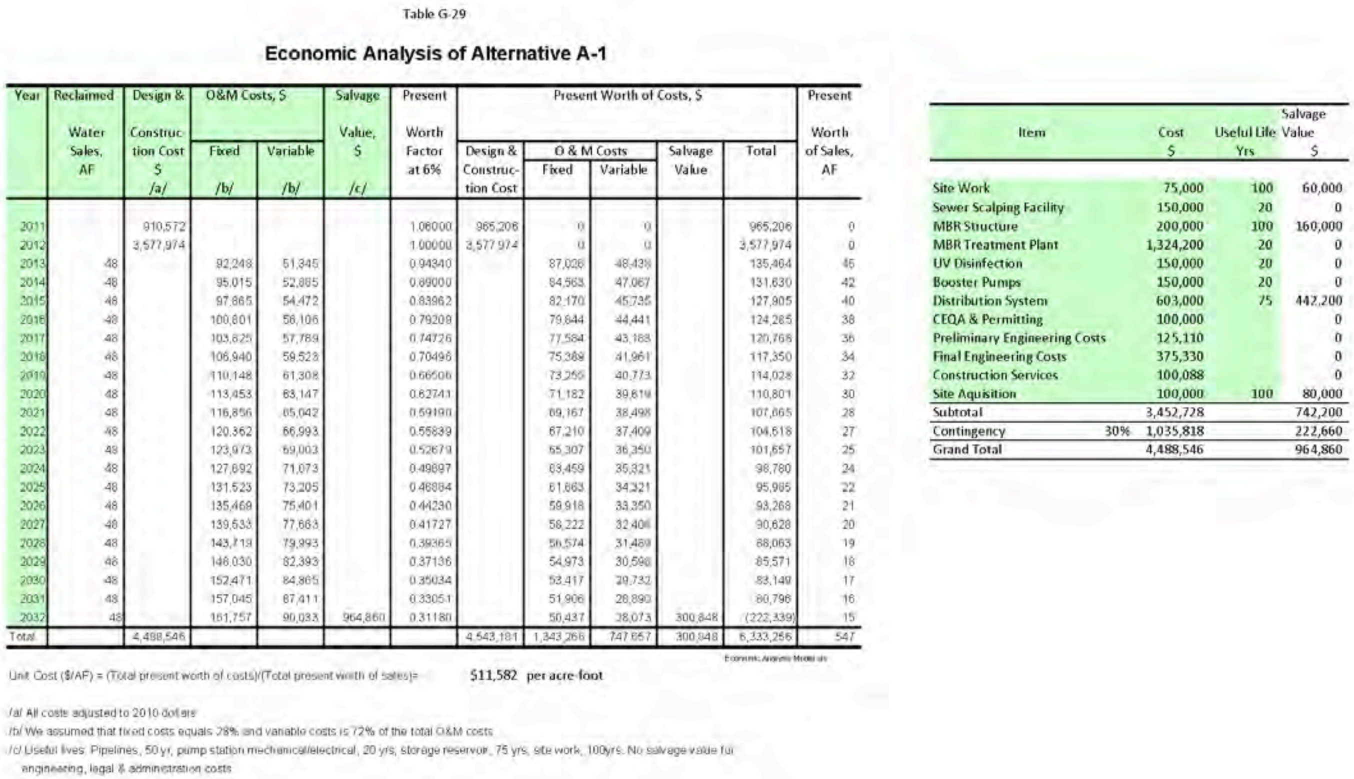

Table G-29

Economic Analysis of Alternative A-1

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		910,572				1.06000	965,206	0	0		965,206	0
2012		3,577,974				1.00000	3,577,974	0	0		3,577,974	0
2013	48		92,248	51,345		0.94340		87,026	48,438		135,464	45
2014	48		95,015	52,885		0.89000		84,563	47,067		131,630	42
2015	48		97,865	54,472		0.83962		82,170	45,735		127,905	40
2016	48		100,801	56,106		0.79209		79,844	44,441		124,285	38
2017	48		103,825	57,789		0.74726		77,584	43,183		120,768	36
2018	48		106,940	59,523		0.70496		75,389	41,961		117,350	34
2019	48		110,148	61,308		0.66506		73,255	40,773		114,028	32
2020	48		113,453	63,147		0.62741		71,182	39,619		110,801	30
2021	48		116,856	65,042		0.59190		69,167	38,498		107,665	28
2022	48		120,362	66,993		0.55839		67,210	37,409		104,618	27
2023	48		123,973	69,003		0.52679		65,307	36,350		101,657	25
2024	48		127,692	71,073		0.49697		63,459	35,321		98,780	24
2025	48		131,523	73,205		0.46884		61,663	34,321		95,985	22
2026	48		135,469	75,401		0.44230		59,918	33,350		93,268	21
2027	48		139,533	77,663		0.41727		58,222	32,406		90,628	20
2028	48		143,719	79,993		0.39365		56,574	31,489		88,063	19
2029	48		148,030	82,393		0.37136		54,973	30,598		85,571	18
2030	48		152,471	84,865		0.35034		53,417	29,732		83,149	17
2031	48		157,045	87,411		0.33051		51,906	28,890		80,796	16
2032	48		161,757	90,033	964,860	0.31180		50,437	28,073	300,848	(222,339)	15
Total		4,488,546					4,543,181	1,343,266	747,657	300,848	6,333,256	547

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$11,582 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr, pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		75,000	100	60,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		200,000	100	160,000
MBR Treatment Plant		1,324,200	20	0
UV Disinfection		150,000	20	0
Booster Pumps		150,000	20	0
Distribution System		603,000	75	442,200
CEQA & Permitting		100,000		0
Preliminary Engineering Costs		125,110		0
Final Engineering Costs		375,330		0
Construction Services		100,088		0
Site Aquisition		100,000	100	80,000
Subtotal		3,452,728		742,200
Contingency	30%	1,035,818		222,660
Grand Total		4,488,546		964,860

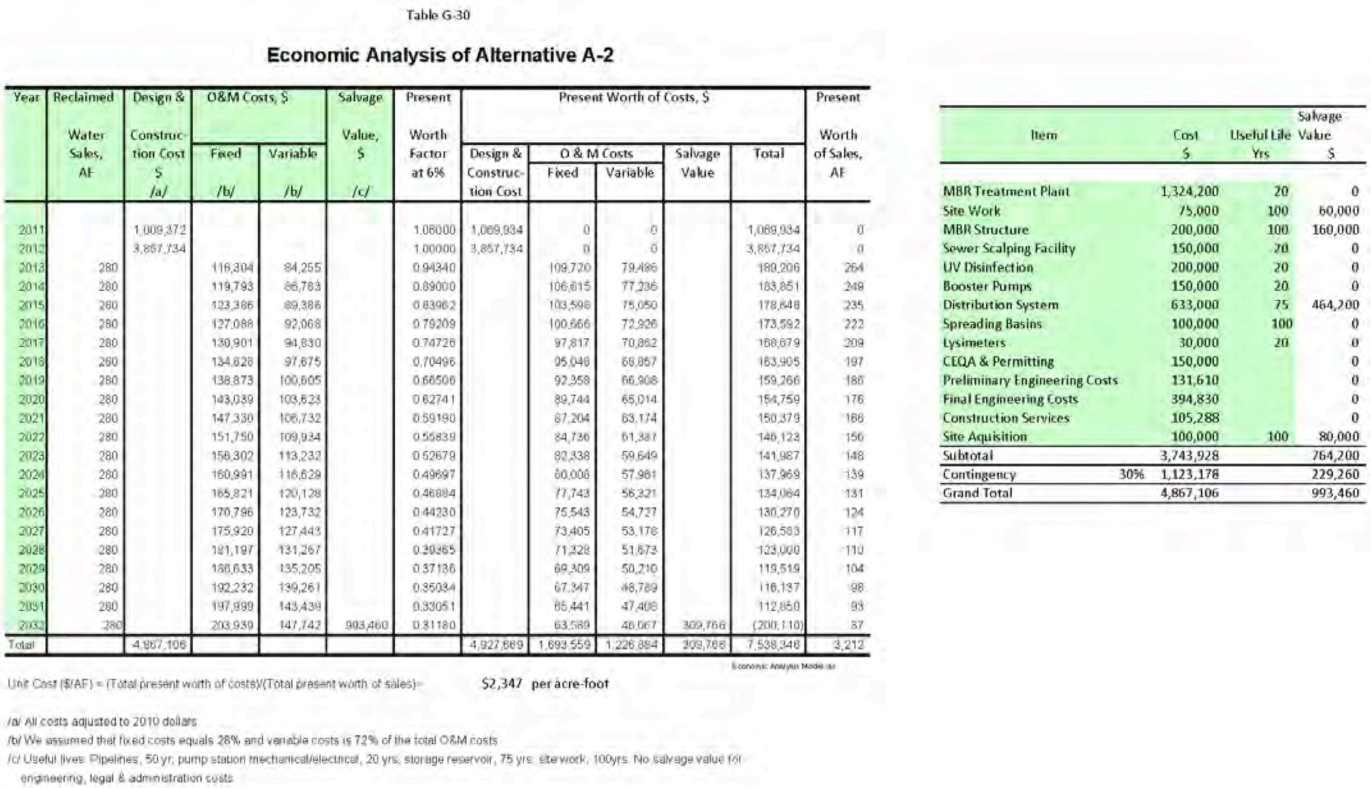

Table G-30

Economic Analysis of Alternative A-2

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		1,009,372				1.06000	1,069,934	0	0		1,069,934	0
2012		3,857,734				1.00000	3,857,734	0	0		3,857,734	0
2013	280		116,304	84,255		0.94340		109,720	79,486		189,206	264
2014	280		119,793	86,783		0.89000		106,615	77,236		183,851	249
2015	280		123,386	89,386		0.83962		103,598	75,050		178,648	235
2016	280		127,088	92,068		0.79209		100,666	72,926		173,592	222
2017	280		130,901	94,830		0.74726		97,817	70,862		168,679	209
2018	280		134,828	97,675		0.70496		95,048	68,857		163,905	197
2019	280		138,873	100,605		0.66506		92,358	66,908		159,266	186
2020	280		143,039	103,623		0.62741		89,744	65,014		154,759	176
2021	280		147,330	106,732		0.59190		87,204	63,174		150,379	166
2022	280		151,750	109,934		0.55839		84,736	61,387		146,123	156
2023	280		156,302	113,232		0.52679		82,338	59,649		141,987	148
2024	280		160,991	116,629		0.49697		80,006	57,961		137,969	139
2025	280		165,821	120,128		0.46884		77,743	56,321		134,064	131
2026	280		170,796	123,732		0.44230		75,543	54,727		130,270	124
2027	280		175,920	127,443		0.41727		73,405	53,178		126,583	117
2028	280		181,197	131,267		0.39365		71,328	51,673		123,000	110
2029	280		186,633	135,205		0.37136		69,309	50,210		119,519	104
2030	280		192,232	139,261		0.35034		67,347	48,789		116,137	98
2031	280		197,999	143,439		0.33051		65,441	47,408		112,850	93
2032	280		203,939	147,742	993,460	0.31180		63,589	46,067	309,766	(200,110)	87
Total		4,867,106					4,927,669	1,693,559	1,226,884	309,766	7,538,346	3,212

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $2,347 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
MBR Treatment Plant		1,324,200	20	0
Site Work		75,000	100	60,000
MBR Structure		200,000	100	160,000
Sewer Scalping Facility		150,000	20	0
UV Disinfection		200,000	20	0
Booster Pumps		150,000	20	0
Distribution System		633,000	75	464,200
Spreading Basins		100,000	100	0
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		131,610		0
Final Engineering Costs		394,830		0
Construction Services		105,288		0
Site Aquisition		100,000	100	80,000
Subtotal		3,743,928		764,200
Contingency	30%	1,123,178		229,260
Grand Total		4,867,106		993,460

Table G-31

Economic Analysis of Alternative A-3

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs		Salvage Value	Total	
								Fixed	Variable			
2011		910,572				1.06000	965,206	0	0		965,206	0
2012		3,577,974				1.00000	3,577,974	0	0		3,577,974	0
2013	160		92,248	67,292		0.94340		87,026	63,483		150,509	151
2014	160		95,015	69,311		0.89000		84,563	61,687		146,250	143
2015	160		97,865	71,390		0.83962		82,170	59,941		142,111	135
2016	160		100,801	73,532		0.79209		79,844	58,244		138,089	127
2017	160		103,825	75,738		0.74726		77,584	56,596		134,180	120
2018	160		106,940	78,010		0.70496		75,389	54,994		130,383	113
2019	160		110.148	80,351		0.66506		73,255	53,438		126,693	107
2020	160		113,453	82,761		0.62741		71,182	51,925		123,107	101
2021	160		116,856	85,244		0.59190		69,167	50,456		119,623	95
2022	160		120,362	87,801		0.55839		67,210	49,028		116,237	89
2023	160		123,973	90,435		0.52679		65,307	47,640		112,948	84
2024	160		127,692	93,148		0.49697		63,459	46,292		109,751	80
2025	160		131,523	95,943		0.46884		61,663	44,982		106,645	75
2026	160		135,469	98,821		0.44230		59,918	43,709		103,627	71
2027	160		139,533	101,786		0.41727		58,222	42,472		100,694	67
2028	160		143,719	104,839		0.39365		56,574	41,270		97,844	63
2029	160		148,030	107,984		0.37136		54,973	40,102		95,075	60
2030	160		152,471	111,224		0.35034		53,417	38,967		92,384	56
2031	160		157,045	114,561		0.33051		51,906	37,864		89,769	53
2032	0		161,757	117,998	964,860	0.31180		50,437	36,792	300,848	(213,619)	0
Total		4,488,546					4,543,181	1,343,266	979,890	300,848	6,565,479	1,788

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $3,672 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		75,000	100	60,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		200,000	100	160,000
MBR Treatment Plant		1,324,200	20	0
UV Disinfection		150,000	20	0
Booster Pumps		150,000	20	0
Distribution System		603,000	75	442,200
CEQA & Permitting		100,000		0
Preliminary Engineering Costs		125,110		0
Final Engineering Costs		375,330		0
Construction Services		100,088		0
Site Aquisition		100,000	100	80,000
Subtotal		3,452,728		742,200
Contingency	30%	1,035,818		222,660
Grand Total		4,488,546		964,860

Table G-32

Economic Analysis of Alternative A-4

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Salvage Value	Total	
2011		976,872				1.06000	1,035,484	0	0		1,035,484	0
2012		3,558,734				1.00000	3,558,734	0	0		3,558,734	0
2013	160		116,304	83,614		0.94340		109,720	78,881		188,601	151
2014	160		119,793	86,122		0.89000		106,615	76,648		183,263	143
2015	160		123,386	88,706		0.83962		103,598	74,479		178,077	135
2016	160		127,088	91,367		0.79209		100,666	72,371		173,037	127
2017	160		130,901	94,108		0.74726		97,817	70,323		168,140	120
2018	160		134,828	96,931		0.70496		95,048	68,333		163,381	113
2019	160		138,873	99,839		0.66506		92,358	66,399		158,757	107
2020	160		143,039	102,834		0.62741		89,744	64,519		154,264	101
2021	160		147,330	105,919		0.59190		87,204	62,693		149,898	95
2022	160		151,750	109,097		0.55839		84,736	60,919		145,655	89
2023	160		156,302	112,370		0.52679		82,338	59,195		141,533	84
2024	160		160,991	115,741		0.49697		80,008	57,520		137,527	80
2025	160		165,821	119,213		0.46884		77,743	55,892		133,635	75
2026	160		170,796	122,789		0.44230		75,543	54,310		129,853	71
2027	160		175,920	126,473		0.41727		73,405	52,773		126,178	67
2028	160		181,197	130,267		0.39365		71,326	51,279		122,607	63
2029	160		186,633	134,175		0.37136		69,309	49,828		119,137	60
2030	160		192,232	138,201		0.35034		67,347	48,418		115,765	56
2031	160		197,999	142,347		0.33051		65,441	47,047		112,489	53
2032	160.2531768		203,939	146,617	967,460	0.31180		63,589	45,716	301,659	(192,354)	50
Total		4,535,606					4,594,219	1,693,559	1,217,543	301,659	7,203,662	1,838

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$3,919 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs, storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Val $
Site Work		50,000	100	40,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		100,000	100	80,000
MBR Treatment Plant		1,324,200	20	0
UV Disinfection		100,000	20	0
Booster Pumps		150,000	20	0
Distribution System		633,000	75	464,200
Spreading Basins		100,000	100	80,000
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		125,360		0
Final Engineering Costs		376,080		0
Construction Services		100,288		0
Site Aquisition		100,000	100	80,000
Subtotal		3,488,928		744,200
Contingency	30%	1,046,678		223,260
Grandtotal		4,535,606		967,460

Table G-33

Economic Analysis of Alternative A-5

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs		Salvage Value	Total	
								Fixed	Variable			
2011		1,061,762				1.06000	1,125,468				1,125,468	
2012		4,130,162				1.00000	4,130,162				4,130,162	
2013	280		112,027	84,255		0.94340		105,686	79,486		185,172	264
2014	280		115,388	86,783		0.89000		102,695	77,236		179,931	249
2015	280		118,849	89,386		0.83962		99,788	75,050		174,839	235
2016	280		122,415	92,068		0.79209		96,964	72,926		169,890	222
2017	280		126,087	94,830		0.74726		94,220	70,862		165,082	209
2018	280		129,870	97,675		0.70496		91,553	68,857		160,410	197
2019	280		133,766	100,605		0.66506		88,962	66,908		155,870	186
2020	280		137,779	103,623		0.62741		86,444	65,014		151,459	176
2021	280		141,912	106,732		0.59190		83,998	63,174		147,172	166
2022	280		146,170	109,934		0.55839		81,620	61,387		143,007	156
2023	280		150,555	113,232		0.52679		79,310	59,649		138,959	148
2024	280		155,071	116,629		0.49697		77,066	57,961		135,027	139
2025	280		159,723	120,128		0.46884		74,885	56,321		131,205	131
2026	280		164,515	123,732		0.44230		72,765	54,727		127,492	124
2027	280		169,451	127,443		0.41727		70,706	53,178		123,884	117
2028	280		174,534	131,267		0.39365		68,705	51,673		120,377	110
2029	280		179,770	135,205		0.37136		66,760	50,210		116,970	104
2030	280		185,163	139,261		0.35034		64,871	48,789		113,660	98
2031	280		190,718	143,439		0.33051		63,035	47,408		110,443	93
2032	280		196,440	147,742	1,280,890	0.31180		61,251	46,067	399,388	(292,070)	87
Total		5,191,924					5,255,630	1,631,282	1,226,884	399,388	7,714,409	3,212

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$2,402 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		75,000	100	60,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		200,000	100	160,000
MBR Treatment Plant		1,324,200	20	0
UV Disinfection		200,000	20	0
Booster Pumps		150,000	20	0
Distribution System		874,500	75	641,300
Leach Fields		60,000	75	44,000
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		141,685		0
Final Engineering Costs		425,055		0
Construction Services		113,348		0
Site Aquisition		100,000	100	80,000
Subtotal		3,993,788		985,300
Contingency	30%	1,198,136		295,590
Grand Total		5,191,924		1,280,890

Table G-34

Economic Analysis of Alternative A-6

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Salvage Value	Total	
2011		849,602				1.06000	900,578				900,578	
2012		2,909,470				1.00000	2,909,470				2,909,470	
2013	280		94,650	46,533		0.94340		89,292	43,899		133,191	264
2014	280		97,489	47,929		0.89000		86,765	42,657		129,422	249
2015	280		100,414	49,367		0.83962		84,309	41,449		125,759	235
2016	280		103,426	50,848		0.79209		81,923	40,276		122,199	222
2017	280		106,529	52,373		0.74726		79,605	39,136		118,741	209
2018	280		109,725	53,944		0.70496		77,352	38,029		115,380	197
2019	280		113,017	55,563		0.66506		75,162	36,952		112,115	186
2020	280		116,407	57,230		0.62741		73,035	35,907		108,942	176
2021	280		119,899	58,947		0.59190		70,968	34,890		105,859	166
2022	280		123,496	60,715		0.55839		68,960	33,903		102,863	156
2023	280		127,201	62,536		0.52679		67,008	32,943		99,951	148
2024	280		131,017	64,413		0.49697		65,112	32,011		97,123	139
2025	280		134,948	66,345		0.46884		63,269	31,105		94,374	131
2026	280		138,996	68,335		0.44230		61,478	30,225		91,703	124
2027	280		143,166	70,385		0.41727		59,738	29,369		89,108	117
2028	280		147,461	72,497		0.39365		58,047	28,538		86,586	110
2029	280		151,885	74,672		0.37136		56,405	27,730		84,135	104
2030	280		156,441	76,912		0.35034		54,808	26,946		81,754	98
2031	280		161,135	79,219		0.33051		53,257	26,183		79,440	93
2032	280		165,969	81,596	631,670	0.31180		51,750	25,442	196,958	(119,766)	87
Total		3,759,072					3,810,048	1,378,243	677,591	196,958	5,668,925	3,212

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$1,765 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs, storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		75,000	100	60,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		200,000	100	160,000
MBR Treatment Plant		1,324,200	20	0
UV Disnifection		150,000	20	0
Booster Pumps		15,000	20	0
Distribution System		193,500	75	141,900
Leach Fields		60,000	75	44,000
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		100,885		0
Final Engineering Costs		302,655		0
Construction Services		40,354		0
Site Aquisition		100,000	100	80,000
Subtotal		2,891,594		485,900
Contingency	30%	867,478		145,770
Grand Total		3,759,072		631,670

Table G-33

Economic Analysis of Alternative A-7

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Source Water	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		132,600					1.06000	140,556					208,017	
2012		182,520					1.00000	182,520					248,071	
2013	48		13,296	0	71,508		0.94340		12,543	0	67,461		76,240	45
2014	48		13,695	0	73,654		0.89000		12,188	0	65,551		74,082	42
2015	48		14,106	0	75,863		0.83962		11,843	0	63,696		71,885	40
2016	48		14,529	0	78,139		0.79209		11,508	0	61,893		69,948	38
2017	48		14,965	0	80,483		0.74726		11,183	0	60,142		67,960	36
2018	48		15,414	0	82,898		0.70496		10,866	0	58,440		66,045	34
2019	48		15,876	0	85,385		0.66506		10,559	0	56,788		64,175	32
2020	48		16,352	0	87,940		0.62741		10,260	0	55,178		62,359	30
2021	48		16,843	0	90,585		0.59190		9,969	0	53,617		60,594	28
2022	48		17,348	0	93,302		0.55839		9,687	0	52,099		58,879	27
2023	48		17,869	0	96,101		0.52679		9,413	0	50,625		57,213	25
2024	48		18,405	0	98,984		0.49697		9,147	0	49,192		55,594	24
2025	48		18,957	0	101,954		0.46884		8,888	0	47,800		54,020	22
2026	48		19,526	0	105,012		0.44230		8,636	0	46,447		52,491	21
2027	48		20,111	0	108,163		0.41727		8,392	0	45,133		51,006	20
2028	48		20,715	0	111,408		0.39365		8,154	0	43,855		49,562	19
2029	48		21,336	0	114,750		0.37136		7,923	0	42,614		48,160	18
2030	48		21,976	0	118,192		0.35034		7,699	0	41,408		46,798	17
2031	48		22,636	0	121,738		0.33051		7,481	0	40,236		7,481	16
2032	48		23,315	0	125,390	129,700	0.31180		7,270	0	39,097	40,129	(32,860)	15
Total		315,120						323,076	193,610	0		40,129	1,517,827	547

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $2,776 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs.

Item		Cost $	Useful Life Yrs	Salvage Val $
Distribution System		135,000	75	99,000
CEQA & Permitting		75,000		0
Preliminary Engineering Costs		6,750		0
Final Engineering Costs		20,250		0
Construction Services		5,400		0
Subtotal		242,400		99,000
Contingency	30%	72,720		29,700
Grand Total		315,120		128,700

Table G-36

Economic Analysis of Alternative A-8

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Source Water	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		263,900					1.06000	279,734					279,734	0
2012		397,280					1.00000	397,280					397,280	0
2013	280		37,352	0	420,000		0.94340		35,238	0	396,226		431,464	264
2014	280		38,473	0	432,600		0.89000		34,240	0	385,012		419,253	249
2015	280		39,627	0	445,578		0.83962		33,271	0	374,116		407,387	235
2016	280		40,816	0	458,945		0.79209		32,330	0	363,528		395,857	222
2017	280		42,040	0	472,714		0.74726		31,415	0	353,239		384,654	209
2018	280		43,301	0	486,895		0.70496		30,526	0	343,242		373,767	197
2019	280		44,600	0	501,502		0.66506		29,662	0	333,527		363,189	186
2020	280		45,938	0	516,547		0.62741		28,822	0	324,088		352,910	176
2021	280		47,316	0	532,043		0.59190		28,007	0	314,916		342,922	166
2022	280		48,736	0	548,005		0.55839		27,214	0	306,003		333,217	156
2023	280		50,198	0	564,445		0.52679		26,444	0	297,343		323,788	148
2024	280		51,704	0	581,378		0.49697		25,695	0	288,927		314,622	139
2025	280		53,255	0	598,820		0.46884		24,968	0	280,750		305,718	131
2026	280		54,853	0	616,784		0.44230		24,261	0	272,804		297,066	124
2027	280		56,498	0	635,288		0.41727		23,575	0	265,083		288,658	117
2028	280		58,193	0	654,346		0.39365		22,908	0	257,581		280,489	110
2029	280		59,939	0	673,977		0.37136		22,258	0	250,291		272,550	104
2030	280		61,737	0	694,196		0.35034		21,629	0	243,207		264,836	98
2031	280		63,589	0	715,022		0.33051		21,017	0	236,324		257,341	93
2032	280		65,497	0	736,473	261,300	0.31180		20,422	0	229,636	81,476	168,583	87
Total		661,180						677,014	543,902	0		81,475	7,255,206	3,212

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $2,259 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs.

Item		Cost $	Useful Life Yrs	Salvage Val $
Distribution System		165,000	75	121,000
Spreading Basins		100,000	100	80,000
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		13,250		0
Final Engineering Costs		39,750		0
Construction Services		10,600		0
Subtotal		508,600		201,000
Contingency	30%	152,580		60,300
Grand Total		661,180		261,300

Table G-37

Economic Analysis of Alternative V-1

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		1,003,002				1.06000	1,063,182				1,063,182	
2012		4,058,610				1.00000	4,058,610				4,058,610	
2013	97		141,772	87,066		0.94340		133,747	82,138		215,885	92
2014	97		146,025	89,678		0.89000		129,962	79,813		209,775	86
2015	97		150,405	92,368		0.83962		126,283	77,554		203,838	81
2016	97		154,918	95,139		0.79209		122,709	75,359		198,069	77
2017	97		159,565	97,994		0.74726		119,236	73,227		192,463	72
2018	97		164,352	100,933		0.70496		115,862	71,154		187,016	68
2019	97		169,283	103,961		0.66506		112,583	69,140		181,723	65
2020	97		174,361	107,080		0.62741		109,396	67,184		176,580	61
2021	97		179,592	110,293		0.59190		106,300	65,282		171,582	57
2022	97		184,980	113,601		0.55839		103,292	63,434		166,726	54
2023	97		190,529	117,010		0.52679		100,368	61,639		162,008	51
2024	97		196,245	120,520		0.49697		97,528	59,895		157,422	48
2025	97		202,132	124,135		0.46884		94,768	58,200		152,967	45
2026	97		208,196	127,859		0.44230		92,085	56,552		148,638	43
2027	97		214,442	131,695		0.41727		89,479	54,952		144,431	40
2028	97		220,876	135,646		0.39365		86,947	53,397		140,343	38
2029	97		227,502	139,716		0.37136		84,486	51,885		136,371	36
2030	97		234,327	143,907		0.35034		82,095	50,417		132,512	34
2031	97		241,357	148,224		0.33051		79,772	48,990		128,762	32
2032	97		248,597	152,671	1,332,370	0.31180		77,514	47,604	415,439	(290,322)	30
Total		5,061,612					5,121,793	2,084,412	1,267,816	415,439	8,038,581	1,113

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$7,225 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		75,000	100	60,000
Sewer Scalping Facility		150,000	20	0
MBR Structure		200,000	100	160,000
MBR Treatment Plant		1,324,200	20	0
UV Disinfection		150,000	20	0
Booster Pumps		120,000	20	0
Distribution System		801,000	75	587,400
Reservoir		187,500	75	137,500
CEQA & Permitting		100,000		0
Preliminary Engineering Costs		142,885		0
Final Engineering Costs		428,655		0
Construction Services		114,308		0
Site Aquisition		100,000	100	80,000
Subtotal		3,893,548		1,024,900
Contingency	30%	1,168,064		307,470
Grand Total		5,061,612		1,332,370

Table G-38

Economic Analysis of Alternative V-2

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $ Design & Construction Cost	Present Worth of Costs, $ O & M Costs Fixed	Present Worth of Costs, $ O & M Costs Variable	Present Worth of Costs, $ Source Water	Present Worth of Costs, $ Salvage Value	Present Worth of Costs, $ Total	Present Worth of Sales, AF
2011		612,170					1.06000	648,900					648,900	
2012		1,931,284					1.00000	1,931,284					1,931,284	
2013	97		144,145	88,428	51,412		0.94340		135,986	83,423	48,502		267,911	82
2014	97		148,470	91,081	52,954		0.89000		132,137	81,062	47,129		260,329	86
2015	97		152,924	93,814	54,543		0.83962		128,398	78,768	45,795		252,961	81
2016	97		157,511	96,628	56,179		0.79209		124,764	76,538	44,499		245,802	77
2017	97		162,237	99,527	57,865		0.74726		121,233	74,372	43,240		238,845	72
2018	97		167,104	102,513	59,601		0.70496		117,802	72,267	42,016		232,085	68
2019	97		172,117	105,588	61,389		0.66506		114,468	70,222	40,827		225,517	65
2020	97		177,280	108,756	63,230		0.62741		111,228	68,235	39,672		219,134	61
2021	97		182,599	112,018	65,127		0.59190		108,080	66,304	38,549		212,932	57
2022	97		188,077	115,379	67,081		0.55839		105,021	64,427	37,458		206,906	54
2023	97		193,719	118,840	69,094		0.52679		102,049	62,604	36,398		201,050	51
2024	97		199,531	122,405	71,166		0.49697		99,161	60,832	35,368		195,360	48
2025	97		205,517	126,078	73,301		0.46884		96,354	59,110	34,367		189,831	45
2026	97		211,682	129,860	75,500		0.44230		93,627	57,437	33,394		184,458	43
2027	97		218,033	133,756	77,765		0.41727		90,977	55,812	32,449		179,238	40
2028	97		224,574	137,769	80,098		0.39365		88,403	54,232	31,530		174,165	38
2029	97		231,311	141,902	82,501		0.37136		85,901	52,697	30,638		169,236	36
2030	97		238,250	146,159	84,976		0.35034		83,468	51,206	29,771		164,446	34
2031	97		245,398	150,543	87,526		0.33051		81,107	49,757	28,928		159,792	32
2032	97		252,759	155,060	90,151	1,252,290	0.31180		78,812	48,348	28,110	390,470	(235,200)	30
Total		2,443,454						2,480,184	2,098,975	1,287,653		390,470	6,224,981	1,113

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $5,595 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs.

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs.

Item		Cost $	Useful Life Yrs	Salvage Value $
Booster Pumps		150,000	20	0
Supply Piping		342,000	75	250,800
Distribution System		675,000	75	495,000
Reservoir		187,500	75	137,500
CEQA & Permitting		100,000		0
Preliminary Engineering Costs		67,725		0
Final Engineering Costs		203,175		0
Construction Services		54,180		0
Site Aquisition		100,000	100	80,000
Subtotal		1,879,580		963,300
Contingency	30%	563,874		288,990
Grand Total		2,443,454		1,252,290

Table G-39

Economic Analysis of Alternative V-3

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs		Salvage Value	Total	
								Fixed	Variable			
2011		1,173,406				1.06000	1,243,810				1,243,810	
2012		5,081,211				1.00000	5,081,211				5,081,211	
2013	560		153,295	18,963		0.94340		144,618	17,889		162,507	528
2014	560		157,894	19,531		0.89000		140,525	17,383		157,908	498
2015	560		162,630	20,117		0.83962		136,548	16,891		153,439	470
2016	560		167,509	20,721		0.79209		132,683	16,413		149,096	444
2017	560		172,535	21,342		0.74726		128,928	15,948		144,876	418
2018	560		177,711	21,983		0.70496		125,279	15,497		140,776	395
2019	560		183,042	22,642		0.66506		121,733	15,058		136,792	372
2020	560		188,533	23,322		0.62741		118,288	14,632		132,920	351
2021	560		194,189	24,021		0.59190		114,940	14,218		129,158	331
2022	560		200,015	24,742		0.55839		111,687	13,816		125,503	313
2023	560		206,015	25,484		0.52679		108,526	13,425		121,951	295
2024	560		212,196	26,249		0.49697		105,455	13,045		118,500	278
2025	560		218,562	27,036		0.46884		102,470	12,676		115,146	263
2026	560		225,119	27,847		0.44230		99,570	12,317		111,887	248
2027	560		231,872	28,683		0.41727		96,752	11,968		108,720	234
2028	560		238,828	29,543		0.39365		94,014	11,629		105,643	220
2029	560		245,993	30,429		0.37136		91,353	11,300		102,653	208
2030	560		253,373	31,342		0.35034		88,768	10,981		99,749	196
2031	560		260,974	32,282		0.33051		86,255	10,670		96,925	185
2032	560		268,803	33,251	1,335,187	0.31180		83,814	10,366	416,318	(322,136)	175
Total		6,254,617					6,325,022	2,232,207	276,123	416,318	8,417,035	6,423

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$1,310 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr, pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs.

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		112,500	100	90,000
Scalping Facility		170,000	20	0
Structure		300,000	100	240,000
MBR		1,944,600	20	0
UV Disinfection		225,000	20	0
Booster		90,000	20	0
PVC Pipe		834,000	75	611,600
Leach Fields		62,000	75	45,467
Lysimeters		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering C		175,655		0
Final Engineering Costs		526,965		0
Construction Services		140,524		0
Site Aquisition		50,000	100	40,000
Subtotal		4,811,244		1,027,067
Contingency	30%	1,443,373		308,120
Grand Total		6,254,617		1,335,187

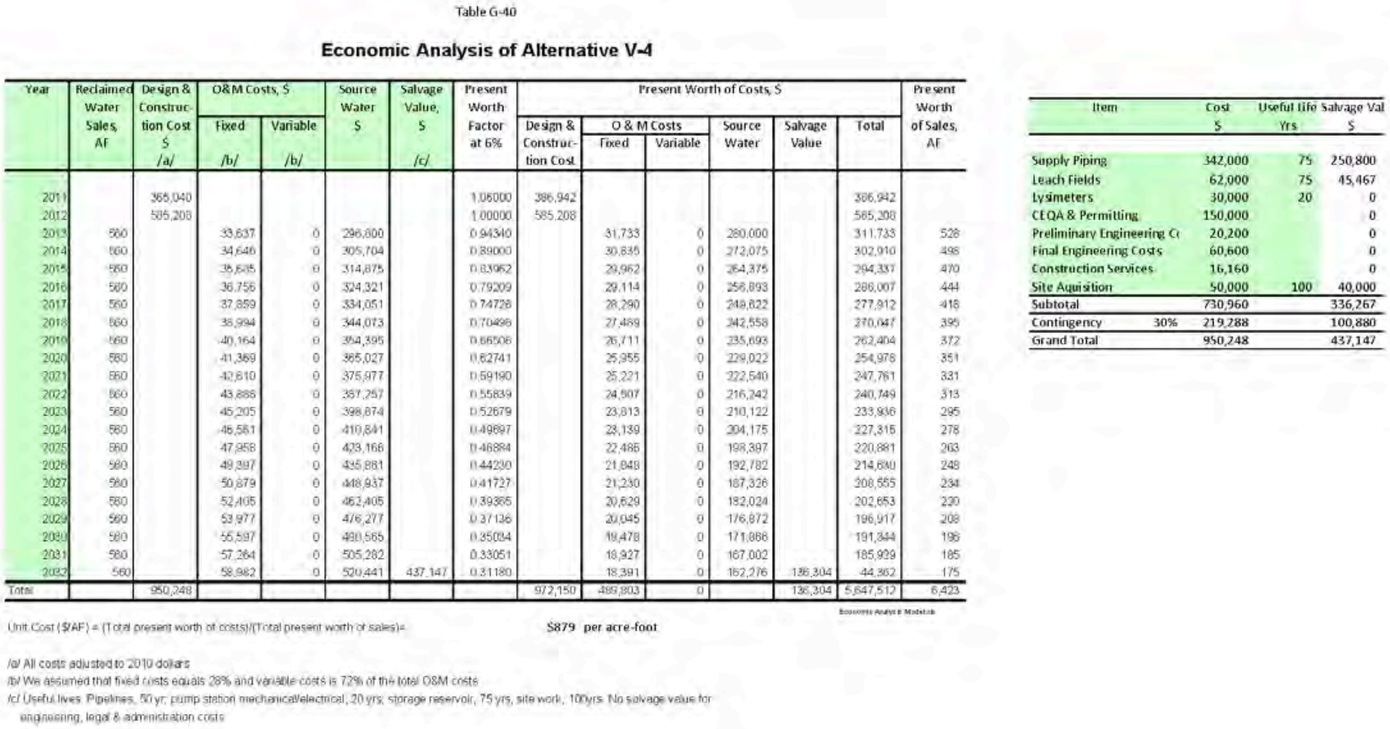

Table G-40

Economic Analysis of Alternative V-4

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $						Present Worth of Sales, AF
			Fixed /b/	Variable /b/				Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Source Water	Salvage Value	Total	
2011		365,040					1.06000	386,942					386,942	
2012		585,208					1.00000	585,208					585,208	
2013	560		33,637	0	296,800		0.94340		31,733	0	280,000		311,733	528
2014	560		34,646	0	305,704		0.89000		30,835	0	272,075		302,910	498
2015	560		35,685	0	314,875		0.83962		29,962	0	264,375		294,337	470
2016	560		36,756	0	324,321		0.79209		29,114	0	256,893		286,007	444
2017	560		37,859	0	334,051		0.74726		28,290	0	249,622		277,912	418
2018	560		38,994	0	344,073		0.70496		27,489	0	242,558		270,047	395
2019	560		40,164	0	354,395		0.66506		26,711	0	235,693		262,404	372
2020	560		41,369	0	365,027		0.62741		25,955	0	229,022		254,978	351
2021	560		42,610	0	375,977		0.59190		25,221	0	222,540		247,761	331
2022	560		43,888	0	387,257		0.55839		24,507	0	216,242		240,749	313
2023	560		45,205	0	398,874		0.52679		23,813	0	210,122		233,936	295
2024	560		46,561	0	410,841		0.49697		23,139	0	204,175		227,315	278
2025	560		47,958	0	423,166		0.46884		22,485	0	198,397		220,881	263
2026	560		49,397	0	435,861		0.44230		21,848	0	192,782		214,630	248
2027	560		50,879	0	448,937		0.41727		21,230	0	187,326		208,555	234
2028	560		52,405	0	462,405		0.39365		20,629	0	182,024		202,653	220
2029	560		53,977	0	476,277		0.37136		20,045	0	176,872		196,917	208
2030	560		55,597	0	490,565		0.35034		19,478	0	171,866		191,344	196
2031	560		57,264	0	505,282		0.33051		18,927	0	167,002		185,929	185
2032	560		58,982	0	520,441	437,147	0.31180		18,391	0	162,276	136,304	44,362	175
Total		950,248						972,150	489,803	0		136,304	5,647,512	6,423

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$879 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item	Cost $	Useful Life Yrs	Salvage Val $
Supply Piping	342,000	75	250,800
Leach Fields	62,000	75	45,467
Lysimeters	30,000	20	0
CEQA & Permitting	150,000		0
Preliminary Engineering Co	20,200		0
Final Engineering Costs	60,600		0
Construction Services	16,160		0
Site Aquisition	50,000	100	40,000
Subtotal	730,960		336,267
Contingency 30%	219,288		100,880
Grand Total	950,248		437,147

Table G-41

Economic Analysis of Alternative V-5

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Salvage Value	Total	
2011		1,227,616				1.06000	1,301,273				1,301,273	
2012		5,782,353				1.00000	5,782,353				5,782,353	
2013	560		106,842	125,275		0.94340		100,794	118,184		218,978	528
2014	560		110,047	129,033		0.89000		97,942	114,839		212,780	498
2015	560		113,349	132,904		0.83962		95,170	111,589		206,758	470
2016	560		116,749	136,891		0.79209		92,476	108,430		200,907	444
2017	560		120,252	140,998		0.74726		89,859	105,362		195,221	418
2018	560		123,859	145,228		0.70496		87,316	102,380		189,695	395
2019	560		127,575	149,564		0.66506		84,845	99,482		184,327	372
2020	560		131,402	154,072		0.62741		82,443	96,667		179,110	351
2021	560		135,344	158,694		0.59190		80,110	93,931		174,041	331
2022	560		139,405	163,455		0.55839		77,843	91,272		169,115	313
2023	560		143,587	168,358		0.52679		75,640	88,689		164,329	295
2024	560		147,894	173,409		0.49697		73,499	86,179		159,678	278
2025	560		152,331	178,612		0.46884		71,419	83,740		155,159	262
2026	560		156,901	183,970		0.44230		69,397	81,370		150,768	248
2027	560		161,608	189,489		0.41727		67,433	79,067		146,501	234
2028	560		166,456	195,174		0.39365		65,525	76,829		142,354	220
2029	560		171,450	201,029		0.37136		63,670	74,655		138,325	208
2030	560		176,594	207,060		0.35034		61,868	72,542		134,411	196
2031	560		181,891	213,271		0.33051		60,117	70,489		130,606	185
2032	560		187,348	219,670	1,684,107	0.31180		58,416	68,494	525,112	(398,202)	175
Total		7,009,969					7,083,626	1,555,783	1,824,169	525,112	9,938,486	6,423

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $1,547 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Site Work		112,500	100	90,000
Scalping Facility		170,000	20	0
Structure		300,000	100	240,000
MBR		1,944,600	20	0
UV Disinfection		300,000	20	0
Distribution Booster		120,000	20	0
PVC Pipe		1,012,500	75	742,500
Recharge Booster		60,000	20	0
Leach Fields		62,000	75	45,467
Lysimeters		30,000	20	0
Reservoir		187,500	75	137,500
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		186,080		0
Final Engineering Costs		558,240		0
Construction Services		148,864		0
Site Aquisition		50,000	100	40,000
Subtotal		5,392,284		1,295,467
Contingency	30%	1,617,685		388,640
Grand Total		7,009,969		1,684,107

Table G-42

Economic Analysis of Alternative V-6

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $						Present Worth of Sales, AF
			Fixed /b/	Variable /b/				Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Source Water	Salvage Value	Total	
2011		482,040					1.06000	510,962					510,962	
2012		2,673,658					1.00000	2,673,658					2,673,658	
2013	560		28,198	7,436	296,800		0.94340		26,602	7,015	280,000		313,617	528
2014	560		29,044	7,659	305,704		0.89000		25,849	6,817	272,075		304,741	498
2015	560		29,915	7,889	314,875		0.83962		25,117	6,624	264,375		296,116	470
2016	560		30,812	8,126	324,321		0.79209		24,406	6,436	256,893		287,735	444
2017	560		31,737	8,369	334,051		0.74726		23,715	6,254	249,622		279,592	418
2018	560		32,689	8,620	344,073		0.70496		23,044	6,077	242,558		271,679	395
2019	560		33,669	8,879	354,395		0.66506		22,392	5,905	235,693		263,990	372
2020	560		34,679	9,145	365,027		0.62741		21,758	5,738	229,022		256,518	351
2021	560		35,720	9,420	375,977		0.59190		21,143	5,576	222,540		249,258	331
2022	560		36,791	9,702	387,257		0.55839		20,544	5,418	216,242		242,204	313
2023	560		37,895	9,993	398,874		0.52679		19,963	5,264	210,122		235,349	295
2024	560		39,032	10,293	410,841		0.49697		19,398	5,115	204,175		228,688	278
2025	560		40,203	10,602	423,166		0.46884		18,849	4,971	198,397		222,216	263
2026	560		41,409	10,920	435,861		0.44230		18,315	4,830	192,782		215,927	248
2027	560		42,651	11,248	448,937		0.41727		17,797	4,693	187,326		209,816	234
2028	560		43,931	11,585	462,405		0.39365		17,293	4,560	182,024		203,878	220
2029	560		45,249	11,933	476,277		0.37136		16,804	4,431	176,872		198,107	208
2030	560		46,606	12,291	490,565		0.35034		16,328	4,306	171,866		192,501	196
2031	560		48,005	12,659	505,282		0.33051		15,866	4,184	167,002		187,053	185
2032	560		49,445	13,039	520,441	1,808,517	0.31180		15,417	4,066	162,276	563,904	(382,145)	175
Total		3,155,698						3,184,620	410,600	108,280		563,904	7,461,459	6,423

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$1,162 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Valu $
Supply Piping		792,000	75	580,800
Distribution Piping		801,000	75	587,400
Distribution Booster		150,000	20	0
Reservoir		187,500	75	137,500
Leach Fields		62,000	75	45,467
Lysimeter		30,000	20	0
CEQA & Permitting		150,000		0
Preliminary Engineering C		42,700		0
Final Engineering Costs		128,100		0
Construction Services		34,160		0
Site Aquisition		50,000	100	40,000
Subtotal		2,427,460		1,391,167
Contingency	30%	728,238		417,350
Grand Total		3,155,698		1,808,517

Table G-43

Economic Analysis of Alternative E-1

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $					Present Worth of Sales, AF
			Fixed /b/	Variable /b/			Design & Construction Cost	O & M Costs		Salvage Value	Total	
								Fixed	Variable			
2011		853,606				1.06000	904,822	0	0		904,822	0
2012		4,178,751				1.00000	4,178,751	0	0		4,178,751	0
2013	560		158,942	83,967		0.94340		149,945	79,214		229,159	528
2014	560		163,710	86,486		0.89000		145,702	76,972		222,674	498
2015	560		168,622	89,080		0.83962		141,578	74,794		216,371	470
2016	560		173,680	91,753		0.79209		137,571	72,677		210,248	444
2017	560		178,891	94,505		0.74726		133,677	70,620		204,297	418
2018	560		184,257	97,340		0.70496		129,894	68,621		198,515	395
2019	560		189,785	100,261		0.66506		126,218	66,679		192,897	372
2020	560		195,479	103,268		0.62741		122,646	64,792		187,438	351
2021	560		201,343	106,367		0.59190		119,175	62,958		182,133	331
2022	560		207,363	109,558		0.55839		115,802	61,176		176,978	313
2023	560		213,605	112,844		0.52679		112,524	59,445		171,969	295
2024	560		220,013	116,230		0.49697		109,340	57,763		167,102	278
2025	560		226,613	119,716		0.46884		106,245	56,128		162,373	263
2026	560		233,412	123,308		0.44230		103,239	54,539		157,777	248
2027	560		240,414	127,007		0.41727		100,316	52,996		153,312	234
2028	560		247,626	130,817		0.39365		97,477	51,496		148,973	220
2029	560		255,055	134,742		0.37136		94,719	50,038		144,757	208
2030	560		262,707	138,784		0.35034		92,038	48,622		140,660	196
2031	560		270,588	142,948		0.33051		89,433	47,246		136,679	185
2032	560		278,706	147,236	667,333	0.31180		86,902	45,909	208,078	(75,267)	175
Total		5,032,357					5,083,574	2,314,439	1,222,684	208,078	8,412,619	6,423

Economic Analysis Models.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= **$1,310 per acre-foot**

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs, storage reservoir, 75 yrs, site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Val $
Site Work		112,500	100	90,000
Sewer Scalping Facility		170,000	20	0
MBR Structure		300,000	100	240,000
MBR Treatment Plant		1,944,600	20	0
UV Disinfection		300,000	20	0
Booster Pumps		6,000	20	0
Lysimeters		30,000	20	0
Monitoring Well		250,000	75	183,333
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		126,655		0
Final Engineering Costs		379,965		0
Construction Services		101,324		0
Site Aquisition		0	100	0
Subtotal		3,871,044		513,333
Contingency	30%	1,161,313		154,000
Grand Total		5,032,357		667,333

Table G-44

Economic Analysis of Alternative E-2

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $						Present Worth of Sales, AF
			Fixed /b/	Variable /b/				Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Source Water	Salvage Value	Total	
2011		491,400					1.06000	520,884					520,884	
2012		1,905,280					1.00000	1,905,280					1,905,280	
2013	560		50,528	0	840,000		0.94340		47,668	0	792,453		840,121	528
2014	560		52,044	0	865,200		0.89000		46,319	0	770,025		816,344	498
2015	560		53,605	0	891,156		0.83962		45,008	0	748,232		793,240	470
2016	560		55,213	0	917,891		0.79209		43,734	0	727,055		770,790	444
2017	560		56,870	0	945,427		0.74726		42,496	0	706,478		748,975	418
2018	560		58,576	0	973,790		0.70496		41,294	0	686,484		727,777	395
2019	560		60,333	0	1,003,004		0.66506		40,125	0	667,055		707,180	372
2020	560		62,143	0	1,033,094		0.62741		38,989	0	648,176		687,165	351
2021	560		64,007	0	1,064,087		0.59190		37,886	0	629,831		667,717	331
2022	560		65,928	0	1,096,009		0.55839		36,814	0	612,006		648,820	313
2023	560		67,905	0	1,128,890		0.52679		35,772	0	594,685		630,457	295
2024	560		69,943	0	1,162,756		0.49697		34,759	0	577,854		612,614	278
2025	560		72,041	0	1,197,639		0.46884		33,776	0	561,500		595,276	263
2026	560		74,202	0	1,233,568		0.44230		32,820	0	545,608		578,428	248
2027	560		76,428	0	1,270,575		0.41727		31,891	0	530,167		562,057	234
2028	560		78,721	0	1,308,693		0.39365		30,986	0	515,162		546,150	220
2029	560		81,083	0	1,347,958		0.37136		30,111	0	500,582		530,693	208
2030	560		83,515	0	1,388,992		0.35034		29,259	0	486,416		515,674	196
2031	560		86,021	0	1,430,044		0.33051		28,431	0	472,640		501,079	185
2032	560		88,601	0	1,472,945	1,325,133	0.31180		27,626	0	459,271	413,183	73,715	175
Total		2,396,680						2,426,164	735,765	0	12,231,607	413,183	14,980,434	6,423

Economic Analysis Module

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $2,332 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs

Item		Cost $	Useful Life Yrs	Salvage Value $
Source Water Piping		1,140,000	75	836,000
Lysimeters		30,000	20	0
Monitoring Well		250,000	75	183,333
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		57,000		0
Final Engineering Costs		171,000		0
Construction Services		45,600		0
Subtotal		1,843,600		1,019,333
Contingency	30%	553,080		305,800
Grand Total		2,396,680		1,325,133

Table G-45

Economic Analysis of Alternative E-3

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $ Fixed /b/	O&M Costs, $ Variable /b/	Source Water $	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $: Design & Construction Cost	Present Worth of Costs, $: O & M Costs Fixed	Present Worth of Costs, $: O & M Costs Variable	Present Worth of Costs, $: Source Water	Present Worth of Costs, $: Salvage Value	Present Worth of Costs, $: Total	Present Worth of Sales, AF
2011		1,170,000					1.06000	1,240,200					1,240,200	
2012		5,434,000					1.00000	5,434,000					5,434,000	
2013	560		80,300	118,991	560,000		0.94340		75,755	112,255	528,302		716,312	528
2014	560		82,709	122,560	576,800		0.89000		73,611	109,078	513,350		696,039	498
2015	560		85,190	126,237	594,104		0.83962		71,527	105,991	498,821		676,340	470
2016	560		87,746	130,024	611,927		0.79209		69,503	102,991	484,704		657,198	444
2017	560		90,379	133,925	630,285		0.74726		67,536	100,077	470,986		638,599	419
2018	560		93,090	137,943	649,193		0.70496		65,625	97,244	457,656		620,525	395
2019	560		95,882	142,081	668,669		0.66506		63,767	94,492	444,703		602,963	372
2020	560		98,759	146,343	688,729		0.62741		61,963	91,818	432,117		585,898	351
2021	560		101,722	150,734	709,391		0.59190		60,209	89,219	419,888		569,316	331
2022	560		104,773	155,256	730,673		0.55839		58,505	86,694	408,004		553,203	313
2023	560		107,916	159,913	752,593		0.52679		56,849	84,240	396,457		537,546	295
2024	560		111,154	164,711	775,171		0.49697		55,240	81,856	385,236		522,333	278
2025	560		114,488	169,652	798,426		0.46884		53,677	79,540	374,333		507,550	263
2026	560		117,923	174,742	822,379		0.44230		52,158	77,288	363,739		493,185	248
2027	560		121,461	179,984	847,050		0.41727		50,681	75,101	353,444		479,227	234
2028	560		125,105	185,384	872,462		0.39365		49,247	72,976	343,441		465,664	220
2029	560		128,858	190,945	898,636		0.37136		47,853	70,910	333,721		452,485	208
2030	560		132,724	196,673	925,595		0.35034		46,499	68,903	324,276		439,678	196
2031	560		136,705	202,574	953,363		0.33051		45,183	66,953	315,099		427,235	185
2032	560		140,807	208,651	981,963	3,384,333	0.31180		43,904	65,058	306,181	1,055,251	(640,108)	175
Total		6,604,000						6,674,200	1,169,291	1,732,886	8,154,458	1,055,251	16,675,384	6,423

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $2,596 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs.

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs.

Item		Cost $	Useful Life Yrs	Salvage Value $
Booster Pumps		450,000	20	0
Source Water Piping		3,300,000	75	2,420,000
Lysimeters		30,000	20	0
Monitoring Well		250,000	75	183,333
CEQA & Permitting		150,000		0
Preliminary Engineering Costs		187,500		0
Final Engineering Costs		562,500		0
Construction Services		150,000		0
Subtotal		5,080,000		2,603,333
Contingency	30%	1,524,000		781,000
Grand Total		6,604,000		3,384,333

Table G-46

Economic Analysis of MWD Supply

Year	Reclaimed Water Sales, AF	Design & Construction Cost $ /a/	O&M Costs, $		MWD Water Rate	MWD Water Cost	Salvage Value, $ /c/	Present Worth Factor at 6%	Present Worth of Costs, $						Present Worth of Sales, AF
			Fixed /b/	Variable /b/					Design & Construction Cost	O & M Costs Fixed	O & M Costs Variable	Source Water	Salvage Value	Total	
2011								1.06000						0	
2012								1.00000						0	
2013	560		0	0	$ 833	466,480		0.94340		0	0	440,075		0	528
2014	560		0	0	$ 877	491,120		0.89000		0	0	437,095		0	498
2015	560		0	0	$ 920	515,200		0.83962		0	0	432,572		0	470
2016	560		0	0	$ 970	543,200		0.79209		0	0	430,265		0	444
2017	560		0	0	$ 1,023	572,880		0.74726		0	0	428,089		0	418
2018	560		0	0	$ 1,079	604,240		0.70496		0	0	425,965		0	395
2019	560		0	0	$ 1,146	641,760		0.66506		0	0	426,807		0	372
2020	560		0	0	$ 1,214	679,840		0.62741		0	0	426,540		0	351
2021	560		0	0	$ 1,287	720,630		0.59190		0	0	426,540		0	331
2022	560		0	0	$ 1,364	763,868		0.55839		0	0	426,540		0	313
2023	560		0	0	$ 1,446	809,700		0.52679		0	0	426,540		0	295
2024	560		0	0	$ 1,533	858,282		0.49697		0	0	426,540		0	278
2025	560		0	0	$ 1,625	909,779		0.46884		0	0	426,540		0	263
2026	560		0	0	$ 1,722	964,366		0.44230		0	0	426,540		0	248
2027	560		0	0	$ 1,825	1,022,228		0.41727		0	0	426,540		0	234
2028	560		0	0	$ 1,935	1,083,562		0.39365		0	0	426,540		0	220
2029	560		0	0	$ 2,051	1,148,575		0.37136		0	0	426,540		0	208
2030	560		0	0	$ 2,174	1,217,490		0.35034		0	0	426,540		0	196
2031	560		0	0	$ 2,305	1,290,539		0.33051		0	0	426,540		0	185
2032	560		0	0	$ 2,443	1,367,972	0	0.31180		0	0	426,540	0	0	175
Total		0							0	0	0	8,565,890	0	0	6,423

Economic Analysis Model.xls

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales)= $1,334 per acre-foot

/a/ All costs adjusted to 2010 dollars

/b/ We assumed that fixed costs equals 28% and variable costs is 72% of the total O&M costs

/c/ Useful lives: Pipelines, 50 yr; pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs; site work, 100yrs. No salvage value for engineering, legal & administration costs.

Table G-47

Comparison of Alternatives

Alternative	Per Acre Foot Present Worth
A-1	$11,582
A-2	$2,347
A-3	$3,672
A-4	$3,919
A-5	$2,402
A-6	$1,765
A-7	$2,776
A-8	$2,259
V-1	$7,225
V-2	$5,595
V-3	$1,310
V-4	$879
V-5	$1,547
V-6	$1,162
E-1	$1,310
E-2	$2,332
E-3	$2,596
MWD	$1,334

H. RECOMMENDED FACILITIES PROJECT PLAN

H-1. Recommended Projects

There is an apparent best alternative within each of the geographical areas of FMWD from a cost perspective. For the Arroyo Seco area, it is Alternative A-6; for the Verdugo Basin area, it is Alternative V-4 and for the Eaton Wash area, it is Alternative E-1. For each of these alternatives, the user ends up as FMWD with groundwater recharge credits in the Raymond Basin available for extraction by their various member agencies. This additional recharge will help in improving the reliability of the Basin for the FMWD member agencies.

However, this low cost approach excludes use of recycled water in the CVWD area although CVWD benefits from the lower costs of wastewater treatment at LAGWRP with lower amounts of wastewater being treated at the facility. Alternative V-6 at a higher cost would include direct use of recycled water in the service area while still recharging the leftover water into the Raymond Basin. The other benefit of this alternative is that it continues to reduce costs to CVWD for the cost of wastewater treatment at LAGWRP. As described in more detail in Section H-5, only the Arroyo Seco option is recommended for implementation as this time.

H-2. Project Refinements

There were no project refinements beyond those done during the alternatives analysis.

H-3. Energy Analysis for Each Alternative (including direct and construction energy).

The energy components for the various alternatives include the energy required to treat the wastewater to the proper quality, the pumping energy to transport the treated wastewater to its point of use and, in the cases incorporating groundwater recharge, the energy required to extract the recharge water. In the cases that include the purchase of treated wastewater from another entity, no treatment energy is included as it would be the same as currently used to treat the wastewater for disposal. The resulting energy requirements are then compared against the existing energy requirements for the imported water supply. In that the incremental imported supply is from the East Branch of the State Water Project, the energy required to get it to the Pasadena area is 3,200 kWh/AF. This is sufficient for the water supply in the Eaton Wash area but it takes FMWD an additional 435 kWh/AF to lift the imported supply to Arroyo Seco area and 1,064 kWh/AF to lift it to the Verdugo Basin area. The energy required to recover the recharged water is based on the average groundwater pumping rate of 570 kWh/AF. The resulting net energy savings, or cost, for each of the alternatives is summarized in Table H-1.

Table H-1 Annual Energy Consumption (kWh)

Alternative	AFY Produced	AFY Recharged	Production	Extraction	Total	Import	Savings
A-1	47.67	-	367,033	-	367,033	173,288	(193,744)
A-2	280.00	232.33	610,617	132,427	743,043	1,017,800	274,757
A-3	160.25	-	485,068	-	485,068	582,520	97,452
A-4	280.00	119.75	610,617	68,256	678,872	1,017,800	338,928
A-5	280.00	232.33	610,617	132,427	743,043	1,017,800	274,757
A-6	280	280	346,408	159,600	506,008	1,017,800	511,792
A-7	47.67	-	-	-	-	173,288	173,288
A-8	280.00	232.33	-	132,427	132,427	1,017,800	885,373
V-1	97.00	-	651,298	-	651,298	413,625	(237,673)
V-2	97.00	-	661,468	-	661,468	413,625	(247,844)
V-3	560.00	560.00	111,038	319,200	430,238	2,387,840	1,957,602
V-4	560.00	560.00	-	319,200	319,200	2,387,840	2,068,640
V-5	560.00	463.00	771,792	263,908	1,035,700	2,387,840	1,352,140
V-6	560.00	463.00	45,662	263,908	309,569	2,387,840	2,078,271
E-1	560.00	560.00	622,359	319,200	941,559	1,792,000	850,441
E-2	560.00	560.00	-	319,200	319,200	1,792,000	1,472,800
E-3	560.00	560.00	880,697	319,200	1,199,897	1,792,000	592,103

H-4. Water Quality Impacts

H-4.1 Effect on Receiving Water by Removing or Reducing Discharge of Effluent, Including Effect on Beneficial Uses Resulting from Reduced Flow

The alternatives evaluated require either development of satellite plants of up to 0.5 MGD capacity or the use of treated effluent from existing tertiary treatment facilities. The wastewater treatment plants potentially affected by the satellite activities include LAGWRP (design capacity of 20 MGD), SJCWRP (design capacity of 100 MGD), and WNWRP (design capacity of 15 MGD).

H-4.2 Groundwater Impacts

This section discusses the groundwater impacts from spreading of effluent produced from the proposed satellite plants. Based on the alternatives evaluation, potential groundwater recharge areas include the eastern Monk Hill subarea, the Arroyo Seco and Eaton Wash.

As indicated in Section E above, it is anticipated the membrane bioreactors will be the treatment technology for the proposed satellite plants, with the residuals being returned to the collection system for treatment. UV disinfection will follow treatment by the membrane bioreactors.

The approximate quality of the effluent from the proposed membrane bioreactors satellite plants is anticipated to be as follows:

- TDS: 800 mg/l
- Total nitrogen: 12 mg/l
- TOC: 10 mg/l
- Turbidity: 0.5 NTU.

As indicated in Section E above, the CDPH Recycled Water Standards and RWQCB Basin Plan Objectives (groundwater) for the Raymond Basin are summarized in the Raymond Basin Management Board's report entitled "Draft Criteria for Delivery of Supplemental Water" (see Appendix L), and the Raymond Basin criteria for the above constituents are as follows:

- TDS: 500-1,000 mg/l (CDPH); 450 mg/l (RWQCB)
- Total nitrogen: 10 mg/l (CDPH); 8 mg/l (RWQCB)
- TOC: 20 mg/l (CDPH; not required by RWQCB)
- Turbidity: 5 NTU (CDPH; not required by RWQCB).

Except for TDS (RWQCB Basin Plan Objectives only) and total nitrogen, the anticipated quality of the effluent from the proposed satellite plants, for the above constituents, are within the criteria for the Raymond Basin.

The draft CDPH groundwater recharge regulations published in August 2008[10] proposes a revised limit for TOC rather than the CDPH limit in the "Draft Criteria for Delivery of Supplemental Water" for the Raymond Basin[11]. The proposed TOC limit is dependent on the recycled water contribution (RWC), as discussed in Section E above. Based on the draft CDPH groundwater recharge regulations, the RWC value for the effluent from the proposed satellite plants with a maximum TOC concentration of 10 mg/l shall not exceed 5.0 percent.

The amount of water entering the Monk Hill subarea, where the Arroyo Seco is located, from precipitation, inflow from mountains, and inflow from hills was approximately 22,410 AFY over a 12 year average (see Section B above). The proposed quantity of groundwater recharge is about 280 AFY for the Arroyo Seco and about 560 AFY for the Verdugo project recharge into the eastern Monk Hill subarea. The Arroyo Seco project

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[10] Groundwater Recharge Reuse, DRAFT Regulation. California Department of Public Health. August 5, 2008.

[11] *Draft Criteria for Delivery of Supplemental Water*, Raymond Basin Management Board, March 2006. Prepared by Stetson Engineers Inc.

would result in an RWC of 1.2 percent, below the allowed 5.0 percent. The Verdugo project would result in an RWC of 2.4 percent, below the allowed 5.0 percent. The amount of water entering the Pasadena subarea where the Eaton Wash is located was approximately 34,420 AFY over a 12 year average period. The proposed quantity of groundwater recharge is about 560 AFY for the Eaton Wash. This would result in an RWC of 1.6 percent, below the allowed 5.0 percent.

An analysis was performed of artificial recharge of recycled water at three potential sites in the Raymond Basin. The three proposed sites are Arroyo, Verdugo, and Eaton Wash (see Figure H-1).

The purpose of the analysis was to determine the recycled water contribution based on the CDPH regulatory guidelines and the amount of diluent water available as underflow at each site. It is proposed to use shallow subsurface infiltration galleries to artificially recharge the recycled water.

The procedure used included reviewing CDPH regulations and Inland Empire Utility Agency's process for recharging recycled water. The use of underflow as diluent water is logical for the proposed recycled water recharge areas as the Raymond Basin is large and the underflow has been clearly defined. Due to the geohydrological characteristics of the ground water basin, recharge or underflow occurs over a broad area and the quantity of underflow will mix with the recycled water to provide sufficient diluent water to meet the Recycled Water Contribution (RWC) requirement. In all scenarios, the proposed RWC was less than the 50% maximum RWC established by CDPH. Specifically, the steps and assumptions included:

- Review of the soil aquifer treatment (SAT) process for removing organics in the vadose zone.
- Maximum allowed Recycled Water Contribution (RWC) is 50% per CDPH regulations.
- Performed analytical calculations of ground water recharge and recycled water mound extent.

- Superimposed ground water recharge mound on regional ground water flow regime.
- Determined area of mixing between underflow as diluent and recycled water recharge from infiltration galleries.
- Determined available diluent from underflow based on lateral extent of recycled water mound and underflow based on a Darcian calculation beneath the infiltration galleries.
- Calculated total Recycled Water Contribution for proposed infiltration gallery fields based on the following relationship:

$$\text{RWC (\%)} = \left(\frac{\text{recycled water}}{\text{recycled water + diluent}} \right) \times 100$$

- Calculated Maximum Total Organic Carbon (TOC) and RWC related based on the following relationship:

$$\text{TOC (mg/L)} = \left(\frac{0.5}{\text{RWC}} \right)$$

- Identified nearest production wells to each of the infiltration galleries and estimated travel time to each of these wells.

Figures H-2, H-3 and H-4 show graphically the proposed infiltration gallery areas for the proposed recharge of recycled water. Included on the figures are summaries of the key parameters used as well as the results.

The following summary table and attached Table H-3 and Figures H-2, H-3 and H-4 summarize the recycled water recharge analysis for the three specific areas:

Table H-2

Summary of Key Parameters for the Three Proposed Recycled Water Recharge Areas

Area	No. of Infiltration Galleries	Individual Recharge Area[1] (acres)	Total Recharge Area (acres)	Recharging Period (days)	Annual Recharge Each Recharge Cycle (acre-ft/yr)	Available Underflow as Diluent Water (acre-ft/yr)	Recycled Water Contribution %
Arroyo	2	(1.5), (1.5)	3.0	365	274/274	371	43/43
Verdugo	3	(1.0 + 0.6), (1.5)	3.1	300	292/274	547	35/33
Eaton Wash	3	(2.25 + 0.75), (3.0)	6.0	365	548/548	2,190	20/20

1 – ( ) denotes infiltration gallery area or combination of infiltration gallery areas which will be used during the recharging period.

Table H-3

Summary of Recycled Water and Recharge Parameters for Arroyo, Verdugo and Eaton Wash Infiltration Galleries

		ARROYO		VERDUGO		EATON WASH	
		Arroyo Infiltration Gallery A	Arroyo Infiltration Gallery B	Verdugo Infiltration Galleries A & B	Verdugo Infiltration Gallery C	Eaton Wash Infiltration Gallery A	Eaton Wash Infiltration Galleries B & C
Saturated Thickness	ft	220	220	150	150	460	460
Groundwater Flow Direction		SE	Se	SE	SE	SE	SR
Hydraulic Gradient	Δh/Δx	0.03	0.03	0.05	0.05	0.053	0.053
Hydraulic Conductivity	gpd/ft^2	100	100	100	100	100	100
Effective Porosity		0.2	0.2	0.2	0.2	0.2	0.2
Seepage Velocity	ft/day	2.01	2.01	3.35	3.35	3.55	3.55
Transmissivity in Infiltration Gallery Area	gpd/ft	22,000	22,000	15,000	15,000	46,000	46,000
Operational Period	days	365	365	300	300	365	365
Number of Infiltration galleries		2	2	2	1	1	2
Surface area of Infiltration Gallery(s)	acres	1.5	1.5	1.6	1.5	3.0	3.0
Infiltration Rate	ft/day	0.5	0.5	0.5	0.5	0.5	0.5
Percolation Rate	MGD	0.24	0.24	0.26	0.24	0.49	0.49
Proposed Recycled Water	acre-ft/yr	274	274	292	274	548	548
Extent of Recharge Mound Perpendicular to Flow Direction	ft	500	500	650	650	800	800
Nearest Downgradient Production Well		P-SHE	P-SHE	LCID-1	LCID-1	P-TOW	P-TOW
Distance to Nearest Downgradient Production Well	ft	1,350	1,350	4,900	4,900	3,600	3,600
Estimated Travel Time to Nearest Production Well	years	1.8	1.8	4.0	4.0	2.8	2.8
Available Diluent from Underflow	acre-ft/yr	371	371	547	547	2190	2190

Recycled Water Contribution (RWC) = RW ÷ (RW + Diluent)	%	42.5%	42.5%	34.8%	34.8%	20.0%	20.0%
Maximum Allowable Total Organic Carbon at Lysimeter TOC = 0.5/RWC	mg/l	1.18	1.18	1.44	1.50	2.50	2.50

The assimilative capacity of the Raymond Basin for TDS will be addressed in a Salt and Nutrient Management Plan that has been initiated for the Raymond Basin. Although the information regarding the inputs and outputs of TDS in the Raymond Basin has not been compiled yet a preliminary evaluation of the assimilative capacity for TDS based on an average basin wide groundwater TDS level of 372 mg/l and approximately 1 million acre feet of groundwater in storage as reported by the California Department of Water Resources Bulletin No. 118, the RWQCB's TDS objective of 450 mg/l, the Raymond Basin would have an assimilative capacity of approximately 280 million pounds. The estimated salt assimilative capacity used by the Verdugo project, the Arroyo Seco project, and the Eaton Wash project combined is approximately 1.3 million pounds per year based on total recharge of 1,400 AFY (560 AFY for the Verdugo project, 280 AFY for the Arroyo Seco project and 560 AFY for the Eaton Wash project), a TDS concentration of 800 mg/l for the recycled water and a Basin Plan Objective for TDS of 450 mg/l. Since the assimilative capacity for TDS that would be used by the projects is a very small portion of the estimated assimilative capacity of the groundwater the projects are not anticipated to have a significant impact on the TDS concentration of the groundwater basin, although a more thorough evaluation of the assimilative capacity of the Raymond Basin will be conducted as part of the Salt and Nutrient Management Plan.

As discussed above it is anticipated the projects will have not have significant impact on the groundwater in the Raymond Basin and will meet the requirements of the RWQCB and the CDPH for TDS, Nitrate, and TOC.

H-5. Additional Project Considerations and Project Implementation

It is FMWD's desire to proceed with the project implementation of the three projects subsequent to the approval of the Feasibility Study. However, it appears that there are a couple of issues of concern that have arisen in regard to two of the alternatives. The Upper Los Angeles River Area (ULARA) Watermaster has indicated that water from the Verdugo Basin may not be exported to another basin. Until this issue is resolved, FMWD will be unable to proceed with Alternative V-5. Additionally, Crescenta Valley and Glendale have indicated an interest in developing their own recycled water project in the Crescenta Valley area. Until a decision is made, FMWD does not wish to proceed on any alternative regarding the Verdugo Study area to avoid duplication of effort. LACSD has also indicated that they have committed all available wastewater from the Altadena and Pasadena areas to the proposed GRIP project and other downstream users. Due to this issue, FMWD will be unable to proceed with Alternative E-1. Based on these considerations, FMWD is proceeding with Alternative A-6 at this time. FMWD preliminary implementation schedule is presented in Figure H-5. It should be noted that unless all agreements are in place, outside funding is obtained, and permitting is acquired, preliminary design will not proceed. A draft recycled water mandatory use ordinance is provided in Appendix M. Copies of letters of interest or intent from recycled water users are provided in Appendix N. Although FMWD plans on owning all facilities, FMWD is a potable water wholesaler and has no certified wastewater system operators, therefore they plan on contracting with one of the contract operations providers that are active in southern California for the ongoing system operations and maintenance.

H-6. CDPH and RWQCB Coordination

On May 12, 2011, FMWD met with CDPH to review the proposed project and infiltration galleries concept. An analysis of recycled water contribution at three recharge sites: John Muir High School, La Canada Unified School District’s ball fields off of Cornishon Avenue, and Eaton Wash were provided. CDPH was provided with a draft of the recycled water report and on November 11, 2011 a conference call was held to discuss the project. CDPH believed that the current draft groundwater regulations allowed for recharge of recycled water through infiltration galleries. They raise the issue of wanting to make sure that TOCs and nitrogen are addressed appropriately to meet the basin plan and lysimeters are placed appropriately to monitor the quality of water. FMWD will coordinate further with CDPH as required.

On June 10, FMWD met with the LARWQB. LARWQB staff said that the following information is needed before a permit can be issued:

1. Current background levels of water quality.
2. Historic use of the land to ensure that there is no constituent that has or could cause problems with this operation.
3. Look at the impact of the perchlorate plume and recharge.
4. Quarterly monitoring of the groundwater and also whatever CDPH specifies. The monitoring should be both up gradient and down gradient of the recharge site and within 300 feet of the site. The screening of the wells is also important in this monitoring.
5. They also asked that we look at the rate of recharge to ensure that there is no overflow from the filtration galleries due to a storm.
6. LARWQB asked that a Form 200 be filled out and submitted. A copy is shown in Appendix O.

FMWD will coordinate further with LARWQCB as required.

H-7. Interagency Agreements

FMWD has met with the Agencies and other entities with which it anticipates having agreements for the implementation of the preferred alternative and has developed outlines of the proposed agreements or drafts of proposed agreements which are included in Appendix P. These Agencies and entities are: LACSD for the extraction of wastewater from their trunk sewer and the return of residuals to the same sewer; Pasadena Unified School District for the use of their athletic fields at John Muir High School for the development and operation of the shallow infiltration galleries; La Cañada United Methodist Church for the placement of the MBR Plant; and the Raymond Basin Management Board for the management and accounting of the recycled water recharged into the basin.

H-8. Public Outreach

Considerable public outreach has been undertaken by FMWD regarding recycled water. Public Outreach regarding development of recycled water in the service area began before the Facilities Planning Study was started as part of FMWD's Local, Reliable Water Supply Program. The Program includes developing recycled water, conservation, capturing stormwater and rehabilitating our current infrastructure.

First a survey was completed by EMC Research, Inc. One of the questions asked in the survey was: "The Local Water Supply Program will include conservation programs, expanded use of recycled water, capturing stormwater and retrofitting our pipes and reservoirs so we can store more water locally." Respondents had a choice of four categories: "Definitely Yes, Probably/Lean Yes, Undecided, Total No". Eighty percent of respondents fell into the categories of "Definitely Yes" and "Probably/Lean Yes".

Significant outreach was done as the District kick-started this program. This outreach included four public forums where recycled water was discussed, two newsletters (copies provided in Appendix Q) and presentations by FMWD staff and members of the Board of Directors at retail agency Board meetings and the City of La Cañada Flintridge City Council and Town Councils of Altadena and La Crescenta. Discussions were also held with the City of La Cañada Flintridge's Mayor's Blue Ribbon Committee on Local Water Issues. In addition, three tours of MBR plants located in Malibu were provided to interested parties. About 30 people attended. A representative of the company that operates the plants explained the MBR process.

During the development of the draft paper, there was discussion with representatives of the Los Angeles County Sanitation Districts, California Department of Public Health, Los Angeles County Regional Board, Raymond Basin Watermaster, Upper Los Angeles River Area Watermaster, City of Pasadena, City of Glendale and Crescenta Valley Water District regarding the development of recycled water.

Finally, before the draft paper was submitted, an FMWD Board of Directors workshop was held on December 6, 2010, which was publicly noticed, to describe the findings of the Facilities Planning Study.

After the workshop, FMWD staff offered to provide the same presentation to member retail agency Board's of Directors. One member retail agency asked for this presentation. Additionally, the Executive Summary of draft findings and the presentation were provided on FMWD's website.

As the paper was updated, presentations were provided at member agency Board of Director meetings. Four member agencies requested the presentation. A presentation was provided to the Raymond Basin Pumping and Storage Committee. No concerns were raised and the attendees were looking forward to a finalized study.

Reaction has been mostly positive from those in attendance. A letter was submitted by Las Flores Water Company asking that substantial funds not be committed to recycled water if the legal rights to wastewater flows have not been obtained from LACSD (See Appendix Q). Because of wastewater flow limitations, the Eaton Canyon Project is on hold at the current time. FMWD and LACSD have had discussions about the Arroyo Project and have had preliminary discussions regarding contract terms with respect to use of the flows as shown in Appendix P. Additionally, one customer has spoken to the Board stating that FMWD is too small to complete this project alone. As stated previously, FMWD has partnered with LACSD, a large organization with experience in recycled water including the construction and operation of an MBR Plant in Antelope Valley. Raymond Basin Water Master submitted a letter of comment which will be addressed as the Plan is developed further. Also, a support letter was provided by Metropolitan Water District of Southern California.

Finally, before the draft paper was submitted, an FMWD Board of Directors workshop was held on December 12, 2011, which was publicly noticed, to describe the findings of the Facilities Planning Study. Some questions were asked and responses provided to the questions. The Board gave no additional direction at the workshop. Staff will begin looking for additional funding to support the feasibility of the project. Once funding is identified, staff will bring further recommendations for action to the Board.

I. CONSTRUCTION FINANCING PLAN AND REVENUE PROGRAM

I-1. Sources and Timing of Funds for Design and Construction

The recycled water project will likely be financed through a single revenue bond issue with the repayment stream generated by the sale of the groundwater recharge credits either to FMWD Member Agencies or to the Raymond Basin Watermaster. (The FMWD Board of Directors will be reviewing this option along with financing other capital projects with a bond.) Expected sunk costs associated with the bond issue may be up to 1% of the size of the loan. (For example, sunk costs for an issuance of a $1,000,000 loan may be up to $10,000.) District revenues and reserves may be used to finance activities during the design and permitting phase with the bond issuance timed to generate funds for the facility construction. FMWD is planning on applying to MWD for financial assistance through their Local Projects Program, to the U.S. Bureau of Reclamation for assistance through Title XVI and to the SWRCB for low interest loans and/or the various bond authorities in which there are remaining funds available (i.e. Proposition 50, Proposition 84). Any assistance that is obtained will assist in reducing the costs of the program and in improving its overall cost effectiveness.

I-2. Pricing Policy for Recycled Water

The price of imported water without any outside funding the first 15 years of the project is estimated to be greater than the price of imported water. Thus, the District will be looking for outside funding to support the project. This funding includes Metropolitan's Local Resources Program (MWD LRP) as well as grants from State and Federal entities. Because the water is being recharged for production by local agency wells, the recycled water price needs to take into consideration the energy cost of pumping groundwater. Should this outside funding not be available, the District will likely not proceed with the project.

I-3. Costs that Can be Allocated to Water Pollution Control

The portions of the capital and the OM&R costs that can be attributed to the MBR systems can be allocated to water pollution control as they replace that which is currently provided either through LACSD or the City of Glendale. As FMWD does not have any direct relationship to the existing wastewater system users nor do any of their Member Agencies with the exception of CVWD, it does not anticipate attempting to recover that portion of the system costs from the wastewater system users.

I-4. Annual Projections

Water prices for each user or category of users.

As there is only one category of users, that being the extraction of recharged recycled water by FMWD member agencies, the water prices will be as calculated using the pricing policy.

Recycled water used by each user.

FMWD member agencies which have pumping rights within the Monk Hill Sub-basin of the Raymond Basin will be allocated a share of the recharged recycled water proportional to their historical 10 year running average of imported water purchases. These agencies include La Cañada Irrigation District, Valley Water Company, Lincoln Avenue Water Company, Los Flores Water Company and Rubio Canyon Water Company. The initial estimated annual share of recycled water for each agency is presented in Table I-2. These shares may be transferred to another member agency either permanently or annually should the retail agency choose to not participate in a project.

Annual costs (required revenue) of recycling project.

Table I-1 presents the projected capital costs, annual costs, and O&M costs for the recommended alternative. This table does not include any outside funding. Table I-3 and Table I-4 (with MWD LRP funding) present the annual costs of the recycling project.

Both tables present the amount of other State and Federal funding required to allow the project to cost less than imported water.

Allocation of costs to users.

Table I-5 presents the projected annual costs to those agencies with access to the recycled water based on their use of their allocation presented in Table I-2 and the unit price from Table I-3/Table I-4 assuming that outside funding is received. Table I-6 conversely shows the projected costs of imported water. Over a 30 year period, there would be a net savings of approximately $5.5 million using recycled water that has been able to obtain funding versus imported water.

Unit costs to serve each user or category of users.

The rates charged will be sufficient to cover the capital recovery including any coverage ratios as well as the operations, maintenance and repair (OM&R) of the installed system. The costs of the system will be accounted for in the development of a single recycled water rate which will increase over time as OM&R costs increase. As there is only one category of users, that being the extraction of recharged recycled water by FMWD member agencies, the unit costs for all users will be the same and will be those identified in Table I-3/Table I-4 under Projected Per Acre-foot Charge For Recycled Water Column assuming all outside funding is obtained.

Unit price of recycled water for each user or category of users.

As there is only one category of users, that being the extraction of recharged recycled water by FMWD member agencies, the water prices will be as calculated using the pricing policy. These prices are presented in Table I-3/Table I-4.

Sensitivity analysis assuming portion of potential users fail to use recycled water.

Should any of the member agencies fail to produce their allocation in a given year, their remaining allocation goes into their respective groundwater storage account which can be reserved for future year use or which can be sold to another producer with pumping rights in the Monk Hill Sub-basin.

I-5. Sunk Costs and Indebtedness

There are no sunk costs or additional indebtedness anticipated for this project other than for the bond issue addressed in Section I-1.

Table I-1 Recycled Water Costs

Alternative	Reclaimed Water Sales (AF)	Total Capital Cost ($)	Annual Capital Cost[1] ($)	O&M Costs ($)	Total Annual Costs ($)	Unit Costs ($/AF)
A-6	280	$ 3,759,072	$ (230,775)	$ 141,183	$ 371,958	$ 1,328.42
V-6[2]	560	$ 3,155,698	$ (193,733)	$ 332,434	$ 526,167	$ 939.58
E-1[2]	560	$ 5,032,357	$ (308,944)	$ 242,909	$ 551,853	$ 985.45

1) based on an interest rate of 4.5%

recovery period in years 30

2) Alternative is being deferred indefinitely

Table I-2 Initial Estimated Annual Share of Recycled Water

	FY 2001-2010 Average Sales (AF)*	% Sales and Share of Recycled Water	Share of 280 AF
LCID	2,806	30%	83
Las Flores	694	7%	21
LAWC	1,564	17%	46
RCL&WA	1,181	12%	35
VWC	3,213	34%	95
TOTAL	9,457	100%	280

** This will change with the ten-year rolling average of imported water sales.*

Table I-3 Annual Costs of Recycling Project

	MWD Tier 1	FMWD Average Energy Cost	Total Average Cost of Imported Water	Recycled Water Cost	Average Cost of Pumping Groundwater Water	Total Cost of Recycled Water	Projected Per AF Charge for Recycled Water	Outside Funding Needed to Cover Costs	Amount Recycled Water Cost is Lower than Cost of Imported Water Based on Receiving Outside Funding
Year 1	$ 794	$ 50	$ 844	$ 1,328	$ 100	$ 1,428	$ 694	$ 634	$ 150
Year 2	$ 833	$ 52	$ 885	$ 1,344	$ 103	$ 1,447	$ 730	$ 614	$ 155
Year 3	$ 877	$ 53	$ 930	$ 1,359	$ 106	$ 1,465	$ 771	$ 588	$ 159
Year 4	$ 920	$ 55	$ 975	$ 1,375	$ 109	$ 1,484	$ 811	$ 564	$ 164
Year 5	$ 970	$ 56	$ 1,026	$ 1,392	$ 113	$ 1,504	$ 857	$ 534	$ 169
Year 6	$ 1,023	$ 58	$ 1,081	$ 1,409	$ 116	$ 1,525	$ 907	$ 502	$ 174
Year 7	$ 1,079	$ 60	$ 1,139	$ 1,426	$ 119	$ 1,546	$ 960	$ 467	$ 179
Year 8	$ 1,146	$ 61	$ 1,207	$ 1,444	$ 123	$ 1,567	$ 1,023	$ 421	$ 184
Year 9	$ 1,214	$ 63	$ 1,277	$ 1,463	$ 127	$ 1,590	$ 1,087	$ 376	$ 190
Year 10	$ 1,287	$ 65	$ 1,352	$ 1,482	$ 130	$ 1,613	$ 1,156	$ 326	$ 196
Year 11	$ 1,364	$ 67	$ 1,431	$ 1,502	$ 134	$ 1,636	$ 1,230	$ 272	$ 202
Year 12	$ 1,446	$ 69	$ 1,515	$ 1,522	$ 138	$ 1,661	$ 1,307	$ 215	$ 208
Year 13	$ 1,533	$ 71	$ 1,604	$ 1,543	$ 143	$ 1,686	$ 1,390	$ 153	$ 214
Year 14	$ 1,625	$ 73	$ 1,698	$ 1,565	$ 147	$ 1,712	$ 1,478	$ 87	$ 220
Year 15	$ 1,722	$ 76	$ 1,798	$ 1,587	$ 151	$ 1,738	$ 1,587	$ -	$ 211
Year 16	$ 1,825	$ 78	$ 1,903	$ 1,610	$ 156	$ 1,766	$ 1,610	$ -	$ 294
Year 17	$ 1,935	$ 80	$ 2,015	$ 1,633	$ 160	$ 1,794	$ 1,633	$ -	$ 382
Year 18	$ 2,051	$ 83	$ 2,134	$ 1,658	$ 165	$ 1,823	$ 1,658	$ -	$ 476
Year 19	$ 2,174	$ 85	$ 2,259	$ 1,683	$ 170	$ 1,853	$ 1,683	$ -	$ 577
Year 20	$ 2,305	$ 88	$ 2,392	$ 1,708	$ 175	$ 1,884	$ 1,708	$ -	$ 684
Year 21	$ 2,443	$ 90	$ 2,533	$ 1,735	$ 181	$ 1,915	$ 1,735	$ -	$ 798
Year 22	$ 2,589	$ 93	$ 2,682	$ 1,762	$ 186	$ 1,948	$ 1,762	$ -	$ 920
Year 23	$ 2,745	$ 96	$ 2,841	$ 1,790	$ 192	$ 1,982	$ 1,790	$ -	$ 1,050
Year 24	$ 2,909	$ 99	$ 3,008	$ 1,819	$ 197	$ 2,017	$ 1,819	$ -	$ 1,189
Year 25	$ 3,084	$ 102	$ 3,186	$ 1,849	$ 203	$ 2,052	$ 1,849	$ -	$ 1,336
Year 26	$ 3,269	$ 105	$ 3,374	$ 1,880	$ 209	$ 2,089	$ 1,880	$ -	$ 1,494
Year 27	$ 3,465	$ 108	$ 3,573	$ 1,912	$ 216	$ 2,127	$ 1,912	$ -	$ 1,661
Year 28	$ 3,673	$ 111	$ 3,784	$ 1,944	$ 222	$ 2,166	$ 1,944	$ -	$ 1,840
Year 29	$ 3,893	$ 114	$ 4,008	$ 1,978	$ 229	$ 2,207	$ 1,978	$ -	$ 2,030
Year 30	$ 4,127	$ 118	$ 4,245	$ 2,012	$ 236	$ 2,248	$ 2,012	$ -	$ 2,232

Table I-4 Annual Costs of Recycling Project (with MWD LRP Funding)

	MWD Tier 1	FMWD Average Energy Cost	Total Average Cost of Imported Water	Recycled Water Cost	LRP Incentive	Average Cost of Pumping Groundwater Water	Total Cost of Recycled Water	Projected Per AF Charge for Recycled Water	Other Outside Funding Needed to Cover Costs	Amount Recycled Water Cost is Lower than Cost of Imported Water Based on Receiving Outside Funding
Year 1	$ 794	$ 50	$ 844	$ 1,328	$ 250	$ 100	$ 1,178	$ 694	$ 384	$ 150
Year 2	$ 833	$ 52	$ 885	$ 1,344	$ 250	$ 103	$ 1,197	$ 730	$ 364	$ 155
Year 3	$ 877	$ 53	$ 930	$ 1,359	$ 250	$ 106	$ 1,215	$ 771	$ 338	$ 159
Year 4	$ 920	$ 55	$ 975	$ 1,375	$ 250	$ 109	$ 1,234	$ 811	$ 314	$ 164
Year 5	$ 970	$ 56	$ 1,026	$ 1,392	$ 250	$ 113	$ 1,254	$ 857	$ 284	$ 169
Year 6	$ 1,023	$ 58	$ 1,081	$ 1,409	$ 250	$ 116	$ 1,275	$ 907	$ 252	$ 174
Year 7	$ 1,079	$ 60	$ 1,139	$ 1,426	$ 250	$ 119	$ 1,296	$ 960	$ 217	$ 179
Year 8	$ 1,146	$ 61	$ 1,207	$ 1,444	$ 250	$ 123	$ 1,317	$ 1,023	$ 171	$ 184
Year 9	$ 1,214	$ 63	$ 1,277	$ 1,463	$ 197	$ 127	$ 1,393	$ 1,087	$ 179	$ 190
Year 10	$ 1,287	$ 65	$ 1,352	$ 1,482	$ 140	$ 130	$ 1,472	$ 1,156	$ 186	$ 196
Year 11	$ 1,364	$ 67	$ 1,431	$ 1,502	$ 79	$ 134	$ 1,557	$ 1,230	$ 193	$ 202
Year 12	$ 1,446	$ 69	$ 1,515	$ 1,522	$ 14	$ 138	$ 1,646	$ 1,307	$ 200	$ 208
Year 13	$ 1,533	$ 71	$ 1,604	$ 1,543	$ -	$ 143	$ 1,686	$ 1,390	$ 153	$ 214
Year 14	$ 1,625	$ 73	$ 1,698	$ 1,565	$ -	$ 147	$ 1,712	$ 1,478	$ 87	$ 220
Year 15	$ 1,722	$ 76	$ 1,798	$ 1,587	$ -	$ 151	$ 1,738	$ 1,587	$ -	$ 211
Year 16	$ 1,825	$ 78	$ 1,903	$ 1,610	$ -	$ 156	$ 1,766	$ 1,610	$ -	$ 294
Year 17	$ 1,935	$ 80	$ 2,015	$ 1,633	$ -	$ 160	$ 1,794	$ 1,633	$ -	$ 382
Year 18	$ 2,051	$ 83	$ 2,134	$ 1,658	$ -	$ 165	$ 1,823	$ 1,658	$ -	$ 476
Year 19	$ 2,174	$ 85	$ 2,259	$ 1,683	$ -	$ 170	$ 1,853	$ 1,683	$ -	$ 577
Year 20	$ 2,305	$ 88	$ 2,392	$ 1,708	$ -	$ 175	$ 1,884	$ 1,708	$ -	$ 684
Year 21	$ 2,443	$ 90	$ 2,533	$ 1,735	$ -	$ 181	$ 1,915	$ 1,735	$ -	$ 798
Year 22	$ 2,589	$ 93	$ 2,682	$ 1,762	$ -	$ 186	$ 1,948	$ 1,762	$ -	$ 920
Year 23	$ 2,745	$ 96	$ 2,841	$ 1,790	$ -	$ 192	$ 1,982	$ 1,790	$ -	$ 1,050
Year 24	$ 2,909	$ 99	$ 3,008	$ 1,819	$ -	$ 197	$ 2,017	$ 1,819	$ -	$ 1,189
Year 25	$ 3,084	$ 102	$ 3,186	$ 1,849	$ -	$ 203	$ 2,052	$ 1,849	$ -	$ 1,336
Year 26	$ 3,269	$ 105	$ 3,374	$ 1,880	$ -	$ 209	$ 2,089	$ 1,880	$ -	$ 1,494
Year 27	$ 3,465	$ 108	$ 3,573	$ 1,912	$ -	$ 216	$ 2,127	$ 1,912	$ -	$ 1,661
Year 28	$ 3,673	$ 111	$ 3,784	$ 1,944	$ -	$ 222	$ 2,166	$ 1,944	$ -	$ 1,840
Year 29	$ 3,893	$ 114	$ 4,008	$ 1,978	$ -	$ 229	$ 2,207	$ 1,978	$ -	$ 2,030
Year 30	$ 4,127	$ 118	$ 4,245	$ 2,012	$ -	$ 236	$ 2,248	$ 2,012	$ -	$ 2,232

Table I-5 Annual Cost Allocations of Recycling Project

	LCID	Las Flores	LAWC	RCL&WA	VWC	TOTAL
Year 1	$ 57,602	$ 14,574	$ 31,924	$ 24,290	$ 65,930	$ 194,320
Year 2	$ 60,590	$ 15,330	$ 33,580	$ 25,550	$ 69,350	$ 204,400
Year 3	$ 63,986	$ 16,189	$ 35,462	$ 26,982	$ 73,236	$ 215,855
Year 4	$ 67,290	$ 17,025	$ 37,293	$ 28,375	$ 77,019	$ 227,004
Year 5	$ 71,168	$ 18,006	$ 39,443	$ 30,011	$ 81,458	$ 240,086
Year 6	$ 75,287	$ 19,049	$ 41,725	$ 31,748	$ 86,172	$ 253,980
Year 7	$ 79,646	$ 20,151	$ 44,141	$ 33,586	$ 91,162	$ 268,687
Year 8	$ 84,910	$ 21,483	$ 47,059	$ 35,805	$ 97,186	$ 286,444
Year 9	$ 90,248	$ 22,834	$ 50,017	$ 38,056	$ 103,296	$ 304,450
Year 10	$ 95,978	$ 24,284	$ 53,193	$ 40,473	$ 109,854	$ 323,782
Year 11	$ 102,062	$ 25,823	$ 56,564	$ 43,038	$ 116,818	$ 344,304
Year 12	$ 108,520	$ 27,457	$ 60,144	$ 45,761	$ 124,210	$ 366,092
Year 13	$ 115,376	$ 29,191	$ 63,943	$ 48,652	$ 132,057	$ 389,220
Year 14	$ 122,653	$ 31,033	$ 67,977	$ 51,721	$ 140,386	$ 413,771
Year 15	$ 131,711	$ 33,324	$ 72,997	$ 55,541	$ 150,754	$ 444,327
Year 16	$ 133,610	$ 33,805	$ 74,049	$ 56,342	$ 152,927	$ 450,733
Year 17	$ 135,566	$ 34,300	$ 75,133	$ 57,166	$ 155,166	$ 457,332
Year 18	$ 137,581	$ 34,810	$ 76,250	$ 58,016	$ 157,472	$ 464,129
Year 19	$ 139,656	$ 35,335	$ 77,400	$ 58,891	$ 159,847	$ 471,129
Year 20	$ 141,794	$ 35,875	$ 78,584	$ 59,792	$ 162,294	$ 478,340
Year 21	$ 143,995	$ 36,433	$ 79,805	$ 60,721	$ 164,814	$ 485,767
Year 22	$ 146,263	$ 37,006	$ 81,061	$ 61,677	$ 167,409	$ 493,416
Year 23	$ 148,598	$ 37,597	$ 82,356	$ 62,662	$ 170,082	$ 501,296
Year 24	$ 151,004	$ 38,206	$ 83,689	$ 63,676	$ 172,836	$ 509,411
Year 25	$ 153,482	$ 38,833	$ 85,062	$ 64,721	$ 175,672	$ 517,770
Year 26	$ 156,034	$ 39,479	$ 86,477	$ 65,798	$ 178,593	$ 526,380
Year 27	$ 158,663	$ 40,144	$ 87,934	$ 66,906	$ 181,602	$ 535,248
Year 28	$ 161,371	$ 40,829	$ 89,434	$ 68,048	$ 184,701	$ 544,383
Year 29	$ 164,159	$ 41,534	$ 90,980	$ 69,224	$ 187,893	$ 553,791
Year 30	$ 167,032	$ 42,261	$ 92,572	$ 70,435	$ 191,181	$ 563,481
Total	$ 3,565,836	$ 902,199	$ 1,976,246	$ 1,503,666	$ 4,081,378	$ 12,029,326

Table I-6 Avoided Cost of Purchasing MWD Water

	LCID	Las Flores	LAWC	RCL&WA	VWC	TOTAL
Year 1	$ 70,052	$ 17,724	$ 38,824	$ 29,540	$ 80,180	$ 236,320
Year 2	$ 73,414	$ 18,575	$ 40,687	$ 30,958	$ 84,028	$ 247,660
Year 3	$ 77,194	$ 19,531	$ 42,782	$ 32,552	$ 88,354	$ 260,413
Year 4	$ 80,895	$ 20,467	$ 44,833	$ 34,112	$ 92,590	$ 272,898
Year 5	$ 85,181	$ 21,552	$ 47,209	$ 35,920	$ 97,496	$ 287,357
Year 6	$ 89,720	$ 22,700	$ 49,724	$ 37,834	$ 102,692	$ 302,670
Year 7	$ 94,512	$ 23,913	$ 52,380	$ 39,855	$ 108,177	$ 318,837
Year 8	$ 100,222	$ 25,357	$ 55,545	$ 42,262	$ 114,712	$ 338,098
Year 9	$ 106,019	$ 26,824	$ 58,758	$ 44,707	$ 121,347	$ 357,655
Year 10	$ 112,223	$ 28,394	$ 62,196	$ 47,323	$ 128,447	$ 378,582
Year 11	$ 118,793	$ 30,056	$ 65,837	$ 50,094	$ 135,968	$ 400,749
Year 12	$ 125,754	$ 31,817	$ 69,695	$ 53,029	$ 143,935	$ 424,229
Year 13	$ 133,127	$ 33,683	$ 73,781	$ 56,138	$ 152,374	$ 449,102
Year 14	$ 140,937	$ 35,659	$ 78,109	$ 59,431	$ 161,313	$ 475,449
Year 15	$ 149,210	$ 37,752	$ 82,695	$ 62,920	$ 170,783	$ 503,359
Year 16	$ 157,974	$ 39,969	$ 87,552	$ 66,616	$ 180,814	$ 532,926
Year 17	$ 167,259	$ 42,319	$ 92,698	$ 70,531	$ 191,441	$ 564,247
Year 18	$ 177,095	$ 44,807	$ 98,149	$ 74,678	$ 202,699	$ 597,428
Year 19	$ 187,514	$ 47,443	$ 103,924	$ 79,072	$ 214,625	$ 632,579
Year 20	$ 198,553	$ 50,236	$ 110,042	$ 83,727	$ 227,260	$ 669,819
Year 21	$ 210,248	$ 53,195	$ 116,523	$ 88,659	$ 240,646	$ 709,271
Year 22	$ 222,638	$ 56,330	$ 123,390	$ 93,884	$ 254,827	$ 751,069
Year 23	$ 235,765	$ 59,651	$ 130,665	$ 99,419	$ 269,852	$ 795,352
Year 24	$ 249,672	$ 63,170	$ 138,373	$ 105,284	$ 285,770	$ 842,268
Year 25	$ 264,407	$ 66,898	$ 146,539	$ 111,497	$ 302,635	$ 891,975
Year 26	$ 280,018	$ 70,848	$ 155,191	$ 118,080	$ 320,503	$ 944,640
Year 27	$ 296,559	$ 75,033	$ 164,358	$ 125,055	$ 339,435	$ 1,000,439
Year 28	$ 314,084	$ 79,467	$ 174,071	$ 132,445	$ 359,494	$ 1,059,560
Year 29	$ 332,652	$ 84,165	$ 184,362	$ 140,275	$ 380,747	$ 1,122,200
Year 30	$ 352,327	$ 89,143	$ 195,265	$ 148,571	$ 403,265	$ 1,188,572
Net Savings	$ 5,204,018	$ 1,316,679	$ 2,884,155	$ 2,194,465	$ 5,956,406	$ 17,555,723
	$ 1,638,182	$ 414,480	$ 907,908	$ 690,800	$ 1,875,028	$ 5,526,398

Foothill Municipal Water District
Recycled Water Project
Update to Incorporate a Watershed Approach

Introduction

This paper will describe the Foothill Municipal Water District (FMWD) Recycled Water Project, its partnerships with Cal Poly Pomona and La Canada High School and elaborate on the multiple benefits that have evolved since conception of the project. Benefits start with the development of a reliable local supply, the associated energy savings as well as lower greenhouse gasses and carbon footprint reduction (water recycling will use one-third the electrical energy as compared to State Water Project (SWP) imported supplies). Through partnerships noted above, benefits have expanded to include a collaborative effort to develop a curriculum to be implemented in conjunction with the project. Education outreach serves as an important component of this watershed approach to include stormwater capture and the abatement of urban runoff. The collaboration includes conservation outreach with drought tolerant landscaping at both sites. This project also seeks to support habitat/ecosystem integrity in nearby Hahamongna Watershed Park, as noted below.

FMWD concluded its Recycled Water Feasibility Planning Study in January 2012. Three geographic areas were reviewed with various alternatives at each location for developing recycled water. One alternative is currently being pursued in the Arroyo Study Area for further development. In this alternative, a 250,000 gallon per day (GPD) membrane bioreactor (MBR) plant will be constructed. The location identified for the MBR site is adjacent to La Canada United Methodist Church off Berkshire Place in the City of La Canada Flintridge. Because of travel time limitations, a recycled water pipeline was to be constructed to the John Muir High School athletic fields located in Pasadena. The treated recycled water would then be recharged with new stormwater capture in the Monk Hill Basin, a sub-basin of the larger Raymond Groundwater Basin in compliance with the Salt Nutrient Plan approved by the Los Angeles Regional Water Quality Control Board, through the use of the infiltration galleries located underneath the athletic fields.

Since completion of that study, draft Title 22 groundwater recharge regulations for recycled water have changed so that the travel time requirements have been reduced and emphasis has been placed on the accumulation of water quality data for determining the impact of recharged recycled water into the basin. Thus, the possibility of using La Canada High School's athletic fields to construct the infiltration galleries is feasible which decreases construction cost and keeps the project within the City of La Canada Flintridge.

The modified recycled water project continues to be consistent with:

- The FMWD funded and State Water Resources Control Board approved recycled water feasibility study,

- The Arroyo Watershed Plan developed by the Army Corps of Engineers,
- Metropolitan Water District's Integrated Resources Plan approved in 2010,
- Pasadena Water and Power's Integrated Resources Plan, and
- Los Angeles Basin's Salt and Nutrient Management Plan.

This change of location for the infiltration galleries coupled with partnerships with Cal Poly Pomona and La Canada High School has allowed the FMWD Recycled Water Project to be integrated into the Arroyo Seco Watershed and a key feature to having a sustainable reliable supply within the Raymond Groundwater Basin. These partnerships, that previously had not existed, align with increased shared benefits. The remainder of this paper will describe the partnership with Cal Poly Pomona and La Canada High School and the benefits that this project incorporates.

Partnership with Cal Poly Pomona

Three of Cal Poly Pomona's departments are involved with the partnership:

- Civil Engineering Department
- Department of Landscape Architecture
- Department of Urban and Regional Planning

The departments received a grant through the Cal Poly Pomona Strategic Interdisciplinary Research Grant Program to assist FMWD in the following aspects of the project:

1. Preparation of a 3D model of the infiltration galleries,
2. Development of a drought tolerant landscaping for both the MBR and school site, and
3. Development of a conservation and educational component to the Project.

As part of the challenge, Cal Poly Pomona must find outside grants to continue this type of grant funding program from the college.

Within the Civil Engineering department the project will be the focus of a one-year capstone course, which is required for graduation. For the Landscape Architecture and Urban and Regional Planning students, this project will provide them with a project based elective which contributes to their degree programs as well. In addition to the 3D model already mentioned, the Capstone project will involve 10 Civil Engineering students for one (1) academic year requiring them to develop preliminary facility designs and analyses needed to demonstrate the feasibility of the project. Because most of the engineering work is below ground, seven (7) Landscape architecture students will design the above ground space adjacent to the MBR plant and above the infiltration gallery. Additionally two (2) Urban and Regional Planning students will assess the impact of water recycling on city planning and examine the ideal policies to encourage these projects moving forward.

The progress made by the three student groups will be assessed a minimum of three times over the course of the project life-time in the form of oral presentations made to industry representatives and to representatives of FMWD. These assessments are tentatively scheduled to take place November 30, 2012, March 15, 2013, and May 31, 2013. The final presentation will be in conjunction with the College

Of Engineering's Capstone symposium. In addition to the on-campus reviews, the project will be reviewed nationally as part of the Parsons-Brinkerhoff Student Design Competition, presented at the Environmental and Water Resources Institute World Congress May 22, 2013.

Benefits of the New Approach

Benefits stemming from the original recycled water project were two-fold. First, the project inherently reduces dependency on imported water, which is unreliable when compared to the availability of recycled water. Please note that the initial development of recycled water is limited to 250,000 gallons per day or 280 acre-feet per year. This number was derived from the low flows in the Los Angeles County Sanitation District owned sewer pipeline, which contains the wastewater stream, during a time when demands for potable water and thus production of wastewater are low due to the economic downturn, increased conservation due to a water shortage and unusually cooler, rainy weather. As these factors change, this low flow number will increase slightly thus guaranteeing the output of 250,000 gallons per day of treated recycled water.

The second benefit with developing recycled water is the reduction of greenhouse gas emissions compared to importing water from Northern California to FMWD's service area. The problem with importing water is that significant amounts of energy are required to pump the water through the California Aqueduct to Southern California. This energy usage is compounded with the significant amount of energy used to pump water to FMWD's service area. During an average year, FMWD can use as much as 6,000 megawatts to pump this water to its service area. Thus, the net energy savings of developing 280 acre-feet of recycled water in FMWD's service area is enough to provide for 85 homes in Southern California for one year.

The partnership with Cal Poly Pomona, adds more benefits. The first benefit is the water conservation feature where the project sites are landscaped with drought tolerant plants. These sites can then be used for tours which showcase Southern California friendly landscaping and improved irrigation technologies. As these sites are used every day by both adults and students, they will naturally be exposed to the landscaping (tours will be documented for recordkeeping purposes). Also, appropriate signage will be placed in the landscaped sites along with information on FMWD's website.

In addition, an education curriculum will be developed. The California State Curricula for fifth grade requires the education of students in earth science, specifically water:

"*Students in grade five learn that cooling in the atmosphere returns water vapor to a liquid or a solid state as rain, hail, sleet, or snow. They are also introduced to factors that control clouds, precipitation, and other weather phenomena. Students also learn that most of Earth's water is present as salt water in the oceans, that oceans cover most of Earth's surface, and that the amount of fresh water on Earth is limited. They study their local watershed to learn about the origins of the water used by their local communities and learn that the availability of fresh water can be extended by recycling and conservation practices. Students in grade five learn that cooling in the atmosphere returns water vapor to a liquid or a solid state as rain, hail, sleet, or snow. They are also introduced to factors that control clouds, precipitation, and other weather phenomena. Students also learn that most of Earth's water is present* *as salt water in the oceans, that oceans cover most of Earth's surface, and that the amount of fresh water on Earth is limited. They study their local watershed to learn about the origins of the water used by their local communities and learn that the availability of fresh water can be extended by recycling and conservation practices."* [1]

As part of the outreach component of this project, a new curriculum will be developed to conform to and enhance this state standard.

When Cal Poly Pomona and FMWD staff met with representatives of La Canada High School they expressed an interest in developing more than the component listed above. A social science component was suggested with a "Careers in Water/Environment" addition. These will be included as part of the newly developed curriculum.

Tours of the MBR plant will be provided and the infiltration galleries explained as well as a model of the infiltration galleries can be provided for further education. Design of the MBR plant will consider public access to allow for tours to promote further education with regards to the treatment process of recycled water. Topics will include imported water and local water sources as well as highlighting conservation inside the home and drought tolerant landscaping. Tours will then go across the street to Hahamongna Park where the watershed, stewardship of the Arroyo Seco and history of the area will be described, with an emphasis on ecosystem and natural habitat features. All tours will be documented and reported each year.

Partnering with La Canada High School

When the site of the infiltration galleries was moved to La Canada High School from John Muir High School, more benefits were derived through the Project. La Canada High School has two athletic fields (baseball and softball fields) with natural turf in addition to a football/soccer field which has artificial turf. Both rainfall and irrigation on the all athletic fields is captured through a subsurface drainage system and diverted to storm drains. Rather than diverting to storm drains, flows will be channeled to the MBR plant, treated and then discharged into the infiltration galleries thus increasing the recharge of the Basin, reducing flows in the storm drains and improving water quality. It is estimated that on average approximately 15 acre-feet per year of stormwater runoff and 23 acre-feet per year of urban runoff will be recharged (see attached tables for calculations). The two athletic fields are jointly utilized by La Canada High School and the City of La Canada Flintridge. This new site location provides additional opportunities to partner with the City of La Canada Flintridge, which allows the project greater communal benefit in education with regards to conservation, imported water, recycled water, storm water, groundwater and overall water supply cycle with FMWD.

A Model for the Future

Most importantly, the Foothill MWD Recycled Water Project offers benefits beyond the local scope of the project, since the infiltration system design, landscape palate, educational curricula and ecosystem

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[1] http://www.cde.ca.gov/ci/cr/cf/documents/glc5thgradecurriculum.pdf

field trips will be created in such a way that they can be modeled for use by other water agencies, school districts, and community groups throughout the state. To our knowledge, this is the first stormwater infiltration gallery project of its type in California and offers a new era of innovation for local source water reliability and sustainability.

Summary

As this project has evolved, benefits continue to increase as new partnerships and input from stakeholders contribute more to the project. The excitement of these stakeholders continues to increase as this project evolves to one which the entire community will embrace and will be a showcase of what successful partnerships with multiple stakeholders can achieve.

USEPA

http://www.epa.gov/cleanenergy/energy-resources/refs.html#houseelec

Home electricity use

In 2009, there were 113.6 million homes in the United States; of those, 71.8 million were single-family detached homes and 6.7 million were single-family attached homes for a total 78.5 million single-family homes* nationally (EIA 2012). On average, each single-family home consumed 11,319 kWh of delivered electricity (EIA 2012). The national average carbon dioxide output rate for electricity generated in 2009 was 1,216 lbs CO_2 per megawatt-hour (EPA 2012), which translates to about 1,301 lbs CO_2 per megawatt-hour for delivered electricity (assuming 7 percent in transmission and distribution losses).

Annual single-family home electricity consumption was multiplied by the carbon dioxide emission rate (per unit of electricity delivered) to determine annual carbon dioxide emissions per home.

Calculation

Note: Due to rounding, performing the calculations given in the equations below may not return the exact results shown.

11,319 kWh per home × 1,301.31 lbs CO_2 per megawatt-hour delivered × 1 mWh/1,000 kWh × 1 metric ton/2,204.6 lb = **6.68 metric tons CO_2/home.**

*A single-family home is defined in the U.S. Department of Energy's Residential Energy Consumption Survey as follows: A housing unit, detached or attached, that provides living space for one home or family. Attached houses are considered single-family houses as long as they are not divided into more than one housing unit and they have independent outside entrance. A single-family house is contained within walls extending from the basement (or the ground floor, if there is no basement) to the roof. A mobile home with one or more rooms added is classified as a single-family home. Townhouses, rowhouses, and duplexes are considered single-family attached housing units, as long as there is no home living above another one within the walls extending from the basement to the roof to separate the units.

Sources

- EIA (2012). 2009 Residential Energy Consumption Survey. Table CE2.6, Household Fuel Consumption in the U.S., Totals and Averages, 2009, Physical Units, Preliminary.
- EPA (2012). eGRID2012 Version 1.0. U.S. Environmental Protection Agency, Washington, DC.

FMWD

If we use 85 homes based upon the 600 megawatt-hour (mWh) then the carbon footprint is:

85 homes X 6.68 metric tons CO^2/home = 567.8 metric tons

A unique feature of FMWD is the significant amount of pumping that must occur from its MWD connection (near the Rose Bowl in Pasadena, CA) to its service area. FMWD on average uses 6,000 megawatts of power per year for this pumping. This energy usage does not include the energy used by MWD to import the water to its service area and then treat it prior to delivery to FMWD. This project will result in a reduction of energy usage to import water and then pump it up into the FMWD service area. The estimated total savings is about 600 megawatts, which is enough power to serve 85 single family homes for one year. These savings are based on the reduced demand of imported State Project Water on the east branch of the California Aqueduct plus the pumping that must occur from FMWD's connection at the Rose Bowl to the member agencies within the FMWD service area. It then nets out the energy used to treat the water through the MBR process and then produce it from the groundwater basin for delivery to retail customers by the participating agencies.

The table below identifies the net energy savings of the Project with explanations listed:

Project Annual Energy Consumption

Alternative	Produced[a] (AFY)	Recharged[a] (AFY)	Production[b] (kWh)	Extraction[c] (kWh)	Total[d] (kWh)	Import[e] (kWh)	Savings[f] (kWh)
A-6 (Arroyo Seco Option)	318	318	353,305	181,260	534,565	1,128,900	594,335

a) Amount to be recharged through infiltration galleries (wastewater, stormwater and urban runoff) and produced later by FMWD member agencies with Raymond Basin pumping rights

b) For typical MBR: $kWh/m^3 = 0.9^*$; $1\ m^3 = 264$ gallons; 318 AF = 103,636,200 gallons = 392,502 m^3

c) On average, 570 kWh to produce 1 AF groundwater (570 kWh × 318 AFY)

d) Total energy use of production and extraction (353,251 kWh + 181,260 kWh)

e) Reduced imported deliveries = 318 AFY; average power use of East Branch of California Aqueduct (3,200 kWh); average power use to pump to FMWD (350 kWh); ∴ 318 AFY(3,200 kWh + 350 kWh) = Import (kWh)

f) Savings = Import (kWh) – Total (kWh)

[*] Source: *Cost Effective & Energy Efficient MBR Systems*. C.L. Wallis-Lage, S.D. Levesque. **Black & Veatch**, 8400 Ward Parkway, Kansas City, MO 64114

Energy savings and reduced CO2 emissions

Reduced reliance on imported water will avoid the extensive energy requirements associated with transporting SWP and CRA water to FMWD. This in turn will result in avoided CO2 emissions (a GHG) associated with the production of this energy.

Background and Historical Conditions

FMWD estimates that the electricity required for the conveyance of 1 AF of imported water is 3.55 MWh (Source)[1]. Comparatively, about 1.68 MWh/AF is required to treat and infiltrate the recycled water and captured stormwater and urban runoff, and then to pump it from the groundwater aquifer. Thus, imported water requires 1.87 more MWh on a per acre foot basis compared to the local water supplies generated by this project.

Electricity used in California is generated within three different energy subregions (known as Western Electricity Coordinating Council, WECC, subregions): California, the Northwest, and the Southwest (CEC, 2011). Almost 70% of California's electricity is generated within the state (CAL). The approximate breakdown of California's major sources of electricity is as follows: 45% is provided by natural gas, 18% is provided by nuclear power, 21% is provided by hydroelectric plants, 2% is provided by coal-fired power plants, and 14% comes from renewable sources (CEC, 2011).

CO2 emissions resulting from the production of electricity, measured as tons of CO2 per MWh, vary by energy source (e.g., hydropower, natural gas, etc.). As detailed above, in California, electricity production relies on a range of energy sources, including those located within California and those located outside of the state. Based on the current mix of energy sources for California, the CO2 emissions rate for energy used to transport imported water is estimated to be 0.354 MT/MWh.

Without-Project Conditions

Without the project, increased dependence on imported water supplies will result in increased energy use and CO2 emissions.

Methods Used to Estimate Benefits

To calculate energy savings associated with the project, we first multiplied the amount of energy required to transport and treat 1 AF imported water (3.55 MWh/AF) by the amount of imported water that will be avoided as a result of the project (318 AFY at full implementation). We then multiplied the amount of energy that would be required to treat and distribute the recycled water produced with the project (1.68 MWh/AF) by the amount of recharge water produced with the project to obtain a net energy savings.

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[1] This estimate is reported in the Equinox Center 2010 report: XXXX. It reflects the blend of CRA and SWP imported water sources purchased by MWD.

To calculate the CO2 emissions rate associated with energy use in California, we relied on 2009 EPA eGrid data. As noted above the California Energy Commission (2011) reports that 70% of electricity used in California is generated in-state, 20% is generated in the WECC Southwest subregion, and 10% is generated in the WECC Northwest subregion. EPA publishes average CO2 emissions rates for these subregions based on the various energy sources used to generate electricity within them (i.e., natural gas, hydropower, etc.). Table 7-X shows the CO2 emissions rate for the three regions that produce the electricity used in California, and the average weighted rate for electricity used within the state. It is assumed that the mix of energy sources used by the state overall is representative of the mix of energy sources used to import water to FMWD.

WECC region	**Emissions rate (MT/MWh)**	**Percent of California electricity use**
California	0.299	70%
Southwest	0.540	20%
Northwest	0.372	10%
Weighted average emissions rate for electricity used in California	**0.354**	

Source: U.S. EPA eGrid data: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_GHGOutputrates.pdf

Given the calculated weighted average CO2 emissions rate of 0.0.354 MT of CO2 emitted per MWh, 1.26 MT of CO2 are produced for every AF of imported water delivered to FMWD (3.55 MWh/AF multiplied by 0.354 MT/MWh). By eliminating use of 318 AFY of imported water (at full implementation), the project will avoid emissions of close to 400 MT of CO2 per year.

Avoided CO2 emissions will be offset to some extent by the CO2 emissions associated with the energy used to treat, infiltrate, and pump the recharged water to customers. FMWD estimates that this requires about 1.68 MWh/AF of recycled water (Equinox, 2010). Assuming the same emissions rate of 0.354 MT of CO2 emitted per MWh, CO2 production per AF of recycled water is estimated to be about 0.595 MT. Thus, CO2 emissions associated with recharged water use will amount to about 190 MT per year at full implementation. Thus, net CO2 emissions reductions are estimated to be 210 MT per year.

Benefit Uncertainty

The carbon emission estimates used for this analysis represent California statewide averages. However, emission factors will vary based on the mix of local energy supply sources. It is uncertain whether more exact emission rates would be higher or lower for the energy used to treat and transport imported water and recycled water.

New Facilities Required to Achieve Benefit

In order to achieve this benefit, facilities planned under the FMWD Water Recycling Project (as described in this grant application) must be completed.

Potential Adverse Physical Effects

Energy savings and associated CO2 emissions reductions due to avoided use of imported water are not expected to result in any potential adverse physical effects.

Summary of Benefit

At full implementation, the project will result in a net energy savings of 594 MWh per year and a net reduction in CO2 emissions of about 210 MT per year. Given the schedule for project construction (with some benefits beginning to accrue in 2016), the project will result in a net energy savings of 29,719 MWh and a net CO2 emissions reduction of 10,521 MT over the 50-year project life.

GEI Consultants
Bookman-Edmonston Division

Geotechnical
Environmental and
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Foothill Municipal Water District Master Plan

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Executive Summary

The following is an Executive Summary for the attached Foothill Municipal Water District Master Plan. The sections presented below correlate to the Master Plan chapters.

Since the final draft of this Master Plan was written in February 2007, two events have occurred which could have impacts on FMWD. The first is the ruling by a federal judge that the biological opinion to the risk for Delta Smelt is flawed and must be rewritten. Along with this ruling, the judge ordered that pumping at the Harvey O. Banks Pumping Plant must be reduced until a biological opinion is in place to guide operations of all pumps. This reduction in pumping may reduce supplies from the State Water Project by about 35 percent in some years. It is possible that a new biological opinion may also have impacts on supplies until such time as a permanent solution to the Bay-Delta challenges can be identified and implemented.

Additionally, an issue has arisen through the Local Agency Formation Commission regarding transferring a portion of Crescenta Valley Water District's retail customer delivery responsibility to the City of Glendale. This potential service area transfer could reduce demands on FMWD by about 20 percent.

Based on these pending events outcomes, it is recommended that FMWD suspend consideration on the construction of a second connection as recommended in the discretionary CIP until a Water Resources Plan can be completed which evaluates among other things impacts of reduced demands on FMWD, the reliability of Metropolitan supplies, construction of satellite plants to deliver recycled water into FMWD's service area and conservation. Any reference to a second MWD connection in this document should take this decision deferral recommendation into consideration.

ES 1 Introduction

Foothill Municipal Water District (FMWD) is a member agency of The Metropolitan Water District of Southern California (MWD), created in 1952 for the express purpose of delivering imported water supplies from the Colorado River into its approximate 22 square mile service area encompassing the unincorporated Los Angeles County areas of La Crescenta and Altadena, plus the incorporated urban area of La Cañada Flintridge. The area's reliance on imported water as a supplemental source of supply has grown with urban development so that in recent years, imported water deliveries have made up on the order of 60 percent of total demand. Increasing demands for imported water deliveries have been particularly acute over the last decade, increasing from a level of about 7,500 to almost 14,000 acre-feet annually. This nearly doubling of deliveries represents an approximate 6 percent annual increase in demand for imported water during this recent time period. Peaking demands on FMWD's delivery system have also increased accordingly during this time period. In view of these significant recent water demand increases on FMWD's system and the ages of many of the originally constructed facilities exceeding 50 years, FMWD retained Bookman-Edmonston/GEI Consultants, Inc. (BE/GEI) in early 2006 to prepare a system Master Plan to address these and other issues. The Plan forecasting period is 10 years through 2015 with consideration of subsequent years as warranted and feasible.

In May 2005, FMWD published a Strategic Plan to provide a framework to conduct current and future operations and planning for the District. Based on the strategic plan development the Board of Directors adopted the following mission statement: ***Foothill Municipal Water District will reliably deliver quality water to its member agencies in a cost efficient manner to meet their projected demands.*** This Master Plan reflects this mission statement plus many of the strategic goals and objectives presented in the Strategic Plan. As stated in the District's mission statement, FMWD is committed to deliver water supplies in a cost efficient manner to meet the projected demands of Member Agencies, with the goal of maintaining the financial health of FMWD. This Master Plan has been developed with the goal of optimizing current facility operations, as well as implementing new infrastructure improvements, with a view to minimizing the overall cost and associated rate impacts resulting from improvement recommendations

ES 2 Service Areas and Operating Characteristics

There are eight retail Member Agencies within the FMWD service area, which individually receive varying amounts of annual imported water deliveries ranging from zero to 100 percent of source of supply. FMWD's service area is generally physically separated by the Arroyo Seco with retail agencies located either in the western or eastern portions of the District. Those retail service areas within the western portion of the District include Crescenta Valley Water District, La Cañada Irrigation District, Valley Water Company and Mesa Crest Water Company. These service areas in the western portion of FMWD are adjacent to each other. The eastern portion of the District includes the retail Member Agencies of Lincoln Avenue Water Company, Las Flores Water Company and Rubio Cañon Land and Water Association. These service areas are also contiguous to each other. All of these eastern service areas serve generally within the unincorporated Los Angeles County area of Altadena. Finally, an eighth retail Member Agency, Kinneloa Irrigation District, is located at the far eastern edge of the FMWD service area and separated by one to two miles from the other eastern service areas. Kinneloa is adjacent to and north of the service areas of the cities of Pasadena and Sierra Madre. FMWD does not currently serve imported water supplies to the Kinneloa Irrigation District.

The FMWD system is designed to provide imported water supplies to three service areas: Eastern (also named Altadena), Central (also named La Cañada) and Berkshire (also known as La Crescenta). Each service area is served by two reservoirs separately ranging in size from 1 to 1.4 MG. Imported water is delivered from MWD’s 116-inch diameter Upper Feeder through a nominal 40 cfs connection (FM-1) located near the Rose Bowl. Water is transmitted through approximately 6,500 feet of 39-inch diameter pipe to the main pumping plant P-1. At this juncture, water is pumped both to the West and East side service areas with four booster pumps devoted to each side.

The West side pumps together can normally deliver 22.5 cfs. East side pumps together can normally deliver 12.5 cfs. FMWD is installing fifth pumps on each service side to increase capacities to 27 and 16 cfs for the West side and East side respectively, for a total of 42 cfs from FM-1. East side pumps at P-1 lift water to the Altadena Reservoirs through an 11,800 foot 24-inch diameter cement mortar lined and coated (CMLC) steel pipeline. West side pumps transmit water through the Central service area to the La Cañada Reservoirs utilizing approximately 1,000 feet of 36-inch, 8,000 feet of 30-inch and 3,500 feet of 24-inch diameter CMLC steel pipelines.

An 18,600 foot 24-inch extension bifurcates from the Central area pipeline to carry water to the Berkshire service area and La Crescenta reservoirs. Water is boosted from the beginning of this pipeline through pumping plant P-2.

Crescenta Valley Water District (CVWD) is the western most retail member of FMWD primarily serving the community of La Crescenta. CVWD is the largest retail Member Agency served by FMWD containing approximately 8,100 service connections, or approximately 1/3 of the total retail customers within the FMWD service area. CVWD is experiencing densification of its housing structures (i.e. conversion of single family dwellings to multi-unit residences). Growth in the number of connections served by CVWD is anticipated to be minimal over the next decade. The two primary sources of supply for CVWD include imported water purchases from FMWD and groundwater pumping through twelve groundwater wells located in the Verdugo Basin. CVWD obtains approximately one-half of its water supply from groundwater sources with the remainder being supplied by FMWD imported supplies on a long term basis. From year to year, imported water deliveries vary from about 40 to 60 percent of total production. The District anticipates that growth in the District’s water demand will be met by additional purchases from FMWD. CVWD pumps groundwater from the Verdugo Basin based on annual adjudicated rights of 3,294 acre-feet. The District is currently faced with potential production reductions due to MTBE contamination in the basin.

The La Cañada Irrigation District (LCID) was formed in 1924 to serve a portion of the community of La Cañada Flintridge and adjoining unincorporated areas. LCID serves about 2,900 service connections of which all but about 100 are residential. Although there are not many vacant lots available for development, a significant portion of LCID’s service area has been undergoing the process of conversion from smaller homes to larger residences (mansionization). LCID relies on imported water from FMWD for about 90 percent of its source of supply. Its remaining sources of supply include surface water from Pickens Canyon and groundwater production from the Raymond Basin. Each of these secondary sources supplies about 5 percent of demands. Groundwater production is accomplished through two wells located in the Raymond Basin (Monk Hill sub-area).

Mesa Crest Water Company (MCWC) is an investor owned water utility regulated by the California Public Utilities Commission (PUC) which serves approximately 700 customers located in the northeastern portion of FMWD's western agencies in the area of the La Cañada Flintridge golf course. Most of its customers are residential users. MCWC has experienced basically no growth in recent years. The sole source of supply for MCWC is imported water delivered from FMWD. The company can receive 1.7 cfs (763 gpm) from FMWD. During peak summer days, MCWC must peak off of storage.

Valley Water Company (VWC) was incorporated in 1910 as a non-profit mutual water company initially to provide a water supply to agricultural users in the area of La Cañada Flintridge. With urban development over the years, VWC today serves almost entirely residential customers in addition to limited commercial customers along Foothill Boulevard. VWC has a service area of approximately 2,400 acres in the City of La Cañada Flintridge encompassing approximately 3,585 service connections. Growth historically has been minimal in recent years and is expected to remain at this level for the foreseeable future. However, some mansionization is occurring as homeowners construct larger homes in place of existing structures. Historically, VWC has relied on imported water supplies from FMWD for approximately 70 percent of its source of supply with the remaining 30 percent produced from groundwater production in the Raymond Basin. The VWC operates four production wells. Well production is primarily constant from May through October but peaking to meet high demands is accomplished by increasing deliveries of imported water supplies.

Lincoln Avenue Water Company (LAWC) was formed as a mutual water company (not for profit) in 1883 to serve customers in the western portion of unincorporated Altadena. Today the company provides service to approximately 4,415 customers, of which 97 percent are residential. There are no longer any significant parcels available for large scale development and housing density remains relatively stable. LAWC has three sources of water supply which include groundwater from the Monk Hill sub-basin of the Raymond Basin, local surface water and FMWD imported water. The company utilizes two wells, Nos. 3 and 5. LAWC also relies on local surface water collected from Millard Canyon and treated in a filtration plant. LAWC takes FMWD imported water in the non-peak months and shifts primary reliance to groundwater in the summer period. However, the system continues to peak off of FMWD resources.

Las Flores Water Company (LFWC) is a mutual water company (not for profit) located between LAWC and RCLWA serving the unincorporated area of Altadena. The company provides service to approximately 1,472 metered connections almost all of which are single family residences. There has been virtually no growth over the last seventeen years. LFWC delivers annual demands from the Raymond Basin and the remainder from imported water delivered by FMWD. LFWC relies on a 650 gpm well (Mountain View Well No. 2) for groundwater production.

Rubio Cañon Land and Water Association (RCLWA) serves an estimated 3,147 connections in the central and eastern areas of Altadena. This purveyor is a non-profit association chartered as a mutual water company. Almost 90 percent of its customers are single family residential or small apartments or condominiums. As with nearby LFWC, RCLWA’s service area is stable with essentially no growth in the recent past nor projected for the future. The company has two wells to produce about 60 percent of its demands from the Raymond Basin. In addition, the association may develop up to 15 percent of its annual demands with adequate rainfall from mountain runoff. The remaining water demands are met through imported water supplies. Unlike the other FMWD member agencies, RCLWA operates its system to receive imported water during non summer months

Kinneloa Irrigation District (KID) is located within unincorporated area of Los Angeles County northeast of the City of Pasadena. The District is also located on the eastern edge of the FMWD service area and is separated from the existing imported water facilities by approximately six to seven miles. There are currently approximately 600 connections, almost all of which are residential. KID obtains its entire water supply from groundwater pumping and tunnel production supplying surface runoff. KID operates two wells to serve its system demands with the larger utilized throughout the year and the smaller well typically pumped only in summer months.

ES 3 Historic and Projected Demands

B-E/GEI analyzed annual historic and projected water demands for FMWD and its retail Member Agencies. B-E/GEI believes, based on the potential connection growth, as reflected in available land for development and changes in housing characteristics that the projected number of connections at the end of the study period is very close to full buildout for the FMWD service area. Increasing demands for imported water deliveries have been particularly acute over the last decade. From fiscal year 1994-95 through 2003-04, firm imported water deliveries have increased from a level of about 7,500 to almost 14,000 acre-feet annually (although it should be noted the highest quantity of water delivery was for only one year; other recent annual amounts have varied from about 10,000 to 12,000 acre-feet). This nearly doubling of deliveries represents an approximate 6 percent annual increase in demand for imported water during this recent time period. In addition to firm water deliveries, FMWD has also delivered imported water supplies for groundwater replenishment through well injection. These deliveries have increased from about 500 to 1,400 acre-feet annually over the last five years (2000-01 through 2004-05).

Projected connection growth for retail water agencies within the FMWD service area are anticipated to increase from about 24,600 at the end of 2005 to just over 25,100 through

2015, a total increase of approximately 500 connections through the study period. This represents a percentage change of about 2.0 percent total over the study period or less than one-quarter of one percent annually. **B-E/GEI recommends that FMWD compare total connection growth on an annual basis with plan projections to confirm the continuing validity of the connection projections throughout the study period.** Actual growth in the FMWD service area connections substantially greater than the projections in this Master Plan might provide early notice of the need for an updated review sooner than the end of this study period (2015).

Projected annual water demands in acre-feet for all water sources for each retail agency and the totals for the entire FMWD service area are based on both normal and dry hydrologic conditions. For normal hydrologic conditions, total water demands are anticipated to increase from an estimated 20,200 acre-feet in 2006 to 21,100 acre-feet in 2015, or approximately 900 acre-feet. This represents an overall increase of about 4.5 percent. Under the assumption of dry precipitation conditions, total water use is expected to be at a demand level of about 23,100 acre-feet in 2015, compared to 22,100 acre-feet in 2006, a difference of about 1,000 acre-feet.

B-E/GEI made projections of FMWD imported water delivery demands annually for both normal and dry precipitation years through the study period based on demand projections for Member Agencies less local water sources and groundwater production. FMWD system demands are anticipated to reach a level in 2015 of about 14,300 acre-feet for firm deliveries for a normal precipitation year and approximately 16,600 acre-feet during a dry year, with both hydrologic conditions indicating increases of 950 to 1,000 acre-feet annually over 2006. These results also represent increases of about 2,100 acre-feet or 17 percent over the last year of normal precipitation (12,200 acre-feet in 2001-02), and 2,800 acre-feet or 20 percent over the last year of dry precipitation (13,800 acre-feet in 2003-04). All growth in water demands for the entire service area is anticipated to be met by FMWD through increasing its deliveries.

Based on a review of current and future water requirements of Kinneloa Irrigation District (KID) compared to its existing supplies, it appears that it is very unlikely that this Member Agency will need imported water for the foreseeable future. However, future imported water supplies may be needed by KID from long term well failure, lost groundwater production from contamination or needed blending supplies for water quality issues. The KID service area is approximately 1 to 2 miles separated from the existing FMWD service area, but it is estimated approximately 6 miles or more of pipeline would be required to interconnect the KID system with the existing FMWD system. Accordingly, extending the FMWD system to serve KID would be very expensive. Alternatively, there are three identified approaches to serve imported water to KID if needed in the future, all of which are considered more economical than extending the FMWD existing system. These include:

- Purchase retail water supplies from Pasadena, perhaps with the need to upsize the existing interconnection depending on the level of supply needed.

- Wheel FMWD imported water supplies through Pasadena, again potentially needing to upsize the existing interconnection with KID or,

- Construct an MWD connection at the Upper Feeder which is located approximately 3,000 feet from the KID system.

ES 4 Sources of Supply

The Master Plan considers alternative sources of supply for the FMWD service area including imported water, recycled water and groundwater. Source of supply enhancement and reliability, as well as improvements in source of supply facilities considered.

In view of imported water supplies meeting on the order of two-thirds of total water demands in the FMWD service area, the reliability of MWD to meet delivery requirements of Member Agencies is critical. An assessment of the ability of MWD to meet current and future water demands needs to consider both water supply and system facility reliability. MWD has a very aggressive program to provide a reliable water supply in its service area over the next several decades. This program is described in detail in its Regional Urban Water Management Plan (UWMP) dated November 2005. The report concludes that MWD has a high level of reliability of service in a single dry or multiple dry years extending through the UWMP study period of 2030. MWD has also identified an amount of buffer supplies under development which could meet unanticipated shortfalls or serve additional needs. The report also discusses other potential water supply reliability risks. These include the potential losses from planned local and MWD programs not implemented, the loss of supply due to unknown water quality problems and catastrophic supply interruptions (such as earthquakes). For these reasons, MWD is planning for an additional 500,000 acre-foot per year buffer water supply. Based on MWD’s UWMP, it is highly probable that the agency has a reliable water supply for the next 25 years.

The 116-inch Upper Feeder is the MWD pipeline serving FMWD and provides treated water from the Weymouth Treatment Plant located in La Verne. The Upper Feeder was one of the initial facilities constructed by MWD in 1941. It is a steel pipeline terminating in Eagle Rock. MWD has a very good track record of system reliability. MWD has made a concerted effort to inspect facilities according to a carefully planned maintenance schedule and provide rehabilitation where needed. Historically, MWD’s water supply has been very reliable. MWD considers reliability to be a first order of business and maintains not only its supply with excess margins but also the delivery capability of its distribution and treatment systems.

FMWD receives treated imported water from MWD’s 116-inch-diameter Upper Feeder at turnout FM-1. The turnout is nominally designed to deliver 40 cubic feet per second (cfs). The pumping capacity of the P-1 station is about 35 cfs when all existing pumps work at their operation points. This turnout is designed to deliver 40 cfs (B-E/GEI, 2004). Consideration was given to increasing flow capacity to 45 cfs based on hydraulic analysis of FM-1 and pumping plant P-1 revisions. The velocity in this 24-inch pipe is about 14.3 ft/s with the 45 cfs flow. B-E/GEI design engineers believe that this velocity of 14.3 ft/s is still in the reasonable working range for this short connection. Therefore, this turnout with the existing 24-inch steel pipe connection can be expected to operate normally with the 45 cfs flow but significant changes would be required at P-1.

In 2004, on behalf of CVWD, in association with LCID, VWC, and FMWD, B-E/GEI investigated the feasibility of providing recycled water to various users within the service areas of the West side purveyors. The proposed recycled water source was the City of Glendale (Glendale). The closest connection points to the Glendale system are along the 16-inch Verdugo Canyon Pipeline in the vicinity of La Crescenta Avenue and Verdugo Road. The last Glendale user is the Oakmont Country Club (Oakmont). Caltrans is the key potential customer in the area. There are no potential industrial users. Irrigation consumption peaks on the same days that the transmission capacity of the supply system (Glendale) is already stressed delivering to its customers. Dependency solely on Caltrans for project revenues presents significant risk. Economic analysis indicates use of Glendale’s recycled water is not cost effective. FMWD and several of its Member Agencies are continuing to consider other alternatives to utilize recycled water in the Foothill corridor to offset the use of imported water such as a small local wastewater treatment plant. It is not known at this time whether such an approach is economically feasible.

As part of this Master Plan assessment, consideration was given to the construction of a second MWD connection. A second MWD connection would provide supply reliability and flexibility to the FMWD system and its Member Agencies. Construction of these facilities during the forthcoming Master Plan study period has both benefits and shortfalls. A second MWD connection would require the construction of a 27,000 foot transmission main of recommended 24-inch diameter, an associated 1,700 horsepower pumping plant, a 1 MG terminal reservoir, an 18-inch looping connection (3,200 feet) to LCID reservoir facilities, and an interconnection between LCID and MCWC at their closest proximity at their northern service area boundaries near Angeles Crest Highway. The total cost for these facilities is estimated to total $19.8 million. The proposed MWD connection is considered discretionary, and the proposed reservoir and associated looping connection to LCID are recommended secondary CIP facilities. Constructing a second MWD imported water connection will support FMWD operations during emergency operations, both on a short and longer term basis. FMWD operations staff estimates that a transmission main break can be repaired in 48 to 72 hours (including restoration of service following disinfection) unless a break causes additional complicating problems other than the break itself.

B-E/GEI estimates the remaining lives of FMWD’s existing pipelines, with appropriate repairs to sections disturbed by Freeway construction, will extend past the Master Plan study period (through 2015). However, it is anticipated replacement of all three transmission mains may be needed in the next Master Planning cycle (2016-2025). Based on the width of right of way, B-E/GEI believes it would be feasible to construct a new East side replacement line before abandoning service in the existing facility. However, with narrower streets on the West side, this approach probably is not feasible. With construction of a second MWD connection, an alternative water supply would be available to facilitate West side transmission line replacements.

ES 5 Evaluation of Existing Facilities

A significant requirement of preparing a Master Plan is to evaluate the condition and anticipated remaining lives of existing facilities in order to identify probable needed replacements during the projected planning period. In order to assess existing condition and estimated remaining lives of FMWD assets, B-E/GEI utilized a three fold approach. First, field visits to all major above ground facilities were conducted with assistance from operating personnel. Observations of existing facility condition were made. A key component of the field assessment was interviews with operating personnel. Operating problems and deficiencies were thoroughly discussed as well as the status of individual facility maintenance. A second major portion of the facility condition and remaining life assessment was a review of all relevant maintenance records, consultant inspection reports and other supporting documents. The third approach B-E/GEI utilized in assessing facility condition and potential remaining lives was through the use of survivor curves. Although B-E/GEI reviewed the inventory and accounting records of FMWD on its facilities, reliance was not placed on straight line depreciated lives as indicated by accounting records. Rather, the use of survivor curves was utilized to estimate the remaining lives of existing facilities. The amount of additional remaining life is determined using what are known as “Iowa-type survivor curves.” B-E/GEI determined the remaining lives of system facilities as indicated by the appropriate survivor curve and based on FMWD indicated installation dates. Initial estimated service lives from the date of installation were based on B-E/GEI’s many years of experience in performing numerous municipal water system evaluations. Indicated survivor curve remaining lives were then evaluated in light of information obtained from the other two approaches described above.

FMWD inventory records account for imported water transmission mains in four categories: Main-Arroyo (from the MWD connection to the main pumping plant, P-1), Westside (from P-1 to the La Cañada reservoirs), La Crescenta (Berkshire extension from the Westside line to the La Crescenta reservoirs) and Altadena (Eastside line from the P-1 pumping plant to the Altadena reservoirs). The transmission main from the MWD connection at FM-1 to the main pumping plant consists of 36-inch and 39-inch diameter cement mortar lined and coated steel pipeline (CMLC) all installed in 1955. Survivor curves indicate a remaining life of 21.6 years for these pipeline facilities. A video log of the entire length of this pipeline indicates the pipeline was in good condition and likely to provide service through the study period.

For the Altadena section of 24-inch diameter CMLC pipeline, an estimated 10,590 feet was installed in 1955 and 1,200 feet was reinstalled as part of freeway construction in 1972. The originally installed portion should have a remaining life on the order of two decades (21.6 years). However, it is believed the reconstructed freeway portion may have mortar damage and corrosion similar to the Berkshire pipeline portion. **Video logging of this reconstructed section of the transmission main should be conducted as soon as practicable with repairs made as necessary.**

The La Crescenta (Berkshire) portion of FMWD's transmission pipelines consists entirely of 24-inch diameter CLMC of which 15,180 feet was installed originally in 1955; plus 670 feet in 1971; 914 feet in 1988; and 1,700 feet in 1998. As indicated above, the originally installed footage is anticipated to extend well past the study period. However, **the reinstalled portions which have been video logged indicate the need for repairs as soon as practicable.** The Westside pipeline (extending from the main pumping plant to the La Cañada reservoirs) is constructed of 36-inch; 30-inch and 24-inch diameter CMLC steel pipeline; plus 198 feet of 30-inch diameter reinforced concrete pipe all installed in or about 1955. In addition, 1,459 feet of 30-inch diameter CMLC steel pipe was reinstalled in 1972 for freeway construction; and 337 feet of the same diameter crossing the Arroyo Seco was modified in 1988 to increase flexibility in order to respond better to earthquakes. In view of the video log results on the freeway constructed Berkshire extension, **the 1,459 foot 1972 reinstalled section of the Westside pipeline should be video logged to assess condition and the need for repairs.** Member Agency connections, mainly installed in 1955 are anticipated to have remaining service lives of about 22 years or greater.

One outstanding maintenance issue is noted for FMWD's continuing timely response. According to operating personnel, approximately seven or eight of the existing seventeen combination air release/vacuum release valves have been rehabilitated or thoroughly cleaned. However, the status of operating condition for the remaining valves at this point in time is unknown. **B-E/GEI supports the current efforts of maintenance staff to continue their efforts to rehabilitate any combination valves not operating at optimal levels.**

Rates for electric and other utility services (water, natural gas, etc.) are typically structured to be fair and non-discriminatory as well as to recover the cost of providing services. The bulk of an electric bill on a "dollars charged" basis for commercial and industrial customers is related to energy consumption and peak demand, both of which are variable cost components and both of which are subject to some degree of control by the customer. Besides recognizing that costs vary according to consumption patterns, utilities and regulatory bodies also recognize that energy is more expensive to provide at certain times of day and during certain seasons. These differences are accounted for in rate structures that recognize time-of-use cost differentials.

A review of the PWP (Pasadena Water and Power) electric bills for the past approximate one year period indicates that the P-1 pumping facility has generally been able to take advantage of the off-peak energy price savings that PWP's time-of-use rates offer. The P-1 pumping plant consists of eight pumps and motors, two surge tanks, and appurtenant plumbing. Analyses using the survivor curves suggest that six of the eight pumps and motors will need replacement or refurbishment before the end of the study period. Inspection at the P-1 facility was primarily visual. Components inside of the panel are free of both rust and dust. The area surrounding the P-1 facility is recreational with no locally generated dust or pollution that can contaminate equipment. Visual inspection indicates that about ten years of useful life remains if the equipment is properly maintained.

Two permitted diesel-powered generators each rated at 500 kW provide backup power for pumping during emergencies. Presently when the two units are operated in parallel the output is limited to 14 cfs because the control system cannot properly synchronize the units when operating at or near full-load (when properly functioning total pumping capacity is about 22 cfs). Also, South Coast Air Quality Management District Rule 1470 regulating particulate emissions will become effective January 1, 2008 thereby making the existing generator units noncompliant and inoperable. The contractor estimated that the cost to upgrade the two generators to perform properly in parallel will cost around $250,000. The contractor is currently analyzing the cost to replace the two generators with either one or two new generators with at least the expected capability of the existing generators. Based on a conversation between B-E/GEI and a generator manufacturer, the complete purchase and installation cost for two new 500kW units is preliminarily estimated at $450,000 (the estimated installed cost for a single 1,000kW unit is $600,000. **B-E/GEI recommends FMWD installs two new 500kW units to correct the current operating shortfall of emergency generation at pumping plant P-1.**

The pumping load at pumping site P-2 is served by the SCE (Southern California Edison) and billed under its Schedule TOU-8 tariff. A review of the SCE electric bills for the past 15 months indicates that the P-2 facility has generally been operated to take advantage of the off-peak and mid-peak energy price savings that the TOU-8 tariff offers to those customers that can shift electrical load away from peak load times. P-2 pumping plant contains four pumps and motors (B-1 through B-4). Field observations indicated all equipment appeared clean and in good operating condition (with minor maintenance issues pending). A skid mounted diesel powered generator rated at 350kW and capable of supporting any one of three of the four 300 horsepower pumps at a time provides backup power for pumping. The generator was originally sized to be able to support running two pumps concurrently, but when the pumps were upgraded to 300 horsepower that ability was lost. Currently, the maximum water production through the P-2 plant is limited to 4 cfs. **B-E/GEI recommends FMWD install two new 500kW units, estimated to cost $450,000, in order to provide on the order of 12 cfs during emergency conditions.**

Both of FMWD's pumping facilities are currently electric powered with limited diesel-fueled backup generation. On-going consideration has been given to using natural gas to displace a portion of the present electrical energy used to meet pumping loads The Master Plan presents several reasons why shifting electrical load to natural gas is not recommended at this time.

The electric rate structures of both PWP and SCE offer opportunities to control electrical bills; however, because of constraints on the ability to alter operations such as reservoir storage requirements and member agency water delivery schedules, there is little opportunity to generate significant electricity cost savings. **It is recommended that FMWD not place unwarranted emphasis on operating its system based upon being able to lower its electric bills but rather focus on its primary mission to provide a safe and reliable supplemental water supply.**

FMWD owns six reservoirs varying in size from 1.0 to 1.4 MG. Three are welded steel (La Crescenta East and West, and La Cañada East), all constructed in 1954, and the remaining three all reinforced concrete, constructed in 1954, 1985 and 1991. The La Cañada East reservoir was most recently inspected in 2005. Coatings appeared to be in excellent condition. The steel where exposed was also in good condition with very little pitting. The La Crescenta West Reservoir was last inspected in April 2002. The reservoir coating system was generally observed to be in very good condition. Sporadic corrosion nodules and coating blisters were present. The La Crescenta East Reservoir, inspected recently in March 2002, appeared to vary from average to excellent condition, although some areas contained corrosion or alligator cracking.

In June 2006, the Altadena North Reservoir was inspected. The steel roof plates and stainless steel tie rods appeared to be in excellent condition with no signs of corrosion. The concrete walls and gunite slope and floor also appeared to be in excellent condition although there were several small areas of corrosion. Coatings on the roof girders, rafters and columns all appeared to be in good condition. Altadena South Reservoir is located on the north side of Harriett Street. The structure is concrete and appeared to be in good condition. Altadena North Reservoir is located on the same property as Altadena South. The structure is concrete with a metal roof and appeared to be in very good condition.

Overall, all reservoirs are being well maintained by FMWD with periodic consultant inspections, followed by implementing recommended repairs and maintenance. Survivor curve analysis by B-E/GEI indicates anticipated remaining lives, with continuing good maintenance, for the three originally constructed reservoirs to be on the order of 20 years. Remaining lives for the remaining three reservoirs, constructed in the late 1980s and early 1990s are all over 40 years.

The FMWD field and administrative offices are located in a residential area next to the La Cañada East reservoir. The administrative and field offices are located in separate buildings with the District Board Room attached to the latter. Although not overly spacious, it appears the facilities are functionally adequate. It also appears the buildings are in basically good condition. In view of the lack of need to move the offices for new facility construction, and the considerably large CIP program recommended for the current study period, **B-E/GEI recommends the FMWD retain its current offices and make renovations as necessary.** A budget amount of $100,000 is identified for this purpose. B-E/GEI recommends FMWD retains the services of an architect or interior designer for this purpose.

The current SCADA (Supervisory Control and Data Acquisition) system operated by FMWD was originally installed by the early 1980s. Since then, several revisions have been undertaken to install upgrades and system amendments to monitor new and upgraded facilities. However, today the system is out of date and operations staff cannot obtain outside technical support. **There is a need for a completely new SCADA system.** Additionally, current security monitoring is deficient. FMWD operations staff has begun to create facilities maintenance schedules to form the foundation of an asset management plan (AMP). Those efforts plus data developed in this Master Plan should provide initial information necessary to **implement an AMP to optimize remaining lives and value of existing facilities.** It is believed such a system may consist mainly of electronic maintenance and replacement schedules, as opposed to a detailed complex AMP.

ES 6 Peaking Analysis and Supply Capability

B-E/GEI conducted an analysis of historic peaking characteristics for the FMWD system based on demand data for the last three years (2003 through 2005). With the exception of May 2004 the maximum monthly demand periods for the years 2003, 2004 and 2005 for firm water deliveries for the system overall occurred during either July or August. The ratio of maximum day to average day for individual zone service areas for the years 2003 and 2004 varied generally from about 1.6 to 1.75, and for the system overall 1.5 to 1.6. The years 2003 and 2004 can be considered typical and very dry precipitation years respectively. In contrast, 2005 was a very wet precipitation year resulting in the maximum day to average day ratio being higher than typical in view of the lower than normal average day usage throughout the year. Consequently, the maximum day to average day ratios for projected demands through the study period are based on results from the 2003 and 2004 analysis.

It should be noted that on occasion the winter deliveries to the eastern service area (Altadena pressure zone) have reached higher maximum day usage than during the summer period due to RCLWA meeting most of its demand from imported deliveries in-lieu of groundwater pumping. These events may result in maximum day deliveries being as much as 20 percent higher than summer maximum day demands indicate. Imported water deliveries for injection and in-lieu credit may also on occasion spike maximum day demands slightly higher than summer period deliveries indicate. However, operating personnel have some flexibility to control and even curtail non-firm deliveries during winter periods. Consequently, it is believed that firm deliveries during the summer period should be the criteria against which to compare system capability.

This analysis also shows that the FMWD wholesale system does not peak like a typical retail system. The FMWD system has a moderately lower peaking factor for the maximum day to average day demand (1.65 to 1.75 instead of the more typical factor of 2.0); and a significantly lower hourly peaking factor compared to the annual average (1.7 to 2.2 instead of the more typical factor of 3.0) than a comparable retail system. It should be noted that both peak day and peak hour projections are considered to be the same regardless of either a normal, wet, or dry precipitation year. Periods of hot weather in the summer months will occur at similar levels regardless of rainfall occurring during non-summer months. FMWD system capacity has an adequate 15 to 20 percent excess capability for every branch for projected demands except 2006 capacity on the West branch which is only 8 percent greater than projected demand. This indicates FMWD is acting prudently in installing additional fifth pumps at Pumping Plant P-1 as soon as practicable.

The FMWD system is anticipated to have adequate excess capacity to meet normal projected maximum day demands throughout the study period. However, there are periods of supply interruptions within the distribution systems of individual Member Agencies which would result in increased temporary demands on the FMWD system. In order to assess the potential impacts to the FMWD system under increased demand occurrences, a variety of supply interruption scenarios were developed for evaluation; with increasing severity of interruptions, all envisioned to occur during times of projected peak day demands for both 2006 and 2015. The eight scenarios evaluated are as follows:

- Scenario 1: Loss of largest well on east side.
- Scenario 2: Loss of largest well on west side.
- Scenario 3: Loss of largest two wells on east side.
- Scenario 4: Loss of largest two wells on west side.
- Scenario 5: Loss of one-half Verdugo Basin production due to long term drought.
- Scenario 6: Loss of one-half of Verdugo Basin production, and loss of two largest wells, one on the east side and one owned by CVWD.
- Scenario 7: Loss of one-half of Verdugo Basin production, and loss of two largest wells on east side.
- Scenario 8: Loss of one-half of Verdugo Basin, and loss of two largest wells on west side.

Results indicated two increased demand scenarios (Nos. 3 and 7) would exceed upgraded system capacity for the East branch under 2006 demands, both at 16.0 cfs compared to an upgraded capacity of 15.7, a probable supply deficit of 0.3 cfs. Scenario 8 would also create a supply deficit of 0.4 cfs on the West branch even with upgraded system capacity. For 2015 demands, occurrences of scenarios 5 through 8 indicate West branch deficits of 0.7 to 2.2 cfs (demands of 26.9 to 28.4 cfs compared to upgraded capacity of 26.2 cfs); scenarios 3 and 7 would create a supply deficit of 1.0 cfs on the East branch (demands of 16.4 compared to 15.4 cfs upgraded capacity); scenario 8 results in lower capacity on the Berkshire branch of 0.6 cfs (16.3 demands versus 15.7 cfs capacity); and a 0.8 cfs shortfall for total FMWD system demands versus capacity for scenario 7. These shortfalls would require additional source of supply, either emergency interconnections or a second MWD connection to mitigate. Conservation measures during drought scenarios (5 through 8) could also be applied to alleviate shortages.

MWD's capacity charge (peaking) is based on a running three-year summer peak. Obviously, the less short notice peaking Member Agencies exert on the FMWD delivery system, the lower the resulting MWD capacity charge. B-E/GEI interviewed other MWD subagencies to obtain information on approaches to peaking mitigation. Subagencies utilize customer education, coordination at high demand periods and capacity charge rate distribution to address peaking. It is believed the recommended CIP in this Master Plan, including additional storage will mitigate most of any future peaking problems. FMWD staff is encouraged to continue working closely with Member Agencies to educate them, as well as encourage cooperation during times of high demand to alleviate peaking to the extent feasible.

ES 7 Storage Requirements

Included in the Master Plan are discussions on storage evaluation criteria, FMWD Member Agency storage facilities and assessment (including a discussion on storage capacity of both East and West side areas), and FMWD storage requirements. Also included is the role of groundwater basin storage as a potential storage source upon which FMWD might rely on.

Primarily, storage is provided to equalize the daily fluctuations of water demands on a system's water supply. Storage is also reserved to provide water to meet fire suppression requirements for a specified period of time within the service area; and provide a source of water in emergency or other extended outage situations. Requirements for the sizing of each of these storage components vary by purveyor depending on applicable regulations, service area characteristics and requirements specific to each system. It is considered that each of the Member Agencies provide for storage to meet the requirements for localized fire events. As a consequence, localized fire demand requirements potentially exerted on the FMWD system are buffered by storage existing in the retail systems of the Member Agencies. B-E/GEI does not believe that localized fire suppression storage volume needs to be provided by FMWD in view of its operating characteristics as a wholesale supplier.

Member Agency demand data indicates that average day demand is approximately twice as high for the West side as the East side, on the order of 12 and 6 MG respectively. Peaking ratios for both areas are close to the same at approximately 1.9 times average day demand to yield peak day demand. Accordingly, peak day demand in the west side is also about twice that for the East side at about 23 and 11 MG respectively.

Days of storage based on average day demand for East side systems vary from about 3.5 to almost 6 days. Overall, this provides the East side with a storage capacity of over 4 days of average day demand. On a peak day demand basis, individual purveyor storage capacities range from about 1.8 to 3.6 days of storage. On an overall service area basis, the east side contains approximately 2 days of storage at peak day demands. The West side contains storage facilities with a combined capacity to meet about 2.8 days of average day demand and 1.5 days of peak day demand. These capacities are slightly improved with the addition of a 1 MG storage facility which LCID plans to add to their zone 2. With this future reservoir addition, the West side service area will have storage on the order of almost 3 days of average day demand and 1.5 days at peak demand.

Combining the East and the West sides representing the entire FMWD service area shows the current total storage operated by the Member Agencies is about 59 MG to serve average day demands of about 18 MG and peak day demands of about 34 MG. The construction of an additional 1 MG reservoir by LCID will bring the total retail level storage to about 60 MG. With either current or future storage volumes, this results in approximately 3.3 days of storage at average demand and 1.7 days of storage at peak demand.

Both East and West side service areas are enhanced with additional wholesale storage from FMWD resulting in approximately 2.4 (increased from 2.2) and 1.7 (increased from 1.5) days of storage at peak demands respectively. The overall FMWD service area storage averages to almost 2 days at peak demand. It appears that both the east and west side service areas within FMWD have adequate storage on an overall demand basis when combined at the distribution and wholesale levels.

Existing FMWD facilities provide 0.74 and 0.50 days of average day wholesale demand storage (about 18 and 12 hours); and 0.42 and 0.31 days of peak demand storage (about 10 and 7 ½ hours) for the east and west side service areas respectively. Demands in 2015 decrease the storage coverage slightly, by about one hour for average day demand (17 and 11 hours) but less for peak day demands (10 and 7 hours), again for the east and west side service areas, respectively. Adding an additional 1 MG reservoir as recommended by B-E/GEI will increase time before storage depletion in the FMWD Westside system by about 2 to 3 hours. Constructing the additional MWD connection could double total times before depletion noted above depending on the location of emergency conditions requiring dependence on available storage.

Proposed California Waterworks Standards, if adopted, will require each municipal water system to meet four hours of peak hourly demand with source capacity, storage capacity, and/or emergency source connections. This requirement is to be met in the system overall as well as in each pressure zone. FMWD existing storage easily meets the proposed state standard even without considering source capacity or emergency interconnections, with current storage in individual service zones having capacities in excess of 4-hour maximum demands ranging from 22 to 100 percent (central and west side service areas, respectively) based on 2015 demands.

Some cities rely heavily on underlying groundwater in preference to surface storage. In view of the role of FMWD as a wholesale supplier of imported water, without direct access to the groundwater basins, it would be exceedingly difficult for the District to develop a viable groundwater operating storage resource. However, in view of the conclusions by B-E/GEI that FMWD will easily meet its storage needs and comply with regulatory requirements following the recommended construction of an additional 1 MG reservoir, no further consideration is given to developing FMWD system storage through groundwater resources.

As discussed above, it appears that the FMWD service area purveyors, considering both the wholesale and distribution levels, have adequate storage capacity in both the east and west side service areas. FMWD wholesale storage capacity currently easily meets proposed state standards. However, in the event of an emergency, currently available FMWD storage, even if full at the time of occurrence could be depleted within 8 hours.   **Therefore, B-E/GEI recommends the construction of an additional 1 MG storage reservoir and a second MWD connection which could double the amount of time before storage depletion. Even if the decision is made to not construct the second MWD connection, B-E/GEI recommends FMWD constructs the additional 1 MG reservoir.**

ES 8 Foothill Conjunctive Use Project

In order to enhance the surface water delivery capability to FMWD Member Agencies during emergencies and drought periods, MWD, FMWD, the Raymond Basin Management Board and Member Agencies of FMWD have jointly been participating in the development of a Foothill Conjunctive Use Program (Foothill CUP) utilizing imported water deliveries during times of adequate supply to store in the Raymond Basin for subsequent production when needed. The Foothill CUP will allow MWD to store in the Monk Hill subarea of the Raymond Basin up to 9,000 acre-feet of available wet period water for subsequent withdrawal at a level of up to 3,000 acre-feet annually during emergencies and droughts. Storing imported water in the groundwater basin would be accomplished through in-lieu deliveries and injection.

Member Agencies participating in the in-lieu deliveries include LCID, VWC, LFWC and RCLWA. Imported water deliveries taken on an in-lieu basis will be delivered at each agency's treated water connection being credited to a storage account. The cost of water deliveries are deferred as no charges for these in-lieu deliveries are made at the time of delivery through the surface water connection. However, when MWD requires the water to be produced on account of drought conditions or other reasons, produced groundwater will be invoiced at the current MWD treated water rate. All groundwater pumping costs will be reimbursed by MWD.

Facilities to implement the Foothill CUP include an addition of pumps and electrical controls at the main pumping station P-1 in order to enlarge the delivery capability of the imported water connection FM-1 to accommodate in-lieu water deliveries, the conversion of three production wells to ASR (aquifer storage and recovery) facilities for alternative operation of injection and production, and needed interconnections between purveyors in the FMWD service area. FMWD is currently waiting for delivery of P-1 pump additions from the manufacturer. In order to initiate the Foothill CUP, FMWD was awarded a grant of $1.7 million under State Proposition 13 funding. Additional funding required under this program is being provided by FMWD.

ES 9 Water Quality

FMWD and its Member Agencies must be concerned with water quality issues of both imported water and groundwater. Imported water delivery reliability is essential in view of the need for five Member Agencies to use blending as a treatment option to mitigate surface and groundwater quality issues. Member Agencies must deliver potable water that meets all primary drinking water standards FMWD as a wholesale provider of treated potable imported water supplies is a member agency of MWD. This regional supplier of imported water supplies throughout southern California is committed to providing water that is safe; plus looks, tastes and smells good. MWD’s water consistently meets all of the standards for drinking water and can be relied on to continue to do so. FMWD performs no additional treatment on supplies received from MWD.

Overall, groundwater quality from both the Verdugo and Raymond Basins is of good quality. However, there are contamination issues which must be addressed by Member Agencies. Blending with imported water is utilized by four purveyors involving almost all contaminants of concern in groundwater. One water quality regulation which FMWD and its Member Agencies have to implement careful monitoring is the Disinfection By-Product (DBP) Rule. Disinfection byproducts of chlorination have suspected adverse health impacts if present at excessive levels. FMWD is expected to continue to meet requirements of the DBP Rule. Discussions with the Member Agencies have indicated that none anticipate a problem with Stage 2 DBP Rule compliance so long as FMWD delivers water that is within MCLs.

ES 10 Recommended CIP Facilities and Implementation Schedule

Presented in this section is an identification by B-E/GEI of recommended facilities (Capital Improvement Program, or CIP) to either be constructed, rehabilitated or replaced over the study period of the Master Plan (through 2015).

CIP facilities have been categorized as either primary, secondary or discretionary. Primary CIP involves those facilities which in B-E/GEI’s opinion are essential for continuing existing operations at a high level of service. A majority of the recommended primary CIP involves replacement of existing facilities anticipated to reach the end of their estimated useful lives before the end of the current study period. Recommended secondary CIP are new facilities which B-E/GEI believes will enhance existing operations. These CIP facilities are highly recommended to be implemented but are not as essential as primary CIP facilities. Those facilities recommended in discretionary CIP will increase system reliability during emergencies and other conditions impacting system supply capability, as well as provide an operating alternative for major facility rehabilitation or replacement. However, it is recognized the high relative cost of the discretionary CIP will require consensus from Member Agencies and rate payers to implement.

B-E/GEI is recommending approximately $1.1 million (2006 dollars) be available to either replace or rehabilitate existing facilities anticipated to reach the end of their useful lives before the end of the study period. Also included is a $100,000 allowance to renovate existing FMWD offices and $1.6 million to provide for new emergency operations and a SCADA system. Recommended secondary CIP new facilities include a 1 MG reservoir and interconnection between LCID and MCWC. Secondary CIP totals about $2.1 million. Discretionary facilities (a second MWD connection and pipeline intertie with LCID from the new reservoir) are estimated to cost $17.7 million (2006 dollars).

A total Do Nothing strategy is not feasible since a significant portion of the recommended CIP involves replacement or rehabilitation of existing facilities which are essential to maintaining good operating conditions. Otherwise, supply capability of the existing FMWD system would be compromised or diminished. On the other hand, it is at least feasible to delay the new facilities recommended in this Master Plan, including the second MWD connection, associated reservoir and connective pipelines to LCID and MCWC facilities until after the current study period analysis. However, implementing the recommended new facilities proposed in this Master Plan will lay the groundwork strategy for eventual pipeline replacement which will eventually be required in any case.

ES 11 Rate Impacts and Cost Allocation

Discussed in Section 11 are revenue requirements and sources of capital funding which FMWD needs to consider in funding the recommended capital improvement plan contained in this Master Plan. Also presented are potential rate impacts occurring from CIP financing as well as potential negative revenue impacts to FMWD from the increased use of groundwater injection and in-lieu imported water deliveries. Finally, a discussion is included on the issue of CIP cost allocation between the Member Agencies according to benefits received. There are a variety of capital funding sources which can potentially be utilized to finance new facilities associated with water resource projects. These include pay as you go, grants, low interest loans, bonds, certificates of participation and public-private partnerships.

Pay As You Go capital funding refers to meeting construction payment obligations from current operating revenues as construction proceeds. Obviously, if a construction budget is large in relation to the available margin of revenues above expenses for the project proponent, this approach is not feasible. Pay As You Go financing is not anticipated to be feasible to implement the major CIP facilities (second MWD connection) recommended in this Master Plan.

No current grant programs for clean water infrastructure facilities are believed to be available by the federal government. In view of the recent southeastern US hurricane damage impacting numerous water and wastewater system facilities, it is unlikely any non-earmarked federal grant programs for water facility construction outside of this region will be available for the foreseeable future.

California has one current grant program available to finance water infrastructure. Proposition 50 authorized the Legislature to appropriate funds for Integrated Regional Water Management (IRWM) projects. This source of grant funding is probably not feasible for FMWD CIP implementation, as projects most likely to be funded should be related to regional rather than local projects. There may be limited funds available through the recently passed Proposition 84 program for FMWD CIP; but the program details have not yet been established.

As with grant programs, both the federal and state governments frequently have low interest loan programs available to support water infrastructure projects. No low interest federal loans were identified which might be a source of financing for the FMWD CIP implementation.

The State Water Conservation Bond Law of 1988 (Proposition 82) continues to have construction money available for public agency water system financing. However, there is only about $11 million left in the program and there is some question of whether or not FMWD could comply with the loan requirements. An alternative source is offered through the State Infrastructure Bank. Loans are subsidized and can be 30-years in term, but are limited to $10 million per project. Loan requirements are quite flexible, however, and if the City of Glendale participates in the discretionary CIP program, this financing avenue may be feasible. Revenue bonds are used to finance capital infrastructure which is revenue producing. Revenue bonds are special obligations of the issuing entity with repayment solely from the revenues produced by the constructed infrastructure and from no other source of funds. Normally, revenues derived from the constructed facilities must also be sufficient to cover the cost of maintaining and operating the facility.

It may be feasible to transfer a portion of the capital costs of a new MWD connection by sharing in capacity or asset ownership with the City of Glendale. B-E/GEI believes this facility may assist in Glendale’s water service in its northern higher elevations. Initial contact with the City suggested a lack of strong motivation for the project. However, if

FMWD proceeds with the recommended second MWD connection, further discussion should be held with the City to invite participation either in joint asset ownership or capacity sharing with associated capital cost contribution.

There are various alternative land secured taxes (property taxes) available to utilize in generating revenues to guarantee or support capital repayment. These include general ad valorem taxes, special taxes (Mello Roos), special assessments and water standby and/or delivery parcel fees. Other potential sources of repayment revenues include user charges, pump taxes or replenishment assessment fees, development impact fees, connection or capacity fees, and reserve funds.

B-E/GEI has projected potential rates to both FMWD and Member Agencies based on implementation of the primary, secondary and discretionary CIP. In view of the uncertainty in obtaining a grant, participation financing from the City of Glendale for discretionary CIP or a low interest loan, the rate analysis assumes pay as you go funding for primary CIP; and conventional revenue bond public agency financing for both secondary and discretionary CIP. Revenue projections to support bond financing are made at a level of 90 percent of the revenue level actually anticipated to account for variance in demands. The FMWD rate for primary CIP is projected to increase from a 2006 level of $105 per acre foot to $151 at the end of the study period (2015).

Implementing the secondary CIP will require revenue bond financing of approximately $2.23 million in addition to the pay as you go financing for the primary CIP. With a 20-year amortization bond FMWD rates will increase (for both primary and secondary CIP) from $105 per acre-foot in 2006 to $163 per acre-foot in 2015. The discretionary CIP (including financing of the secondary CIP plus pay as you go primary financing) would require an estimated total revenue bond of $21.2 million. FMWD rate increases would be significant, increasing to $298 per acre-foot in the first year of CIP implementation, to $328 in the second year and then declining to $316 per acre-foot in year 2015.

As part of the Master Plan analysis on potential rate impacts which would occur from implementing the recommended CIP, B-E/GEI also considered potential negative revenue impacts to FMWD which are likely to occur over the coming years from the increase in use of injection, and in-lieu imported water deliveries as the Raymond Basin conjunctive use programs are implemented.

B-E/GEI believes that FMWD should collect an equal surcharge on all water deliveries made through its system regardless of purpose. If the FMWD administrative and operations surcharge is not applied to all deliveries, purveyors having access to Raymond Basin pumping will have a disproportionate economic advantage over the other purveyor customers of FMWD. Allowing a net shortfall in revenues to occur will ultimately result in FMWD having to raise its rates on firm deliveries which would result in a higher economic impact to non Raymond Basin producers. Revenue shortfalls could amount to $100,000 per year. It is recognized that purveyors which take deliveries through groundwater production long term storage accounts (thereby reducing direct FMWD deliveries) will occur at indeterminate years in the future. At such times, FMWD will experience a revenue shortfall for the year as these excess groundwater production deliveries in-lieu of direct imported water deliveries are made. Accordingly, **we recommend a separate reserve fund be created to receive surcharge amounts collected on interruptible deliveries to balance future revenue levels.**

FMWD embraces the concept of “beneficiary pays.” That is, recommended capital improvements that may be necessary should be constructed and paid for by a Member Agency, or Member Agencies, which benefit. There are many cost allocation approaches utilized by wholesale water agencies for distributing capital costs among Member Agencies. The allocation percentages of many water supply facilities, when provided for different purposes require engineering and economic judgment. If annual delivery capability is the only item under consideration, it is necessary to define whether these percentages should be based on annual flow, peak flow, design flow, or emergency capacity. As a result, professional judgment is required in making cost allocation percentages. Three primary cost allocation approaches include proportional use of facilities, zone of benefit, and “postage stamp” rate methodology.

Clearly, the primary CIP recommended in this Master Plan affects all Member Agencies, although not all facilities impact all purveyors equally. However, almost all of the Primary CIP involves replacement or improvement of existing facilities which will benefit all Member Agencies. No cost allocation is believed warranted for the primary CIP.

Secondary and discretionary CIP is recommended essentially to provide support in emergency operations (including area wide forest fires), future replacement of pipeline facilities and reliability to the entire system in cases of Upper Feeder outages. The Eastside Member Agencies on average receive approximately one-third of total imported water deliveries. Accordingly, it is estimated these purveyors would provide the same proportional level of capital contribution in rates if secondary and discretionary CIP is not specifically allocated. In emergency operations, it is projected 5 to 6 cfs of increased flow could be realized by opening the bypass at P-1 to route water from the west to east. Consequently, during an emergency or outage approximately one-third of the new facilities capacity (5 or 6 cfs compared to 15.7 cfs new connection capacity) would be available to the Eastside. This is a comparable level of estimated capital contribution under current rate policy. Accordingly, at this time, **B-E/GEI does not recommend special cost allocation be applied for any of the recommended CIP (primary, secondary or discretionary).**

B-E/GEI recommends FMWD implement a continuance of Pay As You Go financing for the recommended primary CIP. This would follow the existing financing strategy of the District and would avoid both financing issuance costs and interest carrying costs. **If FMWD elects to implement the recommended secondary CIP, then revenue bond**

financing should be utilized with the State Infrastructure Bank, the most likely best source. Additional grant funding is not likely for these localized system improvements. A financing strategy for including **discretionary CIP (additional connection to MWD) includes in depth discussions with the City of Glendale for its potential participation and financing in the project and aggressive pursuit of any available grant funds** as discussed above. **Revenue bond financing would again be implemented** through the State Infrastructure Bank.

1 Introduction

This introduction to the Foothill Municipal Water District (FMWD) Master Plan discusses the background of FMWD, the principles by which the Plan was developed and a presentation of the organization of subsequent sections.

1.1 Foothill Municipal Water District

FMWD is a member agency of The Metropolitan Water District of Southern California (MWD), created in 1952 for the express purpose of delivering imported water supplies from the Colorado River into its approximate 22 square mile service area encompassing the unincorporated Los Angeles County areas of La Crescenta and Altadena, plus the incorporated urban area of La Cañada Flintridge. During the initial years of operation, FMWD provided less than 20 percent of the service area demands through imported water supplies. However, the area's reliance on imported water as a supplemental source of supply has grown with urban development so that in recent years, imported water deliveries have made up on the order of 60 percent of total demand.

Increasing demands for imported water deliveries have been particularly acute over the last decade. From fiscal year 1994-95 through 2003-04, firm imported water deliveries have increased from a level of about 7,500 to almost 14,000 acre-feet annually, (although it should be noted the highest quantity of water delivery was for only one year; other recent annual amounts have varied from about 10,000 to 12,000 acre-feet). This nearly doubling of deliveries represents an approximate 6 percent annual increase in demand for imported water during this recent time period. Peaking demands on FMWD's delivery system have also increased during this time period as associated annual demands have increased.

In view of these significant recent water demand increases on FMWD's system and the ages of many of the originally constructed facilities exceeding 50 years, FMWD retained Bookman-Edmonston/GEI Consultants, Inc. (BE/GEI) in early 2006 to prepare a system Master Plan to address these and other issues. The Plan forecasting period is 10 years through 2015 with consideration of subsequent years as warranted and feasible. A copy of the scope of work contained in the District's Request for Proposals is contained in Appendix A to this Plan.

1.2 Master Plan Principles

In May 2005, FMWD published a Strategic Plan to provide a framework to conduct current and future operations and planning for the District. Contained within the plan are organizational strategic goals and objectives which provide the principles by which this Master Plan was developed. Based on the strategic plan development and related input from the public, the Board of Directors adopted the following mission statement: ***Foothill Municipal Water District will reliably deliver quality water to its member agencies in a cost efficient manner to meet their projected demands.*** The Master Plan principles presented below reflect this mission statement plus many of the strategic goals and objectives presented in the Strategic Plan.

1.2.1 Customer Service

One of the nine Strategic Plan focus areas presenting goals and objectives of the District is customer service. The stated goal is to continue to provide high quality service to FMWD customers. FMWD also states that it is interested in improving its customer service to meet the increasing expectations of its member agencies (customers). This Master Plan furthers the District's goal to provide high quality service by carefully assessing future demand requirements under various operating scenarios from member agencies as growth in each individual water system and service area occurs. This Master Plan also addresses many of the other issues relating to customer service such as providing a high level of water quality for delivered supplies.

1.2.2 Proactive Planning

In order to continue to provide a high level of reliable water service to its member agencies at a cost efficient basis, it is essential that proactive planning be undertaken by the District and its staff in order to anticipate future needs and problems facing the District in the next decade and beyond. Such planning also needs to consider the potential for a major facility failure and the need to establish an approach to replace transmission mains at the end of their useful lives. This Master Plan is one of the elements needed to be proactive in the planning efforts necessary to continue the historical record of high quality service provided by FMWD.

1.2.3 Reliability

Contained in the mission statement quoted above, FMWD states that it will reliably deliver quality water to its member agencies. In view of the critical dependence that the member agencies have on FMWD in supplying imported water deliveries to the area, reliability of service is essential. Each of the member agencies has a different level of dependence on FMWD currently ranging from no imported water deliveries provided to Kinneloa Irrigation District to 100 percent of the water supply depended upon by Mesa Crest Water Company. In order to further define reliability as a planning concept to support the preparation of this Master Plan, the District commissioned a study by Malcolm Pirnie, Inc. to help define the term "reliability". A copy of the study report and its findings is presented in Appendix B to this Master Plan. This Master Plan takes into account the reliability study findings and recommendations.

1.2.4 Fiscal Responsibility

As stated above in the District's mission statement, FMWD is committed to deliver water supplies in a cost efficient manner to meet the projected demands of Member Agencies, with the goal of maintaining the financial health of FMWD. The Strategic Plan focus area of finance contains the objectives to increase the efficiency of FMWD operations to minimize the magnitude of rate increases and work with the Board of Directors on a determination of funding mechanisms for capital improvements. This Master Plan has been developed with the goal of optimizing current facility operations, as well as implementing new infrastructure improvements, with a view to minimizing the overall cost and associated rate impacts resulting from improvement recommendations. Also contained in this Master Plan is a discussion of financing and Member Agency cost allocation for new facilities construction.

1.3 Master Plan Organization

This Master Plan provides a comprehensive assessment of the water delivery system components and related issues challenging FMWD as it plans for the next 10 years and succeeding years into the future. It is believed this Plan will assist the FMWD Board of Directors and staff in making strategic and facility planning decisions. It is also believed that this Master Plan will assist the eight retail purveyors, actually or potentially receiving supplementary imported water supplies from FMWD, as they participate in making these decisions over the coming decade. The Master Plan sections are organized as follows:

- Section 1 presents an introduction to the Master Plan, an overview of the history and purpose of FMWD, principles which guided the preparation of the Master Plan, and organization of the Master Plan document.

- Section 2 presents service area descriptions for FMWD and its retail purveyors, and system operating characteristics for each retail agency which must be understood in order to develop projected demands on FMWD's system for imported water supplies. Also included is an overview of the FMWD delivery system.

- Section 3 contains historic and projected growth and related demands on the FMWD system based on individual retail purveyor projected demands over the next decade both in terms of connections and unit water use per connection. Also presented in this section are estimates of purveyor local surface and groundwater supplies.

- Section 4 contains an analysis and discussion of the sources of supply available to FMWD. Discussed are supply reliability from MWD, the capacity of the FMWD connection to MWD, groundwater resources for both the Verdugo and Raymond Basins (available to retail agencies thereby offsetting demands on FMWD), the potential use of reclaimed water within the service area and a discussion on the potential for a second connection to MWD.

- Section 5 provides an evaluation of existing facilities comprising the FMWD system, including pipelines and appurtenances, pumping plants, storage facilities, and miscellaneous assets. Also included is an analysis of electricity usage and savings potential; plus the feasibility of utilizing natural gas as a pumping plant energy source.

- Section 6 contains an analysis of peaking and supply capability for the FMWD system. Also included is an assessment of system capacities during increased temporary Member Agency demands and discussion of the mitigation of the FMWD peaking factor.

- Section 7 addresses storage requirements for the FMWD system taking into consideration the storage capacity available to the retail agencies.

- Section 8 contains a description of the Foothill conjunctive use project with MWD in the Raymond Basin and its infrastructure requirements. This project and related facilities are a component of this Master Plan.

- Section 9 contains a discussion on water quality issues pertaining to the use and delivery of imported water supplies. Also discussed are primary water quality issues relating to groundwater production.

- Section 10 presents recommended facilities and a schedule for implementing projected new or replaced facilities anticipated to be required under the Master Plan.

- Section 11 contains a discussion of potential rate impacts, financing and cost allocation for new facilities construction.

2 Service Areas and Operating Characteristics

This section presents descriptions of service areas and operating characteristics for FMWD and each of its' Member Agencies.

2.1 Foothill Municipal Water District

There are eight retail Member Agencies within the FMWD service area, which individually receive varying amounts of annual imported water deliveries ranging from zero to 100 percent of source of supply. Following Figure 1 presents a service area map for FMWD, also showing the member agency service areas. FMWD's service area is generally physically separated by the Arroyo Seco with retail agencies located either in the western or eastern portions of the District. Those retail service areas within the western portion of the District include Crescenta Valley Water District, La Cañada Irrigation District, Valley Water Company and Mesa Crest Water Company. These service areas in the western portion of FMWD are adjacent to each other. The eastern portion of the District includes the retail member agencies of Lincoln Avenue Water Company, Las Flores Water Company and Rubio Cañon Land and Water Association. These service areas are also contiguous to each other. All of these eastern service areas serve generally within the unincorporated Los Angeles County area of Altadena. Finally, an eighth retail member agency, Kinneloa Irrigation District, is located at the far eastern edge of the FMWD service area and separated by one to two miles from the other eastern service areas. Kinneloa is adjacent to and north of the service areas of the cities of Pasadena and Sierra Madre. FMWD does not currently serve imported water supplies to the Kinneloa Irrigation District.

The FMWD system is designed to provide imported water supplies to three service areas: Eastern (also named Altadena), Central (also named La Cañada) and Berkshire (also known as La Crescenta). Each service area is served by two reservoirs separately ranging in size from 1 to 1.4 MG. Imported water is delivered from MWD's 116-inch diameter Upper Feeder through a nominal 40 cfs connection (FM-1) located near the Rose Bowl (Seco Street and Rosemont Avenue). After traveling through short lengths of smaller diameter pipes and metering, water is transmitted through approximately 6,500 feet of 39-inch cement mortar lined and coated (CMLC) steel pipeline to the main pumping plant P-1. At this juncture, water is pumped both to the West and East side service areas with four booster pumps devoted to each side. Figure 2 (following Figure 1 below) presents a schematic of the FMWD distribution system presenting the transmission lines, reservoirs and member agency turnouts.

FIGURE 1

MAP OF FMWD

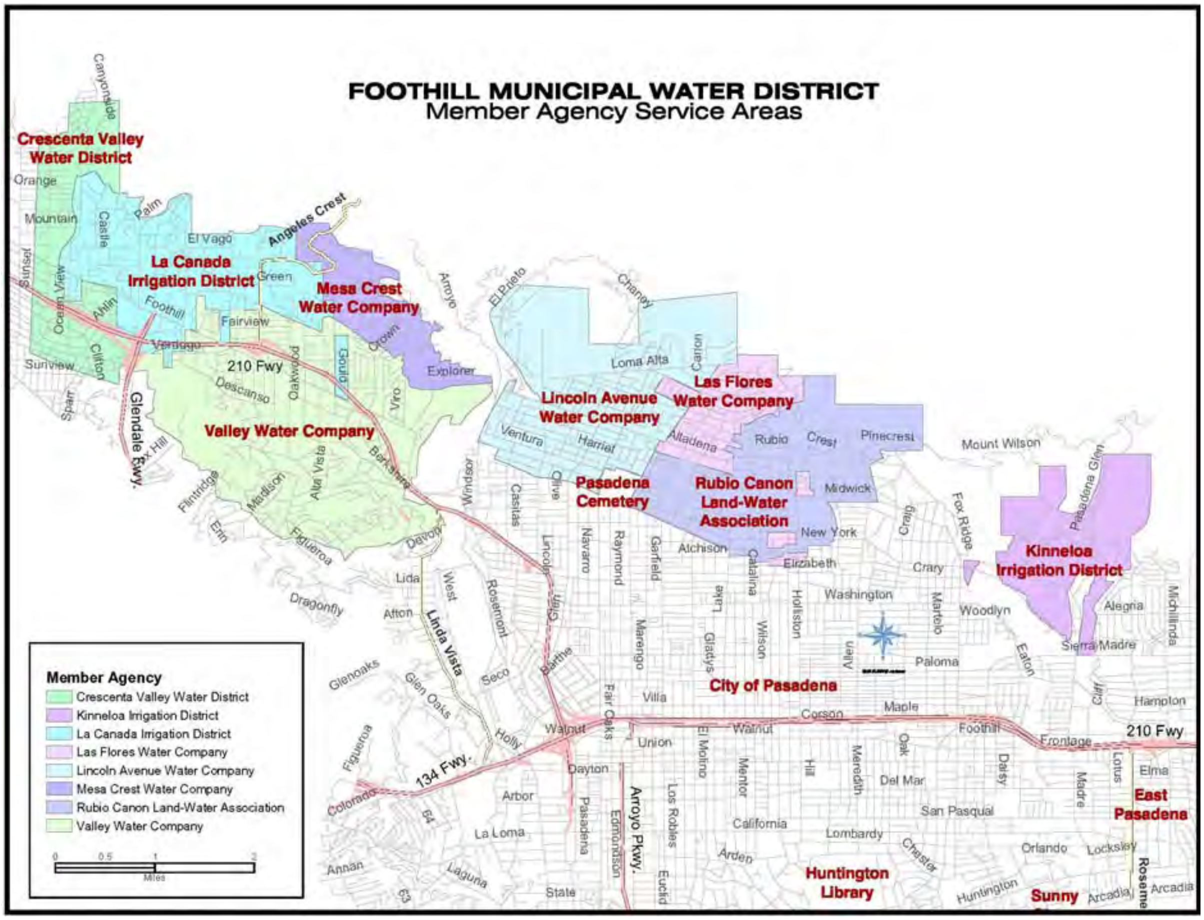
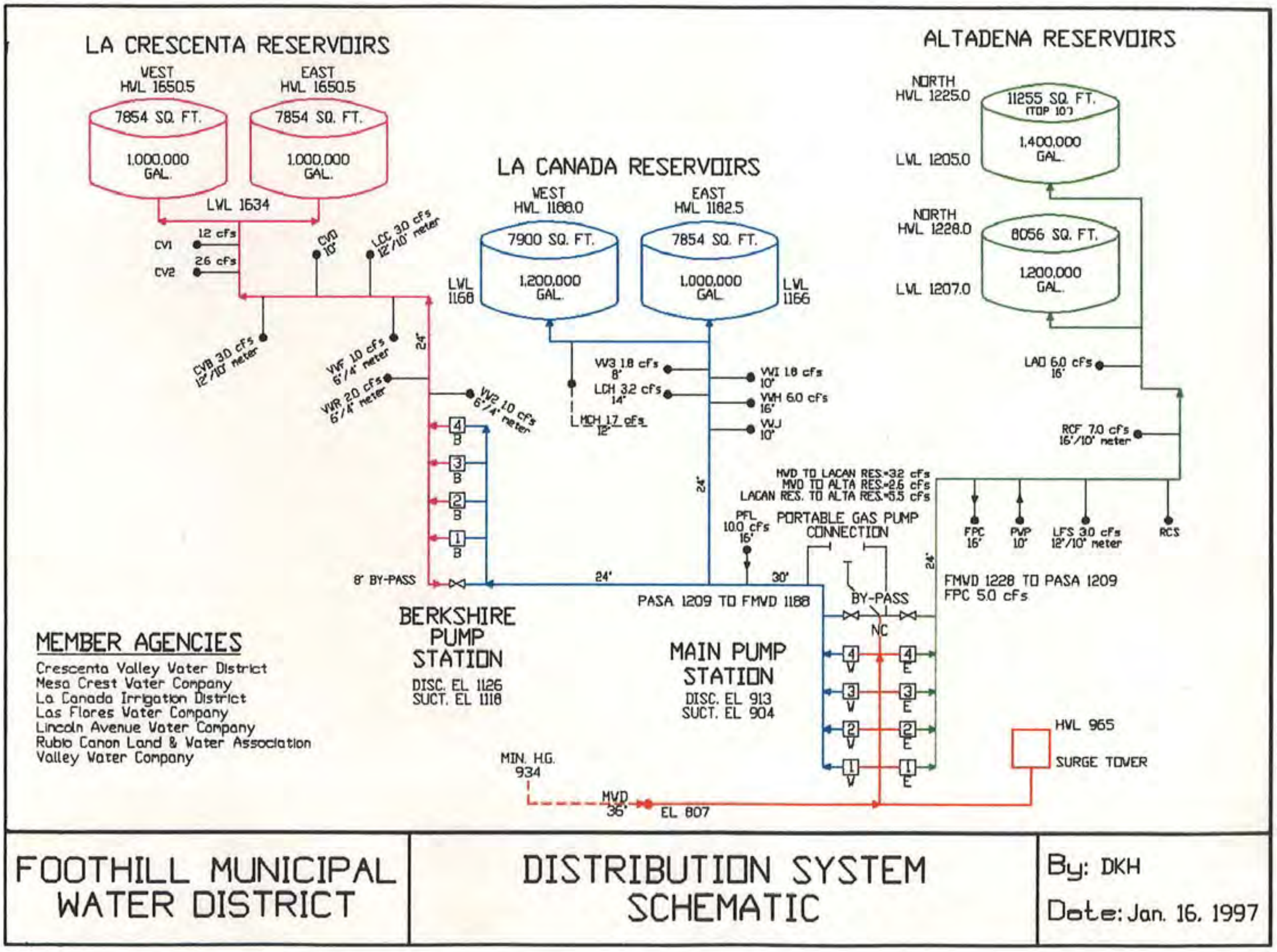


FIGURE 2

DISTRIBUTION SYSTEM SCHEMATIC



Pumps on the West side include three 3,150 gpm and one at 1,655 gpm; those on the East side vary from 1,080 to 2,025 gpm. The West side pumps together can normally deliver 22.5 cfs. East side pumps together can normally deliver 12.5 cfs. With the East side transmission main closed, and an open by-pass, all pumps together can increase the flow to the West side to 29 cfs. As part of the implementation of the Foothill CUP (see Section 8) FMWD is installing fifth pumps on each service side to increase capacities to 27 and 16 cfs for the West side and East side respectively, for a total of 42 cfs from FM-1.

East side pumps at P-1 lift water to the Altadena Reservoirs through a 11,800 foot 24-inch diameter cement mortar lined and coated (CMLC) steel pipeline with turnout service to the three East side purveyors along the route. West side pumps transmit water through the Central service area to the La Cañada Reservoirs utilizing approximately 1,000 feet of 36-inch, 8,000 feet of 30-inch and 3,500 feet of 24-inch diameter CMLC steel pipelines.

An 18,600 foot 24-inch extension bifurcates from the Central area pipeline to carry water to the Berkshire service area and La Crescenta reservoirs. Water is boosted from the beginning of this pipeline through pumping plant P-2. The Berkshire pumping plant contains four pumps and motors (B-1 through B-4), with two at 1,795 gpm, one at 1,935 gpm; and the remaining unit a variable frequency drive. All four associated motors are 300 horsepower.

FMWD currently has two interconnections with the City of Pasadena, one 10 cfs connection at Linda Vista Drive delivering water to the La Cañada Reservoirs of FMWD from the City and the other interconnection at a Caltrans service yard on the East side service area of FMWD delivering water up to 5 cfs to the City.

2.2 Retail Member Agencies

The following sub-sections discuss the service areas and operating characteristics for the individual member agencies within the FMWD.

2.2.1 Crescenta Valley Water District

Crescenta Valley Water District (CVWD) is the western most retail member of FMWD primarily serving the community of La Crescenta. The CVWD service area encompasses approximately four square miles serving customers within the unincorporated areas of La Crescenta and Montrose, in addition to small portions of the cities of Glendale and La Cañada Flintridge. CVWD is adjacent to the City of Glendale on the south and west, and bounded by La Cañada Irrigation District on the east. The northern boundary of the District adjoins Angeles National Forest. CVWD is the largest retail member agency served by FMWD containing approximately 8,100 service connections, or approximately 1/3 of the total retail customers within the FMWD service area. CVWD is experiencing densification of its housing structures (i.e. conversion of single family dwellings to multi-unit residences). However, in recent years, service area school enrollment has been declining. Growth in the number of connections served by CVWD is anticipated to be minimal over the next decade.

Urban development within the service area is primarily residential with two commercial corridors along Foothill Boulevard and Honolulu Avenue. There are no industrial or agricultural water users within the District. The current estimated population within the CVWD is on the order of 25,000.

CVWD provides service through eleven pressure zones and sixteen pumping stations. Service area elevations vary from approximately 1,200 feet to almost 3,000 feet above sea level. There are seventeen storage reservoirs in the distribution system totaling 17.5 million gallons. The two primary sources of supply for CVWD include imported water purchases from FMWD and groundwater pumping through twelve groundwater wells located in the Verdugo Basin. CVWD obtains approximately one-half of its water supply from groundwater sources with the remainder being supplied by FMWD imported supplies on a long term basis. From year to year, imported water deliveries vary from about 40 to 60 percent of total production. On an acre-foot basis, during the last decade, CVWD imported water purchases have varied from a level of about 1,000 to slightly over 3,000 acre-feet. The District has connection capacity with FMWD on the Berkshire transmission main of 8.85 cfs. CVWD also has a minor water supply source from local tunnel water which yields, on the average, about 50 to 60 acre-feet annually. The District anticipates that growth in the District’s water demand will be met by additional purchases from FMWD.

CVWD pumps groundwater from the Verdugo Basin based on annual adjudicated rights of 3,294 acre-feet. The Verdugo Basin is a sub-basin of the San Fernando Basin and was adjudicated in a 1979 court decision. The basin is under the control of a watermaster who may allow excess pumping on an annual basis if there is a surplus condition. Total production by CVWD and the other adjudicated pumper, the City of Glendale, cannot exceed an annual yield of 7,150 acre-feet in the absence of a surplus condition. However, if one party does not produce its whole adjudicated right in a given year, the other producer may be allowed excess pumping. In recent years, the City of Glendale has not produced its full entitlement. It is the goal of CVWD, that, conditions permitting, the District will pump, close to its adjudicated right of 3,294 acre-feet per year in the Verdugo Basin. The District is currently faced with potential production reductions due to MTBE contamination in the basin.

CVWD has several emergency interconnections with adjoining purveyors, as well as plans for construction of one additional facility. Recently, CVWD constructed an interconnection with the City of Glendale with a capacity of 5 cfs. This connection at New York and Honolulu Boulevards is for emergency use only to receive imported water at a cost of the FMWD rate plus $100 per acre-foot. The District has also proposed to construct a new interconnection for emergency service purposes with the City of Los Angles Department of Water and Power. This connection is planned for delivery of about 1,000 gpm. CVWD also has two emergency interconnections with adjacent La Cañada Irrigation District, each rated at from 400 to 500 gpm, and each one-way only but in different directions. Finally, the City of Glendale and CVWD have established six dedicated fire hydrant connections for emergency water transfer use. Utilizing the District's service connection with FMWD and the latter's interconnections with the City of Pasadena, theoretically emergency water can be transferred from Burbank to Glendale to Crescenta Valley to La Cañada Flintridge to Pasadena. However, currently these interconnection routes are envisioned to be activated only during emergency conditions.

2.2.2 La Cañada Irrigation District

The La Cañada Irrigation District (LCID) was formed in 1924 to serve a portion of the community of La Cañada Flintridge and adjoining unincorporated areas. LCID is primarily located north of the 210 Freeway, extending to Ocean View Boulevard to the west and approximately Gould Avenue to the east. The District also abuts the Angeles National Forest to the north. LCID serves about 2,900 service connections of which all but about 100 are residential. The few non-residential connections are commercial and irrigation. The current estimated population in the LCID service area is on the order of 9,000. Although there are not many vacant lots available for development, a significant portion of LCID's service area has been undergoing the process of conversion from smaller homes to larger residences (mansionization).

LCID relies on imported water from FMWD for about 90 percent of its source of supply. Its remaining sources of supply include surface water from Pickens Canyon and groundwater production from the Raymond Basin. Each of these secondary sources supplies about 5 percent of demands. The two infiltration tunnels in Pickens Canyon have a maximum combined capacity of about 300 gpm, but flow is dependent on hydrologic conditions. Groundwater production is accomplished through two wells located in the Raymond Basin (Monk Hill sub-area). Well Nos. 1 and 6 have capacities of 500 and 750 gpm respectively. LCID has a Raymond Basin groundwater right of 100 acre-feet annually. In addition, the District participates in the Long Term Storage Program which allows a maximum storage of 2,300 acre-feet to be withdrawn when needed. LCID maintains seven storage tanks with a total capacity of just over 6 MG. The District has plans to add one additional tank of 1 MG capacity in the near future. LCID receives imported water from two locations, one 1,600 gpm connection at Castle Road (Berkshire line) and the other 1,500 gpm connection at Hampton Road (Central line). As indicated above, LCID has two interconnections with CVWD, each 400 to 500 gpm and one-way but in different directions. LCID is reviewing the feasibility of rehabilitating two emergency interconnections with Valley Water Company for mutual benefit, one at Old Flanders Road (8-inch) and the other at the La Cañada Reservoir site. Consideration is also being given to a two way interconnection with Mesa Crest Water Company at Starlight Crest Drive and Angeles Crest Highway (6- or 8-inch).

2.2.3 Mesa Crest Water Company

Mesa Crest Water Company (MCWC) is an investor owned water utility regulated by the California Public Utilities Commission (PUC) which serves approximately 700 customers located in the northeastern portion of FMWD's western agencies in the area of the La Cañada

Flintridge golf course. Most of its customers are residential users, although the utility does have a small number of large water users including public authorities and irrigation. MCWC has experienced basically no growth in recent years, with only one home being added to the system in the last five years. The area has experienced many remodels and only a few home tear downs. Remodeled structures expanded to 5,000 square feet require an upgrade of fire flow from 1,250 to 2,500 gpm. If not attainable, sprinklers can be installed. One large area potentially which could be developed is a 110 acre golf course. This tract of land has a sole owner who after many decades of ownership may be interested in transferring the property. However, development of this golf course to single family homes is unlikely in the next ten years because of community opposition to other development proposals and in view of there not being current proposed plans to develop the golf course.

The sole source of supply for MCWC is imported water delivered from FMWD. The company can receive 1.7 cfs (763 gpm) from FMWD. Theoretically, if both pumps at the MCWC booster station (100 horse power each) were operated simultaneously the amount of water delivered could reach 3.4 cfs. Transmission lines for the system are designed for this higher flow. However, MCWC expressed some hesitation whether or not this was feasible due to the pressure head and age of the pipelines. The system is designed with four pressure zones which contain five reservoirs totaling 3.5 MG. Normally, tanks are not drawn down more than half way. During peak summer days, MCWC must peak off of storage. MCWC will use about one foot per day or 100,000 gallons from the 2.0 MG reservoir in addition to the 1.7 cfs flow capacity from FMWD. Demand flexibility comes from the ability to reduce deliveries to the golf course for 2 to 3 days (as the course has internal ponds it can draw from).

At present, MCWC does not have any interconnections with adjacent purveyors. MCWC is considering the installation of an interconnection with LCID at Starlight Crest Drive and Angeles Crest Highway where the two systems are in close proximity. The proposed connection would be 6-inch or 8-inch and designed for two-way flow.

2.2.4 Valley Water Company

Valley Water Company (VWC) was incorporated in 1910 as a non-profit mutual water company initially to provide a water supply to agricultural users in the area of La Cañada Flintridge. With urban development over the years, VWC today serves almost entirely residential customers in addition to limited commercial customers along Foothill Boulevard. VWC has a service area of approximately 2,400 acres in the City of La Cañada Flintridge encompassing approximately 3,585 service connections. Growth historically has been minimal in recent years and is expected to remain at this level for the foreseeable future. However, some mansionization is occurring as homeowners construct larger homes in place of existing structures. Although there are approximately 40 acres of mountainous areas which potentially could be developed, the City has an adopted policy of limited growth designed to retain the community's existing natural character, thereby making full development of these areas unlikely.

Historically, VWC has relied on imported water supplies from FMWD for approximately 70 percent of its source of supply with the remaining 30 percent produced from groundwater production in the Raymond Basin. The VWC operates four production wells, each with a capacity of approximately 1,000 gpm. Two of the four (well Nos. 1 and 4) are operated primarily for groundwater production and two (well Nos. 2 and 3) are operated primarily for injection of imported water into the groundwater basin (although these latter facilities can be used also for production). VWC possesses 797 acre-feet of annual groundwater pumping rights in the Raymond Basin and additionally injects winter imported water supplies at a level of about 500 to 700 acre-feet per year to accrue production credits. Currently, the company has approximately 1,500 acre-feet of long term credit built up in the Raymond Basin which can be used at any time. Well production is primarily constant from May through October but peaking to meet high demands is accomplished by increasing deliveries of imported water supplies. It is believed that well production could probably meet average demands without deliveries from FMWD. VWC operates five pressure zones to serve its customers and has 5 reservoir sites totaling approximately 5.4 MG of storage.

VWC has two emergency interconnections with the City of Pasadena (capacities of 800 gpm each). One interconnection allows for water to be delivered to either purveyor. The remaining interconnection provides water only to the City. The company is reviewing the feasibility of rehabilitating two emergency interconnections with LCID for mutual benefit. One 8-inch connection is located at Old Flanders Road and the other is located at the La Cañada Reservoir site.

2.2.5 Lincoln Avenue Water Company

Lincoln Avenue Water Company (LAWC) was formed as a mutual water company (not for profit) in 1883 to serve customers in the western portion of unincorporated Altadena. Today the company provides service to approximately 4,415 customers, of which 97 percent are residential. The remaining 3 percent (149) are commercial and government services. LAWC is the western most service area of the eastern purveyors with the northern service boundary abutting US Forest Service land. There are no longer any significant parcels available for large scale development but the service area population has tended towards slightly larger family size. Housing density remains relatively stable, however.

Service is provided through eight pressure zones with four pumping stations containing 16 pumps having a total capacity of about 15,500 gallons per minute. The system also has 13 storage tanks with a total capacity of 11.44 MG. LAWC has three sources of water supply which include groundwater from the Monk Hill sub-basin of the Raymond Basin, local surface water and FMWD imported water. The company utilizes two wells, Nos. 3 and 5, with capacities of 900 and 1,100 gpm respectively. Groundwater rights in the Raymond

Basin total 567 acre-feet per year. In the past, LAWC has leased water rights from the City of Pasadena in the Raymond Basin; however, the City will not currently lease water rights as it anticipates it will soon pump and treat its own rights. Well No. 5 has been modified to allow Raymond Basin injection for long term storage for later withdrawal in times of emergency and drought. LAWC also relies on local surface water collected from Millard Canyon and treated in a filtration plant which can produce up to about 700 gpm depending on precipitation. In a normal year, the company receives about 150 acre-feet from this source. Surface water which recharges the ground water from canyon runoff also results in Raymond Basin production credits to the company of up to 465 acre-feet annually depending on precipitation. LAWC takes FMWD imported water in the non-peak months and shifts primary reliance to groundwater in the summer period. However, the system continues to peak off of FMWD resources.

LAWC has one interconnection with Las Flores Water Company which can flow in either direction. The flow rate is determined by the elevation of the receiving agency reservoir. The company also has three interconnections with the City of Pasadena. One is believed to be two-way (300 gpm), one flowing only to Pasadena (1,000 gpm) and the last one unknown. A potential interconnection could be implemented with Rubio Cañon Land and Water Association (RCLWA). However, this is currently not under consideration.

2.2.6 Las Flores Water Company

Las Flores Water Company (LFWC) is a mutual water company (not for profit) located between LAWC and RCLWA serving the unincorporated area of Altadena. The company provides service to approximately 1,472 metered connections almost all of which are single family residences (with only about 2 percent of total services consisting of commercial small business and others). There has been virtually no growth over the last seventeen years with only one connection added during the most recent four years. Water sales have also been consistent over many years, varying only with the effects of temperature. The service area is currently experiencing minimal or no conversion to multi-unit dwellings.

LFWC delivers annual demands on the order of 975 acre-feet consisting of approximately 300 acre-feet of groundwater from the Raymond Basin and the remainder from imported water delivered by FMWD. The company has approximately 250 acre-feet of annual groundwater pumping rights in the Raymond Basin plus receives on the order of 50 acre-feet credit additional rights for surface water recharge which has been consistent over past years. Currently, the company also possesses about 20 to 30 acre-feet in long term storage rights. LFWC relies on a 650 gpm well (Mountain View Well No. 2) for groundwater production. The service area is divided into three pressure zones each served by pumping stations to maintain adequate pressure changes. The two highest pressure zones also contain five reservoirs providing a total storage capacity of 4.55 MG.

LFWC has a one-way interconnection with RCLWA with flow direction to the latter. There is a potential for a two-way interconnection with RCLWA at the LFWC maintenance yard. Additionally, the company has one two-way interconnection with LAWC.

2.2.7 Rubio Cañon Land and Water Association

Rubio Cañon Land and Water Association (RCLWA) serves an estimated 3,147 connections in the central and eastern area of Altadena, an unincorporated area in Los Angeles County north of Pasadena. This purveyor is a non-profit association chartered as a mutual water company. Almost 90 percent of its customers are single family residential or small apartments or condominiums. As with nearby LFWC, RCLWA’s service area is stable with essentially no growth in the recent past nor projected for the future. In fact, in the last 2 decades only 47 additional connections have been added to the system. Future water demand variances are expected to be solely based on meteorological conditions. The association also indicates that its service area is not anticipated to experience changes in characteristics such as a densification of housing. The association reports in its UWMP that although there is a remote possibility of future development in the foothill regions at the base of the San Gabriel Mountains, initial steps by developers to construct homes in these areas have been met with considerable public opposition.

RCLWA’s projected water demand during normal precipitation is on the order of 2,500 acre-feet annually. The company has two wells to produce about 60 percent of its demands from the Raymond Basin based on adjudicated annual rights of 1,221 acre-feet plus annual recharge credits. In addition, the association may develop up to 15 percent of its annual demands with adequate rainfall from mountain runoff. The remaining water demands are met through imported water supplies delivered by FMWD. The UWMP prepared by the association indicates that over the last 2 decades, approximately 35 percent of its supply was derived from imported water deliveries. Unlike the other FMWD member agencies, RCLWA operates its system to receive imported water during non summer months in order to make use of lower priced water. During the summer period (June-October) the association relies on groundwater production for its primary source of supply receiving only very limited amounts of imported water deliveries. The RCLWA system also contains four storage reservoirs totaling approximately 7.8 MG.

RCLWA currently has two interconnections, one 8-inch (700 gpm) with the City of Pasadena (two-way) and one with LFWC (one way with service to RCLWA). Three potential interconnections have been identified for consideration. One two-way interconnection with LFWC as indicated above under the discussion for that member agency, one two-way interconnection with LAWC (also indicated above) and a third potential interconnection with the City of Pasadena for wheeling treated groundwater supplies.

2.2.8 Kinneloa Irrigation District

Kinneloa Irrigation District (KID) is located within unincorporated area of Los Angeles County northeast of the City of Pasadena. The District extends onto the slopes of the San Gabriel Mountains and is surrounded by the City of Pasadena on three sides. The District is also located on the eastern edge of the FMWD service area and is separated from the existing imported water facilities by approximately six to seven miles. There are currently approximately 600 connections, almost all of which are residential, with only an estimated 25 to 30 individual parcels in the District which may be developed in the future. A recent development within the KID service area contains 21 large homes that have landscaping anticipated to require extensive water use.

KID obtains its entire water supply from groundwater pumping and tunnel production supplying surface runoff (which is considered groundwater by the Department of Health Services). KID has 516 acre-feet of groundwater rights in the Raymond Basin which are supplemented each year by credit received from surface runoff from tunnel flow which recharges the basin adding to KID’s annual entitlement for pumping. Groundwater recharge credit can accrue to KID’s account up to 1,600 acre-feet per year. Credit in long term storage can also be accrued by not pumping all of the agency’s entitlement. The District currently has about 334 acre-feet in long term storage.

KID operates two wells to serve its system demands with the larger utilized throughout the year and the smaller well typically pumped only in summer months. KID has the groundwater pumping capacity to produce all of its groundwater rights.

KID has two interconnections with the City of Pasadena. In general, the two agencies interchange water through these interconnections with water balance differences settled with deliveries. The District has an agreement with Pasadena to sell to the City the District’s excess groundwater and, on occasion, produce Pasadena’s groundwater on behalf of the City. Also, on occasion, KID serves supplies to an isolated area of Pasadena that is difficult for the later to serve. The District would like to resize these interconnections from 2 and 4-inches to 6 and 8-inches as it sees no real opportunities for additional interconnections with other agencies.

3 Historic and Projected Demands

This section presents annual historic and projected water demands for FMWD and its retail Member Agencies. Also included in this section is a description of water requirements and the forecasting method B-E/GEI utilized in projecting demands for FMWD and its Member Agencies. Anticipated growth in retail water connections for each purveyor service area over the next decade and per connection water use is projected for both a normal precipitation year and a year of dry or below normal rainfall conditions. Finally, addressed in this section is the potential for a future connection by KID connecting to FMWD's existing distribution system. Anticipated representative peaking factors for each retail agency are presented in Section 6.

3.1 Water Requirements and Forecasting Method

Water systems, including both FMWD and its Member Agencies, must be designed and operated in order to provide water supplies at rates which may fluctuate over a wide range. Water demand patterns vary considerably on a yearly, monthly, daily and hourly basis, with higher demands occurring during dry years and in hot periods. Additionally, hourly demands typically follow, at least for a retail purveyor, a diurnal pattern, with hourly peak demands in the early morning and late afternoon, and normally the lowest demands during night time periods.

Water demand parameters most important to analyze are average day demand, maximum day demand and maximum hour demand. Average day demand is simply the total water use annually divided by the number of days in the year. The average day use is frequently used as a basis for deriving the maximum day and maximum hour demands. The maximum day demand is the maximum quantity of water delivered on any one day of the year. Typically, many water system infrastructure facilities are designed to meet the maximum day demand plus some level of margin for planning uncertainties. The water system supply facilities must be able to supply water at the maximum day demand. The peak rate of water delivery during any one hour during the year is known as the maximum hour demand. Maximum hour demands are typically satisfied by storage facilities plus source of supply facilities. Additionally, the sizes of transmission and distribution mains must be adequate to deliver maximum hour demands. If available, historic water production and sales records are analyzed to derive these commonly used system parameters for design requirements. For this Master Plan, adequate historic records were available from both FMWD and Member Agencies for B-E/GEI to assess average and peak day historic water demands.

Several commonly used methods of forecasting water demands include extrapolation of historical demands, and projection of either per capita or per connection demands.

Extrapolation of historic demands is typically used as a screening approach over short time periods (five years or less) to preliminarily identify facility or operational problems potentially needing to be addressed in the short term. Historic extrapolation is typically refined by more detailed methods. Demand projections for longer time periods can either be accomplished by developing future per capita or per connection consumption. In the case of this Master Plan, historic per connection consumption data for FMWD Member Agencies was readily available to assess future consumption patterns based on ongoing trends and changes in service area characteristics. Also, growth in future connections was easier to analyze as opposed to assessing growth in population (the County of Los Angeles does not project growth for limited areas such as FMWD's service area). Therefore, for these reasons, B-E/GEI selected a demand projection approach based on connection growth and per connection unit consumption.

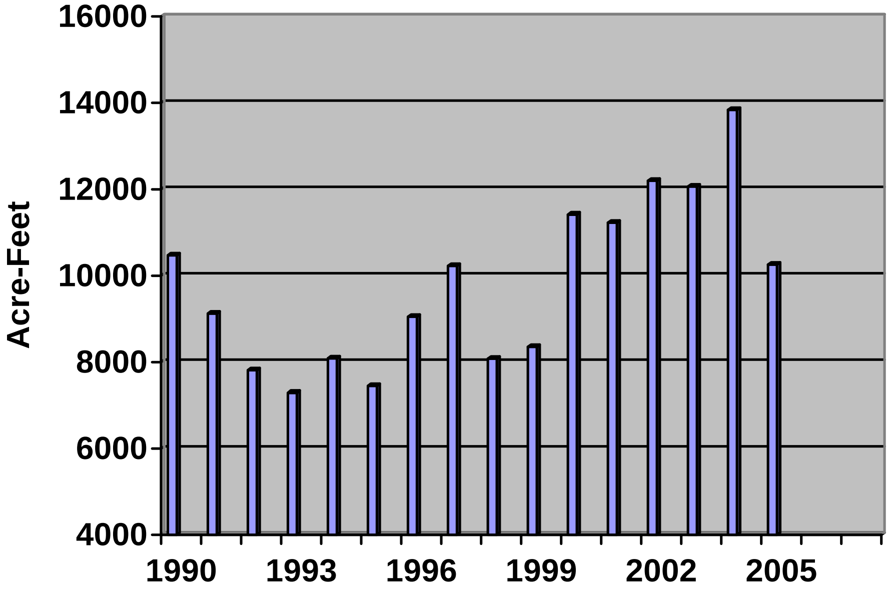
Additionally, it should be noted that B-E/GEI believes, based on the potential connection growth, as reflected in available land for development and changes in housing characteristics, the projected number of connections at the end of the study period is very close to full buildout for the FMWD service area.

3.2 Historic FMWD Water Demands

Figure 3 presents the annual firm water deliveries for FMWD since fiscal year ending 1990.

FIGURE 3

FIRM WATER SALES



As indicated in Section 1, increasing demands for imported water deliveries have been particularly acute over the last decade. From fiscal year 1994-95 through 2003-04, firm imported water deliveries have increased from a level of about 7,500 to almost 14,000 acre-feet annually (although it should be noted the highest quantity of water delivery was for only one year; other recent annual amounts have varied from about 10,000 to 12,000 acre-feet). This nearly doubling of deliveries represents an approximate 6 percent annual increase in demand for imported water during this recent time period.

In addition to firm water deliveries, FMWD has also delivered imported water supplies for groundwater replenishment through well injection. These deliveries have increased from about 500 to 1,400 acre-feet annually over the last five years (2000-01 through 2004-05).

3.3 Retail Member Agency Historic and Future Water Demands

The following subsections present an assessment of historic and future water demands for each of the eight Member Agencies of FMWD.

3.3.1 Crescenta Valley Water District

Presented below are annual water production, connections and unit usage from fiscal year 1996-97 through 2004-05 for CVWD. The source of the data is FMWD’s monthly data sheets. Also shown is a hydrologic generalization for annual precipitation (wet, dry, or normal). As shown below, growth has been only modest during the 9-year period showing an increase of 116 connections in 8 years, or about 14 per year. This indicates an annual increase of less than 0.2 percent per year.

CVWD’s 2005 Urban Water Management Plan (UWMP) estimates that the population will increase from about 38,500 in 2005 to 39,000 in 2015. This is an increase of about 1.3 percent or less than 0.2 percent annually. The projected increase is about 105 connections for the service area over the next 10 years.

TABLE 1

CVWD HISTORIC WATER USE

Year	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	5530.6	7984	0.69
1997-98	Wet	4910.2	7990	0.61
1998-99	Dry	5365.9	8010	0.67
1999-00	Dry	5854.3	8019	0.73
2000-01	Normal	5567.2	8036	0.69
2001-02	Dry	5873.1	8053	0.73
2002-03	Normal	5617.9	8064	0.70
2003-04	Dry	5918.1	8095	0.73
2004-05	Wet	5303.0	8100	0.65
Average Annual Use per connection				0.69
Average during normal years				0.69

As shown, the average annual unit use (which includes unaccounted for water in addition to retail sales) of the 9-year period is 0.69 AF/connection varying from 0.61 to 0.73 representing a 6 percent variance annually from the mean for wet and dry years. The average usage during normal years is 0.69 AF/connection. In comparison, a dry year usage (2003-04) is approximately 6 percent higher. Use per connection does not appear to be changing except for variability in the climate.

An initial projection of demands can be formed based on B-E/GEI’s engineering judgment, historic data and input from the District. The 1.3% growth rate (based on projected population) results in an additional 105 service connections, or about 10 per year (densification may affect the estimated number of increased connections; however, the population increase accounts for this factor making the connection growth valid on an equivalent basis). Conservatively, annual demands can be projected using a per unit usage of 0.69 AF/connection. Consequently, total normal water usage in CVWD for 2015 is anticipated to be 5,661 acre-feet.

Analysis of the use per connection during the 9-year period shows that the maximum unit use occurred in the dry year 2003-04 at 0.73 AF/connection. A projection of dry year annual use can be formed using this use per connection. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected at 5,990 acre-feet.

3.3.2 La Cañada Irrigation District

LCID has stated that there are not many lots available for new construction. However, selected parcels in the area are undergoing the process of being converted from smaller homes to larger homes (mansionization). LCID is of the opinion that the number of residents increase with these larger homes. LCID's 2005 UWMP projects an increase in population from about 9,000 in 2005 to 9,130 in 2015, about a 1.5 percent increase. However, the water deliveries are projected to increase from 2,801 acre-feet in 2005 to 3,000 acre-feet in 2015, an increase of 7 percent. Projected water use suggests that the number of connections will increase by about 45. LCID produces about 10 percent of its total supply from local sources. The remaining, including peaking, comes from imported supplies purchased through FMWD.

Presented in the table below is LCID's use per connection (which includes unaccounted for water in addition to retail sales) based on data from FMWD. The table shows that LCID's unit use is generally between 1.00 and 1.10 AF/connection. There are three outliers to this range. Two of these were dry to very dry years. The dry year 1998-99 was below the range while the dry year 2003-04 was above the range. Usage during 1997-98, a very wet year, was below this range.

TABLE 2

LCID HISTORIC WATER USE

Year	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	3015.2	2863	1.05
1997-98	Wet	2485.5	2868	0.87
1998-99	Dry	2707.9	2877	0.94
1999-00	Dry	3166.3	2884	1.10
2000-01	Normal	2943.6	2892	1.02
2002-03	Normal	2945.5	2897	1.02
2003-04	Dry	3379.2	2899	1.17
2004-05	Wet	2938.2	2903	1.01
Average				1.03
Average of normal years				1.03

As shown, the average annual use per connection of the 9-year period is 1.03 AF/connection, varying from 0.87 to 1.17 representing a 15% and 14% variance annually from the mean for both wet and dry years, respectively. The average usage during normal years of precipitation is also 1.03 AF/connection. In comparison, a dry year usage (2003-04) is approximately 14 percent higher.

B-E considered the ongoing process of mansionization in the LCID service area and its potential impact to water use per connection (with an estimated one-third of potential larger home conversions completed). Increased water usage is not indicated in normal precipitation years from 1996-97 to 2001-02 (actually decreasing from 1.05 to 1.02 AF/connection). However, wet years usage has increased by about 16 percent from 1997-98 (0.87 AF/connection) to 2004-05 (1.01 AF/connection). Dry year usage is more difficult to interpret as B-E considers 1998-99 as somewhat anomalous (less than the normal year usage two years earlier) and the dry year 2003-04, the sixth year during a dry period. Nevertheless, it appears that dry year usage is increasing (particularly in view of the increase from 1.10 AF/connection in 1999-00 to 1.17 AF/connection in 2003-04). Accordingly, projected increased water usage is warranted from the process of larger home construction in the service area and is taken into account in the water use projections below.

A projection of demands can be formed based on B-E/GEI's engineering judgment, historic data and input from the District. The 7 percent growth (based on LCID's projected demands) results in an additional 45 equivalent service connections, or about 5 per year. Conservatively, normal annual demands in 2006 can be projected using the normal historic annual per unit usage of 1.03AF/connection, the historic average use per connection during a normal precipitation year increasing about one percent or 0.01 AF/connection per year over the term of the Study. Consequently, total water usage in LCID is anticipated to be at a maximum normal amount of 2,994 acre-feet in 2006 increasing to 3,302 acre-feet in 2015 (1.12 AF/connection). Dry year usage would have a similar increased use.

Analysis of the usage during the 9-year period shows that the maximum use per connection occurred in the dry year 2003-04 at 1.17 AF/connection. A projection of dry year annual use can be formed using this use per connection initially in 2006 plus the increased dry year usage annually as discussed above. Consequently, the annual usage in a dry year can be conservatively projected as 3,401 acre-feet in 2006 increasing annually to 3,714 acre-feet in 2015.

LCID has three sources of water to meet the demands of its customers: groundwater, local water and imported supplies through FMWD. LCID has a decreed right of 100 acre-feet in the Monk Hill subarea of the Raymond Basin. Table 2 in LCID's UWMP shows that groundwater production by LCID is about 150 acre-feet in most years (groundwater right plus local runoff recharge credit). The UWMP projects that LCID will produce 150 acre-feet of groundwater in any given year. In addition, LCID collects an additional quantity of water from tunnels. In a normal year, it is projected that approximately 75 acre-feet of water will be collected in the tunnels. The 225 acre-feet of tunnel water and groundwater represent less than 10 percent of demands from customers of LCID. The balance of demand must be met through purchases from FMWD.

It is recognized that B-E/GEI's projection of LCID water demands in 2015 is approximately 10 percent higher than the projection contained in the 2005 UWMP. This may in part be explained by B-E/GEI's approach in accounting for higher water use as a result of service area mansionization. In any case, the potential higher overall use projection is consistent with the methodology applied to other FMWD Member Agencies, and is, therefore, considered to be appropriate to rely on in this Master Plan.

3.3.3 Valley Water Company

Based on historic experience and Company input, VWC is expected to have little or no growth over the next 10 years. Tabulated below is the use per connection based on data provided by FMWD. The historic 9-year period indicates that the expected increase in connections would be around 6 per year. VWC's 2005 UWMP projects the population to increase from 9,000 to 9,400 over this same period requiring an additional 25 acre-feet of water supply. Based on the estimated existing ratio of 2.5 people per connection and an increase of 400 in the population, the equivalent increase in connections is indicated to be 160. Some of this population increase may be attributed to higher density housing or more residents per household. Based on an increase of 25 acre-feet and an annual use per connection (see below) of 1.41 AF/connection the equivalent increase in connections is indicated to be 18. Projecting the previous 8 years of growth for the next 10 years yields an increase of 64 connections. B-E/GEI believes that it is prudent to assume the historical growth in connections will continue over the term of the Master Plan. Accordingly, it is assumed that VWC connections will increase by 64 over the next 10 years.

The tabulation presented below indicates that use per connection in the VWC service area has increased over the 9-year period.

TABLE 3

VWC HISTORIC WATER USE

Year	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	4229.8	3525	1.20
1997-98	Wet	3656.4	3528	1.04
1998-99	Dry	4100.0	3512	1.17
1999-00	Dry	4613.8	3538	1.30
2000-01	Normal	4316.7	3552	1.22
2001-02	Dry	4639.3	3554	1.31
2002-03	Normal	4437.4	3570	1.24
2003-04	Dry	5038.9	3576	1.41
2004-05	Wet	4768.5	3581	1.33
Average				1.25
Average of normal years				1.22

As shown, the average annual use per connection of the 9-year period is 1.25 AF/connection, varying from 1.04 to 1.41 representing a 17 percent and 13 percent variance annually from the mean for wet and dry years respectively. The average usage during normal precipitation years is 1.22 AF/connection. In comparison, a dry year usage (2003-04) is approximately 16 percent higher.

A projection of demands can be formed based on B-E/GEI’s engineering judgment, historic data and input from the Company. The 1.7 percent connection growth (based on historical growth of connections) results in an additional 64 service connections, or about 6 per year. Conservatively, normal annual demands can be projected using the 1.24 AF/connection initially for 2006 (the maximum use per connection during a normal precipitation year) increasing by 0.01 AF/connection to recognize that some trend towards higher use may be occurring in the service area. Consequently, total water usage in VWC for 2006 is anticipated to be a normal amount of 4,448 acre-feet and 4,845 in 2015.

Analysis of the usage during the 9-year period shows that the maximum use per connection occurred in the dry year 2003-04 at 1.41 AF/connection. A projection of dry year annual use can be formed using this unit use in 2006 increasing thereafter by 0.01 AF/connection annually to 1.50 AF/connection in 2015. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected as 5,465 acre-feet.

3.3.4 Mesa Crest Water Company

MCWC is expected to have minimal growth over the next 10 years. The golf course is the one large area that could potentially be developed but this is not expected to happen in the next decade in view of the absence of current proposed plans and the considerable resistance to growth mounted by the community to other development projects. From 1996-97 through 2001-02 growth in the system was about 4 connections per year. Only one connection has been added since 2001-02. Further, based on the character of the service area development it is not anticipated that either mansionization or densification will occur during the term of the Master Plan Study.

MCWC is completely reliant upon FMWD for its supplies. Any increase in demand from MCWC's customers will place an equivalent demand upon FMWD.

The use per connection (which includes unaccounted for water in addition to retail sales) is presented below (FMWD annual data sheets). Two years stand out when reviewing use per connection: 1997-98, a very wet year, and 1998-99, a very dry year. These two years are significantly lower in unit water use when compared to other years of similar climatology. Otherwise, it does not appear that the use per connection in the MCWC system is changing and, in fact, is relatively consistent over the last six years (with the exception of 2003-04, a dry year).

TABLE 4

MCWC HISTORIC WATER USE

Year	Precipitation	Total Water Produced	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	664.5	689	0.96
1997-98	Wet	535.1	693 (a)	0.77
1998-99	Dry	602.4	697 (a)	0.86
1999-00	Dry	711.9	702	1.01
2000-01	Normal	674.1	706	0.95
2001-02	Dry	742.9	709	1.05
2002-03	Normal	706.5	709	1.00
2003-04	Dry	789.2	710	1.11
2004-05	Wet	686.1	710	0.97
Average				0.96
Average of normal years				0.97

(a) Straight line interpolation from prior and succeeding years.

As shown, the average annual unit use of the 9-year period is 0.96 AF/connection, varying from 0.77 to 1.11 representing a 20 percent and 15 percent variance annually from the mean for wet and dry years respectively. The average usage during normal years of precipitation is 0.97 AF/connection. In comparison, a dry year usage (2003-04) is approximately 14 percent higher.

Based on B-E/GEI's engineering judgment, historic data and input from the Company, a projection of new water connections can be assumed reasonable at 4 per year over the next 10 years. Projecting normal annual demands can be performed by utilizing the average normal historic usage at 0.97 AF/connection. The projected use in 2015 for MCWC is about 728 acre-feet per year.

Analysis of the use per connection during the 9-year period shows that the maximum unit use occurred in the dry year 2003-04 at 1.11 AF/connection. A projection of dry year annual use can be formed using this use per connection. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected as 833 acre-feet.

3.3.5 Lincoln Avenue Water Company

LAWC has stated that there are not many lots available for new construction. However, there may be limited development to higher density housing. Nevertheless, growth in new demand is anticipated to be modest in the next decade or more. Presented below are annual water deliveries, connections and unit usage from fiscal year 1996-97 through 2004-05. As shown, there has been a 49 percent increase in water delivered over the 9-year period compared to a 7 percent increase in the number of connections.

TABLE 5

LAWC HISTORIC WATER USE

Years	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	2304.7	4370	0.53
1997-98	Wet	2004.7	4443	0.45
1998-99	Dry	2141.0	4535	0.47
1999-00	Dry	2497.2	4625	0.54
2000-01	Normal	2454.0	4647	0.53
2001-02	Dry	2843.6	4666	0.61
2002-03	Normal	2831.6	4681	0.60
2003-04	Dry	3387.9	4685	0.72
2004-05	Wet	3439.9	4689	0.73
Average				0.58
Average during normal years				0.55

Unit water use has been increasing over the nine year period from about 0.5 to 0.7 AF/connection. However, it should be noted that LAWC has delivered water historically through an interconnection to the City of Pasadena (322.7 acre-feet in 2003 and 403.4 acre-feet in 2004). Use per connection is likely about 0.65 AF/connection or less in these two years. LAWC's 2005 UWMP projects a growth of about 3 percent in the population from 2005 to 2015 but lower demands on account of the further implementation of conservation programs.

A projection of demands can be formed based on B-E/GEI's engineering judgment, historic data and input from the Company. The 3 percent growth results in an additional 242 service connections, or about 24 per year (an annual connection growth of 0.5 percent). Conservatively, annual demands can be projected using an annual unit usage amount of 0.63 acre-feet per connection which gives greater weight to the last four years of water demand considering the increasing trend over the period of record. Consequently, total water usage in LAWC for 2015 is anticipated to be at a normal amount of 3,107 acre-feet.

Analysis of the use per connection during the 9-year period shows that the maximum use occurred in the very dry year 2003-04 at 0.65 AF/connection (taking into account deliveries to the City of Pasadena). A projection of dry year annual use can be formed using this use per connection. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected as 3,205 acre-feet.

LAWC has three sources of water to meet the demands of its customers: groundwater, local water and imported supplies through FMWD. LAWC has a decreed right of 567 acre-feet of groundwater production in the Raymond Basin. In addition, LAWC receives a spreading credit (up to 465 acre-feet per year) based on the flows from Millard Canyon and El Prieto Canyon. LAWC does lease groundwater production rights for its use when available and reasonable. Between 2000 and 2004, LAWC has had groundwater production that ranged from a low of 927 acre-feet to a high of 1,574 acre-feet. The maximum year of production occurred during a year in which LAWC had an agreement with Pasadena for pumping and treating some of Pasadena's water for delivery to the City.

LAWC has a decreed right to surface water from Millard and El Prieto Canyons. The Company has a surface water treatment plant for waters collected from Millard Canyon with a capacity of 700 gpm. It is estimated that LAWC will receive about 300 acre-feet of surface water during normal years.

The balance of demand must be met through purchases of FMWD. LAWC projects that it will be able to produce about 1,000 acre-feet of groundwater and treat about 300 acre-feet of surface water in a normal precipitation year. That leaves a balance of 1,807 acre-feet in 2015 to be met with purchases from FMWD during normal years.

3.3.6 Las Flores Water Company

LFWC has experienced little to no growth over the last 9-year period with only 2 additional connections. Presented below are annual water deliveries, connections and unit usage from fiscal year 1996-97 through 2004-05. As shown, there has been virtually no change in the number of connections, and the total water delivered appears to have been a function of weather.

TABLE 6

LFWC HISTORIC WATER USE

Year	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	961.1	1470	0.65
1997-98	Wet	806.6	1470	0.55
1998-99	Dry	888.3	1470	0.60
1999-00	Dry	1012.5	1470	0.69
2000-01	Normal	971.2	1471	0.66
2001-02	Dry	1023.47	1471	0.70
2002-03	Normal	1002.1	1471	0.68
2003-04	Dry	1098.9	1472	0.75
2004-05	Wet	986.1	1472	0.67
Average Annual Use per Connection				0.66
Average of normal years				0.66

As shown, the average annual use per connection for the 9-year period is 0.66 AF/connection varying from 0.55 to 0.75 AF/connection representing a 17 percent and 14 percent variance annually from the mean for wet and dry years respectively. The average usage during normal years is 0.66 AF/connection. In comparison, a dry year usage (2003-04) is approximately 14 percent higher.

Based on B-E/GEI’s engineering judgment, historic data and input from the Company a reasonable projection of new water connections can be assumed that LFWC will gain one connection per year over the next 10 years for a total of 10 connections. Projecting annual demands can be performed by utilizing the average normal historic usage per connection at 0.66 acre-feet per year. The projected use in 2015 for LFWC is 978 acre-feet.

Analysis of the use per connection during the 9-year period shows that the maximum use per connection occurred in the dry year 2003-04 at 0.75 AF/connection. A projection of dry year annual use can be formed using this use per connection. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected as 1,112 acre-feet.

3.3.7 Rubio Cañon Land and Water Association

RCLWA does not anticipate a change in demand from that represented by the historical record. RCLWA does not anticipate an increase in the service area population – built out and no densification – nor does RCLWA anticipate a change in the water demand from their customer base –mansionization. RCLWA's UWMP indicates that there are currently 3,147 connections with a population of about 9,600. The UWMP also states that no change in future demand is anticipated.

A projection of growth can be made based on B-E/GEI's engineering judgment, historic data and discussions with the Association. To be conservative, it is assumed reasonable that the number of connections will potentially increase by 15 over the next 10 years based on historic experience.

RCLWA pumps about 60 percent of the system demand from the Raymond Basin (decreed right of 1,221 acre-feet in the Monk Hill Subarea) and treated surface water runoff can account for up to an additional 15 percent of demands. The balance of its demands comes from FMWD. Data from Exhibit 1 of RCLWA's Updated UWMP (December 27, 2005) shows that on average for the last 20 years, 65 percent of Rubio Canon's total supply comes from local sources and 35 percent is imported.

An analysis of RCLWA's use per connection (which includes unaccounted for water in addition to retail sales) in the following table (FMWD data sheets) shows that usage is generally consistent.

TABLE 7

RCLWA HISTORIC WATER USE

Year	Precipitation	Total Water Produced (AF)	Connections	Annual Use per Connection (AF/connection)
1996-97	Normal	2473.9	3129	0.79
1997-98	Wet	2133.1	3133	0.68
1998-99	Dry	2315.3	3133	0.74
1999-00	Dry	2603.5	3134	0.83
2000-01	Normal	2443.0	3135	0.78
2001-02	Dry	2545.0	3135	0.81
2002-03	Normal	2546.9	3136	0.81
2003-04	Dry	2465.1	3142	0.88
2004-05	Wet	2584.8	3141	0.82
Average				0.79
Average of normal years				0.79

As shown, the average annual unit use for the 9-year period is 0.79 AF/connection varying from 0.68 to 0.88 representing a 14 percent and 11 percent variance annually from the mean for wet and dry years respectively. The average usage during normal years is 0.79 AF/connection. In comparison, a dry year usage (2003-04) is approximately 11 percent higher.

Projecting annual demands can be performed by utilizing the average normal annual historic usage per connection at 0.79 acre-feet per year. The projected use in 2015 for RCLWA is about 2,493 acre-feet.

Analysis of the use per connection during the 9-year period shows that the maximum unit use occurred in the dry year 2003-04 at 0.88 AF/connection. A projection of dry year annual use can be formed using this use per connection. Consequently, the annual usage in 2015 assuming a dry year can be conservatively projected as 2,777 acre-feet.

3.3.8 Kinneloa Irrigation District

Based on a review of current and future water requirements of KID compared to its existing supplies, it appears that it is very unlikely that this Member Agency will need imported water for the foreseeable future. This conclusion is based on an interview with the District’s General Manager, review of its operations reports, water master plan and annual system inspection report issued by the State Department of Health Services. KID currently delivers approximately 750 to 850 acre-feet annually of water (2000-05). The build out service area water demand is estimated at a level ranging from about 850 to 950 acre-feet per year. In order to meet this current and future demand, KID receives tunnel flow on the order of 150 to 350 acre-feet per year with the remaining demand anticipated to be met by groundwater production. However, future imported water supplies may be needed by KID from long term well failure, lost groundwater production from contamination or needed blending supplies for water quality issues.

As indicated above, the KID service area is approximately 1 to 2 miles separated from the existing FMWD service area. However, it is estimated approximately 6 miles or more of pipeline would be required to interconnect the KID system with the existing FMWD system. Accordingly, extending the FMWD system to serve KID would be very expensive. Alternatively, there are three identified approaches to serve imported water to KID if needed in the future, all of which are considered more economical than extending the FMWD existing system. These include:

- Purchase retail water supplies from Pasadena, perhaps with the need to upsize the existing interconnection depending on the level of supply needed.
- Wheel FMWD imported water supplies through Pasadena, again potentially needing to upsize the existing interconnection with KID or,
- Construct an MWD connection at the Upper Feeder which is located approximately 3,000 feet from the KID system.

Accordingly, it is concluded that it is highly unlikely that KID would ever have the need to connect to an extended FMWD imported water delivery system. Therefore, for purposes of this Master Plan, projections of FMWD demand growth and associated peaking requirements for system facilities are exclusive of the KID system and its customers.

3.3.9 Summary of Retail Water Agency Projected Connection Growth and Water Demands

Based on the above discussion, Table 8 presents a summary of projected connection growth for retail water agencies within the FMWD service area. As shown, total customers are anticipated to increase from about 24,600 at the end of 2005 to just over 25,100 through 2015, a total increase of approximately 500 connections through the study period. This represents a percentage change of about 2.0 percent total over the study period or less than one-quarter of one percent annually. **B-E/GEI recommends that FMWD compare total connection growth on an annual basis with Table 8 projections to confirm the continuing validity of the connection projections throughout the study period.** Actual growth in the FMWD service area connections substantially greater than the projections in this Master Plan might provide early notice of the need for an updated review sooner than the end of this study period (2015).

Tables 9 and 10 present summaries of the projected annual water demands in acre-feet for each retail agency and the totals for the FMWD service area based on both normal and dry hydrologic conditions. For normal hydrologic conditions, total water demands are anticipated to increase from an estimated 20,200 acre-feet in 2006 to 21,100 acre-feet in 2015, or approximately 900 acre-feet. This represents an overall increase of about 4.5 percent. Under the assumption of dry precipitation conditions, total water use is expected to be at a demand level of about 23,100 acre-feet in 2015, compared to 22,100 acre-feet in 2006, a difference of about 1,000 acre-feet.

TABLE 8

PROJECTION OF CONNECTION GROWTH FOR FMWD RETAIL AGENCIES

Agency	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crescenta Valley WD	8,100	8,111	8,121	8,132	8,142	8,153	8,163	8,174	8,184	8,195	8,205
La Cañada ID	2,903	2,908	2,912	2,917	2,921	2,926	2,930	2,935	2,939	2,944	2,948
Valley WC	3,581	3,587	3,593	3,600	3,606	3,612	3,618	3,624	3,631	3,637	3,643
Mesa Crest WC	710	714	718	722	726	730	734	738	742	746	750
Rubio Canon L&W	3,141	3,143	3,144	3,146	3,147	3,149	3,150	3,152	3,153	3,155	3,156
Lincoln Avenue WC	4,689	4,713	4,737	4,762	4,786	4,810	4,834	4,858	4,883	4,907	4,931
Las Flores WC	1,472	1,473	1,474	1,475	1,476	1,477	1,478	1,479	1,480	1,481	1,482
Total	24,596	24,648	24,700	24,752	24,804	24,856	24,907	24,959	25,011	25,063	25,115

TABLE 9

PROJECTION OF TOTAL SERVICE AREA WATER DEMAND GROWTH BASED ON NORMAL PRECIPITATION FOR THE PERIOD

Acre-Feet of Demand

Agency	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crescenta Valley WD	5,596	5,603	5,611	5,618	5,625	5,632	5,640	5,647	5,654	5,661
La Cañada ID	2,995	3,028	3,062	3,096	3,130	3,164	3,199	3,233	3,267	3,302
Valley WC	4,448	4,492	4,535	4,579	4,623	4,667	4,712	4,756	4,801	4,845
Mesa Crest WC	693	696	700	704	708	712	716	720	724	728
Rubio Canon L&W	2,483	2,484	2,485	2,486	2,487	2,489	2,490	2,491	2,492	2,493
Lincoln Avenue WC	2,969	2,985	3,000	3,015	3,030	3,046	3,061	3,076	3,091	3,107
Las Flores WC	972	973	974	974	975	975	976	977	977	978
Total	20,156	20,261	20,367	20,472	20,578	20,685	20,794	20,900	21,006	21,114

TABLE 10

PROJECTION OF TOTAL SERVICE AREA WATER DEMAND GROWTH BASED ON DRY PRECIPITATION FOR THE PERIOD

Acre-Feet of Demand

Agency	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crescenta Valley WD	5,921	5,928	5,936	5,944	5,951	5,959	5,967	5,974	5,982	5,990
La Cañada ID	3,402	3,436	3,471	3,505	3,540	3,575	3,609	3,644	3,679	3,714
Valley WC	5,058	5,103	5,147	5,192	5,237	5,283	5,328	5,373	5,419	5,465
Mesa Crest WC	793	797	801	806	810	815	819	824	828	833
Rubio Canon L&W	2,765	2,767	2,768	2,769	2,771	2,772	2,773	2,775	2,776	2,777
Lincoln Avenue WC	3,064	3,079	3,095	3,111	3,127	3,142	3,158	3,174	3,189	3,205
Las Flores WC	1,105	1,106	1,106	1,107	1,108	1,109	1,109	1,110	1,111	1,112
Total	22,108	22,216	22,324	22,434	22,544	22,655	22,763	22,874	22,984	23,096

3.4 Projected FMWD Water Demands

Based on the previous discussion and analysis of projected annual water demands for the entire service area (excluding KID) through 2015, annual demands on FMWD's system can be projected. However, local water supplies and groundwater production must first be assessed monthly and annually to determine what portion of the total demands will be met from these sources. B-E/GEI analyzed monthly groundwater production and local water deliveries for member agencies for years 2001 through 2003, plus reviewed UWMP's, State Department of Health Services Engineering and Annual Inspection Reports and conducted Member Agency interviews in order to project anticipated deliveries from local and groundwater sources during both normal and dry precipitation years. Appendix C contains a 2006 normalized monthly table of total water demands together with sources of supply to meet those demands from local supplies, groundwater production and FMWD imported deliveries. Appendix C also contains similar monthly data for the end of the study period (2015) for both normal and dry precipitation years.

Tables 11 and 12 present projections of FMWD imported water delivery demands annually for both normal and dry precipitation years through the study period based on demand projections for Member Agencies less local water sources and groundwater production. As shown, FMWD demands are anticipated to reach a level in 2015 of about 14,300 acre-feet for firm deliveries for a normal precipitation year and approximately 16,600 acre-feet during a dry year, with both hydrologic conditions indicating increases of 950 to 1,000 acre-feet annually over 2006. These results also represent increases of about 2,100 acre-feet or 17 percent over the last year of normal precipitation (12,200 acre-feet in 2001-02), and 2,800 acre-feet or 20 percent over the last year of dry precipitation (13,800 acre-feet in 2003-04). Figures 4 and 5 present total demands in the FMWD service area by source for both a normal and dry precipitation year. As shown, all growth in water demands for the entire service area is anticipated to be met by FMWD through increasing its deliveries.

TABLE 11

PROJECTION OF FMWD SYSTEM DEMAND BASED ON NORMAL PRECIPITATION FOR THE PERIOD

Acre-Feet of Demand

Agency	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crescenta Valley WD	2,246	2,252	2,260	2,267	2,275	2,281	2,289	2,296	2,304	2,310
La Cañada ID	2,822	2,855	2,890	2,923	2,958	2,991	3,026	3,060	3,095	3,129
Valley WC	3,651	3,694	3,739	3,783	3,826	3,870	3,914	3,960	4,004	4,048
Mesa Crest WC	693	697	700	704	708	712	716	720	724	728
Rubio Canon L&W	1,145	1,146	1,147	1,148	1,150	1,151	1,152	1,153	1,154	1,155
Lincoln Avenue WC	2,210	2,225	2,241	2,256	2,271	2,286	2,302	2,317	2,332	2,348
Las Flores WC	583	584	585	585	586	586	587	588	588	589
Total	13,349	13,452	13,561	13,665	13,773	13,876	13,985	14,093	14,200	14,306

TABLE 12

PROJECTION OF FMWD SYSTEM DEMAND BASED ON DRY PRECIPITATION FOR THE PERIOD

Acre-Feet of Demand

Agency	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crescenta Valley WD	2,575	2,582	2,590	2,598	2,606	2,613	2,621	2,628	2,636	2,644
La Cañada ID	3,245	3,279	3,314	3,348	3,383	3,418	3,453	3,487	3,523	3,557
Valley WC	4,261	4,305	4,351	4,396	4,440	4,485	4,530	4,577	4,622	4,668
Mesa Crest WC	793	797	801	806	810	815	819	824	828	833
Rubio Canon L&W	1,506	1,507	1,508	1,509	1,511	1,512	1,514	1,515	1,516	1,517
Lincoln Avenue WC	2,392	2,408	2,424	2,440	2,456	2,471	2,487	2,503	2,519	2,534
Las Flores WC	816	817	817	818	819	820	820	821	822	823
Total	15,587	15,694	15,804	15,914	16,024	16,133	16,243	16,354	16,465	16,575

FIGURE 4

TOTAL DEMANDS NORMAL YEAR

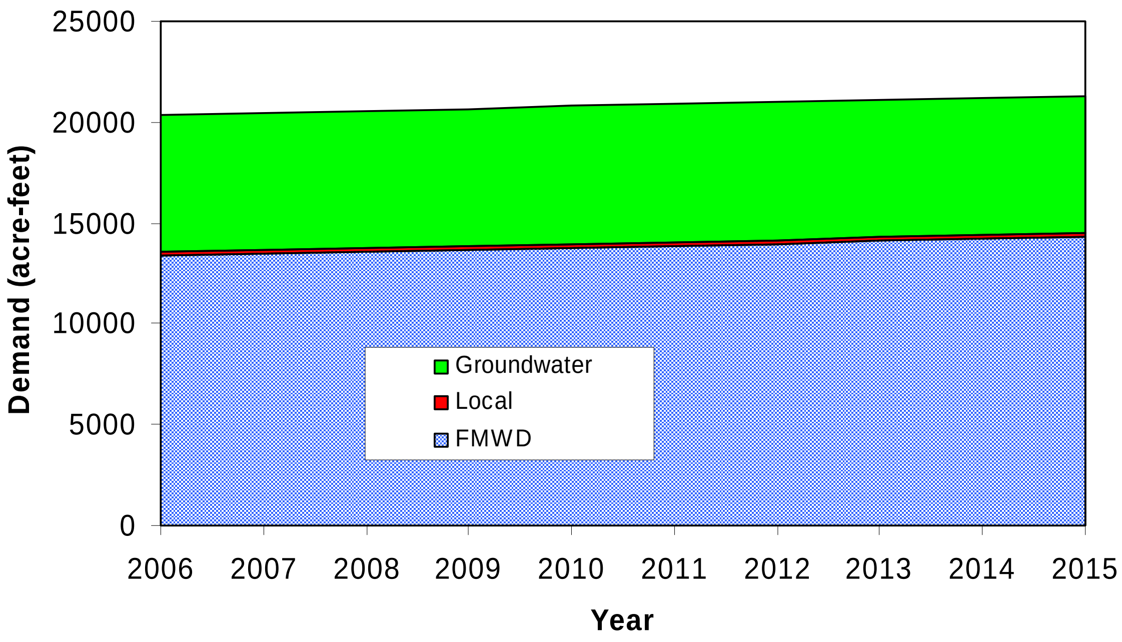
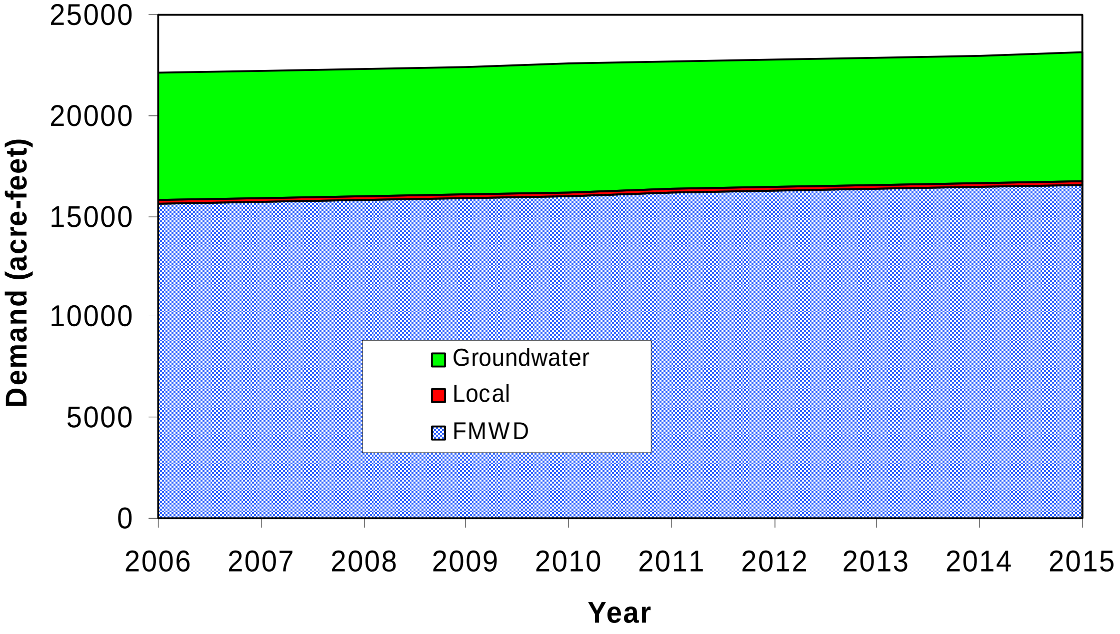


FIGURE 5

TOTAL DEMANDS DRY YEAR



4 Sources of Supply

This section discusses reliability and other issues related to imported water supplies available from MWD, as well as other potential sources of supply available to either FMWD or its Member Agencies. To the extent significant additional supplies are available to Member Agencies, future demands on FMWD would be mitigated.

4.1 Supply Reliability from MWDSC

In view of imported water supplies meeting on the order of two-thirds of total water demands in the FMWD service area, the reliability of MWD to meet delivery requirements of Member Agencies is critical. An assessment of the ability of MWD to meet current and future water demands needs to consider both water supply and system facility reliability.

4.1.1 Water Supply Reliability

MWD has a very aggressive program to provide a reliable water supply in its service area over the next several decades. This program is described in detail in its Regional Urban Water Management Plan (UWMP) dated November 2005. Following the requirements for an UWMP, the document identifies water supply for a single dry year, multiple dry years and an average year. To replicate these conditions, the report analyzes 1977 hydrology as a single dry year, 1990 to 1992 as a three year dry period and an average of 1922 to 2004 hydrogeologic conditions to derive a typical average year.

The report concludes that MWD has a high level of reliability of service in a single dry or multiple dry years extending through the UWMP study period of 2030. MWD has also identified an amount of buffer supplies under development which could meet unanticipated shortfalls or serve additional needs. The following Table 13 presents MWD's multiple dry-year supply capability and projected demands in acre-feet (repeat of 1990-1992 hydrology):

TABLE 13

MWD PROJECTED MULTIPLE DRY YEAR SUPPLY CAPABILITY AND DEMANDS

	2010	2015	2025	2030
Supply capability with maximum Colorado River Aqueduct of 1.25 million acre-feet	2,651,000	2,804,000	2,757,000	2,740,000
Firm demands on Metropolitan	2,392,000	2,302,000	2,448,000	2,585,000
Potential reserve and replenishment supplies	259,000	502,000	309,000	155,000

The report also discusses other potential water supply reliability risks. These include the potential losses from planned local and MWD programs not implemented, the loss of supply due to unknown water quality problems and catastrophic supply interruptions (such as earthquakes). For these reasons, MWD is planning for an additional 500,000 acre-foot per year buffer water supply.

Based on MWD's UWMP, it is highly probable that the agency has a reliable water supply for the next 25 years. Appendix D to this report contains the section of the MWD report on water supply reliability.

4.1.2 Facility Reliability

The 116-inch Upper Feeder is the MWD pipeline serving FMWD and provides treated water from the Weymouth Treatment Plant located in La Verne. The Upper Feeder was one of the initial facilities constructed by MWD in 1941. It is a steel pipeline terminating in Eagle Rock.

MWD has a very good track record of system reliability. There have been very few unscheduled shutdowns of facilities. Scheduled shutdowns typically occur at intervals measured in years. The MWD administrative code allows for winter shutdowns of up to seven days and member agencies are expected to have alternative supplies or storage to cover an interruption in imported water deliveries for these periods.

MWD has made a concerted effort to inspect facilities according to a carefully planned maintenance schedule and provide rehabilitation where needed. Typically, the items needing maintenance and replacement are distribution system appurtenant items such as air release and vacuum valves and the associated piping. MWD carefully plans the activities of a shutdown so that all maintenance matters can be addressed at that time. Failure of most of these items would not be catastrophic but more of an inconvenience. Accordingly, distribution system preventive maintenance through careful planning and an extensive maintenance schedule ensures outages are minimized and infrequent.

The Upper Feeder was shutdown in December 2006 for five days for inspection of gates at the San Gabriel Control structure and miscellaneous work (including work at Weymouth). The interior of the Upper Feeder pipeline was also carefully inspected by a walk through. The inspection revealed that several slide gates need replacement. MWD will proceed with final design followed by installation at a future date. Also, valves in the Eagle Rock outlet tower will be replaced.

4.1.3 Conclusions

Historically, MWD's water supply has been very reliable. MWD considers reliability to be a first order of business and maintains not only its supply with excess margins but also the delivery capability of its distribution and treatment systems. For maintenance purposes, shutdowns of up to seven days during the winter should be expected with occasional rare slightly longer periods.

4.2 Capacity of Foothill MWD Connection to MWDSC (FM-1)

FMWD receives treated imported water from MWD's 116-inch-diameter Upper Feeder at turnout FM-1 located at the vicinity of Seco Street and Rosemont Avenue in Pasadena near the Rose Bowl. The turnout is nominally designed to deliver 40 cubic feet per second (cfs). The minimum hydraulic grade line (HGL) at the turnout is 934 feet. At the turnout, there is a 14 foot long 24-inch pipe with a valve close to the connection point to MWD's Upper Feeder. After the 24-inch pipe, there is a 240 foot long 36-inch pipe. This 36-inch pipe is connected to a 39-inch pipe with a Venturi meter. The 39-inch pipe extends for about 6,500 feet. The end of this 39-inch pipe is connected to a 36.5-inch pipe with a 39-inch-to-36.5-inch reducer. The 36.5-inch pipe is 35.88 feet long and connected to the suction line of Pumping Plant P-1 through a 36-inch butterfly valve. The elevation of the centerline of the suction pipe is 904.5 feet.

Net Positive Suction Head Available (NPSHA) is defined as the actual fluid energy at the pump inlet (page 4-5, Civil Engineering Reference Manual, Michael R. Lindeburg, 1997). It can be expressed as follows:

$$NPSHA = h_a + h_s - h_f - h_{vp}$$

Where

h_a = Atmospheric head,

h_s = Static suction head, the vertical distance in feet above the centerline of the inlet to the free level of fluid source,

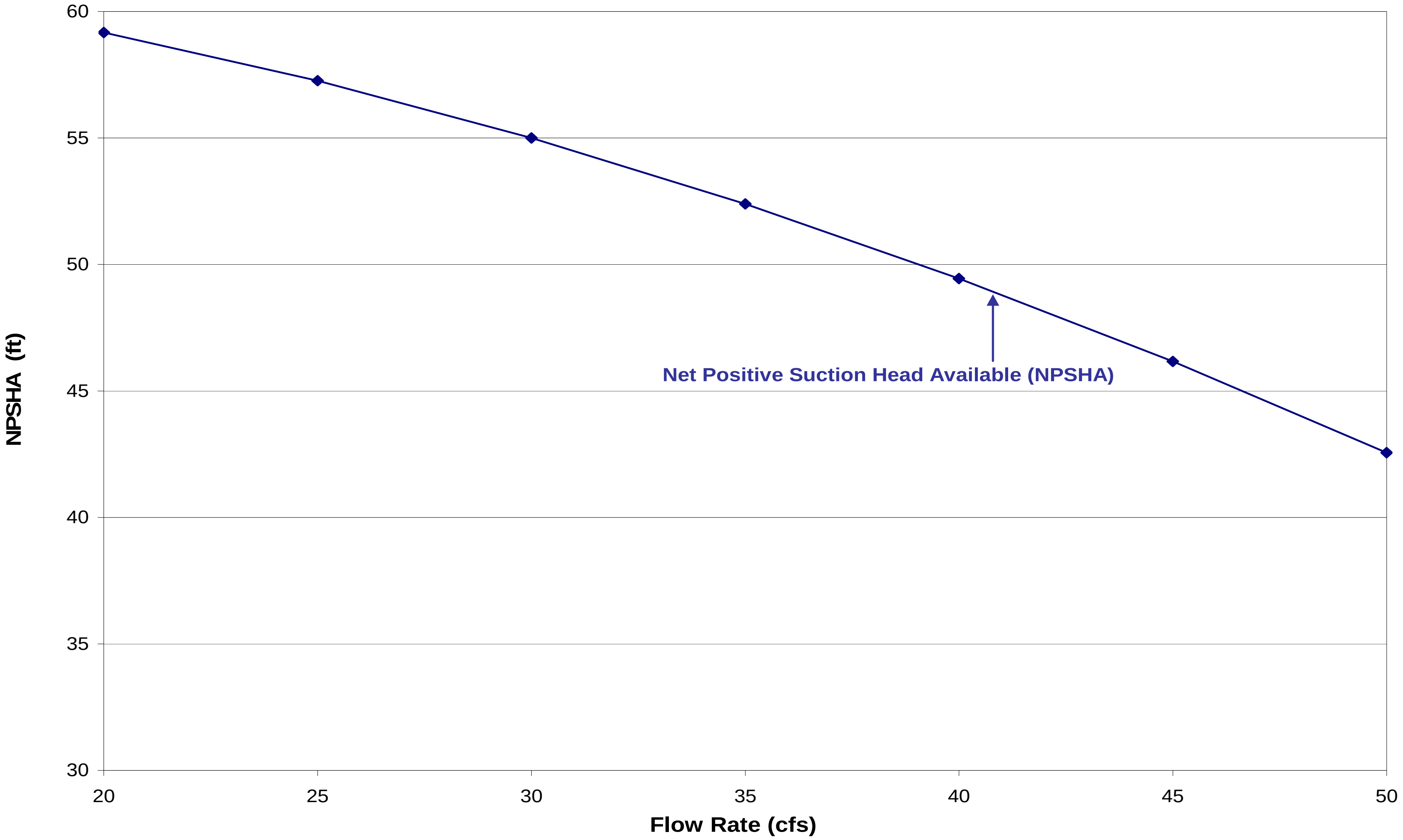
h_f = Head loss, and

h_{vp} = Vapor pressure head.

Atmospheric head is about 34 feet with assumptions of atmospheric pressure of 14.7 psia and water specific weight of 62.4 lbf/ft^3 (water temperature of 60^{0}F). Static suction head, the vertical distance in feet above the centerline of the inlet to the HGL of the fluid source, is 29.5 feet (934 feet – 904.5 feet). Head loss, h_f, under flow rates from 20 to 50 cfs is estimated using Hazen William equations and shown in Table E-1 (Appendix E). Vapor pressure head is estimated as 0.59 feet (water temperature of 60^{0}F). The calculated NPSHA vs. flow rate is plotted in Figure 6.

FIGURE 6

NET POSITIVE SUCTION HEAD AVAILABLE



The Net Positive Suction Head Required (NPSHR) is the minimum fluid energy required at the inlet by the pump. NPSHR is usually specified by the pump manufacturer. NPSHA should be greater than the NPSHR under the normal pump operation. The P-1 pump capacity curves provided by FMWD (Main Pumping Plant Water System Evaluation, B-E/GEI 2004) only shows the NPSHR for the West No. 1 pump. The pumping capacity of the P-1 station is about 35 cfs when all existing pumps work at their operation points. The NPSHA is about 52 ft when the flow rate is 35 cfs as shown in Figure 6. The NPSHR of West No. 1 pump is about 25 feet when it works at the operation point of 3,230 gpm (7.2 cfs) (B-E/GEI 2004). Therefore, the NPSHA is high enough for the operation of West No. 1 pump.

B-E/GEI proposed several alternatives to increase the nominal capacity of P-1 from 35 cfs to 40 cfs and provided the pump performance curves for all the pumps recommended to increase the capacity (B-E/GEI, 2004). The NPSHA is about 49 ft with the flow rate of 40 cfs as shown in Figure 6. The NPSHRs for all the pumps recommended to increase the P-1 capacity to 40 cfs are below 40 feet. Therefore, the NPSHA is high enough for these pumps recommended to increase the capacity of P-1 to 40 cfs.

Consideration was given to potentially increasing the flow from FM-1 up to 45 cfs. There is a 14 foot long 24-inch steel pipe connected to MWD’s turnout. This turnout is designed to deliver 40 cfs (B-E/GEI, 2004). The velocity in this 24-inch pipe is about 14.3 ft/s with the 45 cfs flow. B-E/GEI design engineers believe that this velocity of 14.3 ft/s is still in the reasonable working range for this short connection. Therefore, this turnout with the existing 24-inch steel pipe connection can be expected to operate normally with the 45 cfs flow.

4.3 Groundwater Resources

FMWD Member Agencies rely on both the Verdugo and Raymond Basins for groundwater production to serve customers. Any loss of groundwater production from either source will require an increased demand on imported water.

4.3.1 Verdugo Basin

The Verdugo Basin is an essential water supply component for the FMWD service area. Two municipal producers, the City of Glendale and CVWD, possess all production rights. The Basin, adjudicated in 1979, encompasses approximately 5,000 acres and was determined to have a safe yield of 7,150 acre-feet per year. CVWD was granted 3,294 acre-feet of production annually. Recent dry years, water quality threats and conversion of septic tanks to sewers have all resulted in declining water levels and loss of CVWD well production.

Water quality has generally been very good for municipal use although some parts of the Basin contain elevated nitrate concentrations and volatile organic compounds. CVWD has addressed the former by either blending produced supplies with imported water or treating production at the Glenwood Nitrate Reclamation Facility. VOC contamination includes both PCE (tetrachloroethylene) and MTBE (methyl tert-butyl ether). PCE has typically been detected at less than one-half of the maximum contaminant level, but MTBE has recently become more of a concern with increasing concentration and likely movement of a known plume from gas station sources. CVWD is pursuing cost recovery and cleanup from responsible parties.

A groundwater evaluation and monitoring study was conducted in 2004 by B-E/GEI on behalf of CVWD. The project entailed the drilling, installation and sampling of three monitoring wells to accomplish the following goals: protect water quality; balance management and development of water resources; and reduce dependency on imported State Water Project (SWP) supplies. Owing to the generally limited areal extent of the District's production wells, part of this Project entailed identifying and characterizing geological and hydrogeologic conditions outside the District's primary well field areas.

The results of this study suggested that subsurface soils although granular in nature are sufficiently consolidated and/or cemented as to limit the quantity of groundwater available to wells. Further, a general trend of declining groundwater levels appears to correspond to the conversion of on site septic systems to a centralized sewer system in the mid 1980s. As a result, incidental recharge from septic systems was eliminated. Exacerbating this problem is the densification and development of vacant or previously developed lands with low to non-permeable coverings such as asphalt, concrete and residential and/or commercial structures. As a result, rainfall that previously recharged the local aquifers now runs off the developed sites into local storm drains and ultimately in the Verdugo Wash where it drains into the Los Angeles River and on to the Pacific Ocean. In addition, because rainfall has generally been lower in recent years, opportunities for natural recharge to occur have been reduced.

The study found that owing to the apparent natural and man-induced impacts affecting groundwater supply and availability in the Verdugo Basin the recent unsuccessful construction of new high-yield production wells by CVWD and the results from the construction of three new monitoring wells, it appeared that additional investigation was warranted to identify other areas in CVWD's service area which may provide long-term groundwater supply reliability. One such potential area included that portion of the Verdugo Basin located between the Park fault and the Sierra Madre fault zone. In addition, developing a more detailed hydrologic inventory which accounts for the loss in septic system recharge and reduction in rainfall recharge due to urbanization of the watershed area and lining of the flood control channels was recommended which would further assist in identifying with more certainty the actual amount of natural water supplies available to CVWD.

A subsequent study by Geomatrix Consultants, Inc. on behalf of CVWD was performed in 2005. The purpose of the study was to evaluate the potential for capturing, retaining, and percolating or injecting storm water or other water supplies to enhance the yield of the Verdugo Groundwater Basin. The evaluation included groundwater modeling to simulate

Basin storage and recovery capacity and to assess the most cost-effectiveness of a conjunctive use program. Geomatrix made the following conclusions:

- Mountain runoff onto the Basin varies considerably from year to year, with median runoff of only a few hundred acre-feet per year.
- Hydrogeologic data are sparse in some areas of the Basin. Data are especially sparse for the upper half of the Basin.
- The configuration of the Basin makes groundwater levels particularly sensitive to variations in precipitation.
- A partial barrier to groundwater flow appears to be present in the upper part of the Basin. The presence of this feature, generally co-incident with Foothill Boulevard, is supported by the results of the groundwater modeling and bedrock outcrops in the Basin.
- There appears to be some capacity in the Basin for additional water storage. The amount of water that could be stored, however, would be very limited.
- It is technically feasible to augment recharge in the Basin. Recharge of precipitation runoff using infiltration galleries at Crescenta Valley County Park is the preferred alternative.
- There is considerable potential for implementation of small neighborhood artificial recharge projects.
- Production for CVWD’s existing wells is already at or near maximum capacity.

Geomatrix recommended monitoring of both surface runoff and groundwater in selected areas of the Basin, geophysical studies for locating new production wells and groundwater model updating, and further evaluation and design of the preferred alternative for recharge of precipitation runoff at Crescenta Valley County Park. Soil borings in the park were recommended to evaluate the infiltration capacity of the soil and provide information for the design of the infiltration gallery and other systems components. Geomatrix suggested opportunities to increase the efficient use of groundwater resources in the Basin. Opportunities include additional wells and facilities to increase production in portions of the Basin where the saturated aquifer is relatively thick and groundwater supply wells are not currently present; and regular maintenance and on going redevelopment of the existing wells to maintain or increase extraction rates.

The geology of the basin and the location of CVWD in the upper reach of the Basin create a situation that makes it difficult for CVWD to achieve long-term storage in the basin. Short-term storage, or seasonal demand shift, could be accomplished. CVWD could inject imported water during the winter months and extract the water during the summer months. To be economically feasible, CVWD would need to receive a discount on the imported water received to offset the pumping cost.

CVWD has been investigating the potential of recharging storm water at the Crescenta Valley Park. Recharge would be accomplished through a network of perforated pipes underneath the park. CVWD would later extract the recharged water at the wells located down gradient of the park. **B-E/GEI recommends CVWD continues to evaluate groundwater recharge of both imported and storm waters. It appears to B-E/GEI that other recommendations made by Geomatrix to increase the groundwater production efficiency in the Basin appear prudent and should be implemented. Finally, MTBE cleanup and cost recovery needs to be aggressively continued in order to mitigate future reductions in groundwater pumping.**

4.3.1 Raymond Basin

The Raymond Basin is an essential groundwater source of supply for six of the eight FMWD Member Agencies. Overall, the Basin covers an estimated 25,600 acres and is divided into the Santa Anita, Pasadena and Monk Hill subareas. KID produces from the Pasadena subarea and the remaining five Member Agencies have wells in the Monk Hill subarea. Water quality is generally of very high quality with the exception of areas of volatile organic compound, perchlorate and nitrate contamination. These contaminants are treated by either blending with imported water or treatment facilities.

In 2003, an assessment of the Basin was conducted by the consulting firm of Geoscience Support Services, Inc. on behalf of the Raymond Basin Management Board. Based on the Study reviewing available data and basin management the consultant recommended basin management either be based on a basinwide monitoring program or through an annual groundwater audit process in order to maintain water levels, production rates and water quality trends. This information could then be used to make recommendations for pumping in the following year. Recommendations were also made to maximize conjunctive use operations through artificial recharge (spreading and injection) and indirect recharge through in-lieu pumping. Furthering the strategy of conjunctive use has been the recent implementation of the Foothill CUP (See Section 10). Specific recommendations to enhance conjunctive use include:

- Maximize in-lieu recharge
- Expansion of existing facilities in the Santa Anita, Eaton Canyon and Sierra Madre areas
- Utilization of existing debris basins within the foothills of the Raymond Basin

- Testing of injection wells as a tool to recharge selected areas below impermeable layers
- Development of additional surface basin-type recharge facilities to the extent land is available

B-E/GEI had a meeting with the Raymond Basin Management Board Executive Office to discuss the status of implementing the above recommendations. It was related that the Board is still in the early stages of exploring many of these approaches to enhance basin management and was continuing to evaluate their feasibility of implementation. **B-E/GEI recommends FMWD continues to support the Raymond Basin Management Board in its efforts to enhance Raymond Basin operations, particularly in the joint efforts to implement the Foothill CUP.**

4.4 Reclaimed Water

In 2004, on behalf of CVWD, in association with LCID, VWC, and FMWD, B-E/GEI investigated the feasibility of providing recycled water to various users within the service areas of the West side purveyors. The purpose of this study was to:

- Determine the availability of recycled water.
- Determine possible users of recycled water within the service areas of the three retail agencies.
- Determine the demands and design conditions for a recycled water system.
- Develop a preliminary configuration of a recycled water system (pump station, pipelines, and storage) and estimate the capital cost and annual operating/maintenance cost for the system.
- Evaluate the economic feasibility of the three agencies constructing and operating the system.

The proposed recycled water source was the City of Glendale (Glendale). Its recycled system has up to 1,200 acre feet per year of supply available for additional users. The closest connection points to the Glendale system are along the 16-inch Verdugo Canyon Pipeline in the vicinity of La Crescenta Avenue and Verdugo Road. The last Glendale user is the Oakmont Country Club (Oakmont). Oakmont uses the majority of transmission capacity during hot summer days during the night, drawing down storage even with Glendale’s Fern Lane Pump Station operating continuously.

Caltrans is the key potential customer in the area with 377 acre-feet per year of consumption compared to 724 for all users of more than 5 acre-feet per year in 2002. During 2002, Caltrans consumed substantially more water than the historic average. Using fifteen years of record for deliveries by CV and 2002 for the other sources, Caltrans deliveries average 156 acre-feet per year. Most of the remaining customers are either schools or parks. There are no potential industrial users.

A review of the possible customers shows several challenges. The only likely use for recycled water is irrigation (although groundwater injection is a possible use, its feasibility is uncertain due to significant regulatory obstacles, treatment requirements, economic feasibility and other factors). Thus consumption peaks on the same days that the transmission capacity of the supply system (Glendale) is already stressed delivering to its customers. Further, the additional facilities must be designed with peaking factors to account for irrigation use. Use during the winter would be a small fraction of summer use. Additionally, dependency solely on Caltrans for project revenues presents significant risk (such as a conversion to desert low water use landscaping).

Based on the water market and design criteria two systems were developed for initial evaluation. The Caltrans Market Alternative allowed evaluation of a system that would serve approximately half of the total water market, but only one customer. The Enlarged Market Alternative started with the Caltrans Market Alternative and extended that system to serve additional potential customers. The added customers were those relatively close to the pipelines required to serve Caltrans. The added customers are along Foothill Boulevard or south of Foothill Boulevard. Elevations and pumping costs increase rapidly north of Foothill Boulevard.

The 2004 capital cost of the Caltrans Market Alternative was estimated to be $4,580,870 and the estimated deliveries 156 acre-feet per year. Using a 40-year capital recovery period and a five percent interest rate the cost would be $1,771 per acre foot. The enlarged market alternative yielded a project cost of $2,585 per acre-foot. The study concluded that recycled water at $1,771 to $2,585 was not an affordable option in view of the retail price for water within the study area varying from approximately $750 to $1000 per acre foot.

As part of this current FMWD Master Plan evaluation, B-E/GEI evaluated whether it was feasible for FMWD to participate in a proposed project by the City of Pasadena to bring Glendale recycled water to the spreading grounds above the Devil’s Gate Reservoir; thereafter constructing facilities to pump this source of supply to the Foothill corridor to serve the above described market. However, based on the needed length of pipeline, pumping plant and reservoir, it is apparent that unit costs would be very similar to those found in the earlier report. Consequently, B-E/GEI has concluded that Glendale recycled water is not an economical source of supply for FMWD at this time.

FMWD and several of its Member Agencies are continuing to consider other alternatives to utilize recycled water in the Foothill corridor to offset the use of imported water such as a small local wastewater treatment plant. It is not known at this time whether such an approach is economically feasible.

4.5 Potential Second MWD Connection

As part of this Master Plan assessment, consideration was given to the construction of a second MWD connection. MWD's Foothill Area Study (Report No. 1098, dated May 1996), evaluates a number of alternatives to deliver water to Arroyo Seco via a 24-inch pipeline with a presumed delivery rate of 17 cfs. One of these alternatives, the East Valley Feeder Extension, would deliver water from the East Valley Feeder in Glendale through Crescenta Valley and La Cañada to Arroyo Seco at an estimated capital cost of $16.3 million at 2006 price levels. Constructing this MWD extension so that water is only delivered to the vicinity of FMWD's existing pipeline or the La Crescenta Reservoirs would reduce the length of the pipeline by roughly one-half with a similar reduction in cost.

4.5.1 Benefits and Shortfalls

A second MWD connection would provide supply reliability and flexibility to the FMWD system and its Member Agencies. Construction of these facilities during the forthcoming Master Plan study period has both benefits and shortfalls. Among the latter are the following:

- It was preliminarily thought that the City of Glendale may be interested in sharing the cost of this extension in order to deliver water to certain hard to serve areas in the northern portions of its service area. However, initial contact with the City did not indicate a strong desire to participate in the cost sharing of such a project at this time.

- B-E/GEI's assessment of water demand growth for the FMWD system indicates existing facilities with some improvements will be able to meet demands through the study period with reasonable capacity margin. Without considering the need for support of both emergency operations and eventual replacement of transmission mains, it is probable that FMWD could provide service through the study period (through 2015) relying solely on existing facilities.

- With the likely need to make significant system replacements representing major capital investment in the decade following the end of the study period, incurring significant debt and associated rate impacts now for a second connection could complicate future system financing.

However, the benefits to FMWD and its Member Agencies (both on the West and East sides) are significant and persuasive both in meeting unforeseen emergencies and laying the facility strategy for eventually replacing the FMWD transmission mains. Among the benefits are the following:

- A second MWD connection on the East Valley Feeder would make imported water supplies available from the West Branch of the State Water Project providing reliability in the case of scheduled or unscheduled outages on the Upper Feeder delivering supplies from the Weymouth Treatment Plant located to the east.

- A water service interruption on either the Central or Berkshire service lines from a pipeline break could be mitigated by a second MWD connection enabling backflow service as described below.
- A water service spike in demand occurring on the east side service area from facility failure could be mitigated by supplying west side demand in part from a second MWD connection thereby allowing increased flows to the east side.
- A second MWD connection would allow alternative service to the west side providing for individual transmission main replacement when the need arises.
- An additional water supply flowing directly to higher elevations of the west side retail service areas would provide crucial water supplies in the event of a foothill forest fire.

4.5.2 New Facilities Description

A second MWD connection would require the construction of a 27,000 foot transmission main of recommended 24-inch diameter, an associated 1,700 horsepower pumping plant, a 1 MG terminal reservoir, an 18-inch looping connection (3,200 feet) to LCID reservoir facilities, and an interconnection between LCID and MCWC at their closest proximity at their northern service area boundaries near Angeles Crest Highway. This new MWD connection would provide an estimated 15.7 cfs in imported water supplies from an alternative source to FM-1. The capacity of this pipeline at a design velocity of 5 feet per second would be essentially equivalent to the upsized capacity of the Berkshire line.

Figure 7 presents the proposed alignment for this new imported water connection. The total cost for these facilities is estimated to total $19.8 million. As developed further in this Plan, CIP facilities have been categorized as primary, secondary and discretionary (see also Tables 5 and 10). As Figure 7 indicates, the proposed MWD connection is considered discretionary, and the proposed reservoir and associated looping connection to LCID are recommended secondary CIP facilities. Appendix F contains tables of cost estimates for the pipeline, pumping plant and connection; a regulating reservoir; and the loop connection from the reservoir to LCID’s Castle Road reservoir.

FMWD Master Plan

Foothill MWD

PROPOSED FACILITIES
SECONDARY AND DISCRETIONARY CIP

FEBRUARY 2007

FIGURE 7

B-E/GEI evaluated alternative routes for a second MWD connection to serve the West side. Based on this assessment it appears the optimal routing would be a connection on the East Valley Feeder in Glendale near the intersection of Glendale Avenue and Glenoaks Boulevard. This is also the approximate location of MWD's interconnection between the East Valley and Santa Monica Feeders. From this initial connection it is envisioned to construct the FMWD transmission main northerly along Glendale Avenue and the merged Verdugo Road. At the street bifurcation near Glendale College, the pipeline is then routed north on La Cañada Boulevard. It is also proposed to construct the required 1,700 horsepower pumping plant at a site located within Verdugo Park. Routing continues north along La Cañada Boulevard and then along the merged Verdugo Road to Ocean View Boulevard, continuing north to CVWD's Ocean View reservoir site. The capital costs (2006 dollars) for the pipeline connection to MWD and pumping plant are estimated to total $16.6 million.

At the terminal location, it is proposed to construct a new 1 MG regulating reservoir to provide storage for operating flexibility, off peak pumping and mitigation of excessive pump cycling. CVWD has indicated it is interested in participating in the construction of an oversized facility resulting in joint reservoir ownership with FMWD. B-E/GEI also evaluated several other alternative high elevation reservoir sites including economic analysis. However, because of significant additional pipeline footage required, the Ocean View site is considered the most desirable.

From a new terminal reservoir constructed at CVWD's reservoir site on Ocean View Boulevard, it is recommended to install 3,200 feet of 18-inch loop connection to LCID's reservoir at Castle Road. This pipeline is estimated to cost $1,122,000. Finally, new construction would include an interconnection between LCID and MCWC at Angeles Crest Highway to facilitate emergency operations and transmission main replacement as described below. The cost of this short length of 10-inch pipeline is estimated to not exceed $50,000.

4.5.3 Support of Emergency Operations

Constructing a second MWD imported water connection will support FMWD operations during emergency operations, both on a short and longer term basis. Although there are myriad emergency scenarios which might occur (particularly the specific location of a mainline break), the following generic events can be addressed. It should be noted that, in general, FMWD operations staff estimates that a transmission main break can be repaired in 48 to 72 hours (including restoration of service following disinfection) unless a break causes additional complicating problems other than the break itself.

- Break on the Berkshire transmission main: CVWD and LCID receive service from this facility. The Berkshire line could be isolated for repairs by a valve near Booster Station P-2. Service could be immediately transferred to the second MWD connection serving CVWD from the proposed FMWD terminal reservoir at Ocean

View, and LCID from the connection loop between FMWD's Ocean View reservoir and LCID's reservoir at Castle Road.

- Break on the 24-inch Central transmission line above the Berkshire branch: LCID, VWC and MCWC would be primarily affected. The Central line could be isolated for repairs by a valve just above the bifurcation with the Berkshire line. Again, an imported supply could be provided to LCID's Castle Road reservoir to meet normal supplies LCID receives at Hampton Road on the Central line. The Berkshire transmission line could be isolated and serve VWC through existing emergency FMWD connections, and MCWC could be supplied through a proposed interconnection with LCID at Angeles Crest Road. LCID believes it could wheel FMWD water from west to east through its system to serve MCWC average day demands. System pilot testing would be required to determine potential delivery flows above average day demands.

- Break on the primary 36-inch West side line: All West side purveyors would be affected. CVWD and LCID could be served in a similar manner as described for a break on the Berkshire line. The Berkshire line would be isolated with back feeding to serve VWC, and MCWC would be served through wheeling across LCID's system. However, a proposed second MWD connection capacity of 15.7 cfs is about 7 cfs less than peak West side delivery demands. Therefore, emergency connections with the cities of Glendale (CVWD) and Pasadena (VWC) would have to also be activated.

- Break on the East side transmission line: All East side purveyors would be affected. This scenario would require FMWD to repair the break as soon as practicable. However, RCLWA has production facilities capable of meeting peak day demands without imported water. In addition, RCLWA has an emergency interconnection with the City of Pasadena to receive 700 gpm. LAWC and LFWC both have the ability to supply average day demands, but not peak day demands. Both purveyors also have imported water blending requirements. It is recommended that LAWC and LFWC install interconnections with RCLWA to benefit from the latter's excess production capacity during an emergency.

- Failure of East side Member Agency facilities: With a second imported water source, additional supplies could be transmitted to the East side service area. A trial test was performed by operations staff isolating the East side line and opening the bypass to route water from the East side dedicated pumps at P-1 to the West side. Flow increased by about 5 to 6 cfs to the West side. Reverse operation would likely produce similar results to the East side for limited time periods with the alternate MWD supply supplementing reduced West side deliveries.

Failure of West side facilities or reduced dry year production in the Verdugo Basin: either reduced supply scenario could be mitigated by a second MWD connection with similar delivery scenarios as indicated above.

4.5.4 Support of Transmission Main Replacement

As indicated in Section 5, B-E/GEI estimates the remaining lives of FMWD's existing pipelines, with appropriate repairs to sections disturbed by Freeway construction, to extend past the Master Plan study period (through 2015). However, it is anticipated replacement of all three transmission mains may be needed in the next Master Planning cycle (2016-2025). Based on the width of right of way, B-E/GEI believes it would be feasible to construct a new East side replacement line before abandoning service in the existing facility. However, with narrower streets on the West side, this approach probably is not feasible. With construction of a second MWD connection, an alternative water supply would be available to facilitate West side transmission line replacements.

The Berkshire line could be shut down with a valve near the P-2 pumping plant. Water service could be totally replaced by the second connection which would serve CVWD through the proposed FMWD reservoir at Ocean View (likely to be jointly owned with CVWD). LCID would be served through the loop interconnection at this purveyor's Castle Road reservoir. For the replacement of the Central line to the Main Pumping Plant, the Berkshire line would be isolated to remain in service. CVWD and LCID would be served through the second connection as indicated above with the VWC receiving delivery through existing emergency interconnections by back flowing the Berkshire line. MCWC would be served through the proposed interconnection with LCID thereby wheeling FMWD supplies easterly from Ocean View reservoir across the LCID system.

4.5.5 Construction Schedule

Proposed facilities are scheduled (see Tables 35 and 36 in Section 10) for construction including permitting, environmental review, design and other activities from the first half of 2007 through late 2009 in order to be available for the extended scheduled outage on the Upper Feeder due in November 2009.

4.6 Existing and Potential Interconnections

FMWD currently has two interconnections with the City of Pasadena, one 10 cfs connection at Linda Vista Drive delivering water to the La Cañada Reservoirs of FMWD from the City and the other interconnection at a Caltrans service yard on the East side service area of FMWD delivering water up to 5 cfs to the City.

B-E/GEI considered the potential construction of an additional interconnection between FMWD and an adjoining water agency. However, in view of the recommendation for the construction of a second MWD connection, B-E/GEI does not consider it necessary at this time.

5 Evaluation of Existing Facilities

A significant requirement of preparing a Master Plan is to evaluate the condition and anticipated remaining lives of existing facilities in order to identify probable needed replacements during the projected planning period. This section addresses the existing condition and estimated remaining lives of the FMWD assets according to the major categories of pipelines and appurtenances, pumping plants and storage reservoirs. A subsection on miscellaneous assets such as SCADA (Supervisory Control and Data Acquisition) is also included.

5.1 Assessment Approach

In order to assess existing condition and estimated remaining lives of FMWD assets, B-E/GEI utilized a three fold approach. First, field visits to all major above ground facilities were conducted with assistance from operating personnel. Observations of existing facility condition were made to identify facility defects, potential deferred maintenance and likely remaining lives. Evidences of wear such as corrosion, paint peeling and scaling, and concrete or asphalt cracking were carefully noted. A key component of the field assessment was interviews with operating personnel. Operating problems and deficiencies were thoroughly discussed as well as the status of individual facility maintenance. Also investigated were the ongoing maintenance programs and practices currently being undertaken by the operating staff.

A second major portion of the facility condition and remaining life assessment was a review of all relevant maintenance records, consultant inspection reports and other supporting documents. Examples include reservoir consultant inspection reports and pipeline inspection videos.

The third approach B-E/GEI utilized in assessing facility condition and potential remaining lives was through the use of survivor curves. In view of the existing facilities not being new, their reduction in service lives is represented by the accrued depreciation of those facilities. Depreciation takes place as the result of several factors which reduce the remaining period over which service may be expected from any given facility and further reduce the quality of the service rendered. These factors can be categorized as physical depreciation (deterioration) and functional depreciation (obsolescence). Accrued depreciation is not necessarily equal to the accrued depreciation that would normally be carried on the records of a regulated water company or public agency under the term “book value,” which depreciation is an accounting method of recovering, over their estimated useful lives, the costs of the facilities.

Accordingly, although B-E/GEI reviewed the inventory and accounting records of FMWD on its facilities, reliance was not placed on straight line depreciated lives as indicated by accounting records. Rather, the use of survivor curves was utilized to estimate the remaining lives of existing facilities. To explain this approach, a hypothetical example involving meters will be used. It will be assumed that the average life of a group of newly installed meters is estimated to be 35 years. This average would consist of some meters which would have to be retired in less than 35 years and other meters which would last longer than the average 35-year life. After a period of time (say, for purposes of illustration, 10 years) has elapsed, a portion of the meters will have been retired from service. These are obviously all meters which have considerably less than the average service life. Accordingly, the meters which still remain in service at the end of 10 years will have an average total life of more than 35 years and an average remaining life of more than 25 years. The amount of additional remaining life is determined using what are known as "Iowa-type survivor curves." The curves expressing this relationship, and the particular curve applicable to each type of asset, were developed by studies made by the Engineering Experiment Station of Iowa State College. These data have been published in PUC Standard Practice U-4, "Determination of Straight-line Remaining Life Depreciation Accruals."

B-E/GEI determined the remaining lives of system facilities as indicated by the appropriate survivor curve and based on FMWD indicated installation dates. Initial estimated service lives from the date of installation were based on B-E/GEI's many years of experience in performing numerous municipal water system evaluations. Indicated survivor curve remaining lives were then evaluated in light of information obtained from the other two approaches described above. Appendix G contains the results of the survivor curve remaining life analysis including facility original costs and escalated present day replacement costs utilizing the Handy-Whitman Index of Municipal Water System Construction.

5.2 Transmission Pipelines and Appurtenances

FMWD inventory records account for imported water transmission mains in four categories: Main-Arroyo (from the MWD connection to the main pumping plant, P-1), Westside (from P-1 to the La Cañada reservoirs), La Crescenta (Berkshire extension from the Westside line to the La Crescenta reservoirs) and Altadena (Eastside line from the P-1 pumping plant to the Altadena reservoirs).

The transmission main from the MWD connection at FM-1 to the main pumping plant consists of 242 feet of 36-inch and 6,517 feet of 39-inch diameter cement mortar lined and coated steel pipeline (CMLC) all installed in 1955. Survivor curves indicate a remaining life of 21.6 years for these pipeline facilities. A video log of the entire length of this pipeline as discussed below indicates the pipeline was in good condition and likely to provide service through the study period. Valves for this section (check, butterfly, blowoff and air vent-vacuum relief) have all been installed in 2000 and anticipated to provide service for the next two decades of the estimated life of the pipeline. However, the mainline meter, installed in 1982, is projected to need replacement before the end of the study period.

For the Altadena section of 24-inch diameter CMLC pipeline, an estimated 10,590 feet was installed in 1955 and 1,200 feet was reinstalled as part of freeway construction in 1972. As indicated above for the Main-Arroyo section the originally installed portion should have a remaining life on the order of two decades (21.6 years). However, it is believed the reconstructed freeway portion may have mortar damage and corrosion similar to the Berkshire pipeline portion. **Video logging of this reconstructed section of the transmission main should be conducted as soon as practicable with repairs made as necessary.** Many of the associated valves and appurtenances are indicated to be at or near the end of their service lives according to survivor curve analysis. However, operating personnel perform maintenance exercising and report all valves are believed to be in good operating condition. Nevertheless, B-E/GEI has identified these facilities to be in need of periodic replacement during the projected study period and has included them in the discussion of recommended improvements.

The La Crescenta (Berkshire) portion of FMWD's transmission pipelines consists entirely of 24-inch diameter CLMC of which 15,180 feet was installed originally in 1955; plus 670 feet in 1971; 914 feet in 1988; and 1,700 feet in 1998. As indicated above, the originally installed footage is anticipated to extend well past the study period. However, **the reinstalled portions which have been video logged indicate the need for repairs as soon as practicable. It is believed the remaining sections of disturbed pipeline on this segment may also need repairs. Video logging of these replaced sections should be performed with follow up repairs, again as soon as practicable.** Many of the originally installed valves and appurtenances are at or near their expected service lives, even with the use of survivor curves. However, operating personnel perform maintenance exercising and report all valves are believed to be in good operating condition. Nevertheless, B-E/GEI has included these facilities in the list of recommended periodic replacements during the study period.

The Westside pipeline (extending from the main pumping plant to the La Cañada reservoirs) is constructed of 867 feet of 36-inch; 7,898 feet of 30-inch and 3,516 feet of 24-inch diameter CMLC steel pipeline; plus 198 feet of 30-inch diameter reinforced concrete pipe all installed in or about 1955. In addition, 1,459 feet of 30-inch diameter CMLC steel pipe was reinstalled in 1972 for freeway construction, and 337 feet of the same diameter crossing the Arroyo Seco was modified in 1988 to increase flexibility in order to respond better to earthquakes. In view of the video log results on the freeway constructed Berkshire extension, **the 1,459 foot 1972 reinstalled section should be video logged to assess condition and the need for repairs.** Many of the associated valves and appurtenances are indicated to be at or near the end of their service lives according to survivor curve analysis. However, operating personnel perform maintenance exercising and report all valves are believed to be in good operating condition. Nevertheless, B-E/GEI has identified these facilities to be in need of periodic replacement during the projected study period and has included them in the discussion of recommended improvements.

FMWD has had three sections of the pipeline inspected using a video camera. The first section is the 39-inch diameter CMLC section leading from the connection with MWD towards the Main Pumping Plant. The second and third video logs were taken on the Berkshire section of the 24-inch transmission main. Both Berkshire logs begin at the same location and run in opposite directions. The second log videos the section beginning at South Alta Canyada Road and runs to Verdugo Blvd. The third log begins at South Alta Canyada Road and runs to Foothill Blvd.

The video log and subsequent report were reviewed by B-E/GEI for the 39-inch section of pipeline running approximately from the 24-inch MWD gate valve to the Main Pumping Plant (Station 67+70). It was intended to begin at the gate valve but the valve at the time was leaking and has since been repaired. The inspection began at Station 2+38. A total of 6,532 feet were inspected. With the exception of the one joint near the flexible coupling at Station 67+70, the pipeline inspected was in good condition. Hairline circular cracks were seen along the pipeline. Hairline circular cracks are expected to occur as the mortar lining shrinks from drying. The joint near Station 67+70 was repaired using quick set cement.

FMWD Operations Division staff was questioned about the pipeline inspection performed along Alta Canyada Road. It was indicated that a section of pipe was removed south of the freeway overpass to allow access for the camera. The contractor then sent the camera north and south from this access point. The section with significant problems is the northerly one that crosses over the freeway.

The video log for the 24-inch CMLC pipeline running from Alta Canyada Road upstream towards Verdugo Blvd was reviewed by B-E/GEI. The video log covers about 300 feet. Three areas of concern should be noted. At the joint located 7.9 feet from the beginning of the inspection, approximately half of the seal over the joint is missing. Moderate to severe corrosion of the steel can be seen. At 10.3 feet from the beginning of the inspection, one-fourth to one-half of the joint seal is missing. Again, corrosion of the steel can be seen. At 12.3 feet from the beginning of the inspection, a deep pit can be seen in the steel. The remainder of the inspection noted several small to medium circular cracks (less than 1/8 inch) but no obvious corrosion of the steel is seen.

The video log for the third section of the pipeline running from Alta Canyada Road with the flow towards Foothill Blvd was reviewed. The video log covers approximately 627 feet. Many circular cracks of small to medium size are seen in the log. None exhibited obvious signs of corrosion. In addition, several joints along this section of pipeline are missing all or part of the mortar seal. The exposed flexible couplings for crossing the freeway at these joints show signs of moderate to severe corrosion. Problems were noted at 39.6 feet, 94.1 feet, 96.5 feet, 113.6 feet, 153.3 feet, 193.2 feet, 236.5 feet, 276.1 feet, 300.6 feet, 316.6 feet, 335.0 feet, 357.3 feet, 396.7 feet, 436.7 feet, 476.5 feet, 516.8 feet, 522.7 feet, 548.0 feet, 549.8 feet, and 626.7 feet (end of run). At the end of run, several joints can be seen in the distance but not closely inspected. One of these joints appeared to be missing the mortar seal but no close-up video was shot.

Member Agency connections, with varying pipeline lengths of 750 feet or less, were mainly installed in 1955 (one constructed in 1978). All are anticipated to have remaining service lives of about 22 years or greater. However, selected meters, valves and regulators are anticipated to need periodic replacement before the end of the study period and are included in the list of recommended facilities contained in Section 10.

One outstanding maintenance issue is noted for FMWD's continuing timely response. According to operating personnel, approximately seven or eight of the existing seventeen combination air release/vacuum release valves have been rehabilitated or thoroughly cleaned. However, the status of operating condition for the remaining valves at this point in time is unknown. Visual inspection of one of the valves in the field would support the concern that some of these valves are not operating in accordance with optimal operation. Maintenance personnel indicate that it is their intention to continue to address the remainder of these combination valves. **B-E/GEI supports the current efforts of maintenance staff to continue their efforts to rehabilitate any combination valves not operating at optimal levels.**

5.3 Pump Stations

Included in this subsection are discussions of rates and billings; inspection of pumping equipment, electrical control panels and service connections; emergency power supplies; and consideration of hybrid energy (electric and gas) supply. Also included are discussions on facility remaining lives based on survivor curves.

5.3.1 General Discussion of Rates and Billings

Rates for electric and other utility services (water, natural gas, etc.) are typically structured to be fair and non-discriminatory as well as to recover the cost of providing services. Electrical rate cost components are both variable (based upon consumption patterns) and fixed. The bulk of an electric bill on a "dollars charged" basis for commercial and industrial customers is related to energy consumption and peak demand, both of which are variable cost components and both of which are subject to some degree of control by the customer. Taken together, these two rate components enable electric rates to be designed to take into account the impact of customer consumption patterns and provide for the recovery of most all of the utility's costs of providing electricity. When analyzing energy and demand costs (which generally account for more than 90 percent of a commercial or industrial electric bill), it is useful to think in terms of unit costs when considering energy consumption (generally $/kWh) and demand (generally $/kW). The energy charge is designed to recover the cost of supplying energy (generation, fuels and purchased power), while the demand charge is designed to reflect the utility's fixed costs for the infrastructure necessary for generating and delivering electricity, however, the details of how a particular electric utility chooses to breakdown the various cost components in order to recover its costs will vary.

Besides recognizing that costs vary according to consumption patterns, utilities and regulatory bodies also recognize that energy is more expensive to provide at certain times of day and during certain seasons. These differences are accounted for in rate structures that recognize time-of-use cost differentials. Customers with pumping loads or other electrical loads that can be shifted to time periods when rates are lowest are generally able to take advantage of time-of-use rate features subject to system operation limitations. Both the City of Pasadena's Water and Power Department (PWP) and the Southern California Edison Company (SCE) serve the FMWD under time-of-use (TOU) rates that include both energy and demand charges.

From the customer standpoint, there is always the operational tradeoff of trying to balance the benefits of utilizing lower priced off-peak energy against cost increases that will result from incurring a higher demand. Minimum reservoir fill levels as set by the California Department of Health Services and adjusted by FMWD, the water delivery schedules of the member agencies, and the electrical demand placed by the P-2 facility on the P-1 facility all constrain and limit the flexibility that operations personnel have to shift power and energy to off-peak periods as well as limit demand.

5.3.2 Pumping Site P-1

5.3.2.1 PWP Rate Structure and Analysis

PWP's rate structure is less complex than that of SCE. It incorporates time-of-use rates that include both seasonal (summer/winter) and daily (on-peak and off-peak) differentials. Unlike the SCE rate structure, its rate structure does not include a daily mid-peak element. Summer and winter months are defined as June through September and October through May, respectively. Summer on-peak hours run from noon to 8:00 p.m. (8 hours) and winter on-peak hours run from 8:00 a.m. to 10:00 p.m. (14 hours). All hours on weekends and holidays are off-peak.

A review of the PWP electric bills for the past approximate one year period indicates that the P-1 pumping facility has generally been able to take advantage of the off-peak energy price savings that PWP's time-of-use rates offer. At first glance it appears that the FMWD has been able to take greater advantage of off-peak energy during summer months than in winter months; however, this is explained by the fact that the daily on-peak period in the winter extends for 14 hours, compared to just 8 hours in the summer. The table below shows typical energy use at the plant during on- and off peak periods, as well as typical energy costs in those time blocks for both the most recent summer and winter periods.

TABLE 14

P-1 ENERGY CHARGES - SUMMER (FOUR MONTHS):

Daily Periods	% of Energy Used	Typical Unit Cost ($/kWh)*	Typical Monthly Cost (470,000 kWh base)
On-Peak	~22%	0.1260	$ 13,028
Off-Peak	~78%	0.0705	$ 25,845
Total:			$ 38,873

*Includes pro rata share of transmission cost at $0.0121/kWh.

TABLE 15

P-1 ENERGY CHARGES - WINTER (EIGHT MONTHS):

Daily Periods	% of Energy Used	Typical Unit Cost ($/kWh)	Typical Monthly Cost (260,000 kWh base)
On-Peak	~44%	0.0829	$ 9,484
Off-Peak	~56%	0.0737	$10,731
Total:			$20,220

*Includes pro rata share of transmission cost at $0.0121/kWh.

PWP’s demand related charges are very reasonable and consumer friendly representing less than 25% of a typical FMWD monthly bill on average. The demand charge is based upon highest 15-minute demand incurred over a rolling 12 month period. Throughout 2005 it was set at 1216 kW. (The 1216 kW demand last incurred in May 2005; however, during the period June 2005 through March 2006 demand has not exceeded 928 kW.) The first line of data in the table below shows typical demand and related charges which were billed over the past 12 month period, while the second line of data shows a new rate based upon the 928 kW demand that occurred in August, 2005, and will go into effect in mid-2006, if it has not been exceeded in the following 12-month period.

TABLE 16

P-1 DEMAND (DISTRIBUTION) CHARGES – SUMMER AND WINTER

Daily Periods	Typical Peak Demand (kW)	Typical Unit Cost ($/kW)	Typical Monthly Cost
Prior to June, 2006	1216	6.87	$8,354
Since June, 2006*	928	6.87	$6,375

* based upon rolling 12-month average established in Aug. 2005 at 928 kW

From the discussion above that relates to recent electricity usage patterns, several things can be noted:

- Currently about 22% of electricity costs during the four summer months for the P-1 facility is consumed on-peak at a price differential of about 79% over that of the off-peak price. However, for each 1% of summer on-peak energy that could be shifted to off-peak the annual savings would still only be approximately $2,300. A significant shift away from consuming energy on-peak (an unlikely event) would have to occur to make a noticeable impact on the annual cost of electricity which is now approximately $450,000 for the P-1 facility.
- Overall, the annual electrical load factor of 42.3% for the operation of the P-1 facility during 2005 indicates that FMWD operations personnel are generally taking advantage of the benefits offered by PWP's off-peak energy prices rather than those offered by limiting demand. Such an operating strategy is warranted given PWP's TOU rate structure.

5.3.2.2 Inspection and Analysis of Pumping Equipment

The P-1 pumping plant consists of eight pumps and motors, two surge tanks, and appurtenant plumbing. Table 17 presents the replacement record for the P-1 pump and motor equipment indicating good maintenance by FMWD staff. Analyses using the survivor curves suggest that six of the eight pumps and motors will need replacement or refurbishment before the end of the study period. Replacement of the six pumps and motors with similar sized pumps and motors is estimated to cost on the order of $500,000. Similarly, the analyses suggest that three meters will need replacement or refurbishment within the next 10 years at a cost of about $30,000. At the time of B-E/GEI's site inspection, the Cla-valves were in the process of being refurbished. It is estimated that these valves will last at least through the study period with proper maintenance and exercising. **The interiors of the surge tanks at P-1 should be inspected.**

Currently, there are four pumping units on each service area side. Pumps on the West side include three at 3,150 gpm and one at 1,665 gpm; those on the East side vary from 1,080 to 2,025 gpm. The West side pumps together can normally deliver 22.5 cfs. East side pumps together can normally deliver 12.5 cfs. With the East side transmission main closed, and an open by-pass, all pumps together can increase the flow to the West side to 29 cfs. As part of the implementation of the Foothill CUP (see Section 8) FMWD is installing fifth pumps on each service side to increase capacities to 27 and 16 cfs for the West side and East side respectively, for a total of 43 cfs from FM-1.

TABLE 17

PUMP AND MOTOR MAINTENANCE FOR STATION P-1

Facility	Size (hp)	Year Installed	Most Recent Maintenance (a)	Comments
Main 1W	250	1978	4/9/2005	Pump rebuilt in 1993 and 2003. New motor in 1978. Motor rebuilt in 1993. Cla Val pump control replaced in 2002. Capacitors replaced in 1999. Replace copper tubing, suction to seal.
Main 2W	250	1978		New pump and motor in 1978. Pump rebuilt in 1994. Motor repaired in 1994. Cla Val control replaced in 2002
Main 3W	250	1979	7/11/2005	New pump and motor in 1979. Bowls rebuilt in 1995. Motor repaired in 1995 and 1999. Cla Val control replaced in 2002. Capacitors replaced in 1999. Inspected with recommendation to replace seal.
Main 4W	125	1979	3/30/2005	New pump and motor in 1979. Bowls repaired in 1992. Motor repaired in 1992. Motor rebuilt in 2002. Cla Val control replace in 2002. Capacitors replaced in 1999. Oil changed in 2005
Main 1E	200	1978	7/13/2005	New pump and motor in 1978. Bowls rebuilt in 1998. Motor rebuilt in 1998. Cla Val control replaced in 2002. Capacitors replaced in 1999. Replace return line on seal in 2005.
Main 2E	200	1978		New pump and motor in 1978. Bowls rebuilt in 1999. Motor bearings replaced in 1999. Cla Val control replaced in 2002. Capacitors replaced in 1999.
Main 3E	150	1979		Bowls rebuilt in 1995. New motor in 1979. Motor repaired in 1995. Cla Val control replaced in 2002. Capacitors replaced in 1999.
Main 4E	100		2/14/2005	New seal in 2005
Portable Pump			3/2/2006	Pump and associated equipment was maintained through the 1990s with only oil changes and lubing reported. In 2005 old fuel was drained. In March 2006, the pump was test run for 30 minutes.

(a) Cla Val associated with each pump and motor were rebuilt in May 2006 per conversation with FMWD staff.

5.3.2.3 Inspection of Electric Control Panels and Service Connections

Inspection at the P-1 facility took place on the morning of May 24, 2006 and was primarily visual. A representative number of panels were opened and viewed, but no testing was conducted. The interior control panels, wiring, relays, etc. are relatively old (age unknown) but are utility grade and in well maintained condition. There is evidence to indicate that some of the cable and wiring is fairly new and is predated by the mounting panels and enclosures. Components inside of the panel are free of both rust and dust. The area surrounding the P-1 facility is recreational with no locally generated dust or pollution that can contaminate equipment.

FMWD operators report only minor past problems with motor control centers. Visual inspection indicates that about ten years of useful life remains if the equipment is properly maintained; however, the contractor that periodically maintains and tests the equipment and components for FMWD is in a better position to comment on useful life projections.

Inspection tags indicate that maintenance service and testing was last performed in 2000. A copy of the Maintenance Test Report dated March 24, 2000, was obtained and reviewed. The inspection and testing done at that time was found to be thorough and well documented. The P-1 facility was found to be in good condition.

The P-1 facility receives its electric supply off of an overhead pole that sits adjacent to the facility on Rosemont Avenue and provides power via an underground dip. The pole was installed in 1996 and was inspected by an independent contractor working for the city this year. Visual inspection of the pole shows that it has fairly wide splits that would not normally be expected in a ten-year old pole; however, splits are not an indication that the strength of the pole has been compromised. **The pole should be protected by stanchions that protect it from roadway traffic.** FMWD log books indicate that three service interruptions due to problems on the PWP system have occurred in the past two calendar years (2004 and 2005) at the P-1 facility. This is well within an acceptable range of service.

5.3.2.4 Discussion of Emergency Power Supply

Two permitted diesel-powered generators each rated at 500kW provide backup power for pumping during emergencies. FMWD operators report that reliability is good and aborted starts are not a problem. Presently when the two units are operated in parallel the output is limited to 14 cfs because the control system cannot properly synchronize the units when operating at or near full-load (when properly functioning total pumping capacity is about 22 cfs). Also, South Coast Air Quality Management District Rule 1470 regulating particulate emissions will become effective January 1, 2008 thereby making the existing generator units noncompliant and inoperable. The FMWD is currently reviewing a proposal it received in June 2006 to correct this operational limitation. The contractor estimated that the cost to upgrade the two generators to perform properly in parallel will cost around $250,000. The contractor is currently analyzing the cost to replace the two generators with either one or two new generators with at least the expected capability of the existing generators. Based on a conversation between B-E/GEI and a generator manufacturer, the complete purchase and installation cost for two new 500kW units is preliminarily estimated at $450,000 (the estimated installed cost for a single 1,000kW unit is $600,000). **B-E/GEI recommends FMWD install two new 500kW units to correct the current operating shortfall of emergency generation at pumping plant P-1.**

5.3.3 Pumping Site P-2

5.3.3.1 SCE Rate Structure and Analysis

The pumping load served by the SCE is billed under its Schedule TOU-8 tariff: Time-of-Use/General Service-Large. The TOU-8 rate provides for rate differentials that vary both seasonally (four month summer period and eight month winter period), and daily (on-peak, mid-peak, and off-peak). It is the proper and applicable rate schedule for the characteristics of the electrical load (generally exceeding 500kW) and service voltage (480 volts) of the P-2 facility.

SCE's summer and winter months are defined as June through September and October through May, respectively. Summer on-peak hours run from noon to 6:00 p.m. (6 hours). There are no on-peak hours in winter. Mid-peak hours run from 8:00 a.m. to noon and from 6:00 p.m. to 11:00 p.m. in summer months (9 hours) and from 8:00 a.m. to 9:00 p.m. (13 hours) during winter months. All other hours and all weekend and holiday hours are off-peak.

A review of the SCE electric bills for the past 15 months indicates that the P-2 facility has generally been able to take advantage of the off-peak and mid-peak energy price savings that the TOU-8 tariff offers to those customers that can shift electrical load away from peak load times. The tables below shows typical energy use at P-2 during those three time periods, as well as typical energy costs in those time blocks for both the most recent summer and winter periods.

TABLE 18

P-2 ENERGY CHARGES - SUMMER (FOUR MONTH PERIOD):

Daily Periods	% of Energy Used	Typical Unit Cost ($/kWh)*	Typical Monthly Cost (285,000 kWh base)
On-Peak	~10%	0.1285	$ 3,662
Mid-Peak	~30%	0.0752	$ 6,430
Off-Peak	~60%	0.0417	$ 7,131
Total:			$10,099

* Includes pro rata share of transmission cost at $0.0093/kWh

TABLE 19

P-2 ENERGY CHARGES - WINTER (EIGHT MONTH PERIOD):

Daily Periods	% of Energy Used	Typical Unit Cost ($/kWh)*	Typical Monthly Cost (110,000 kWh base)
On-Peak	**	**	**
Mid-Peak	~30%	0.0977	$3,224
Off-Peak	~70%	0.0489	$3,765
Total:			$6,989

*Includes pro rata share of transmission cost at $0.0110/kWh

** There is no “on-peak” period during winter months.

Demand charges are given significantly more weight under SCE’s TOU rate structure than they are in that for PWP’s rate structure. SCE’s demand charges for the P-2 facility represent approximately 50% of a typical summer month bill and 33% of a typical winter month bill.

The monthly demand charge under the TOU-8 rate is based upon the highest 15-minute demand occurring during each peak period (on-peak, mid-peak, and off-peak), however, since the rate structure does not include an on-peak period during winter months, there are three cumulative demand charges during summer months and only two in winter months. The first three lines of data in the table below shows typical kW demand and demand related charges which are imposed over a typical summer month, while the table which follows shows the same information in a typical winter month. Both tables apply to the operation of the P-2 facility only.

TABLE 20

P-2 DEMAND CHARGES - SUMMER (FOUR MONTH PERIOD):

Daily Periods	Typical Peak Demand (kW)	Typical Unit Cost ($/kW)	Typical Monthly Cost
On-Peak	350	$9.87 (Delivery) $15.93 (Generation)	$ 3,440 $ 5,575
Mid-Peak	705	$0.84 (Delivery) $3.30 Generation)	$ 592 $ 2,327
Off-Peak	700	*	*
Facilities Related Demand**	705	$7.02 (Delivery) $1.76 (Generation)	$ 4,935 $ 1,240
Total:			$18,109

* There are no off-peak demand charges in summer months.

** Facilities Related Demand billed at whichever demand (on-peak, mid-peak or off-peak) is greatest.

TABLE 21

P-2 DEMAND CHARGES - WINTER (EIGHT MONTH PERIOD):

Daily Periods	Typical Peak Demand (kW)	Typical Unit Cost ($/kW)	Typical Monthly Cost
On-Peak	n/a	*	*
Mid-Peak	480	-	-
Off-Peak	470	-	-
Facilities Related Demand**	480	$7.00 (Delivery) $1.76 (Generation)	$3,360 $ 845
Total:			$4,205

* There are no “on-peak” demand charges during winter months.

** Facilities Related Demand billed at whichever (mid-peak or off-peak demand) is greater.

From the above tables that reflect recent electricity usage patterns, several things can be noted:

- All but about 10% of energy pumping requirements in the summer months for the P-2 facility are being met during mid-peak and off-peak periods, thus avoiding on-peak energy prices that are on the order of 81% higher than mid-peak prices and 268% higher than off-peak prices; and by limiting on-peak demand to half of that during mid-peak and off-peak periods, monthly demand savings on the order of $9,000/month are being achieved.

- If all of the pumping energy now consumed on peak could be shifted to mid-peak, the annual savings would only be approximately $6,000; and if it could be shifted to off-peak, the annual energy savings would only be approximately $10,000. (This compares to the current annual energy bill for the P-2 account of about $243,000.)
- The average energy component of the bills has been about $0.052/kWh (5.2 cents/kWh) irrespective of the seasonal period.
- On an annual basis, energy and demand related charges constitute about 88% of the power bill at the P-2 facility, with demand charges accounting for about 55% of that total.
- The seasonal difference in the cost of operating the P-2 facility is attributable to two factors:
    - Heavier pumping requirements in the summer months
    - Significantly higher demand charges when summer rates are in effect.

The power factor adjustment penalty paid monthly by the FMWD under the TOU-8 tariff was found to range from $56.50 to $98.44 over a one year period. Although the power factor is readily correctable, the amount of the penalty is so small relative to other billing cost components, and because of the cost associated with the purchase and installation of the equipment, the investment to install shunt capacitors is not warranted at this time.

5.3.3.2 Inspection and Analysis of Pumping Equipment

The Berkshire pumping plant contains four pumps and motors (B-1 through B-4), with two at 1,795 gpm, one at 1, 935 gpm; and the remaining unit a variable frequency drive. All four associated motors are 300 horsepower and three were installed in the last three years. Pump units B-1 and B-4 had minor visible corrosion. Staff indicated that this equipment would be scrubbed with a wire brush and painted. Otherwise, all equipment appeared clean and in good operating condition. The pump and electric panel house structures and general site also appeared in good condition and well maintained. As discussed in the following subsection, new electric panels and switch gear equipment is in the process of being replaced.

With essentially all new pumps, motors, and electric equipment at P-2, the estimated projected facility lives are 20 to 25 years (recognizing that the pumps and motors have already been in service for a period of up to three years). At the time of B-E/GEI's site inspection, the Cla-valves were in the process of being refurbished. It is estimated that these valves will last at least through the study period with proper use and exercising.

5.3.3.3 Inspection of Electric Control Panels and Service Connections

Inspection at the P-2 facility took place on the morning of May 24, 2006 and was primarily visual. Control panels were not opened and no testing was conducted. With the exception of new solid-state relays that have been retrofitted into the panels, the metering and other devices appear to be 1950s vintage. Inspection tags indicate that service was last performed in 2000. Again, a copy of the Maintenance Test Report dated March 24, 2000, was reviewed and the inspection and testing done at that time was found to be thorough and well documented. Several recommendations were made relating to the need to retrofit or replace existing equipment, one of which cautioned the FMWD about possible personnel exposure to live electrical contact. One of the FMWD operators reported that the panels and switchgear lineup are scheduled for replacement. A discussion with Robert Steward on June 9, 2006 confirmed that new equipment has been purchased and that funding has been approved for hiring an electrical contractor to perform the work. The work will need to be scheduled in coordination with activities of FMWD's Member Agencies.

The P-2 facility receives its electric supply off of an overhead pole that sits adjacent to the facility and provides power via an underground dip. It appears that the pole was installed in 1955, but it is still in good condition. It was inspected by an independent contractor working for SCE in 2002. Visual inspection of the pole shows that it is in good condition and that it is not susceptible to damage from passing vehicles. FMWD log books indicate that six service interruptions due to problems on the SCE system have occurred in the past two calendar years (2004 and 2005) at the P-2 facility. This number of outages would appear to be excessive, but can probably be explained by the number of large trees that interfere with the overhead circuit serving the facility.

5.3.3.4 Discussion of Emergency Power Supply

A skid mounted diesel powered generator rated at 350kW and capable of supporting any one of three of the four 300 horsepower pumps at a time provides backup power for pumping. The generator was originally sized to be able to support running two pumps concurrently, but when the pumps were upgraded to 300 horsepower that ability was lost. The fourth pump is equipped with a variable frequency drive not capable of operating with existing emergency power generation. Currently, the maximum water production through the P-2 plant is limited to 4 cfs. Operations staff believes it is necessary to be able to produce at least 8 cfs during emergency operations. **B-E/GEI recommends FMWD install 1 mw emergency generator capacity in order to provide on the order of 12 cfs during emergency conditions.** Based on a conversation between B-E/GEI and a generator manufacturer, the complete purchase and installation cost for two new 500kW units is preliminarily estimated at $450,000, (the estimated installed cost for a 1,000kW unit is $600,000 and will take approximately one year longer to receive delivery compared to two units; two units in place of one will also provide the better alternative for maintenance). **B-E/GEI recommends FMWD install two new 500kW units to correct the current operating shortfall of emergency generation at pumping plant P-2.**

5.3.4 Consideration of Hybrid Energy (Electric and Gas) Supply

Both of FMWD's pumping facilities are currently electric powered with limited diesel-fueled backup generation. On-going consideration has been given to using natural gas to displace a portion of the present electrical energy used to meet pumping loads. There are several reasons why **shifting electrical load to natural gas is not recommended at this time.**

- With the exception of the period following the deregulation of the electrical utility industry in California as a result of the passage of AB-1890 in 1996, natural gas prices have exhibited less stability (and predictability) than electricity prices. (However, if FMWD is able to enter into a multi-year purchase agreement with a third party supplier, it can likely negotiate a fixed price arrangement.)
- Competition for natural gas is increasing as all of the larger conventional power plants recently built or being built in the west are generally designed for base load operation and use natural gas as a fuel.
- The establishment of liquefied natural gas facilities on the west coast in the future will increase supply, but its effect on price is largely unknown.
- The electricity price outlook for FMWD's two existing electricity suppliers (City of PWP at P-1 and SCE at P-2) is fairly positive:
    - The cost of PWP's power supply should maintain a high degree of price stability at competitive rates over many years to come as over 60% of its power supply is likely to continue to be provided by coal-fueled and hydro-electric sources. (Coal plants exhibit little cost volatility and water is essentially free.)

  - In approximately five years, SCE's energy costs should decrease because the high-priced energy being supplied by the California Department of Water Resources (CDWR) under long-term pass-through power contracts signed during the power crises to ensure continuity of service will expire. (CDWR is currently supplying approximately 25% of the energy billed by SCE at a price that at times during off-peak periods has been ten times greater than that for SCE supplied energy. Approximately 64% of the total energy used at the P-2 plant is consumed off-peak.)

- Establishing an operating practice of fuel shifting from electricity to natural gas could end up resulting in higher rather than lower costs for several reasons:
  - It will be difficult to constantly attempt to manage the demand charges that will be imposed for each of the four separate utility services
  - On-going changes in rates by both electric and gas utilities will also have to be factored into operating procedures.
  - "Fuel switching" decisions placed upon water operations personnel may also shift their attention away from their primary mission of providing reliable and safe water deliveries to their agency members.
- Certain tools, materials and generation equipment unique to natural gas systems will need to be purchased and will require additional space. Operator O&M training, establishing new operating procedures and added spare parts inventories will all introduce new cost factors.
- Residents have expressed concerns over the noise associated with the running of the present stand-by generators during their limited periods of use. (One resident is even notified when the generator at the P-1 facility is going to come on-line.) More hours of operation will likely lead to more complaints.
- The FMWD will be required to pay connection fees associated with its new service connections at both the P-1 and P-2 facilities.

5.3.5 Conclusions and Recommendations

The electric rate structures of both PWP and SCE offer opportunities to control electrical bills; however, because of constraints on the ability to alter operations such as reservoir storage requirements and member agency water delivery schedules, there is little opportunity to generate significant electricity cost savings. Current usage patterns confirmed through discussions with operators indicate that FMWD is taking reasonable advantage of both PWP and SCE rate structures. Operators use both graphical plots and demand histories that enable them to optimize off-peak energy use and exercise control over peak demands, subject to operational limitations. This can often become a careful balancing act because energy and demand cost elements in the rates of both utilities are interrelated. Often savings in either demand or energy costs will produce increased costs in the other. **It is recommended that FMWD not place unwarranted emphasis on operating its system based upon being able to lower its electric bills but rather focus on its primary mission to provide a safe and reliable supplemental water supply.**

A power pole located near the entrance to the P-1 facility on Rosemont Avenue interconnects P-1 to the PWP electric distribution system. **It should be shielded from roadway traffic by stanchions that can protect it and the underground service cables attached to the pole. It is recommended that FMWD request PWP install such protective measures.**

Maintenance tests were last performed at the P-1 and P-2 facilities in 2000. **It is recommended that trip testing and other electrical maintenance and operational tests be performed at both the P-1 and P-2 facilities at approximate two-year intervals.**

The skid mounted diesel powered generator at the P-2 facility is only capable of supporting any one of three of the four 300 horsepower pumps at a time. **Consideration should be given to upgrading the stand-by emergency power generator so that two pumps can be powered at the same time.**

5.4 Storage Reservoirs

FMWD owns six reservoirs varying in size from 1.0 to 1.4 MG. Three are welded steel (La Crescenta East and West, and La Cañada East), all constructed in 1954, and the remaining three all reinforced concrete, constructed in 1954, 1985 and 1991. Table 22 presents the results of B-E/GEI's review of maintenance performed on these facilities by FMWD, including construction data.

The La Cañada East Reservoir was most recently inspected in 2005. Coatings on the roof plates, rafters, reservoir floor, shell and stiffener rings all appeared to be in excellent condition. Some limited areas did have corrosion or blistering due to failed coating. However, it appears the steel where exposed was in good condition with very little pitting. Coating on the girders appeared to be in good condition although some areas contained significant corrosion. Finally, the coating on the reservoir columns indicated to be in poor condition although the steel was in good condition with very little pitting. Recommendations were made by the consultant to sand blast or power wire brush various areas and recoat with appropriate materials, and repair any pitted areas as necessary.

The La Crescenta West Reservoir was last inspected in April 2002. The reservoir coating system was generally observed to be in very good condition. Sporadic corrosion nodules and coating blisters were present. Repairs were recommended by wire brushing and application of enamel coating material.

The La Crescenta East Reservoir was inspected recently in March 2002. Coatings on the floor, columns, rafters and girders all appeared to be in good condition with sporadic corrosion nodules. Coating on the interior shell appeared to vary from average to excellent condition, although some areas contained corrosion or alligator cracking. The coating on the underside of the roof plates appeared to be in average condition with about 10 to 15 percent of the area involved exhibiting coating failure. The consultant also noted that the enamel coating on the shell from the floor to the third stiffener ring is original and likely near the end of its useful life. It was recommended to examine the substrate during the next inspection for potential total replacement of the coating. Areas of corrosion were recommended to be sand blasted and recoated. This reservoir has recently been re-inspected in 2006. Operations staff accompanied the consultant and report that no major deficiencies exist, although some maintenance appears to be warranted. A consultant report is pending.

TABLE 22

RESERVOIR MAINTENANCE BY FMWD

Facility	Size (MG)	Height (feet)	Size (feet)	Material	Year Installed	Most Recent Maintenance	Comments
La Cañada East	1.0	18	100 Diameter	Welded Steel	1954	2/11/2005	Recoated in 1967. Inspected in 1980. Recoated in 1981. Inspected 1987. Inspected 1995. Inspected 2001 with remedial work performed. Inspected in February 2005. Recoating recommended. Installed new circulation pump in February 2005.
La Cañada West	1.2			Reinforced Concrete	1985	7/25/2005	Recoated in 1967. Inspected in 1977. Circulation pump rebuilt and installed in July 2005.
La Crescenta East	1.0	18	100 Diameter	Welded Steel	1954	2/3/2006	Recoated in 1967. Recoated lower section in 1972. Recoated in 1988-89. Inspected in March 2002. New circulation pump in 2004. Pump shorted in January 2006.
La_Crescenta West	1.0	18	100 Diameter	Welded Steel	1954	2/8/2006	Recoated in 1967. Recoated in 1994. Inspected in April 2002. New circulation pump in 2004. New transducer installed in 2005. Circulation pump repaired in February 2006.
Altadena North	1.4	20	90x100	Reinforced Concrete	1954	8/16/2005	Cleaned roof and walls of reservoir in August 2005. Installed pump in December 2003. Inspected June 2006.
Altadena South	1.2			Reinforced Concrete	1991	10/22/2005	Installed new transducer.

In June 2006, the Altadena North Reservoir was inspected. The steel roof plates and stainless steel tie rods appeared to be in excellent condition with no signs of corrosion. The concrete walls and gunite slope and floor also appeared to be in excellent condition although there were several small areas of corrosion. Coatings on the roof girders, rafters and columns all appeared to be in good condition; although there were isolated spots of corrosion. Finally, there appeared to be some corrosion around the perimeter of the roof vent. Recommendations included the removal of corrosion, perform needed repairs and apply appropriate coatings.

B-E/GEI conducted site visits to all of the reservoirs. The La Cañada Reservoirs, both East and West, appeared to be in good or very good condition. The La Crescenta facilities also appeared to be in good condition although it was noted that the exterior paint on La Crescenta West had been chipped in places along the bottom and there was some corrosion on the extension from the roof. The air vent covers varied in condition with some showing only slight corrosion and others significant corrosion. The La Crescenta East Reservoir was being inspected by a consultant at the time of the site visit. The reservoir also appeared to be in good condition. However, similar to La Crescent West, the air vent covers have various levels of corrosion.

Altadena South Reservoir is located on the north side of Harriett Street. The structure is concrete and appeared to be in good condition. Of note was the evidence of deposition on the exterior from where the construction holes have been plugged. Also, there was some evidence that the concrete has been patched.

Altadena North Reservoir is located on the same property as Altadena South. The structure is concrete with a metal roof and appeared to be in very good condition. However, the asphalt at the site showed evidence of cracking and will need to be repaired in the near future. Also, the decorative three-foot fence at the front of the property is in poor condition as evidenced by the corrosion along the bottom of the fencing. Repair or replacement will need to be done in the near future.

Overall, all reservoirs are being well maintained by FMWD with periodic consultant inspections, followed by implementing recommended repairs and maintenance. Survivor curve analysis by B-E/GEI indicates anticipated remaining lives, with continuing good maintenance, for the three originally constructed reservoirs to be on the order of 20 years. Remaining lives for the remaining three reservoirs, constructed in the late 1980s and early 1990s are all over 40 years.

5.5 Miscellaneous Assets

5.5.1 FMWD Field and Administrative Offices

The FMWD field and administrative offices, located in a residential area are next to the La Cañada East reservoir. Abutting this property are the offices and facilities of the VWC. Located next to the 210 Freeway, this location is both easily accessible and somewhat centrally sited.

The administrative and field offices are located in separate buildings with the District Board Room attached to the latter. Although not overly spacious, it appears the facilities are functionally adequate. It also appears the buildings are in basically good condition.

In view of the lack of need to move the offices for new facility construction, and the considerably large CIP program recommended for the current study period, **B-E/GEI recommends the FMWD retain its current offices and make renovations as necessary.** A budget amount of $100,000 is identified for this purpose. **B-E/GEI recommends FMWD retains the services of an architect or interior designer for this purpose.**

5.5.2 SCADA System and Asset Management

The current SCADA (Supervisory Control and Data Acquisition) system operated by FMWD was originally installed by the early 1980s. Since then, several revisions have been undertaken to install upgrades and system amendments to monitor new and upgraded facilities. However, today the system is out of date and operations staff cannot obtain outside technical support. There is a need for a completely new SCADA system. Additionally, current security monitoring is deficient. Camera monitoring at Pumping Plant P-1 is visual onsite only. Although alarm signals are received at the operations center, it is necessary to field check any alarm signal to determine its source. There needs to be a new security camera and alarm system installed at each pumping plant and reservoir site integrated into the SCADA system. **B-E/GEI recommends these improvements be implemented by FMWD and is estimating a total cost of $550,000 for software, hardware, installation and training.**

FMWD operations staff has begun to create facilities maintenance schedules to form the foundation of an asset management plan (AMP). Those efforts plus data developed in this Master Plan should provide initial information necessary to implement an AMP to optimize remaining lives and value of existing facilities. **B-E/GEI recommends FMWD continues with its efforts to create and implement an AMP.** It is believed such a system may consist mainly of electronic maintenance and replacement schedules, as opposed to a detailed complex AMP. However, **FMWD should explore the possibility of obtaining an AMP at the same time as procurement of a SCADA system.** Some software vendors offer both products. It is estimated that the recommended cost of a new SCADA system indicated above will accommodate the development of an AMP at the same time.

5.6 Replacement Costs of FMWD Assets

Appendix G contains a table of FMWD facility inventory together with escalated original costs to reflect current replacement costs. As shown, the total 2006 replacement cost for all FMWD facilities totals approximately $18 million. However, one reservoir facility is not on the inventory list. Additionally, comparison of selected escalated historic costs with B-E/GEI new facilities cost estimates suggests that the escalated replacement costs may not reflect current construction conditions. The former cost estimates may be understating current replacement costs by 15 to 20 percent. Therefore, the current total replacement cost for all FMWD facilities is estimated to be on the order of $22 to 23 million.

6 Peaking Analysis and Supply Capability

This section presents an analysis of historic peaking characteristics for the FMWD system based on demand data for the last three years (2003 through 2005). Results of peaking factors obtained are applied to average day demands projected at the end of the study period (2015) to evaluate system capability to meet projected peaking demands from retail member agencies.

6.1 FMWD Peaking Analysis

Normally, municipal water systems are designed so that sources of supply can at least meet the maximum day demand with a buffer of 10 to 20 percent to account for planning uncertainties. Pipelines and pumping stations are designed to at least meet maximum hourly demands (again typically with some buffer to meet unanticipated demands). As an approximation, in the absence of detailed analysis, a retail water system would be expected to have maximum day demands on the order of two times the average annual daily demand and hourly maximum demands on the order of three times the average hourly demand (based on the annual average); or alternatively, one and one-half times the hourly average during the daily maximum to derive hourly maximum flow. Proposed California Waterworks Standards require systems over 1,000 connections to meet maximum day demand; and four hours of peak hourly demand for source capacity (normal plus emergency sources, storage capacity and auxiliary power).

6.1.1 Historic Maximum Monthly Demands

With the exception of May 2004 (an unusual operating period due to exceptional demand on the FMWD system as a result of well failure in one of the retail member agency’s system), B-E/GEI determined that the maximum monthly demand periods for the years 2003, 2004 and 2005 for firm water deliveries for the system overall occurred during either July or August. Accordingly, hourly demands were plotted in cfs for these two months in order to identify maximum day and maximum hourly events and derive ratios of maximum deliveries (daily and hourly) to average deliveries.

6.1.2 Historic Maximum Daily Demands

Table 23 presents the FMWD historical daily average and maximum day demands for the years 2003, 2004 and 2005 for the July-August period. Flows are shown to the central area (La Cañada zone), Berkshire service area (La Crescenta zone) and east delivery area (Altadena zone). Flows to the western area (central plus Berkshire areas) and for the system overall are also presented. Maximum day usage for the total FMWD system varied from about 26.4 to 27.6 cfs.

TABLE 23

HISTORICAL AVERAGE AND MAXIMUM DEMANDS FOR FMWD

Year	Average Day (cfs)	Maximum Day (cfs)	Ratio Max Day to Avg Day	Maximum Hour (cfs)	Ratio Max Hour to Avg Day	Ratio Max Hour to Max Day
Central Area						
2003	6.13	10.63	1.73	12.70	2.07	1.19
2004	6.58	10.61	1.61	12.70	1.93	1.20
2005	5.51	11.68	2.12	14.00	2.54	1.20
Berkshire						
2003	6.46	11.30	1.75	11.30	1.75	1.00
2004	6.77	10.8	1.60	11.30	1.67	1.05
2005	4.34	9.27	2.13	10.30	2.37	1.11
West (Central plus Berkshire)						
2003	12.59	19.95	1.58	22.30	1.77	1.12
2004	13.34	20.64	1.55	24.00	1.80	1.16
2005	9.85	19.90	2.02	23.30	2.37	1.17
East						
2003	4.23	7.36	1.74	9.10	2.15	1.24
2004	4.97	8.03	1.62	9.40	1.89	1.17
2005	3.81	7.93	2.08	8.20	2.15	1.03
FMWD Basic (East plus West)						
2003	16.82	26.43	1.57	28.60	1.70	1.08
2004	18.31	27.63	1.51	30.20	1.65	1.09
2005	13.66	27.03	1.98	29.50	2.16	1.09

(a) Excludes deliveries for injection or in-lieu replenishment

Table 23 also presents the calculated ratios of maximum day to average day firm deliveries for each FMWD zone service area. As shown, the ratio of maximum day to average day for individual zone service areas for the years 2003 and 2004 varied generally from about 1.6 to 1.75, and for the system overall 1.5 to 1.6. On the other hand, the ratios for 2005 are typically 2.0 to 2.1 for both the individual zone areas and the overall system. The years 2003 and 2004 can be considered typical and very dry precipitation years respectively. In contrast, 2005 was a very wet precipitation year resulting in the maximum day to average day ratio being higher than typical in view of the lower than normal average day usage throughout the year. Consequently, the maximum day to average day ratios for projected demands through the study period are based on results from the 2003 and 2004 analysis.

However, in every case, peaking ratios are greatest for a normal precipitation year due to the higher average day demands experienced in a dry year suppressing the peaking ratios.

Table 24 presents FMWD service zone peaking ratios and peak flows in cfs for 2006 projected demands based on normal precipitation. Peaking ratios as presented below are selected based on the above discussion and are used for projecting peak demands for the study period (through 2015).

TABLE 24

FMWD SERVICE ZONE PEAK FLOWS AND PEAKING RATIOS IN CFS

FOR 2006 NORMAL PRECIPITATION

Service Area	Average Day	Maximum Day	Maximum Hour	Ratio Max Day to Avg Day	Ratio Max Hour to Avg Day
Central	7.37	12.89	15.47	1.75	2.1
Berkshire	5.64	9.86	9.86	1.75	1.75
West Branch	13.00	20.80	23.40	1.6	1.8
East Branch	5.44	9.52	11.70	1.75	2.15
Total	18.44	29.50	31.35	1.6	1.7

It should be noted that on occasion the winter deliveries to the eastern service area (Altadena pressure zone) have reached higher maximum day usage than during the summer period due to RCLWA meeting most of its demand from imported deliveries in-lieu of groundwater pumping. These events may result in maximum day deliveries being as much as 20 percent higher than summer maximum day demands indicate. Imported water deliveries for injection and in-lieu credit may also on occasion spike maximum day demands slightly higher than summer period deliveries indicate. However, operating personnel have some flexibility to control and even curtail non-firm deliveries during winter periods. Consequently, it is believed that firm deliveries during the summer period should be the criteria against which to compare system capability.

6.1.3 Historic Maximum Hourly Demands

Table 23 and following Figures 8 through 22 present data results from the analysis of the maximum hourly demands for the FMWD system and each of the service area zone branches. As shown, the ratios of maximum hour to average hourly flow for 2003 and 2004 vary from 1.65 to 2.15. In all cases but one the greatest ratio of peak hour flow for these two years occurred in 2003, a year of normal precipitation. In the one exception (West Branch), B-E/GEI used the 2004 (a dry year) greater ratio of peak hour flow. As with maximum daily flows, Table 25 also presents peak hour flows and the associated peaking factors for 2006.

FIGURE 8

PEAK DELIVERIES FOR TOTAL FMWD SYSTEM IN 2005

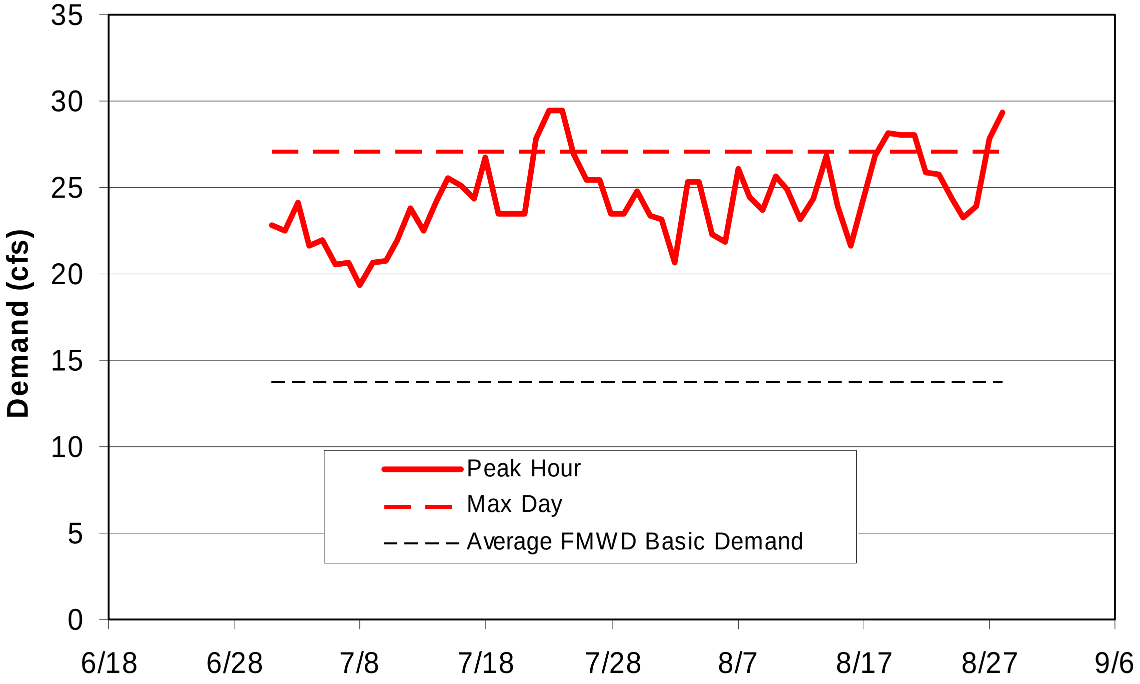


FIGURE 9

PEAK DELIVERIES FOR TOTAL FMWD SYSTEM IN 2004

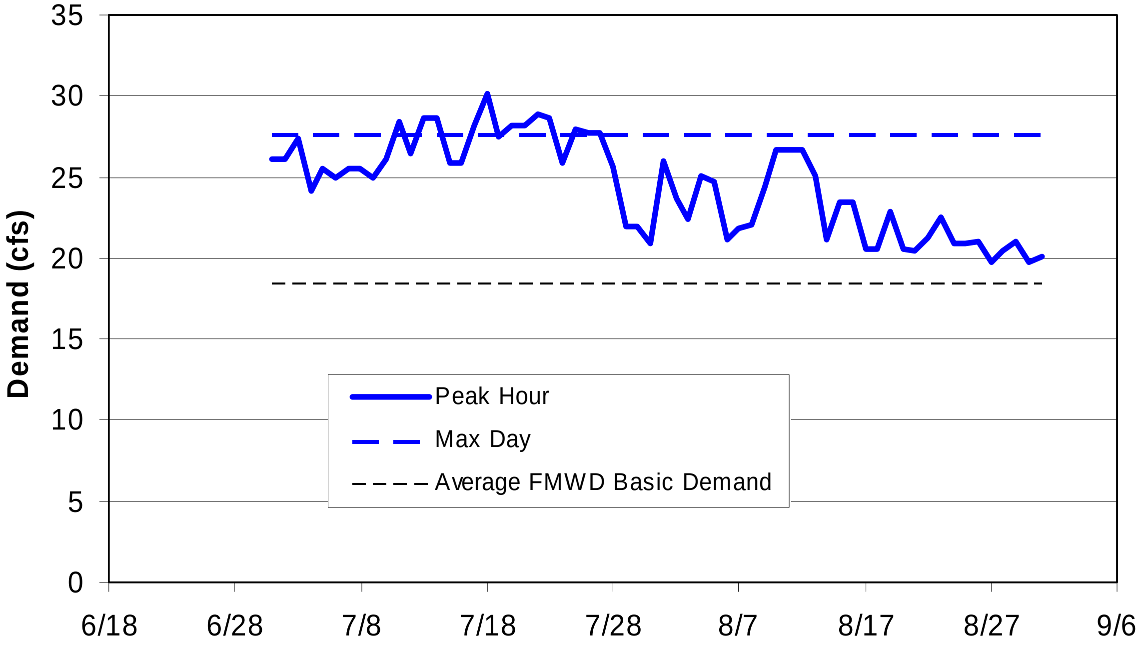


FIGURE 10

PEAK DELIVERIES FOR TOTAL FMWD SYSTEM IN 2003

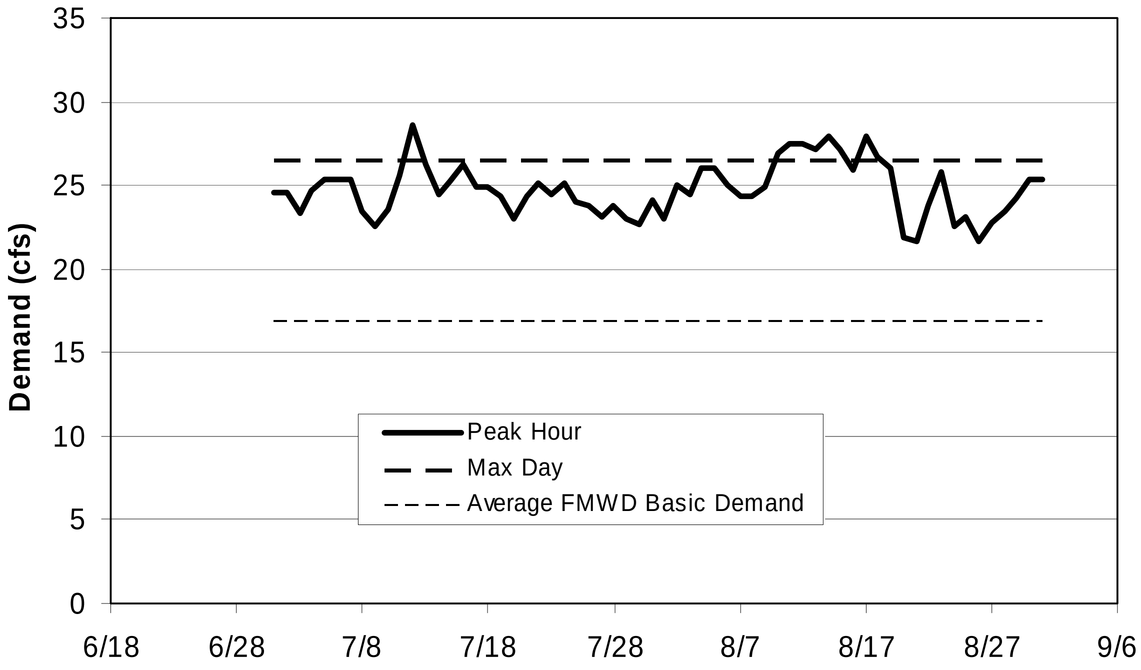


FIGURE 11

PEAK DELIVERIES FOR WEST BRANCH OF FMWD SYSTEM IN 2005

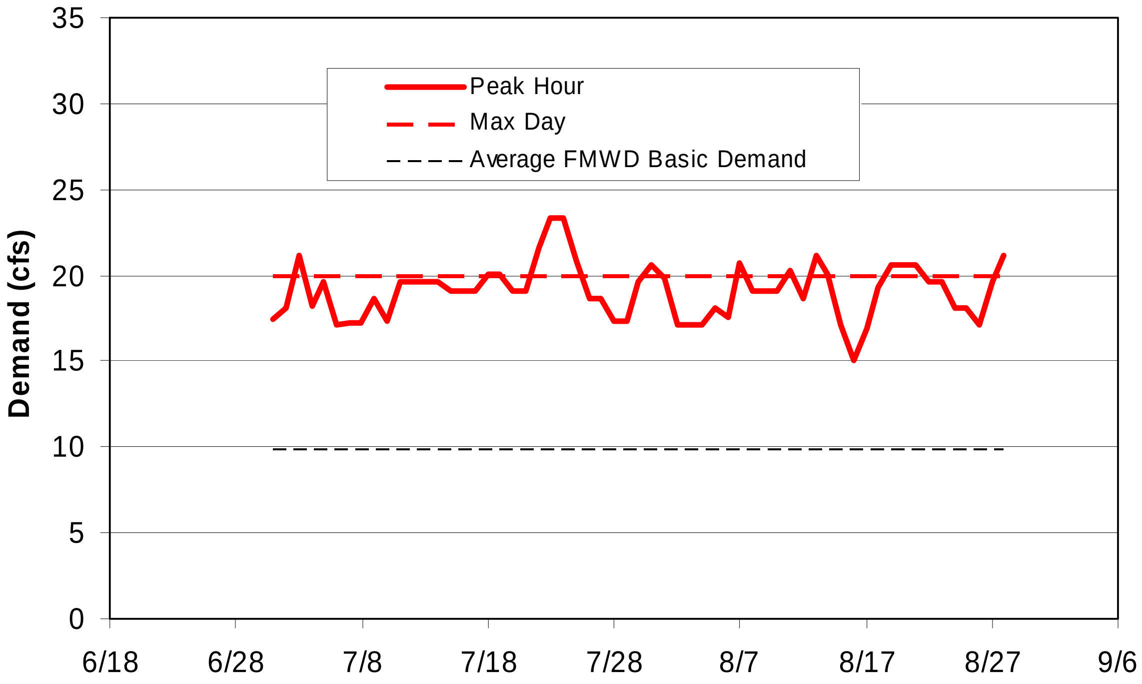


FIGURE 12

PEAK DELIVERIES FOR WEST BRANCH OF FMWD SYSTEM IN 2004

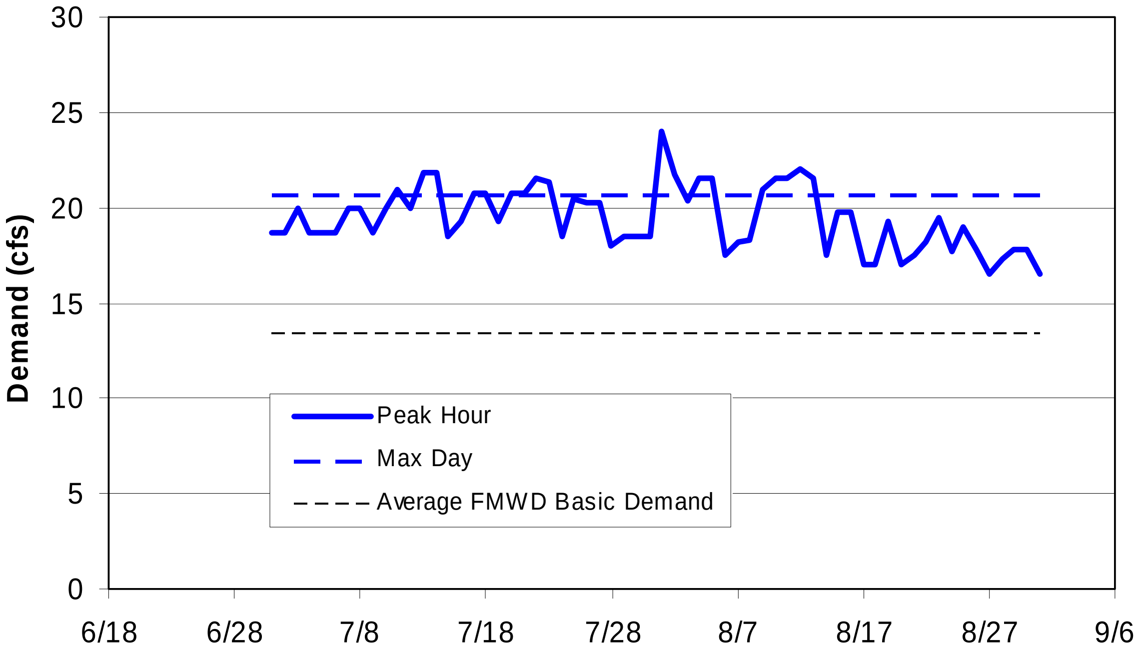


FIGURE 13

PEAK DELIVERIES FOR WEST BRANCH OF FMWD SYSTEM IN 2003

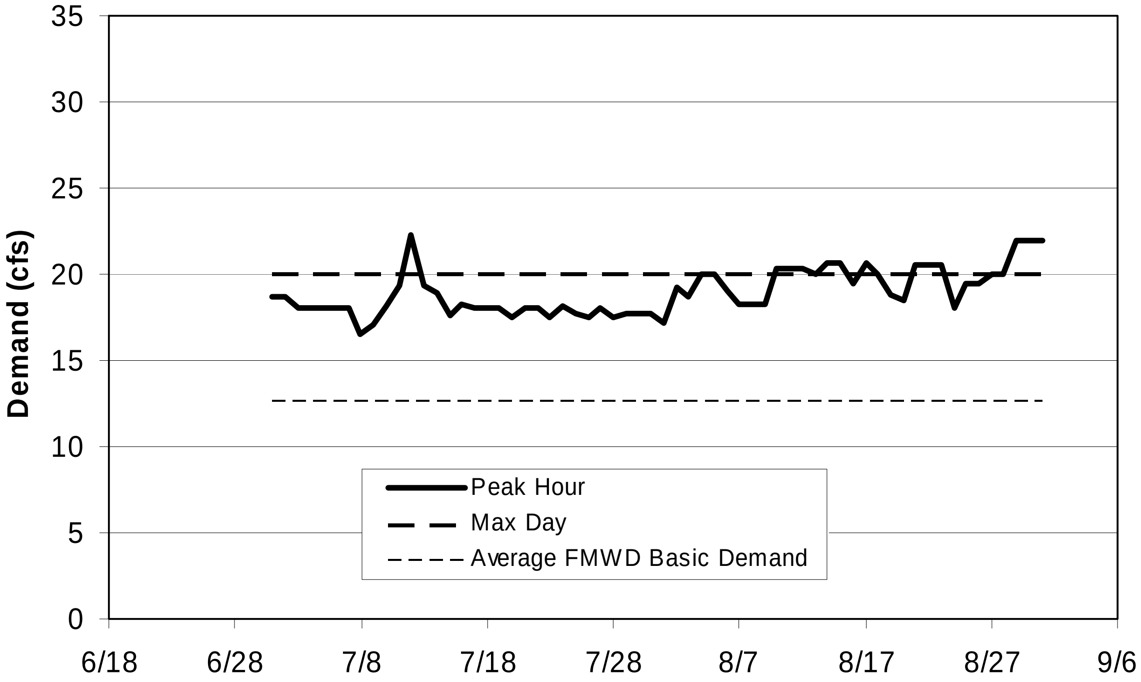


FIGURE 14

PEAK DELIVERIES FOR BERKSHIRE BRANCH OF FMWD SYSTEM IN 2005

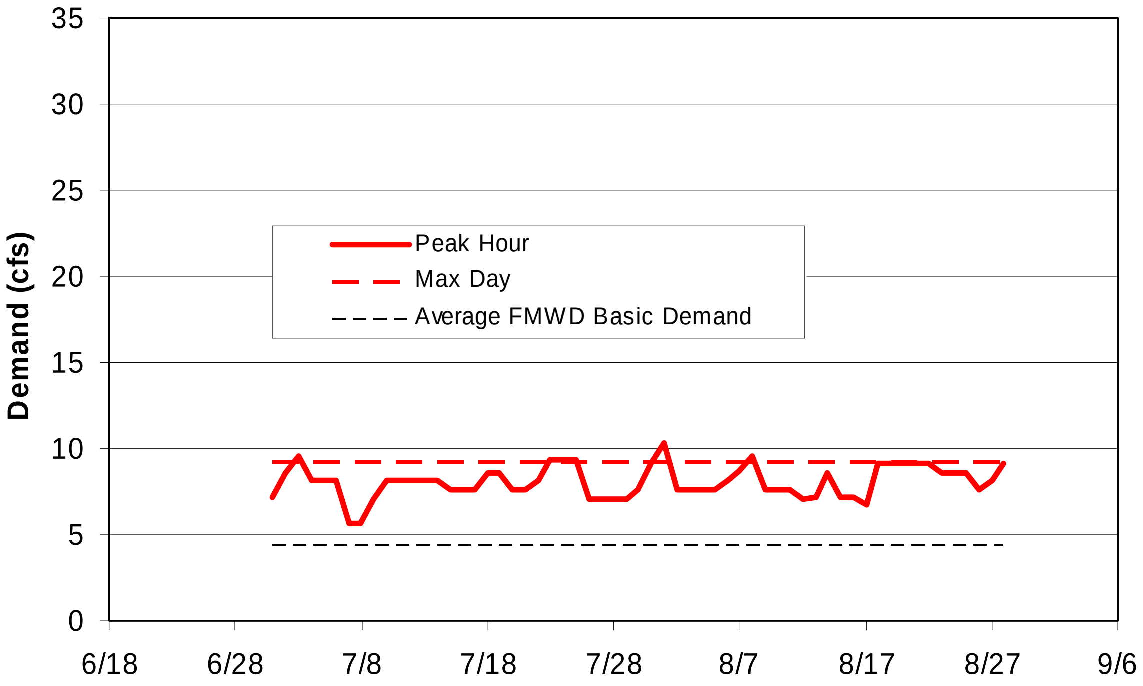


FIGURE 15

PEAK DELIVERIES FOR BERKSHIRE BRANCH OF FMWD SYSTEM IN 2004

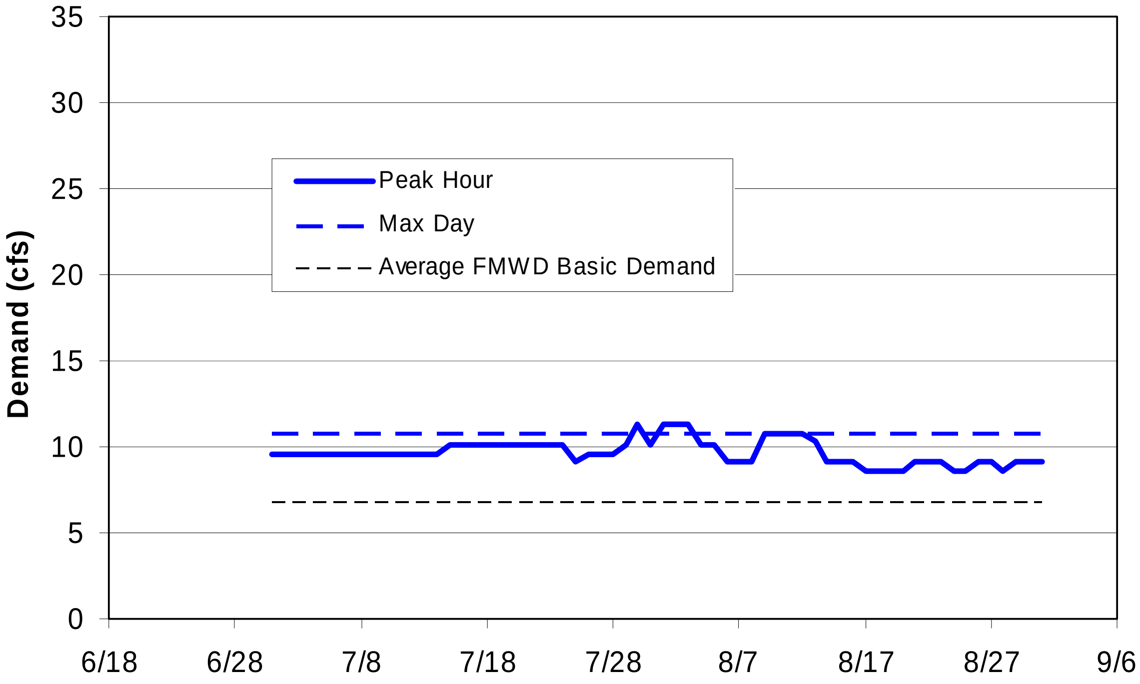


FIGURE 16

PEAK DELIVERIES FOR BERKSHIRE BRANCH OF FMWD SYSTEM IN 2003

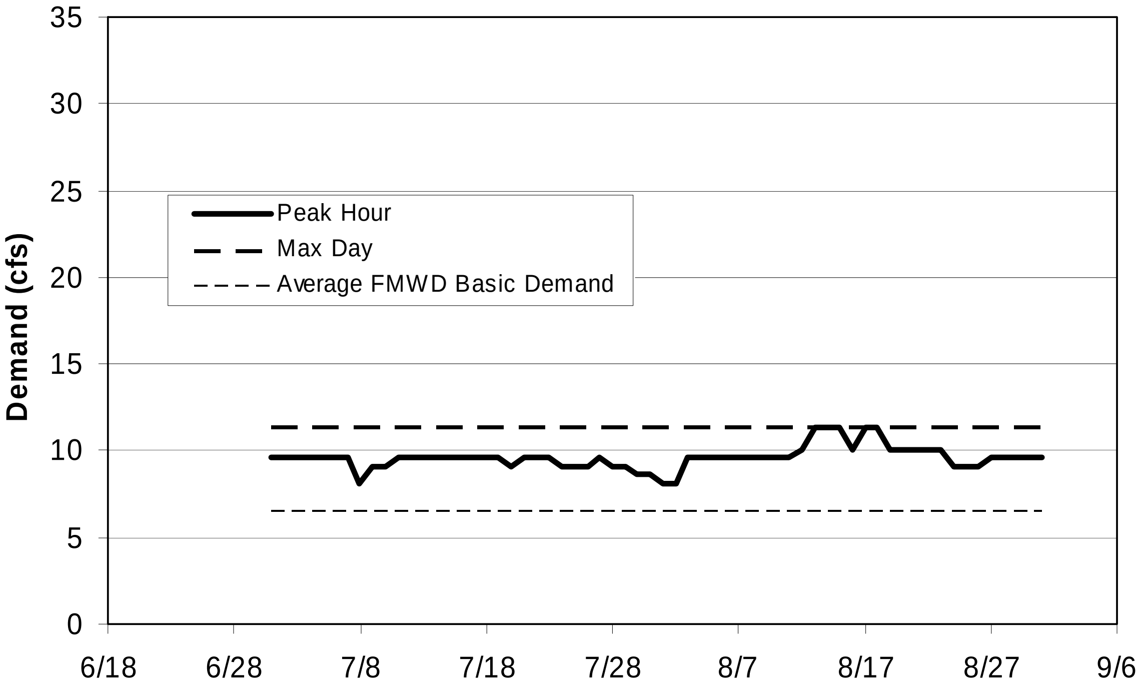


FIGURE 17

PEAK DELIVERIES FOR CENTRAL AREA OF FMWD SYSTEM IN 2005

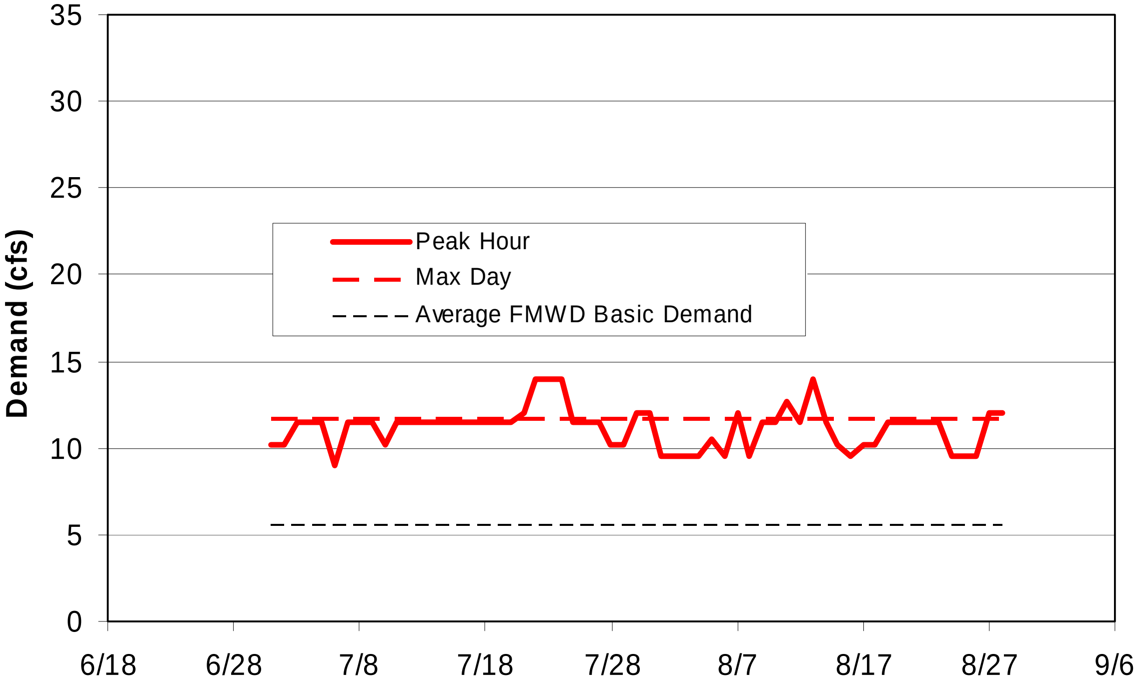


FIGURE 18

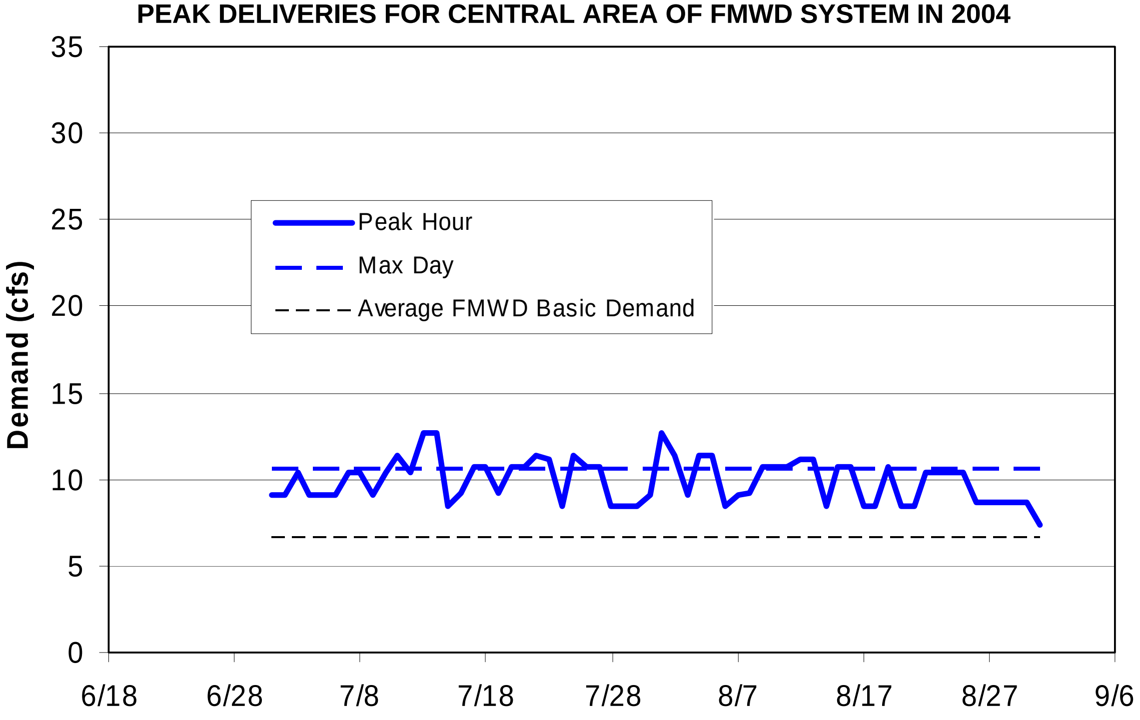


FIGURE 19

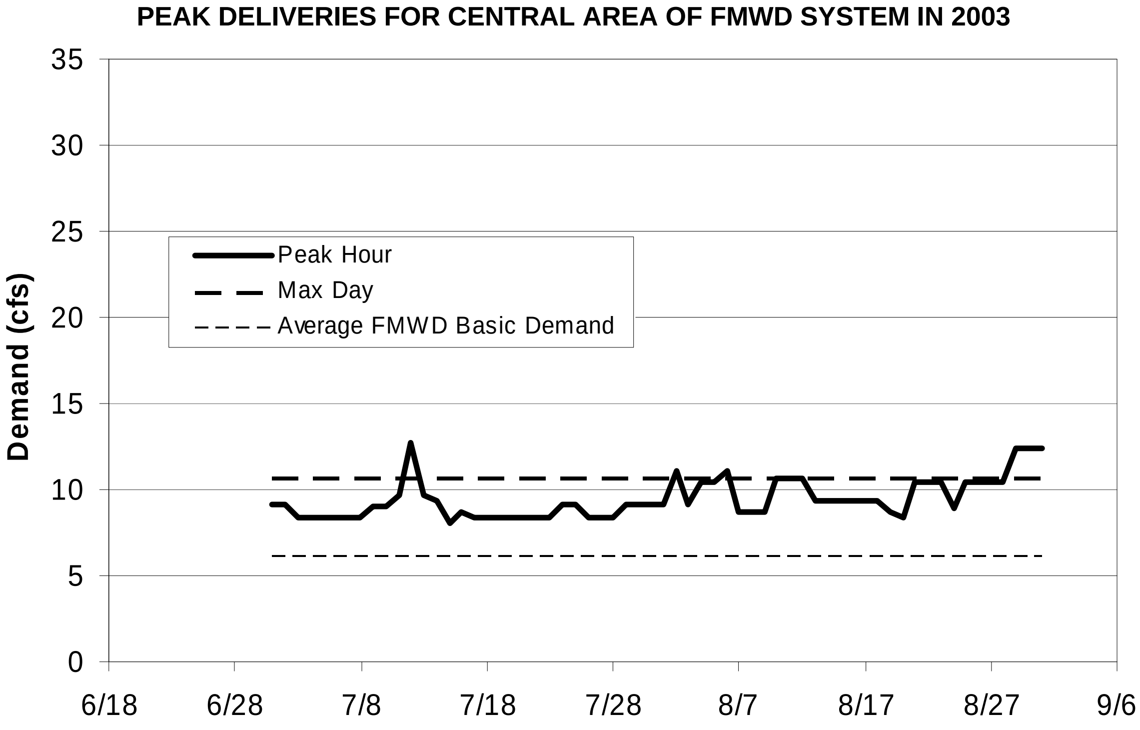


FIGURE 20

PEAK DELIVERIES FOR EAST BRANCH OF FMWD SYSTEM IN 2005

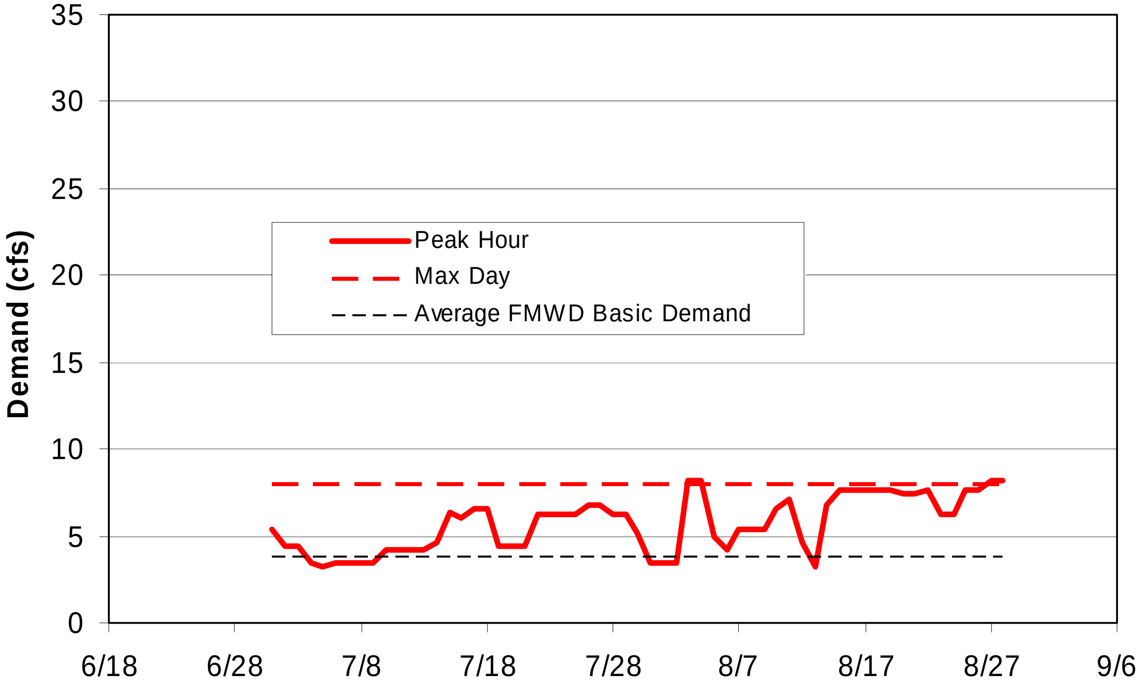


FIGURE 21

PEAK DELIVERIES FOR EAST BRANCH OF FMWD SYSTEM IN 2004

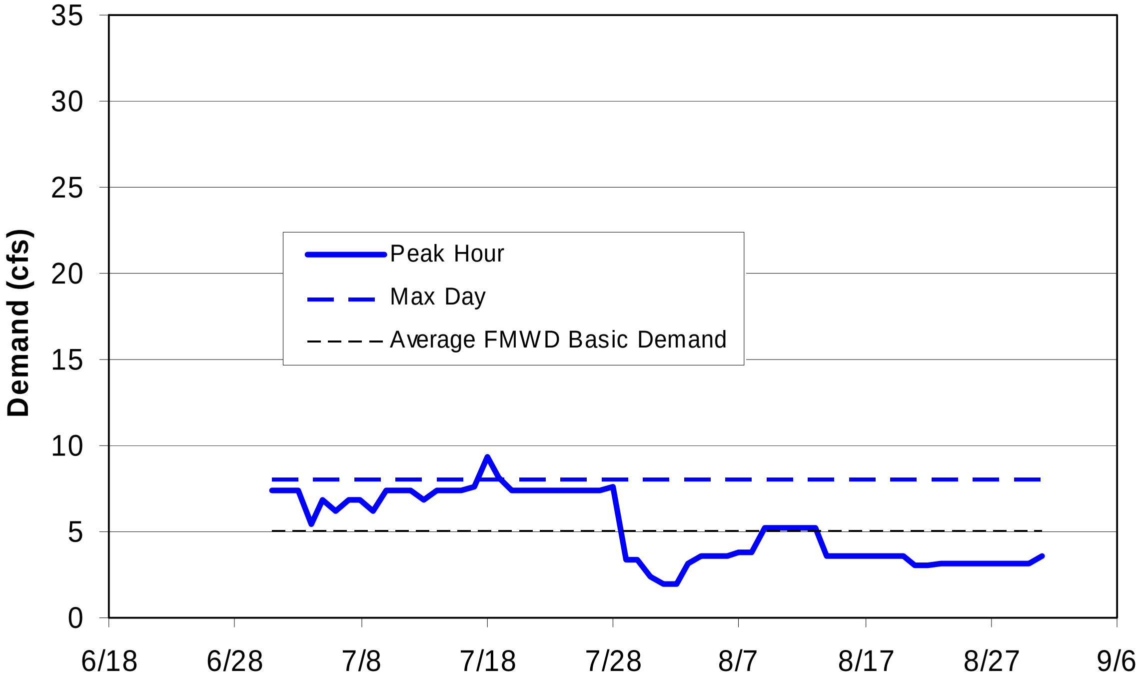
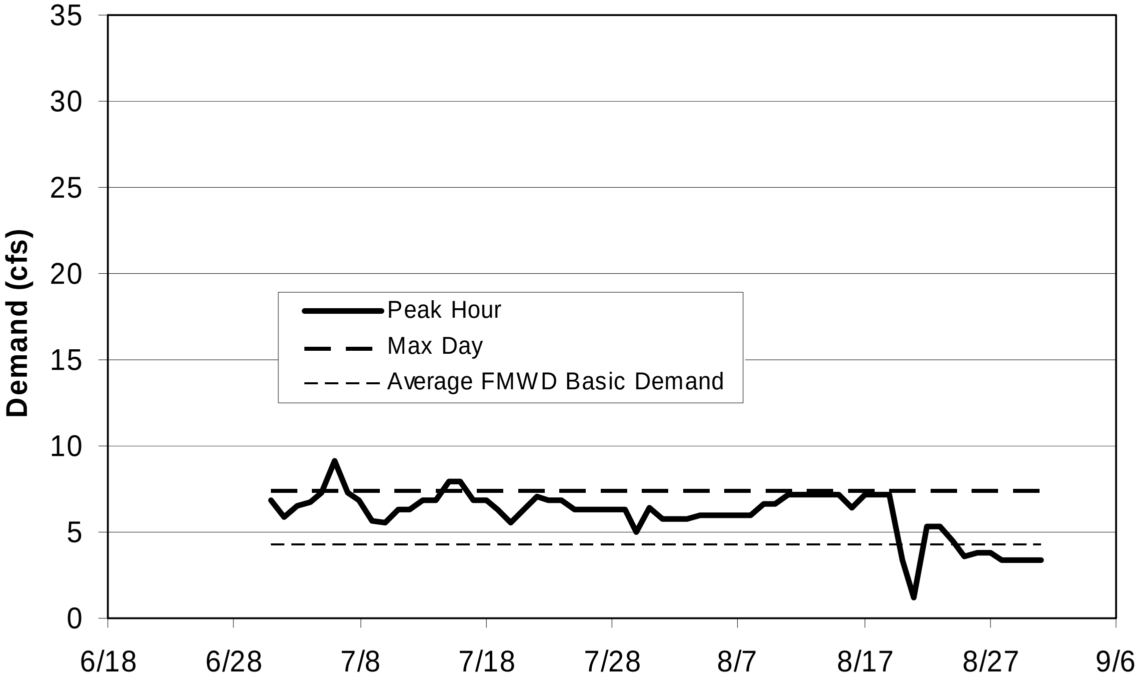


FIGURE 22

PEAK DELIVERIES FOR EAST BRANCH OF FMWD SYSTEM IN 2003



This analysis also shows that the FMWD wholesale system does not peak like a typical retail system. The FMWD system has a moderately lower peaking factor for the maximum day to average day demand (1.65 to 1.75 instead of the more typical factor of 2.0); and a significantly lower hourly peaking factor compared to the annual average (1.7 to 2.2 instead of the more typical factor of 3.0) than a comparable retail system. It appears the distribution service area demand variability exerted by consumers is buffered by the retail agencies before impacting FMWD. In fact, the total system hourly peaking factor is only about 6 percent higher than the max day peaking factor (1.7 compared to 1.6) and for the Berkshire Branch the hourly and max day peaking factors are the same (that is, maximum day demands are the same as maximum hourly demands). These peaking characteristics are contrasted to a typical retail system which has hourly peak flows which are 50 percent higher than hourly flows during the max day. The analysis shows that on occasion, for selected days, the peak hour demands are equivalent to the max day demands. This appears to be most characteristic of the Berkshire line.

6.2 Projected Service Zone Demands

Table 25 presents the projected peak FMWD demands by service zone over selected years of the study period (2006, 2010 and 2015) for normal precipitation years. Included are both maximum day and maximum hour flows. It should be noted that both peak day and peak hour projections are considered to be the same regardless of either a normal, wet, or dry precipitation year. Periods of hot weather in the summer months will occur at similar levels regardless of rainfall occurring during non-summer months.

TABLE 25

PROJECTED DEMANDS (CFS)

	Average			Max Day			Max Hour		
Agency	2006	2010	2015	2006	2010	2015	2006	2010	2015
Berkshire	5.64	5.80	6.00	9.86	10.15	10.50	9.86	10.15	10.50
Central	7.37	7.69	8.10	12.89	13.46	14.18	15.47	16.15	17.01
West Branch	13.00	13.49	14.10	20.80	21.58	22.56	23.40	24.28	25.38
East Branch	5.44	5.54	5.64	9.52	9.70	9.87	11.70	11.91	12.13
Total	18.44	19.03	19.74	29.50	30.45	31.58	31.35	32.35	33.56

6.3 Projected Peak Demands Compared to System Capacity

Based on the prior FMWD system description (see Section 2.1) the projected maximum day demands can be compared to existing and projected system capacities for each delivery zone in order to evaluate adequacy, and the amount of excess capacity to provide for uncertainties in the peak demand analysis.

Table 26 presents by service branch the FMWD delivery capabilities at existing and upgraded conditions in cfs. Also shown for each branch are projected max day demands in 2006, 2010 and 2015 (also in cfs), together with system delivery capacities stated as percent of excess capacity (over max day). For purposes of this comparison, it is assumed the 2006 demand is contrasted with existing capacity and both 2010 and 2015 projected demands are compared to upgraded capacities. As indicated, FMWD system capacity has an adequate 15 to 20 percent excess capability for every branch under assumed conditions for projected demands except 2006 capacity on the West branch which is only 8 percent greater than projected demand. This indicates FMWD is acting prudently in installing additional fifth pumps at Pumping Plant P-1 as soon as practicable.

TABLE 26

COMPARISON OF CAPACITIES TO MAXIMUM DAY DEMANDS

Service Branch	Existing Capacity (cfs)	Upgraded Capacity (cfs)	Max Day (cfs)			Excess Capacity over Max Day (percent)		
			2006	2010	2015	2006	2010	2015
Berkshire	15.7	15.7	9.86	10.15	10.50	59	55	50
Central	18.8	18.8	12.89	13.46	14.18	46	40	32
West Branch	22.5	26.2	20.80	21.58	22.56	8	21	16
East Branch	12.5	15.4	9.52	9.70	9.87	31	59	56
Total	35.0	41.6	29.50	30.45	31.58	19	37	32

This analysis also demonstrates that the FMWD system, including its individual pressure zones, easily meets the proposed State Waterworks Standard that a potable water system serving over 1,000 connections must meet maximum day demands with production facilities at all times.

6.4 System Capacities During Increased Temporary Member Agency Demands

As discussed above, the FMWD system is anticipated to have adequate excess capacity to meet normal projected maximum day demands throughout the study period. However, there are periods of supply interruptions within the distribution systems of individual Member Agencies which would result in increased temporary demands on the FMWD system. Such interruptions might last for several weeks in the case of well outages to several years in the case of drought or groundwater contamination. In order to assess the potential impacts to the FMWD system under increased demand occurrences, a variety of supply interruption scenarios were developed for evaluation; with increasing severity of interruptions, all envisioned to occur during times of projected peak day demands for both 2006 and 2015. The eight scenarios evaluated are as follows:

- Scenario 1: Loss of largest well on east side.
- Scenario 2: Loss of largest well on west side.
- Scenario 3: Loss of largest two wells on east side.
- Scenario 4: Loss of largest two wells on west side.
- Scenario 5: Loss of one-half Verdugo Basin production due to long term drought.
- Scenario 6: Loss of one-half of Verdugo Basin production, and loss of two largest wells, one on the east side and one owned by CVWD.
- Scenario 7: Loss of one-half of Verdugo Basin production, and loss of two largest wells on east side.
- Scenario 8: Loss of one-half of Verdugo Basin, and loss of two largest wells on west side.

Table 27 presents projected 2006 peak day FMWD demands in cfs together with each scenario and associated loss of production, and resulting net demands for each pressure zone service area. Net demands shown in blue exceed existing system capacities, but will be totally mitigated by installation of fifth pumps on the east and west sides at pumping plant P-1 (See Table 26 above for current and upgraded branch capacities). Numbers indicated in red will require additional source of supply, either emergency interconnections or a second MWD connection to mitigate. Conservation measures during drought scenarios (5 through 8) could also be applied to alleviate shortages.

As Table 27 indicates, two increased demand scenarios (Nos. 3 and 7) would exceed upgraded system capacity for the East branch under 2006 demands, both at 16.0 cfs compared to an upgraded capacity of 15.7 a probable supply deficit of 0.3 cfs.

In addition, scenario 8 would create a supply deficit of 0.4 cfs on the West branch even with upgraded system capacity.

TABLE 27

ANALYSIS OF IMPACTS TO THE FMWD SYSTEM FLOWS UNDER EIGHT SCENARIOS IN THE YEAR 2006 (CFS)

Non Drought Scenarios

			Scenario 1 Less Largest Well on East Side				Scenario 2 Less Largest Well on West Side				Scenario 3 Less Two Largest Wells on East Side				Scenario 4 Less Two Largest Wells on West Side		
Agency	Projected Peak Day FMWD Demand		Projected Peak FMWD Demand	Largest Well on East	Net FMWD Demand		Projected Peak FMWD Demand	Largest Well on West	Net FMWD Demand		Projected Peak FMWD Demand	Two Largest - System	Net FMWD Demand		Projected Peak FMWD Demand	Two Largest - CVWD	Net FMWD Demand
West Branch	20.8		20.8		20.8		20.8	1.3	22.1		20.8		20.8		20.8	2.5	**23.3**
East Branch	9.5		9.5	4.0	**13.5**		9.5		9.5		9.5	6.5	**16.0**		9.5		9.5
Central Area	12.9		12.9		12.9		12.9		12.9		12.9		12.9		12.9		12.9
Berkshire	9.9		9.9		9.9		9.9	1.3	11.2		9.9		9.9		9.9	2.5	12.4
Total	29.5		29.5	4.0	33.5		29.5	1.3	30.8		29.5	6.5	**36.0**		29.5	2.5	32.0

Drought Scenarios

	Scenario 5 Less Reduced Verdugo Basin Production				Scenario 6 Less Reduced Verdugo Basin Production and Largest Wells on East Side and CVWD					Scenario 7 Less Reduced Verdugo Basin Production and Two Largest Wells on East Side					Scenario 8 Less Reduced Verdugo Basin Production and Two Largest Wells on West Side				
Agency	Projected Peak FMWD Demand	GW Reduction	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	CVWD and Largest Well	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	Two Largest - System	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	Two Largest - Berkshire	Net FMWD Demand	
West Branch	20.8	4.3	**25.1**		20.8	4.3	0.7	**25.8**	(c)	20.8	4.3		**25.1**		20.8	4.3	1.5	**26.6**	(b)(c)
East Branch	9.5		9.5		9.5		4.0	**13.5**		9.5		6.5	**16.0**		9.5			9.5	
Central Area	12.9		12.9		12.9			12.9		12.9			12.9		12.9			12.9	
Berkshire	9.9	4.3	14.2		9.9	4.3	0.7	14.9	(c)	9.9	4.3		14.2		9.9	4.3	1.5	**15.7**	(b)(c)
Total	29.5	4.3	33.8		29.5	4.3	4.7	**38.5**		29.5	4.3	6.5	**40.3**		29.5	4.3	1.5	**35.3**	

(a) It is presumed that the peak day demand for a normal year and dry year are similar.
(b) LCID estimates that only about 1/2 of production from Well No. 6 could be met by Well No. 1.
(c) It is assumed that capacities of wells are reduced when Verdugo Basin is low.

For 2015 demands, as indicated in Table 28, occurrences of scenarios 5 through 8 indicate West branch deficits of 0.7 to 2.2 cfs (demands of 26.9 to 28.4 cfs compared to upgraded capacity of 26.2 cfs); scenarios 3 and 7 would create a supply deficit of 1.0 cfs on the East branch (demands of 16.4 compared to 15.4 cfs upgraded capacity); scenario 8 results in lower capacity on the Berkshire branch of 0.6 cfs (16.3 demands versus 15.7 cfs capacity); and a 0.8 cfs shortfall for total FMWD system demands versus capacity for scenario 7.

6.5 Mitigation of Peaking Factor

MWD’s capacity charge (peaking) is based on a running three-year summer peak. Obviously, the less short notice peaking Member Agencies exert on the FMWD delivery system, the lower the resulting MWD capacity charge. B-E/GEI interviewed other MWD subagencies to obtain information on approaches to peaking mitigation. Following are the results for those subagencies which addressed peaking:

- MWDOC (Municipal Water District of Orange County) distributes MWD’s capacity charge based on each member agency’s running average three-year summer peak.
- SDCWA (San Diego County Water Authority) uses a three phase program to reduce peaking.
    - Phase I is to educate member agencies and large users.
    - Phase II is to contact member agencies at times of high demand to encourage cooperation and reliance on other sources.
    - Phase III is to physically reduce deliveries based on MWD’s reduced delivery.
- Other MWD subagencies pass through the capacity charges in the rate structures without specific penalties.

It is believed the recommended CIP in this Master Plan, including additional storage will mitigate most of any future peaking problems. **FMWD staff is encouraged to continue working closely with Member Agencies to educate them, as well as encourage cooperation during times of high demand to alleviate peaking to the extent feasible.**

TABLE 28

ANALYSIS OF IMPACTS TO THE FMWD SYSTEM FLOWS UNDER EIGHT SCENARIOS IN THE YEAR 2015 (CFS)

Non Drought Scenarios

			Scenario 1 Less Largest Well on East Side				Scenario 2 Less Largest Well on West Side				Scenario 3 Less Two Largest Wells on East Side				Scenario 4 Less Two Largest Wells on West Side		
Agency	Projected Peak Day FMWD Demand		Projected Peak FMWD Demand	Largest Well on East	Net FMWD Demand		Projected Peak FMWD Demand	Largest Well on West	Net FMWD Demand		Projected Peak FMWD Demand	Two Largest - System	Net FMWD Demand		Projected Peak FMWD Demand	Two Largest - CVWD	Net FMWD Demand
West Branch	**22.6**		22.6		**22.6**		22.6	1.3	**23.9**		22.6		**22.6**		22.6	2.5	**25.1**
East Branch	9.9		9.9	4.0	**13.9**		9.9		9.9		9.9	6.5	**16.4**		9.9		9.9
Central Area	14.2		14.2		14.2		14.2		14.2		14.2		14.2		14.2		14.2
Berkshire	10.5		10.5		10.5		10.5	1.3	11.8		10.5		10.5		10.5	2.5	13.0
Total	31.6		31.6	4.0	**35.6**		31.6	1.3	32.9		31.6	6.5	**38.1**		31.6	2.5	34.1

Drought Scenarios

	Scenario 5 Less Reduced Verdugo Basin Production				Scenario 6 Less Reduced Verdugo Basin Production and Largest Wells on East Side and CVWD					Scenario 7 Less Reduced Verdugo Basin Production and Two Largest Wells on East Side					Scenario 8 Less Reduced Verdugo Basin Production and Two Largest Wells on West Side				
Agency	Projected Peak FMWD Demand	GW Reduction	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	CVWD and Largest Well	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	Two Largest - System	Net FMWD Demand		Projected Peak FMWD Demand	GW Reduction	Two Largest - Berkshire	Net FMWD Demand	
West Branch	22.6	4.3	**26.9**		22.6	4.3	0.7	**27.6**	(c)	22.6	4.3		**26.9**		22.6	4.3	1.5	**28.4**	(b)(c)
East Branch	9.9		9.9		9.9		4.0	**13.9**		9.9		6.5	**16.4**		9.9			9.9	
Central Area	14.2		14.2		14.2			14.2		14.2			14.2		14.2			14.2	
Berkshire	10.5	4.3	14.8		10.5	4.3	0.7	15.5	(c)	10.5	4.3		14.8		10.5	4.3	1.5	**16.3**	(b)(c)
Total	31.6	4.3	**35.9**		31.6	4.3	4.7	**40.6**		31.6	4.3	6.5	**42.4**		31.6	4.3	1.5	**37.4**	

(a) It is presumed that the peak day demand for a normal year and dry year are similar.
(b) LCID estimates that only about 1/2 of production from Well No. 6 could be met by Well No. 1.
(c) It is assumed that capacities of wells are reduced when Verdugo Basin is low.

7 Storage Requirements

This section presents a discussion and analysis of storage requirements for FMWD. Included are discussions on storage evaluation criteria, FMWD Member Agency storage facilities and assessment (including a discussion on storage capacity of both East and West side areas), and FMWD storage requirements. For the latter topic of discussion, conclusions and recommendations are made regarding current FMWD storage facilities and the role of groundwater basin storage as a potential storage source upon which FMWD might rely on.

7.1 Storage Evaluation Criteria

Water storage facilities are designed to serve several purposes. Primarily, storage is provided to equalize the daily fluctuations of water demands on a system's water supply. Storage is also reserved to provide water to meet fire suppression requirements for a specified period of time within the service area; and provide a source of water in emergency or other extended outage situations. Requirements for the sizing of each of these storage components vary by purveyor depending on applicable regulations, service area characteristics and requirements specific to each system.

7.1.1 Operating Storage

Operating storage (or equalization storage) is necessary to provide a supply during peak hourly water demands that exceed a system's production capacity. Typically, constructing supply and treatment facilities at levels to meet peak water demands occurring during limited times of the day is inefficient and uneconomical since a substantial portion of facility capacity will remain unused for a majority of the time. For many retail water purveyors, operating storage volumes are based on the amount of water needed to supply peak hourly demands that exceed the average maximum day demand. For example, the Truckee Meadows Water Authority (an urban regional water purveyor serving the areas of Reno and Sparks, Nevada, with approximately 100,000 service connections) has established as a criterion the provision of 15 percent of the maximum day demand as operational storage in order to meet hourly and peak daily fluctuations in demands. This criteria was established based on detailed analysis of the daily demand fluctuations within that area's water system.

7.1.2 Fire Suppression Storage

Typically, required fire flows are established by a local fire protection agency based on an evaluation process developed by the insurance industry. This process takes into account several factors including the type of structure (residential, commercial, industrial or other) building exposure and separation from adjacent structures and other factors. Fire suppression storage is determined by multiplying the required fire flow by the required time necessary to extinguish the fire. For example, fire flow requirements for residential structures are frequently 1,500 gpm for two hours, or a total required storage volume for each pressure zone of 180,000 gallons. However, consideration must be given to the need for fire suppression storage for FMWD as a wholesale water supplier. It is considered that each of the Member Agencies provide for storage to meet the requirements for localized fire events. As a consequence, localized fire demand requirements potentially exerted on the FMWD system are buffered by storage existing in the retail systems of the Member Agencies. B-E/GEI does not believe that localized fire suppression storage volume needs to be provided by FMWD in view of its operating characteristics as a wholesale supplier.

7.1.3 Emergency Storage

This third component of storage volume is provided to meet the requirements of water demands during system failures, power outages and other emergencies. The level of this storage component is dependent on the susceptibility of facilities to failure, the time needed to make repairs, the reliability and diversity of supply sources, and the physical characteristics of the system which could affect the operator’s ability to transfer supplies from zone to zone.   For a retail purveyor, it is frequently considered prudent to provide a maximum day demand volume of water with the largest well or pumping unit out of service. However, in the case of FMWD Member Agencies this total criteria would not be applicable in view of the alternative imported water source of supply to rely on in the case of well outage.

7.1.4 California Waterworks Proposed Standards

The state DHS has developed regulations to determine if a water system has an adequate source of water supply. These proposed regulations are pending and if adopted will be contained in California Waterworks Standards, Section 64553. Proposed regulations are as follows:

- At all times, a public water system’s water sources shall have the capacity to meet the system’s maximum day demand;

- For systems with 1,000 or more service connections, the system shall be able to meet four hours of peak hourly demand with source capacity, storage capacity, auxiliary power, and/or emergency source connections;

- Both the maximum day demand and peak hourly demand requirement shall be met in the system as a whole and in each individual pressure zone.

It should be noted that these regulations to evaluate source of supply and storage capacity are not enforceable by DHS in evaluation of any California potable water system at this time. Nevertheless, in its most recent system inspection report (September 16, 2005) DHS evaluated the FMWD system in accordance with these proposed regulations. Although it concluded that the source capacity and related storage met the requirements of the proposed regulations both for the system as a whole and for each pressure zone, it concluded that facilities had a very thin margin of source capacity and recommended the District consider construction of additional water storage. However, as discussed below (see subsection 7.3.2), in performing its evaluation, DHS utilized typical peaking factors for a retail water system without a detailed water assessment of peak hourly demands occurring on the FMWD system as a wholesale provider. Accordingly, the source capacity assessment results performed by DHS in B-E/GEI's opinion are inaccurate.

7.2 FMWD Member Agency Storage

In order to assess the differences between water demands and the need for storage on the west side of the FMWD service area compared to the east side of the service area, it is necessary to review the available storage and demands for each purveyor in both areas.

7.2.1 East Side Member Agency Storage

Table 29 presents the available storage for each Member Agency located in the East side of the FMWD service area in million gallons compared to both average day demand and peak day demand. Both of these demand parameters are based on 2005 data as reported by each purveyor in its reports to DHS, Urban Water Management Plans or other documents. Also shown in Table 29 are the number of days of storage expressed in terms of average day and peak day demands.

TABLE 29

EAST SIDE MEMBER AGENCY STORAGE

System	Area	Number of Storage Tanks	Storage (MG)	Average Day Demand (MG)	Days of Storage at Average Demand	Peaking Ratio	Peak Day Demand (MG)	Days of Storage at Peak Demand
Las Flores	East	7	5.13	0.87	5.9	1.65	1.44	3.58
Lincoln Ave	East	13	11.44	2.65	4.32	2.10	5.57	2.06
Rubio Cañyon	East	4	7.82	2.22	3.52	1.90	4.22	1.85
Eastside	East	24	24.40	5.74	4.25	1.95	11.22	2.17

As shown, days of storage based on average day demand for east side systems vary from about 3.5 to almost 6 days. Overall, this provides the east side with a storage capacity of over 4 days of average day demand. On a peak day demand basis, individual storage capacities range from about 1.8 to 3.6 days of storage. On an overall service area basis, the east side contains approximately 2 days of storage at peak day demands.

7.2.2 West Side Member Agency Storage

Presented below in Table 30 are similar storage capacity data for West side area purveyors. Storage data is also presented for both the Central and Berkshire imported water transmission line service areas. LCID receives imported supplies off of both transmission lines. It should also be noted that MCWC is able to rely on golf course storage ponds by suspending deliveries to this user during peak demand periods. This additional source of peak demand storage is not accounted for in this discussion.

TABLE 30

WEST SIDE MEMBER AGENCY STORAGE

System	Area	Number of Storage Tanks	Storage (MG)	Average Day Demand (MG)	Days of Storage at Average Demand	Peaking Ratio	Peak Day Demand (MG)	Days of Storage at Peak Demand
MCWC	Central	6	3.51	0.65	5.4	2.10	1.37	2.57
VWC	Central	5	5.42	3.97	1.37	2.10	8.34	0.65
LCID	Central	3	2.75	1.21	2.27	2.10	2.54	1.08
LCID	Berkshire	4	3.33	1.46	2.28	2.10	3.07	1.09
CVWD	Berkshire	14	19.49	4.99	3.91	1.55	7.73	2.52
	Central	14	11.68	5.83	2	2.10	12.24	0.95
	Berkshire	18	22.82	6.45	3.54	1.67	10.80	2.11
	Westside	32	34.50	12.28	2.81	1.88	23.04	1.5
Central with Future		15	12.68	5.83	2.17	2.10	12.24	1.04
Berkshire w/ Future		18	22.82	6.45	3.54	1.67	10.80	2.11
Westside w/ Future		33	35.50	12.28	2.89	1.88	23.04	1.54
LCID with additions		8	7.08	2.67	2.65	2.10	5.61	1.26

(a) LCID plans to add 1 MG storage to their Zone 2

As indicated in Table 30, purveyors possess storage capacities in terms of average day demands ranging from about 1.4 to over 5 days. On a peak day demand basis, capacities vary from about 0.7 up to 2.6 days of storage. It would appear that VWC with less than one day of storage at peak demand would be deficient in storage capacity. However, it should be noted that VWC has backup well production for each of its two primary well facilities. It should also be noted that it is outside the scope of this Master Planning study for B-E/GEI to evaluate and develop conclusions on the adequacy of storage for each individual system.

Table 30 also contains similar storage data and analysis in terms of demands for each of the two imported water service areas on the West side. As shown, average day demand storage capacities vary from about 2.0 to 3.5 for the Central and Berkshire areas respectively. On a peak day demand basis, the Central service area contains about one day of storage and the

Berkshire area contains approximately 2 days. Overall, the West side contains storage facilities with a capacity to meet about 2.8 days of average day demand and 1.5 days of peak day demand. These capacities are slightly improved with the addition of a one million gallon storage facility which LCID plans to add to their zone 2. With this future reservoir addition, the west side service area will have storage on the order of almost 3 days of average day demand and 1.5 days at peak demand.

7.2.3 Total Member Agency Storage

Following Table 31 shows area wide Member Agency storage at the retail distribution level. Demand data indicates that average day demand is approximately twice as high for the west side as the east side, on the order of 12 and 6 MG respectively. Peaking ratios for both areas are close to the same at approximately 1.9 times average day demand to yield peak day demand. Accordingly, peak day demand in the west side is also about twice that for the east side at about 23 and 11 MG respectively. As indicated above, the east side service area has on the order of 2 days of peak day storage compared to the west side at about 1.5 days. Combining the east and the west sides representing the entire FMWD service area shows the current total storage operated by the Member Agencies is about 59 MG to serve average day demands of about 18 MG and peak day demands of about 34 MG. The construction of an additional 1 MG reservoir by LCID will bring the total retail level storage to about 60 MG. With either current or future storage volumes, this results in approximately 3.3 days of storage at average demand and 1.7 days of storage at peak demand.

TABLE 31

AREA WIDE STORAGE

System	Area	Number of Storage Tanks	Storage (MG)	Average Day Demand (MG)	Days of Storage at Average Demand	Peaking Ratio	Peak Day Demand (MG)	Days of Storage at Peak Demand
	Eastside	24	24.40	5.74	4.25	1.95	11.22	2.17
	Westside	32	34.50	12.28	2.81	1.88	23.04	1.5
Total System		56	58.90	18.02	3.27	1.90	34.26	1.72
Total System- Future (a)		57	59.90	18.02	3.32	1.90	34.26	1.75
FMWD	East	2	2.60					
FMWD	Central	2	2.20					
FMWD	Berkshire	2	2.00					
FWWD	West	4	4.20					
Combined	East	26	27.00	5.74	4.7	1.95	11.22	2.41
Combined	Central	16	13.88	5.83	2.38	2.10	12.24	1.13
Combined	Berkshire	20	24.82	6.45	3.85	1.67	10.80	2.3
Combined	West	24	38.70	12.28	3.15	1.88	23.04	1.68
Total System		50	65.70	18.02	3.65	1.90	34.26	1.92
Total System- Future (a)		51	66.70	18.02	3.7	1.90	34.26	1.95

(a) LCID plans to add 1 MG storage to their Zone 2

Also shown in Table 31 is storage available from the FMWD system by service area. This additional available storage is then combined with Member Agency storage to yield total storage available throughout the FMWD service area both on the wholesale and retail levels. As shown, both East and West side service areas are enhanced with this additional storage resulting in approximately 2.4 (increased from 2.2) and 1.7 (increased from 1.5) days of storage at peak demands respectively. The overall FMWD service area storage averages to almost 2 days at peak demand.

The total combined storage for the central service area on the West side has the minimum days of storage at peak demands at 1.1. If general storage requirement criteria are applied to this area, assuming one day of peak demand storage for emergencies, 15 percent of peak day storage for equalization or operating storage plus fire reserve, the resulting storage appears to be deficient. However, in view of LCID receiving water from FMWD on both the Central and Berkshire transmission lines, as well as extending across both FMWD service zones, it is more important to consider storage on the West side overall. Therefore, it appears that both the East and West side service areas within FMWD have adequate storage on an overall demand basis when combined at the distribution and wholesale levels.

7.3 FMWD Storage

7.3.1 FMWD Current Storage Facilities

Table 32 presents FMWD storage availability by pressure zone service areas together with corresponding average day and peak day demands on the FMWD system for both 2006 and 2015.

TABLE 32

FMWD STORAGE

System	Area	Number of Storage Tanks	Storage (MG)	Average Day Demand (MG)	Days of Storage at Average Demand	Peaking Ratio	Peak Day Demand (MG)	Days of Storage at Peak Demand
2006								
FMWD	East	2	2.60	3.51	0.74	1.75	6.14	0.42
FMWD	Central	2	2.20	4.76	0.46	1.75	8.33	0.26
FMWD	Berkshire	2	2.00	3.64	0.55	1.75	6.37	0.31
FMWD	West	4	4.20	8.4	0.50	1.6	13.44	0.31
FMWD	Total	6	6.80	11.91	0.57	1.6	19.06	0.36
Proposed Storage Addition								
FMWD	Berkshire	3	3.00	3.64	0.82	1.75	6.37	0.47
FMWD	West	5	5.20	8.40	0.62	1.60	13.44	0.39
FMWD	Total	7	7.80	11.91	0.65	1.60	19.06	0.41
2015								
FMWD	East	2	2.60	3.65	0.71	1.75	6.39	0.41
FMWD	Central	2	2.20	5.24	0.42	1.75	9.17	0.24
FMWD	Berkshire	2	2.00	3.88	0.52	1.75	6.79	0.29
FMWD	West	4	4.20	9.12	0.46	1.6	14.59	0.29
FMWD	Total	6	6.80	12.77	0.53	1.6	20.43	0.33
Proposed Storage Addition								
FMWD	Berkshire	3	3.00	3.88	0.57	1.75	6.79	0.44
FMWD	West	5	5.20	9.12	0.57	1.60	14.59	0.36
FMWD	Total	7	7.80	12.77	0.57	1.60	20.43	0.38

As shown for 2006, existing FMWD facilities provide 0.74 and 0.50 days of average day demand storage (about 18 and 12 hours); and 0.42 and 0.31 days of peak demand storage (about 10 and 7 ½ hours) for the East and West side service areas respectively. Demands in 2015 decrease the storage coverage slightly, by about one hour for average day demand (17 and 11 hours) but less for peak day demands (10 and 7 hours), again for the East and West side service areas, respectively.

7.3.2 FMWD Proposed Storage Facility and Second MWD Connection

Table 32 also shows the impact of adding a 1 MG reservoir on the West side as proposed in Section 4. For 2006, the west side average day demand storage would increase from 12 to 15 hours, and peak day demand storage would increase from about 7 ½ to 9 ½ hours. Similar increases would occur for 2015 demands for the West side by the additional reservoir, from 11 to 13.5 and 7 to 8.5 hours for average and peak day demands respectively.

However, even more important is the beneficial impact on hours of storage availability with the construction of a second MWD connection. In addition to providing a separate second source of supply at a strategic location for flexibility in delivering water, the hours of available storage both under average and peak day demands could be double those noted above depending on the location of emergency conditions requiring dependence on available storage.

7.3.3 FMWD Storage Adequacy

Proposed California Waterworks Standards (see subsection 7.1.4), if adopted, will require each municipal water system to meet four hours of peak hourly demand with source capacity, storage capacity, and/or emergency source connections. This requirement is to be met in the system overall as well as in each pressure zone. When evaluating the FMWD system, the state DHS applied generic peaking factors (maximum hourly flow of 3.0 times average annual hourly flow) in lieu of analyzing actual historic maximum hourly peaking factors. As discussed in subsection 6.1.3, the FMWD as a wholesale provider has lower maximum peaking factors than a typical retail purveyor. Table 33 presents a comparison of 4-hour maximum demands in 2015 with existing and proposed FMWD storage both for the system overall and each pressure zone. As indicated, FMWD existing storage easily meets the proposed state standard even without considering source capacity or emergency interconnections, with current storage in individual service zones having capacities in excess of 4-hour maximum demands ranging from 22 to 100 percent (central and west side service areas, respectively) based on 2015 demands.

TABLE 33

FMWD Storage Compared to 4-Hour Maximum Demand in 2015

Area	Storage (MG)	Max Hour Demand (CFS)	4-Hour Max Demand (MG)	Excess Storage Capacity (Percent)
East	2.6	12.13	1.3	100
Berkshire	2.0	10.15	1.1	82
Central	2.2	17.01	1.8	22
West	4.2	25.38	2.7	56
Total	6.8	33.56	3.6	89
Proposed Storage Addition				
Berkshire	3.0		1.1	173
West	5.2		2.7	92
Total	7.8		3.6	116

7.3.4 Potential Groundwater Storage

Some Central Valley cities such as Fresno and Modesto rely heavily on underlying groundwater storage in preference to surface storage. For example, the City of Fresno, with an estimated 124,000 connections, has only two storage tanks but approximately 250 wells in order to rely on groundwater production to meet almost all fire, operating, and emergency demands. The following list presents some of the comparable characteristics of groundwater versus surface storage from the perspective of the FMWD system.

Groundwater Storage

Benefits

- Flexibility in storage approach through in-lieu or injection
- Storage additions shift system capacity demands to non-peak winter months
- No additional or minimal land requirements
- Lower cost source of supply to replenish storage through use of MWD non-peak storage discount rates
- Flexibility of extraction locations
- Significant potential storage capacity available in Raymond Basin

Shortfalls

- Economic cost of recovering stored groundwater
- Percentage of stored groundwater “lost” from both groundwater hydraulics and administrative cost
- Potential for groundwater contamination with adverse economic impact if treatment needed
- FMWD does not possess groundwater rights or facilities for production
- Verdugo Basin does not adequately retain stored water
- CVWD cannot be served Raymond Basin groundwater
- Additional production facilities needed to extract groundwater during high demand periods
- Extraction locations at lower elevations in service area
- DHS has historically voiced concerns over blending of potentially contaminated groundwater into FMWD’s imported water system

Surface Water Storage

Benefits

- Shorter time for storage replenishment
- Available for immediate response to peaking or emergency needs providing greater flexibility
- Directly under operational control of FMWD
- Lower water quality concerns with proper reservoir design and operations
- No loss of water between replenishment and extraction
- Can locate storage at strategic locations at high elevations

Shortfalls

- Larger land requirements
- Large capital requirements for tank construction
- No discounted water rates for storage replenishment

In view of the role of FMWD as a wholesale supplier of imported water, without direct access to the groundwater basins, it would be exceedingly difficult for the agency to overcome the many shortfalls listed above and develop a viable groundwater operating storage resource. However, in view of the conclusions by B-E/GEI that FMWD will easily meet its storage needs and comply with regulatory requirements following the recommended construction of an additional MWD connection and associated 1 MG reservoir, no further consideration is given to developing FMWD system storage through groundwater resources.

7.3.5 FMWD Storage Recommendations

As discussed above, it appears that the FMWD service area purveyors, considering both the wholesale and distribution levels, have adequate storage capacity in both the east and west side service areas. FMWD wholesale storage capacity currently easily meets proposed state standards. However, in the event of an emergency, currently available FMWD storage, even if full at the time of occurrence could be depleted within 8 hours. Therefore, **B-E/GEI recommends the construction of an additional 1 MG storage reservoir and a second MWD connection which could double the amount of time before storage depletion.**

8 Foothill Conjunctive Use Project

In order to enhance the surface water delivery capability to FMWD Member Agencies during emergencies and drought periods, MWD, FMWD, the Raymond Basin Management Board and Member Agencies of FMWD have jointly been participating in the development of a Foothill Conjunctive Use Program (Foothill CUP) utilizing imported water deliveries during times of adequate supply to store in the Raymond Basin for subsequent production when needed. Currently under development are conjunctive use programs for both the Pasadena subunit (Raymond CUP) and the Monk Hill subunit (Foothill CUP). It is the latter program which is discussed below and incorporated into this FMWD Master Plan.

8.1 Concept Goals of Program

The Foothill CUP will allow MWD, in cooperation with FMWD and its Member Agencies, to store in the Monk Hill subarea of the Raymond Basin up to 9,000 acre-feet of available wet period water for subsequent withdrawal at a level of up to 3,000 acre-feet annually during emergencies and droughts. Storing imported water in the groundwater basin would be accomplished through in-lieu deliveries and injection. In addition to the goal of enhancing imported water reliability, program goals also include improvement of groundwater basin water levels and containment of known contaminant plumes.

8.2 Description of Program

The concept of a conjunctive use storage program in the Raymond Basin has been considered for at least the last two decades. As a partial implementation of this concept, the Foothill CUP utilizing the Monk Hill subarea of the basin was approved in 2004. Member Agencies participating in the in-lieu deliveries include LCID, VWC, LFWC and RCLWA. Each Member Agency has an individual water storage agreement with FMWD. Imported water deliveries taken on an in-lieu basis will be delivered at each agency’s treated water connection being credited to a storage account. The cost of water deliveries are deferred as no charges for these in-lieu deliveries are made at the time of delivery through the surface water connection. However, when MWD requires the water to be produced on account of drought conditions or other reasons, produced groundwater will be invoiced at the current MWD treated water rate. All groundwater pumping costs will be reimbursed by MWD. Water storage credits will also be accrued by some Member Agencies through direct injection of imported water supplies. Those member agencies participating in this storage approach include LCID, VWC and RCLWA.

Annual “put” amounts during years of available imported water supplies will vary up to 2,250 acre-feet annually. For a full put, MWD deliveries will be increased during non-peak periods from November through April offset by no well production during this period (except for LAWC). During the peak demand months of May through October wells located in the Monk Hill subarea will operate the same as normal. For a partial put of less than 2,250 acre-feet per year, increased MWD deliveries will be made at the beginning of January until the desired put amount is achieved. Likewise, Monk Hill production wells will be dormant during this same period (again, except for LAWC). During a year when MWD requests, imported water deliveries will be decreased from January through April for a full take amount of 3,000 acre-feet. Also during this time, Monk Hill wells will be pumped to capacity until 3,000 acre-feet is taken and no imported water injection implemented. For the remaining months of May through December, Monk Hill wells will operate the same as normally.

8.3 Funding and Recommended Facilities

Facilities to implement the Foothill CUP include an addition of pumps and electrical controls at the main pumping station P-1 in order to enlarge the delivery capability of the imported water connection FM-1 to accommodate in-lieu water deliveries, the conversion of three production wells to ASR (aquifer storage and recovery) facilities for alternative operation of injection and production, and needed interconnections between purveyors in the FMWD service area. FMWD is currently waiting for delivery of P-1 pump additions from the manufacturer. Installation is anticipated for the first half of 2007. Minor improvements also include new pumps at the La Cañada reservoir site to provide for imported water deliveries to the LCID proposed injection well. In addition to LCID, one of RCLWA's production wells has been converted to an ASR facility. In order to initiate the Foothill CUP, FMWD was awarded a grant of $1.7 million under State Proposition 13 funding. Additional funding required under this program is being provided by FMWD.

9 Water Quality

FMWD and its Member Agencies must be concerned with water quality issues of both imported water and groundwater. Imported water delivery reliability is essential in view of the need for five Member Agencies to use blending as a treatment option to mitigate local surface water and groundwater quality issues.

9.1 Imported Water Quality

Member Agencies must deliver potable water that meets all primary drinking water standards established by the US EPA in accordance with the authority under the Safe Drinking Water Act. California enforces these standards through adoption of federal maximum contaminant levels, and in limited cases establishes more stringent requirements. EPA continues to monitor for up to 30 additional potential contaminants in five year cycles. Depending on monitoring results and potential health effects, EPA will continue to target additional compounds to regulate.

FMWD as a wholesale provider of treated potable imported water supplies is a member subagency of MWD. This regional supplier of imported water supplies throughout Southern California is committed to providing water that is safe; plus looks, tastes and smells good. MWD's water consistently meets all of the standards for drinking water and can be relied on to continue to do so. MWD maintains state of the art treatment plants and has a nationally recognized water department which performs research on water quality issues. FMWD performs no additional treatment on supplies received from MWD.

9.2 Groundwater Quality

Overall, groundwater quality from both the Verdugo and Raymond Basins is of good quality. However, there are contamination issues which must be addressed by Member Agencies before produced groundwater can be served to consumers. Table 34 presents contaminants of concern by agency together with purveyor response or treatment. As shown, contaminants include the major minerals of nitrate and fluoride, volatile trace organic compounds (trichloroethylene or TCE, tetrachloroethylene or PCE, and methyl tert-butyl ether or MTBE) and the non-volatile trace organic compound perchlorate. One purveyor, LCID, also is concerned with the rising levels of radiological contaminates in the aquifer, although these levels do not exceed MCLs. Increasing local water levels may be influencing concentrations. Blending with imported water is utilized by four purveyors involving almost all contaminants of concern.

TABLE 34

MEMBER AGENCY GROUNDWATER QUALITY ISSUES

Agency	Issue	Response or Treatment
CVWD	Nitrate	Ion exchange
	PCE	Low levels, below ½ MCL.
	MTBE	Currently only a problem in two wells. CVWD is researching mitigation.
LCID	Nitrate	Blend with FMWD imported water supplies.
	Radiological	Increasing level in groundwater aquifer. Currently monitoring rising concentrations.
VWC	PCE/TCE	Airstripper
	Nitrate	Blend with FMWD imported water supplies.
LAWC	VOCs	Add liquid carbon for removal; blend with FMWD imported water supplies.
	Perchlorate	Anion exchange resins; blend with FMWD imported water supplies.
LFMWC	PCE	Granular activated carbon treatment.
	Perchlorate	Blend with FMWD imported water supplies.
RCLWA	Fluoride	Occasionally exceeds MCL in local surface supply; blend with FMWD imported water supplies.
	Perchlorate	Occasionally detected above detection limit.

9.3 Disinfection By-Product Rule

One water quality regulation which FMWD and its Member Agencies have to monitor carefully is the Disinfection By-Product (DBP) Rule. Since the beginning of 2002, systems serving surface water and at least 10,000 people began to initially comply with Stage 1 of the Rule by monitoring. Currently, potable water systems are required to meet MCLs of 0.080 milligrams per liter (mg/l) for total trihalomethanes (TTHMs) and 0.060 mg/l for haloacetic acids.

MWD changed its disinfection technology a number of years ago from free chlorine to chloramines in order to better control THM formation. Water which is allowed to stagnate such as in reservoirs may also form excessive THMs and cause other water quality problems. As a consequence, FMWD has installed circulation pumps in each of its reservoirs to prevent water from stagnating.

Purveyors are currently reacting to Stage 2 of the DBP Rule which applies to all public water systems that add a chemical disinfectant to their supplies. The main difference between

Stage 1 was based on a system wide running annual average. Stage 2 is based on running annual averages at each monitoring location. An initial distribution system evaluation by each purveyor must be submitted to the state within two years after publication of the final rule which occurred in 2005. FMWD is expected to continue to meet requirements of the DBP Rule. Discussions with the Member Agencies have indicated that none anticipate a problem with Stage 2 DBP Rule compliance so long as FMWD delivers water that is within MCLs.

10 Recommended CIP Facilities and Implementation Schedule

Presented in this section is an identification by B-E/GEI of recommended facilities (Capital Improvement Program, or CIP) to either be constructed, rehabilitated or replaced over the study period of the Master Plan (through 2015). There is also a recommended CIP implementation schedule. Finally included below is a discussion of the "Do Nothing" alternative.

10.1 Recommended CIP Facilities and Implementation Schedule

CIP facilities have been categorized as either primary, secondary or discretionary. Primary CIP involves those facilities which in B-E/GEI's opinion are essential for continuing existing operations at a high level of service. A majority of the recommended primary CIP involves replacement of existing facilities anticipated to reach the end of their estimated useful lives before the end of the current study period. Recommended secondary CIP are new facilities which B-E/GEI believes will enhance existing operations. These CIP facilities are highly recommended to be implemented but are not as essential as primary CIP facilities. Those facilities recommended in discretionary CIP will increase system reliability during emergencies and other conditions impacting system supply capability, as well as provide an operating alternative for major facility rehabilitation or replacement. However, it is recognized the high relative cost of the discretionary CIP will require consensus from Member Agencies and rate payers to implement.

Table 35 presents the Master Plan primary CIP recommended by B-E/GEI to make needed replacements of facilities anticipated to reach the end of their useful lives before the end of 2015.

As shown, **B-E/GEI is recommending approximately $2.7 million (2006 dollars) be available as Primary CIP. Of this amount, $1.1 million is required to either replace or rehabilitate existing facilities anticipated to reach the end of their useful lives before the end of the study period.** These facilities represent pumps and motors, meters, valves and structures which are either identified in the text (Section 5) or contained in the Appendix G inventory remaining life analysis. Operating staff will need to make a decision on the best alternative of total replacement or rehabilitation of these facilities at the time operating conditions warrant. **Also included is a $100,000 allowance to renovate existing FMWD offices and $1.5 million to provide for new emergency generators and a SCADA system.**

Shown in Table 36 are recommended secondary and discretionary CIP. The former are new facilities including a 1 MG reservoir and interconnection between LCID and

MCWC. Secondary CIP totals about $2.1 million. Discretionary facilities (a second MWD connection and pipeline intertie with LCID from the new reservoir) are estimated to cost $17.7 million (2006 dollars) and are further described in Section 4.5. These discretionary facilities are recommended to be installed in order to increase service reliability and flexibility in meeting unforeseen emergencies; and provide a water delivery strategy to be utilized in making major transmission main replacements in the next Master Plan cycle (2016-2025).

TABLE 35

COST AND SCHEDULE OF RECOMMENDED PRIMARY CIP

Description	Dimensions	Quantity	Cost	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
REPLACEMENT OR REHABILITIATION OF EXISTING FACILITIES													
Pumps and Motors													
East			$326,716							$186,922	$121,625	$101,272	
West			291,517							246,030	112,991		
Meters													
Joint Facilities			52,431										$71,755
East			1,954										2,675
Valves and Structures													
East			79,339		13,687	15,637	9,416	16,281	11,759	16,287	3,389	3,561	
West			321,750		69,077	104,194	89,737	71,702				7,602	41,381
Emergency Generators and SCADA													
Joint Facilities			1,050,000		500,000		594,880						
West			500,000			520,000							
Office Renovation													
Joint Facilities			100,000		100,000								
Total CIP by Area													
Total East			408,009		13,687	15,637	9,416	16,281	11,759	203,209	125,014	104,833	2,675
Total West			1,113,268		69,077	624,194	89,737	71,702		246,030	112,991	7,602	41,381
Total Joint Facilities			1,202,431		500,000		594,880						71,755
Total Replacement and Rehabilitation			$2,723,708	$0	$682,764	$639,832	$694,033	$87,983	$11,759	$449,239	$238,005	$112,435	$115,811

TABLE 36

RECOMMENDED SECONDARY AND DISCRETIONARY CIP

Description	Dimensions	Quantity	Cost	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Recommended Secondary CIP													
New Reservoir (b)	1 MG	1 ea	$2,069,600		$500,000	$520,000	$1,203,155						
Interconnection			50,000			52,000							
Total Recommended Secondary CIP			$2,119,600	$0	$500,000	$572,000	$1,203,155	$0	$0	$0	$0	$0	$0
Recommended Discretionary CIP													
MWD Connection (a)	24 in	27,000 ft	$16,610,500		$900,000	$3,016,000	$14,410,070						
Connection to LCID	18 in	3,200 ft	1,122,100		100,000	104,000	1,037,237						
Total Recommended Discretionary CIP			$17,732,600	$0	$1,000,000	$3,120,000	$15,447,307	$0	$0	$0	$0	$0	$0

(a) Includes a pump station.

(b) Includes a pipeline to connect new reservoir with existing la Crescenta reservoirs.

10.2 Do Nothing Alternative

A total Do Nothing strategy is not feasible since a significant portion of the recommended CIP involves replacement or rehabilitation of existing facilities which are essential to maintaining good operating conditions. Otherwise, supply capability of the existing FMWD system would be compromised or diminished.

On the other hand, it is at least feasible to delay the new facilities recommended in this Master Plan, including the second MWD connection, associated reservoir and connective pipelines to LCID and MCWC facilities until after the current study period analysis. Supply capability by B-E/GEI indicates that under normal demand conditions and all but the most rigorous increased demand scenarios, the FMWD system is capable of meeting demands. Further, the FMWD system through 2015 is anticipated to easily meet proposed DHS Waterworks Standards.

However, as existing transmission pipelines remain in service approaching the end of their useful lives, there will be an increasing risk of premature major facility failure requiring emergency reaction. Additionally, implementing the recommended new facilities proposed in this Master Plan will lay the groundwork strategy for eventual pipeline replacement which will eventually be required in any case.

11 Rate Impacts and Cost Allocation

Discussed in this section are revenue requirements and sources of capital funding which FMWD needs to consider funding the recommended capital improvement plan contained in this Master Plan. Also presented below are potential rate impacts occurring from CIP financing as well as potential negative revenue impacts to FMWD from the increased use of groundwater injection and in-lieu imported water deliveries as the Raymond Basin Conjunctive Use Program (Foothill CUP) is implemented. Finally, a discussion is included on the issue of CIP cost allocation between the Member Agencies according to benefits received.

11.1 Sources of Capital Funding

There are a variety of capital funding sources which can potentially be utilized to finance new facilities associated with water resource projects. These include pay as you go, grants, low interest loans, bonds, certificates of participation and public-private partnerships. Each of these capital funding sources is described below.

11.1.1 Pay As You Go

Pay As You Go capital funding refers to meeting construction payment obligations from current operating revenues as construction proceeds. This approach is commonly utilized by large utilities or public agencies which have excess revenues or net incomes significantly larger than construction payment obligations. Smaller public agencies also favor this approach, if feasible, for small construction projects as the issuance costs for a bond financing can be substantial in relation to the capital generated. Obviously, if a construction budget is large in relation to the available margin of revenues above expenses for the project proponent, this approach is not feasible. Pay As You Go financing is not anticipated to be feasible to implement the major CIP facilities (second MWD connection) recommended in this Master Plan.

11.1.2 Grants

From time to time, both the federal and state governments have grant programs to help fund assorted water infrastructure projects.

11.1.2.1 Federal Grants

No current grant programs for clean water infrastructure facilities are believed to be available by the federal government. In view of the recent southeastern US hurricane damage, impacting numerous water and wastewater system facilities, it is unlikely any non-earmarked federal grant program for water facility construction outside of this region will be available for the foreseeable future.

11.1.2.2 State Grants (Propositions 50 and 84)

California has one current grant program available to finance water infrastructure. Proposition 50 (known as the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002) authorized the Legislature to appropriate funds for Integrated Regional Water Management (IRWM) projects. This grant program is jointly administered by the Department of Water Resources and State Water Resources Control Board.

Chapter 8 of the act provides about $380 million for Integrated Regional Water Management Projects. Grant funding is available to local agencies for projects that are formulated through an integrated regional planning process. Funding is available for implementation of regional projects (Implementation Grant) and to support development of Integrated Regional Water Management Plans (IRWMPs). Two cycles of funding were being used to select projects for funding. The first cycle projects submittal deadline is past leaving only on the order of $200 million available for cycle two funding. To qualify for Implementation Grant funding, the proposed projects need to be the outcome of an IRWMP. Only one Implementation Grant application will be accepted from each region. However, each grant application may request funding for more than one project. Each grant is limited to a maximum of $50 million. This source of grant funding is probably not feasible for FMWD CIP implementation, as projects most likely to be funded should be related to regional rather than local projects.

The second phase of funding may not occur as some of the remaining money could be used to fund cycle I projects not initially selected for funding. Any remaining money would be transferred to the recently passed Proposition 84 program. There may be limited funds available through the Proposition 84 program for FMWD CIP; but the program details have not yet been established.

11.1.3 Loans (low interest)

As with grant programs, both the federal and state governments frequently have low interest loan programs available to support water infrastructure projects.

11.1.3.1 Federal

No low interest federal loans were identified which might be a source of financing for the FMWD CIP implementation.

11.1.3.2 State

A conversation with the Department of Water Resources revealed two potential sources of state financing for the secondary and discretionary CIPs. The Water Conservation Bond Law of 1988 (Proposition 82) continues to have construction money available for public agency water system financing. A potential loan is limited to $5 million per project and a 20-year term at the State's borrowing rate (4.55 percent for this program). However, there is only about $11 million left in the program and there is some question of whether or not FMWD could comply with the loan requirements.

An alternative source is offered through the State Infrastructure Bank. Loans are subsidized and can be 30-years in term, but are limited to $10 million per project. Loan requirements are quite flexible, however, and if the City of Glendale participates in the discretionary CIP program, this financing avenue may be feasible.

11.1.4 Bonds

11.1.4.1 General Obligation Bonds

General obligation bonds (also termed GO bonds) are issued by public agencies (state, counties and cities, and special districts) to raise capital for public works and other purposes, including water system infrastructure construction. They are guaranteed by the faith, credit and taxing power of the issuer. Although typically secured by a pledge of the issuer's ad valorem taxing power, in some cases repayment security may derive from other revenue sources such as user charges. For example, water replenishment districts are authorized to issue GO bonds based on a repayment commitment from replenishment assessments. Authority to issue GO bonds normally must be obtained from public agency voters with a two-thirds approval. Other restrictions also apply. For example, a city is limited in its ability to issue GO bonds in the aggregate not to exceed 15 percent of all assessed property, both real and personal, within the city. Likewise, counties have a GO debt limit of 5 percent of all assessed valuation. In view of the low default rates of GO bonds, market interest rates are typically lower than for revenue bonds.

11.1.4.2 Revenue Bonds

Revenue bonds are used to finance capital infrastructure which is revenue producing. Revenue bonds are special obligations of the issuing entity with repayment solely from the revenues produced by the constructed infrastructure and from no other source of funds. Normally, revenues derived from the constructed facilities must also be sufficient to cover the cost of maintaining and operating the facility. In addition, bond covenants pledge that net revenues will be equal to an amount sufficient to meet all repayment and expense obligations plus an operating margin or coverage which typically varies from about 1.2 to 1.5 times the amount of the debt service. Coverage margins typically reflect the source of the loan as well as the financial characteristics and credit worthiness of the issuing agency. Water system facilities are typically financed with the use of revenue bonds in accordance with the

Revenue Bond Law of 1941. In accordance with this Act, an election must be held with a majority of the voters at the election approving the revenue bond issue.

11.1.4.3 Assessment Bonds (1911 or 1915 Acts)

Since the passage of Proposition 13 limiting the allowable increases in annual property taxes, the creation of assessment districts, in existence since the early 1900s, has been a popular alternative method of financing public infrastructure. Approximately one third of privately owned property in California is included within an assessment district. Assessment districts are created in accordance with either the Improvement Act of 1911 or the Municipal Improvement Act of 1913. The former act can also be used to fund improvement maintenance. These two acts set forth the procedures for implementing an improvement project and for levying the assessment to pay for such work. Assessment bonds to fund capital improvements can be issued by assessment districts in accordance with associated assessment bond acts. The prior referenced Improvement Act of 1911 provides for authorization to levy assessments and issue related bonds. However, the Improvement Act of 1913 has no bond procedures, but improvements can be financed through a subsequent bond act known as the Improvement Bond Act of 1915 (solely a bond act). These acts may be utilized in various combinations. There may be a 1911 act assessment with a 1911 or 1915 act bond; or a 1913 act assessment with a 1911 act or 1915 act bond. However, there is no such thing as a 1913 act bond or a 1915 act assessment.

An assessment district is created by a local sponsoring governmental agency. Property owners typically initiate the assessment district creation by circulating a petition which must be signed by property owners representing 60% of the benefited land area. It is essential that properties within the assessment district, which will bear the burden of tax levies to pay for the bond financings receive a direct and special benefit (as distinguished from general benefits obtained by the community as a whole). Following the creation of the assessment district bonds can be approved by the governing board only after the preparation of an Engineer’s Report and at the conclusion of a public hearing. In accordance with Proposition 13, the property assessment cannot be based directly on the value of each property but on a mathematical formula that takes into account how much each property will benefit from the constructed infrastructure. Each parcel in the assessment district is obligated for a fixed percentage of the total district debt and will be assessed each year for that portion of the annual debt service.

11.1.5 Certificates of Participation

Proposition 13, passed by the voters in 1978, raised the voter approval threshold for bond debt financing by public agencies from a simple majority to two-thirds. Thereafter, public agencies found it more difficult and cumbersome to obtain debt financing. In response, the alternative of financing with the use of Certificates of Participation (COP) became a widespread practice. In essence, COPs are lease financing agreements which are created in the form of securities that can be purchased by investors as they would any debt instruments.

COPs are legally not considered debt, however, thereby not requiring voter debt approval, but only a majority approval by a governing body. COPs are a long term financing approach through a lease or lease purchase agreement that legally is not considered indebtedness under the state constitutional debt limitations and restrictions.

COPs are issued under the following procedure.

1. The public agency identifies the leasable asset, and the purpose and amount of the associated debt.

2. The public agency leases or transfers the asset to a Lessor

3. The Lessor leases the asset back to the public agency.

4. The Lessor transfers its right to receive lease payments to a Trustee (usually a non-profit corporation).

5. The Trustee sells COPs.

COPs are tax exempt, marketable and transferable. However, they normally have a slighter higher interest rate than comparable bond instruments.

11.1.6 Private – Public Partnerships

Public Private Partnerships (PPPs) can involve a wide variety of contractual relationships between the public and private sectors to optimize private sector involvement in public projects with the goal of optimal cost savings and operational performance. Project design involving the private sector in public operations can range from a simple outsourcing of public sector functions to a private operator to the other end of the spectrum where privatization is accomplished through the sale of public sector assets to a private sector purchaser and operator. Risk sharing and economic return allocation will vary depending on the level of complexity involved with PPP arrangements.

With regard to alternative sources of capital funding, two alternative arrangements are common. The first is known as Build-Own-Operate (BOO). For this type of arrangement, a private contractor constructs and operates a facility for performing public services without transferring ownership of the facility to the public sector. Legal title to the facility remains with the private sector entity. The second alternative PPP arrangement which would provide a source of capital funding for water system infrastructure is known as Build-Operate-Transfer (BOT). Under this option, the private partner builds a facility to the specifications agreed to by the public agency, operates the facility for a specified time period under a contract or franchise agreement with the agency, and then transfers the facility to the public agency at the end of the specified period of time. Usually, the private partner provides all or part of the financing, so the contract is structured to be of sufficient length to enable the private partner to realize a reasonable return on investment.

The two PPP examples above would provide a source of capital funding from the private sector. Private sector funding would be through conventional approaches such as corporate utility bond sales, use of corporate retained earnings, marketing of corporate preferred or common stock and other conventional financing methods. However, such private sector funding would likely be higher in cost than utilizing alternative public agency sector financing approaches. One mitigating method of lowering private sector financing of public sector projects is through the use of private activity bonds. These tax exempt bonds could be issued by or on behalf of local or state government for the purpose of providing financing benefits for qualified projects. These bonds are typically used to attract private financing for projects that have some public benefit.

Unfortunately, under the rules governing private activity bonds enforced by the Internal Revenue Service, federally mandated state volume cap restrictions have limited their use for less politically attractive water and wastewater infrastructure financing needs. In California, no private activity bonds have been authorized for water infrastructure in recent years.

However, a congressional bill (Clean Water Investment and Infrastructure Security Act of 2005) would amend the Internal Revenue Code of 1986 to provide that the volume cap for private activity bonds shall not apply to bonds for water and wastewater facilities. This legislation is currently in committee. If successful, this legislation would provide the opportunity to sell tax exempt private activity bonds for PPP contract arrangements thereby lowering the financing cost for such projects when compared to private sector financing alone.

11.1.7 Facility Ownership and Cost Sharing

It may be feasible to transfer a portion of the capital costs of a new MWD connection by sharing in capacity or asset ownership with the City of Glendale. B-E/GEI believes this facility may assist in Glendale’s water service in its northern higher elevations. Initial contact with the City suggested a lack of strong motivation for the project. However, if FMWD proceeds with the recommended second MWD connection, further discussion should be held with the City to invite participation either in joint asset ownership or capacity sharing with associated capital cost contribution.

11.2 Sources of Repayment Revenues

There are various alternative land secured taxes (property taxes) available to utilize in generating revenues to guarantee or support capital repayment. These include general ad valorem taxes, special taxes (Mello Roos), special assessments and water standby and/or delivery parcel fees. Other potential sources of repayment revenues include user charges, pump taxes or replenishment assessment fees, development impact fees, connection or capacity fees, and reserve funds. Each alternative is described in the following subsections.

11.2.1 Property Taxes

11.2.1.1 General Ad Valorem Taxes

Since 1978 with the passage of Proposition 13, California has had an acquisition-value assessment system for the levying of ad valorem property taxes. This system provides that property is to be assessed at its acquisition value either through a change of ownership or new construction (all property at the time of Proposition 13 passage was initially established at 1975-76 assessed values). The property tax rate cannot exceed 1 percent of the assessed value without a voter approved override. Further, the assessed value of residential property can increase by the consumer price index each year up to a maximum of 2 percent. Proposition 218, passed in 1996, further requires all local governments to obtain a majority vote approval for new or increased general taxes. Because GO bonds normally are repaid from ad valorem property taxes, a two-thirds voter approval must be obtained to override the limitations of Proposition 13.

11.2.1.2 Special Tax (Mello-Roos)

A commonly utilized approach for financing infrastructure through land secured debt is through the creation of a Mello-Roos Community Facilities District (CFD). The legislation creating this financing vehicle approach was enacted in 1982 by the state legislature to provide an alternative means of financing public infrastructure and service in response to the 1978 passage of Proposition 13. This legislation complies with Proposition 13 allowing local governments to create defined areas which, in accordance with a two-thirds approval vote, are subject to special taxes to pay for public improvements and services necessary to serve the created area. The targeted area subject to a special tax is known as a Community Facilities District (CFD). Water and sewer lines, as well as utility improvements are among those facilities which can be financed through a Mello Roos CFD. Projects financed through this approach are not required to meet a special benefit test in view of financing through a tax as opposed to an assessment. However, there should be a relationship between the special tax levied and benefits received to a specific land use. There are two primary restrictions on the amount of financing available for any CFD. One is the value to lien ratio, which is the ratio of the land value to the principal amount of the special tax lien. A minimum value to lien ratio of 4 to 1 is required by statute. Second, although not a legal limit, a total effective tax rate (ad valorem property tax rate, plus voter approved bonded indebtedness; and other taxes, assessments and parcel charges) should not exceed 2% of market value which is considered a level of tax payer resistance for residential development throughout the state.

11.2.1.3 Water Standby/Delivery Parcel Fees

The Metropolitan Water District of Southern California and its sub-agency, the West Basin Municipal Water District, in the past both have imposed a standby charge on all assessable parcels in their respected service areas in accordance with statutory authority. The imposition of a water standby charge is subject to voter (land owner) approval consistent with the passage of Proposition 218. In the case of West Basin Municipal Water District, the agency is required to establish the standby charge each year following a public hearing. However, unless the standby charge is increased, there is no additional statutory protest procedure, referendum requirement, or other alternative procedure available to protest the standby charge imposition. Standby charges are collected through the County of Los Angeles real property general tax roles.

11.2.1.4 Special Assessments (CSD Financing and Assessment Bonds)

Some public agencies, such as a Community Services District, have the authority to levy special assessments in order to finance their facilities and services. A CSD is an independent special district as frequently created to provide a wide variety of public facilities and services such as supplying domestic, irrigation, industrial, fire protection and recreational water. In selected cases CSD’s have also been granted addition powers on an individual basis, such as the authority to operate and construct hydroelectric generation facilities. In addition to many other funding alternatives, a CSD can levy a special assessment upon formation of an improvement district, which fees assessed must directly relate to the benefits being received by the property incurring the obligation. The CSD services may be broken into zones to target limited benefited areas within the district for the purpose of financing. For each zone created, special assessments or taxes may be levied to pay for the improvements or service being provided, as well as bonds issued to raise capital funds.

As indicated above, the creation of an assessment district and the marketing of associated bonds for capital improvements create debt service requirements for parcel owners. Each parcel in an assessment district has an associated responsibility for a fixed percentage of assessment district debt and is levied that portion of the debt service due on the bond financing each year.

11.2.2 User Charges

Under this approach, the cost for principal and interest payments per loan or bond repayment terms are collected by surcharges or an addition to the monthly service charges for water delivered. These collected surcharges are accrued by the public agency to make annual payments (or payments based on other terms) to the lender. Public agencies making improvements to water systems have in the passed borrowed safe drinking water funds from the state with a surcharge mechanism attached to water rates or service created for loan repayment. This kind of user fee is not approved by a vote of the users or rate payers. They are generally established following public hearings and adoption by the governing public agency board.

11.2.3 Development Impact Fees

Impact fees are not taxes and, therefore, do not require a voter approval. These are one time charges levied on new construction projects by a local public agency to fund new public facility infrastructure in support of new development. Impact fees are commonly used to create revenue to support funding of sewer and water treatment plant expansion to meet new development. Operational expenses cannot be paid for from impact fees. In addition, these charges are distinct from connection fees (see below). The Mitigation Fee Act, passed by the State Legislature in the late 1980's, permits a broad range of public facilities to be finance through this revenue source including water distribution and treatment facilities, water storage, sewage treatment and disposal plant infrastructure, storm drainage facilities and many other publicly constructed infrastructure. Among other requirements, impact fees can be imposed by local government if they: 1) Identify the purpose of the fee; 2) Identify the uses of the fee, including identification of the infrastructure improvements to be financed; 3) Show a reasonable relationship between the type of development and the fees use; and 4) Present a reasonable relationship between the amount of the fees and the cost of the facilities constructed as a result of the fees. Impact fees cannot provide security for bonds although they can be used in association with debt financing to help retire bonds secured by other means.

11.2.4 Connection or Capacity Fees

Another alternative to utilize for the funding of new development infrastructure is through the use of connection fees (also called capacity fees). As with impact fees discussed above, connection fees are assessed on a one time basis when the customer makes the connection to a water, sewer, or storm drainage system. Funds raised through this approach are used to pay for capital improvements required by the system infrastructure required for new demands in growth.

11.2.5 Reserves

A source of repayment revenues for capital funding may be derived from the use of reserve funds. Reserve accounts are established to accrue a level of current revenues in support of future capital needs as projected in a public agency's capital improvement plan. For example, in the past the Santa Clara Valley Water District established a reserve fund for immediate or emergency replacement of water system infrastructure with annual accrued amounts paid into the fund at approximately 2 percent of the book value of the water enterprise plant and equipment. Naturally, the use of reserve funds for capital funding is only feasible if a fund has been in existence for a sufficient number of years to build up an adequate balance from which to draw.

11.3 Master Plan Rate Impacts

11.3.1 Potential Rate Impacts from CIP funding

B-E/GEI has projected potential rates to both FMWD and Member Agencies based on implementation of the primary, secondary and discretionary CIP. Table 37 presents the results of these projections and Appendix H contains more detail on the rate analysis. In view of the uncertainty in obtaining a grant, participation financing from the City of Glendale for discretionary CIP or a low interest loan, the rate analysis assumes pay as you go funding for primary CIP; and conventional revenue bond public agency financing for both secondary and discretionary CIP. Revenue projections to support bond financing are made at a level of 90 percent of the revenue level actually anticipated to account for variance in demands.

As shown, the FMWD rate for primary CIP is projected to increase from a 2006 level of $105 per acre foot to $151 at the end of the study period (2015). Associated Member Agency or imported water rates including anticipated changes in the MWD wholesale rate, are projected to increase from $653 up to $900 per acre-foot over the study period, representing annual increases of 1.1 to 9.3 percent.

Implementing the secondary CIP will require revenue bond financing of approximately $2.23 million in addition to the pay as you go financing for the primary CIP. With a 20-year amortization bond FMWD rates will increase (for both primary and secondary CIP) from $105 per acre-foot in 2006 to $163 per acre-foot in 2015. Bond financing for 30 years would result in a lower FMWD rate per year by $4 per acre-foot. Associated Member Agency imported water rate increases would be over 10 percent in the first year, but decrease each year thereafter (from about 8 percent in the second year to about 2 percent in the 10th year), under either 20- or 30-year amortization. Imported water rates would increase up to $910 per acre-foot with 20-year bonds under these projections.

The discretionary CIP (including financing of the secondary CIP plus pay as you go primary financing) would require an estimated total revenue bond of $21.2 million. FMWD rate increases would be significant, increasing to $298 per acre-foot in the first year of CIP implementation, to $328 in the second year and then declining to $316 per acre-foot in year 2015. A 30-year amortization term would decrease these increased rates under 20-year financing by about $32 per acre-foot. Associated Member Agency rates with 20-year bond financing would increase by about 34 percent in the first year of annual implementation with modest annual increases thereafter (0.9 to 6.5 percent) reaching $1,063 per acre-foot in 2015.

TABLE 37

COMPARISON OF FMWD RATES ($/AF) WITH IMPLEMENTATION OF PRIMARY, SECONDARY AND DISCRETTIONARY CIP

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Primary CIP only Pay As You Go										
FMWD Rate	105	135	165	143	143	143	143	146	148	153
Member Agency Rate	653	714	771	782	812	842	851	867	882	900
Percent Change (%)		9.3	8.0	1.5	3.9	3.6	1.1	1.8	1.8	2.0
Secondary CIP ($2,229,000) 20-Year Amortization										
FMWD Rate	105	145	175	153	153	153	153	156	158	163
Member Agency Rate	653	724	781	792	822	852	861	877	892	910
Percent Change (%)		10.8	7.9	1.5	3.8	3.5	1.1	1.8	1.8	1.9
30-Year Amortization										
FMWD Rate	105	141	171	149	149	149	149	152	154	159
Member Agency Rate	653	720	777	788	818	848	857	873	888	906
Percent Change (%)		10.2	7.9	1.5	3.8	3.6	1.1	1.8	1.8	2.0
Discretionary CIP($21,202,000) 20-Year Amortization										
FMWD Rate	105	298	328	306	306	306	306	309	311	316
Member Agency Rate	653	877	934	945	975	1,005	1,014	1,030	1,045	1,063
Percent Change (%)		34.2	6.5	1.2	3.2	3.0	0.9	1.6	1.5	1.7
30-Year Amortization										
FMWD Rate	105	266	296	274	274	274	274	277	279	284
Member Agency Rate	653	845	902	913	943	973	982	998	1,013	1,031
Percent Change (%)		29.3	6.7	1.3	3.3	3.1	1.0	1.6	1.6	1.7

11.3.2 Potential Rate Impacts from Non-Firm Deliveries

As part of the Master Plan analysis on potential rate impacts which would occur from implementing the recommended CIP, B-E/GEI also considered potential negative revenue impacts to FMWD which are likely to occur over the coming years from the increase in use of injection, and in-lieu imported water deliveries as the Raymond Basin conjunctive use programs are implemented. In support of this consideration, we have contacted other Metropolitan Water District member agencies in order to receive insight on alternative policies to mitigate this issue. In addition, we have discussed the Foothill Conjunctive Use Project (CUP) with representatives of MWD and long term groundwater storage with the Raymond Basin Watermaster.

The current rates applied for imported water deliveries by FMWD (Resolution No. 720-0705) provide for customers to pay the MWD cost of water plus an energy surcharge (incurred by FMWD for delivery to one of three alternative reservoir sites), plus an amount of $105 per acre-foot to cover additional administrative and operating costs incurred by the District for all firm water purchases (both tier one and tier two deliveries). However, for interruptible long term storage deliveries (accomplished either through injection or in-lieu means), FMWD charges customers only the MWD price of water per acre-foot plus an energy surcharge to deliver the water to its reservoirs. The $105 surcharge component which is applied to all firm water deliveries is not included in the interruptible long term storage rates by FMWD. Accordingly, if rates are not adjusted, FMWD will incur a negative revenue impact as a result of increasing long term storage deliveries for injection by its customers (which results in a storage credit with the Raymond Basin Watermaster for extraction at a later time by that producer). Long term storage activities through injection or in lieu by several of FMWD water purveyors (apart from the Foothill CUP) potentially will create a revenue shortfall of $100,000 annually. Therefore, an adjustment in the current rates schedule for FMWD is needed in order to keep the District financially whole.

B-E/GEI contacted several other MWD member agencies in order to obtain information on policies implemented to account for different types of water delivered through their systems. The Central Basin MWD and West Basin MWD indicated that both agencies apply the same policy of charging surcharge rates to cover operating and administrative costs for all water delivered through their systems. This incremental charge for the Central Basin MWD is $38 per acre-foot and $32 per acre-foot for West Basin MWD. These surcharges are applied on all water deliveries in order to keep each agency financially whole. Both agencies have firm municipal deliveries and injection deliveries for seawater intrusion barriers. In addition, Central Basin delivers replenishment water for spreading grounds. A representative for the Upper San Gabriel Valley MWD indicated to B-E/GEI that it applies a 5% administrative surcharge on all water delivered regardless of the purpose. This agency has significant replenishment water deliveries through spreading in addition to firm water deliveries. MWD of Orange County has a similar policy of applying a level or consistent surcharge to all water deliveries in order to remain financially whole. However, one member agency does allow replenishment water to be delivered without an administrative cost to be recovered. Three Valleys MWD indicated that previously a $20 surcharge was applied to replenishment deliveries to cover administrative costs. This service charge was discontinued this year as a form of goodwill in view of the small amount of replenishment deliveries that the agency maintains (estimated on the order of less than 1% of total deliveries).

B-E/GEI believes that FMWD should collect an equal surcharge on all water deliveries made through its system regardless of purpose. If the FMWD administrative and operations surcharge is not applied to all deliveries, purveyors having access to Raymond Basin pumping will have a disproportionate economic advantage over the other purveyor customers of FMWD. Allowing a net shortfall in revenues to occur will ultimately result in FMWD having to raise its rates on firm deliveries which would result in a higher economic impact to non Raymond Basin producers (unlike Raymond Basin producers which have the opportunity to be involved in long term storage thereby netting out the higher rates with the economic advantage of escaping the surcharge through interruptible deliveries). It is recognized that purveyors which take deliveries through groundwater production long term storage accounts (thereby reducing direct FMWD deliveries) will occur at indeterminate years in the future. At such times, FMWD will experience a revenue short fall for the year as these excess groundwater production deliveries in-lieu of direct imported water deliveries are made. Accordingly, **we recommend a separate reserve fund be created to receive surcharge amounts collected on interruptible deliveries.** This would be similar to balancing accounts maintained by regulated utilities to smooth out sporadic expense demands as they occur over time (collected from customers in level charges, but paid out sporadically as variable expenses are incurred). Earnings on such a reserve account may allow for a future reduction in interruptible delivery surcharge rates particularly if stored water remains in the basin and is not required to be produced for a significant number of years.

11.4 Cost Allocation

FMWD embraces the concept of “beneficiary pays.” That is, recommended capital improvements that may be necessary should be constructed and paid for by a Member Agency, or Member Agencies, which benefit. There are many cost allocation approaches utilized by wholesale water agencies for distributing capital costs among Member Agencies. The allocation percentages of many water supply facilities, when provided for different purposes require engineering and economic judgment. If annual delivery capability is the only item under consideration, it is necessary to define whether these percentages should be based on annual flow, peak flow, design flow, or emergency capacity. As a result, professional judgment is required in making cost allocation percentages.

Three primary cost allocation approaches include proportional use of facilities, zone of benefit, and “postage stamp” rate methodology. An example of the first approach is utilized in cost recapture of selected costs associated with the State Water Project (SWP). The Transportation Facility costs are allocated to each contractor on the basis of proportional use of facilities. Transportation Facility costs are allocated to each contractor on the basis of proportional use of facilities. The Transportation Facilities were divided into separate reaches with some 60 allocation reaches in the aqueduct system from the Delta to Perris Reservoir near Riverside. Each contractor is assigned the required capacity in cubic feet per second to deliver that contractor's water through that reach. However, contractors have different peaking capabilities provided in their contracts. Generally, SWP agricultural contractors have a higher peaking requirement than urban contractors. For this reason, a number of contractors during negotiations with the state proposed that the proportionate use of Transportation Facilities be determined on the basis of each contractor's maximum annual entitlement to water measured in acre-feet per year. The procedure selected during negotiations was to use the two procedures noted above (capacity allocation in cubic feet per second, cfs, and annual entitlement allocation) and to take the average of the two methods.

A second alternative methodology for allocating capital costs for a water project is through establishment of zones of benefit. Simply stated, zones of benefit can be created to assess changes for capital and variable costs for those directly benefited within an area. A simple example would be the creation of a pumping cost surcharge applied to homeowners within a high pressure zone in order to boost domestic water from a lower area for delivery.

A third capital cost allocation approach is the "postage stamp" method. The Metropolitan Water District distribution facilities are allocated on a simple "Postage Stamp" rate methodology (the FMWD has historically utilized the same method). The charge to all subagencies is the same regardless of location in the MWD service area and the requirement of facilities to serve the subagency member. The second component is a treatment charge which is allocated on an annual cost in dollars per acre-foot to those entities utilizing treated water. In recent years, numerous changes have occurred in the Metropolitan rate structure for various reasons. However, the basic premise of charging a postage stamp rate for distribution facilities remains unchanged.

Clearly, the primary CIP recommended in this Master Plan affects all Member Agencies, although not all facilities impact all purveyors equally. However, almost all of the Primary CIP involves replacement or improvement of existing facilities which will benefit all Member Agencies. No cost allocation is believed warranted for the primary CIP.

Secondary and discretionary CIP is recommended essentially to provide support in emergency operations (including area wide forest fires), future replacement of pipeline facilities and reliability to the entire system in cases of Upper Feeder outages. The Eastside Member Agencies on average receive approximately one-third of total imported water deliveries. Accordingly, it is estimated these purveyors would provide the same proportional level of capital contribution in rates if secondary and discretionary CIP is not specifically allocated. In emergency operations, it is projected 5 to 6 cfs of increased flow could be realized by opening the bypass at P-1 to route water from the west to east. Consequently, during an emergency or outage approximately one-third of the new facilities capacity (5 or 6 cfs compared to 15.7 cfs new connection capacity) would be available to the Eastside. This is a comparable level of estimated capital contribution under current rate policy. Accordingly, at this time, **B-E/GEI does not recommend special cost allocation be applied for any of the recommended CIP (primary, secondary or discretionary)**.

11.5 CIP Financing Plan

B-E/GEI recommends FMWD implements a continuance of Pay As You Go financing for the recommended primary CIP. This would follow the existing financing strategy of the District and would avoid both financing issuance costs and interest carrying costs. Some minor grant funding may be available such as for installation of security equipment at facility sites.

If FMWD elects to implement the recommended secondary CIP, then revenue bond financing should be utilized with the State Infrastructure Bank, the most likely best source. Additional grant funding is not likely for these localized system improvements.

A financing strategy for including discretionary CIP (additional connection to MWD) **includes in depth discussions with the City of Glendale for its potential participation and financing in the project and aggressive pursuit of any available grant funds** as discussed above. **Revenue bond financing would again be implemented** through the State Infrastructure Bank.

TABLE 38

NET POSITIVE SUCTION HEAD AVAILABLE (NPSHA) CALCULATION

	24" Pipe Section		36" Pipe Section		39" Pipe Section		36.5" Pipe Section		Total Friction Headloss (ft)	Minor Loss (Assuming 15% of the Friction Loss) (ft)	Total Loss (ft)	Total Suction Head(2) (ft)	
	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5					
	Pipe Length (ft)	14	Pipe Length (mi)	239.55	Pipe Length (mi)	6475.7	Pipe Length (mi)	35.88					
	Total Length (ft)	14	Total Length (ft)	239.55	Total Length (ft)	6475.7	Total Length (ft)	35.88					
Assumed	D (inch)	24	D (inch)	36	D (inch)	39	D (inch)	36.5					Static suction head
Q (cfs)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)					29.5
20	6.37	0.07	2.83	0.16	2.41	2.99	2.75	0.02	3.25	0.49	3.7	59.2	Atmospheric Head
25	7.96	0.10	3.54	0.25	3.01	4.52	3.44	0.03	4.91	0.74	5.6	57.3	34 ft
30	9.55	0.15	4.24	0.35	3.62	6.34	4.13	0.05	6.88	1.03	7.9	55.0	Vapor Head
35	11.14	0.19	4.95	0.46	4.22	8.43	4.82	0.06	9.15	1.37	10.5	52.4	0.59 ft
40	12.73	0.25	5.66	0.59	4.82	10.79	5.50	0.08	11.71	1.76	13.5	49.4	
45	14.32	0.31	6.37	0.73	5.42	13.42	6.19	0.10	14.56	2.18	16.7	46.2	
50	15.92	0.37	7.07	0.89	6.03	16.31	6.88	0.12	17.70	2.65	20.3	42.6	

(1) Hazen-Williams Head Loss hf =(3.022) (v ^1.85) L / (C^1.85 D ^1.165), where v = velocity (ft/s), L = total length (ft),C = Hazen-Williams Coefficient, and D = pipe diameter (ft),

(2) Static suction head =29.5 ft, atmospheric head=34 ft, and vapor head=0.59 ft

Appendix A

Master Plan Scope of Services

Request for Proposals

This Request for Proposals ("RFP") is issued by the Foothill Municipal Water District (FMWD). The district's intent is to engage the services of a consulting firm to complete a ten-year master plan on behalf of the district.

- **INTRODUCTION:**

  FMWD, a public agency incorporated in 1952 under the Municipal Water District Act, is a wholesale distributor of imported water purchased from the Metropolitan Water District of Southern California (Metropolitan). FMWD is one of Metropolitan's 26 member agencies. FMWD wholesales this water to its seven member agencies (retailers) within the district. An eighth agency is included in the district, but is not currently connected to FMWD's distribution system. Total population in the service area is approximately 85,000 people. FMWD delivers approximately 12,000 acre-feet of water a year to its member agencies. The member agencies pump local groundwater to the extent it is available. Demand beyond their ability to pump groundwater is met through purchases from FMWD. FMWD member agencies also purchase water from FMWD for groundwater storage. These purchases are usually discounted from the full price and are sometimes delivered in lieu. In an in-lieu delivery, a member agency takes delivery of water directly from FMWD instead of pumping available groundwater. The unpumped groundwater in the same amount as delivered directly is considered to be stored water.

  Details to be included in the master plan are noted below under Scope of Services. In general, FMWD's infrastructure is aging, demands are increasing and costs continue to rise. The master plan will be a critical component of the district's efforts to continue meeting its mission statement –***Foothill Municipal Water District will reliably deliver quality water to its member agencies in a cost-efficient manner to meet their projected demands*** – well into the future.

  Additional information about FMWD can be found at www.fmwd.com. Specific documents such as a map of the service area, the strategic plan, the Conjunctive Use Project and other public documents may be requested from the district. In the case of extraordinarily large documents, such as engineering studies, basin management plans and the like, you will be asked to review those documents at our offices or they may be taken away, photocopied and returned.

SCOPE OF SERVICES

- **MASTER PLAN CONTENTS:**

  The consultant engaged by the District will take into consideration a 10-year planning horizon (2006-2016) during which time the District will likely need to build, rehabilitate or even abandon infrastructure for the purpose of maintaining and improving its ability to meet the needs of the District's customers. A recently completed Strategic Plan will provide potential proposers on this project with an overarching view of where the District is headed and what its priorities are. The specific goal of the master plan is to determine what facilities or system improvements are necessary to meet future demands to ensure a high level of reliability and how such facilities will be financed including discussions concerning rate impacts. The master plan will look at system weaknesses, define upgrades and use economic evaluations and value engineering to determine the best solutions for needed improvements. The existing Foothill Conjunctive Use Program (FHCUP) will be integrated into the master plan.

Specifically, the master plan will include the following details.

- Review of existing system including the planned FHCUP facilities with a view to:
    - Supply: Review existing supply reliability from Metropolitan; determine if existing single connection to Metropolitan can be upsized; plot pump suction against service connection (valve) capacity; review groundwater resources with member agencies and plot probable demands against likely supply availability during study period. Include an assessment of the Raymond and Verdugo basins as they impact FMWD and its member agencies and recommend actions to improve supply reliability.
    - Distribution System: Provide an analysis of potential usable life of existing pipelines, pumps, valves and related equipment, including tank reservoir storage, necessary to distribute water purchased from Metropolitan and delivered at FMWD's P-1 pump station.
    - Pump Stations: Provide an analysis of potential usable life of existing pumps and appurtenances located at FMWD's two pumping sites – P-1 and P-2. Analysis should include any recommendations to make the pump plants more efficient, the availability of any special pricing programs offered by FMWD's electrical suppliers (City of Pasadena and Edison), the potential for hybrid energy (natural gas and electricity), and plots for taking advantage of off-peak power while still meeting demands
    - Storage facilities: Assess state of FMWD-owned reservoirs as well as appurtenances including valves, actuators and telemetering/SCADA equipment; assess total system storage (including groundwater basins and member agency-owned reservoirs and provide recommendations on the need for additional storage including preferred site locations. Include a discussion as to what degree, if any, the cost of additional storage can be offset by lowered energy costs by refilling reservoirs during non-peak hours.
    - Member Agencies: Determine with Kinneloa Irrigation District when and if they are likely to need to connect to FMWD's system to receive imported water and discuss recommendations regarding the most efficient way of providing that connection and meeting projected demand. Discuss the differences between water demands and the need for storage on the west side of the service area compared to the east side of the service area and make recommendations regarding the use of funds collected district-wide to build infrastructure that may be required on one side of the service area, but not the other. Consultant will hold at least three meetings with the member agencies during the course of this project – one as a kick-off meeting, the second as a mid-term report and the third as a final report before going to the FMWD Board of Directors.
    - Water Quality: Analyze existing and emerging water quality regulations as they may impact FMWD, its Member Agencies and make recommendations that will allow FMWD to continue meeting those requirements in a cost-efficient manner.
- Review of System Demands will include the following details. (Existing demand is a maximum of 14,000 acre-feet a year without injection).
    - Future demand with regard to population projections and potential losses of local supply. This should include forecasts of water-use changes in the

    service area such as the potential conversion of single-family homes to multi-family apartments or condominiums and/or the emergence of large extended families populating dwellings that are currently populated by only 1-3 people.

  - Need for new facilities to include will include available data on the FHCUP as well as the consultant's recommendation for other facilities. These recommendations, if any, will be prioritized with the most critical needs listed first.

  - Daytime peaking factors will be explored and the consultant will make recommendations regarding eliminating peaking to the extent possible. Recommendations should include both physical solutions, such as additional reservoir storage, as well as administrative solutions such as peaking rates, penalties and related methods. The water service rules of others agencies, including Metropolitan, should be reviewed for applicability to FMWD.

  - Groundwater basin storage vs. surface storage – These two storage methods should be compared and contrasted from the viewpoints of cost, losses, flexibility and meeting peaking demands. Discount programs from Metropolitan for stored water should be considered.

  - Consultant should make specific recommendations regarding covering the cost of new or rehabilitated infrastructure including the concept of "beneficiary pays," the potential availability of grant funds, impacts on rates, selling bonds versus paygo and related financial events.

  - Engineering review of system capacity with and without recommended improvements. Consultant should provide the district with a narrative that discusses the "do nothing" option in terms of water supply reliability, costs, lost opportunity costs and future costs necessitated by deferring projects.

- Review of other capital improvement projects to include

  - New facilities: Using standard engineering estimates, consultant will provide the district with a reasonable range of estimated costs and construction time required for any recommended new facilities.

  - Rehabilitation of existing facilities: If certain facilities are recommended to be rehabilitated, consultant will provide a comparison of costs and life-spans of new versus rehabilitated equipment or facilities.

  - Abandonment of facilities: Consultant will make recommendations regarding the purpose and feasibility of abandoning any particular facilities. Recommendations here will include how best to dispose of any property and/or equipment.

  - Expansion of existing facilities: Consultant will provide a discussion that compares and contrasts the utility of expanding existing facilities versus constructing new facilities as appropriate.

  - Existing headquarters building should be reviewed with an emphasis on rehabilitating the structure or selling it in favor of a new structure at some other site. If the recommendation is to build a new structure, consultant will provide a reasonable estimate of the market value of the existing structure and a recommendation as to where a new structure could be built – including a reasonable estimate of the costs of building such a structure assuming the square footage is similar to the existing structure. Cost should include the costs of relocating all equipment in the administrative and operations areas of the existing structure.

- Reclaimed water: Consultant will provide a discussion concerning the availability of reclaimed water from other entities (exp.: City of Los Angeles, City of Glendale, City of Pasadena) and the efficacy of marketing such water within FMWD's service area for non-potable uses. Consultant should consider local parks, greenbelts, golf courses, residential irrigation in new developments where discrete pipelines could be built and freeway irrigation by the California Department of Transportation. Consultant should provide recommendations on where and how the district might pursue grant funding for reclaimed water projects.

- Assess the potential rate impacts of implementing the capital improvements recommended including the use of bonded indebtedness and/or pay-as-you-go financing. Consultant will provide a spreadsheet indicating potential rate increases considering capital improvement costs, a four percent rate of inflation for ten years, and a review of Metropolitan's rate studies that forecast future rates. The purpose of the component of the study is to understand the impact of rate increases with and without capital expenditures and with and without incurring bonded debt. Along those lines, consultant will recommend a financing plan that meets the needs and philosophy of the board of directors and the member agencies.

- Assess opportunities for additional or upgraded interconnections between FMWD and the cities that surround it for the purposes of meeting emergency demands and/or reducing the impact of peaking demands and/or allowing for additional storage on behalf of FMWD.

- Consultant should make recommendations regarding which, if any, capital improvements that may be necessary should be constructed and paid for by a member agency, or member agencies, in the interest of equity throughout the service area. This is related to the concept above – the beneficiary pays.

COST: We anticipate the cost of this master plan to be in the range of $100,000 to $200,000. Firms submitting proposals should provide the district with a reasonable estimate of costs based on the information above. The District will select three finalists for interview. Final costs will be negotiated with the preferred proposal at the conclusion of the three interviews. In the event the District and the consultant cannot agree on a price the District will negotiated with the second preferred proposal and so on.

SELECTION PROCESS; The cost estimates requested in this RFP are intended to be a guide only. Firms that are substantially out of range with other proposals will not be further considered. In arriving at the three finalists chosen for interview, FMWD will rank the strength of each firm, as demonstrated by the proposals, in a matrix of the various tasks as listed above. Scores will be totaled and the top three scores will be asked to attend an interview.

TIMING:

Request for Proposals distributed by October 1, 2005

Proposals returned to the District by November 15, 2005

A committee of the board reviews proposals, interviews top three candidate firms

Appendix B

Malcolm Pirnie Report on FMWD Service Reliability

Reliability Defined

A study prepared for the Foothill Municipal Water District

April 2006

Study purpose: To help define the term "reliability" as determined by the Foothill Municipal Water District member agencies and Board of Directors with the intention that determinations from this study guide the preparation of a master plan for the district.

Prepared by Malcolm Pirnie, Inc.

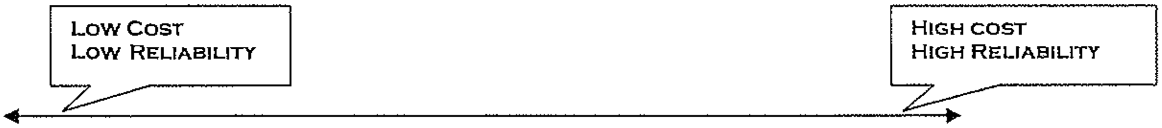
Introduction

Foothill Municipal Water District (FMWD) is at the beginning stages of a Master Plan as recommended in a Strategic Plan completed for the district in late 2005. As part of the Strategic Plan, the Board of Directors, FMWD staff and its member agencies jointly developed a Mission Statement that was adopted by the Board.

> ***"Foothill Municipal Water District will reliably deliver quality water to its member agencies in a cost-efficient manner to meet their projected demands."***

In order to move ahead with the Master Plan, FMWD requested Malcolm-Pirnie to assess the word "reliably" found in the mission statement as that word might be interpreted by its member agencies. That interpretation is important because reliability translates to costs – the more reliable a water agency wants to be, the greater will be its costs. Because the master plan will necessarily address reliability and the need to add infrastructure or increase maintenance protocols, it is important to understand what "reliability" means to the member agencies.

The concept of reliability can be seen along a continuum where the lack of reliability might be at the left end and maximum reliability is at the right.



With a philosophy of reducing costs to the absolute minimum, a water agency elects to do no maintenance, does not plan or build new infrastructure and generally allows its pipelines and rotating equipment to run to failure. At that point the failed piece of infrastructure is replaced and water deliveries can resume. The cost of operating a water agency in such a mode would likely be lower than average, but no responsible water agency would operate that way because reliability would be minimal at best.

To the extreme right on the continuum is an agency that spends unlimited funds replacing infrastructure ahead of schedule, building redundant systems and having enough people on staff to respond very rapidly to any situation – emergency or otherwise. In this scenario, the agency would be considered to be ultra-reliable, but the cost of service would likely be prohibitive. Again, no responsible water agency would operate in this mode either.

Determining the meaning of "reliability" for the purposes of this study means selecting a point on the imaginary continuum. At that point, customers are willing to pay the cost of service and they are satisfied that the agency is as reliable as is their willingness to pay.

Stated another way, a retail agency dissatisfied with a wholesale agency's reliability is generally willing to pay more to achieve greater reliability; a retail agency that is satisfied with the wholesale agency's reliability is unwilling to pay any more for greater reliability.

Process

Each of FMWD's eight general managers agreed to be interviewed on the topic of FMWD's reliability – what that meant to them?, what was their willingness to pay, what factors should be considered in finalizing a master plan for the district? This report was then submitted to FMWD as a draft. In turn, FMWD provided the draft to the eight member agencies for review before being presented in a workshop format with FMWD's staff, board member agency managers and others. Following the workshop, comments received were incorporated into the document and this final report was submitted to FMWD staff for inclusion in the master plan.

Agencies

Crescenta Valley Water District (CVWD)
Dennis Erdman and David Gould

Kinneloa Irrigation District (KID)
Mel Matthews

La Cañada Irrigation District (LCID)
Douglas Caister

Las Flores Water Company (LFMW)
John Lopez

Lincoln Avenue Water Company (LAWC)
Bob Hayward

Mesa Crest Water Company (MCWC)
Tim Flynn

Rubio Cañon Land &Water Company (RCLWC)
Lillian Woods, Wally Weaver, Jan Fahey, Pete Vicario

Valley Water Company (VWC)
Bob Fan

Three of the agencies (LCID, KID and CVWD) are public water agencies, four are mutual water companies (VWC, LAWC, LFWC and RCLWC) and one is a privately owned water company (MCWC).

General Findings

FMWD's member agencies are generally satisfied with the level of effort taken in the past three years or so to improve system operations and all are supportive of the Master Planning effort that is underway. Some agencies indicated a willingness to increase their own rates somewhat to fund whatever recommendations emerge from the Master Plan and are ultimately approved by FMWD's Board of Directors. Other agencies desire the opportunity to review whatever projects are recommended before agreeing to help pay for them.[1] In discussing pay-as-you-go financing versus incurring debt (which results in a long-term payback), the agencies were generally comfortable with a hybrid approach whereby FMWD would increase its rates slightly now, in anticipation of making capital improvements. Such funds, if collected, would be set aside in an account earmarked specifically for capital construction. It is unlikely that enough funds could be set aside to entirely pay for anticipated improvements. There is a comfort level among the agencies to continue these higher rates to pay down bonded indebtedness that may be necessary. This willingness to pay, however, should not be read as a carte blanche. All agencies indicated the need to be aware of rate sensitivities and they indicated that future rate increases for capital construction must be "within reason."

The term "within reason" also takes on different meanings from agency to agency. Some member agencies provide service to high-income areas where five to ten percent rate increases might have little or no impact. Other agencies serve areas where some consumers are at the middle rung, or lower, on the economic scale and where rate increases of that magnitude are more meaningful to their monthly budgets. Because FMWD necessarily passes through rate increases from Metropolitan, plus increases in their own modest add-on, care must be taken in adding one more increase to the monthly water costs of many consumers.

The member agencies all recognize that FMWD's infrastructure is somewhat aged and that some substantial investments will need to be made in the near future to retain what all agree is a high level of reliability since the district began delivering water in the mid-1950s. There is also general agreement that FMWD needs additional storage capacity, additional "take" capacity from Metropolitan Water District and there is a desire to see FMWD ultimately connect to Metropolitan's distribution system from the west side the service area (State Water Project from the Joseph Jensen Treatment Plant) to augment water that currently can only be delivered from the F.E. Weymouth Treatment Plant (usually a blend of SWP and Colorado River water). Such a project

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[1] It is noted here that FMWD's board of directors represents five distinct geographic regions within the district rather than representing the interests of one or more specific member agencies. Directors are elected to FMWD's board at large within their respective geographic districts without regard to which member agencies might reside within those districts. Further, as noted above, only three of the member agencies are public agencies with publicly elected directors. Four are mutual water agencies whose shareholders elect their directors. One is a private company. Thus, the interests of the individual directors representing each of the five geographic districts might not coincide with the interests of the member agencies that reside within those respective districts to the extent that two agencies within one of the five geographic districts may have competing interests. All of this is to say that FMWD's board of directors is not obligated to champion the interests of any one member agency, but rather to represent the people who live in that district.

would be a second point of delivery from Metropolitan – a luxury enjoyed by most of Metropolitan's other member agencies.[2]

All of FMWD's member agencies have, or are planning, interconnections with other agencies – both within the FMWD family and with outside agencies such as the Los Angeles Department of Water and Power and the City of Pasadena. Given those interconnections, the need for FMWD to construct redundant facilities is somewhat blunted. However, differing water quality parameters from agency to agency and differing water treatment strategies can limit the ability to transfer water from agency to agency through their owns systems or through FMWD's system. Further, because all of FMWD's agencies are located in foothill areas, there may be substantial pipeline pressure differentials from agency to agency that must be solved before any substantial system integration can occur.

There was also general agreement that the concept of "beneficiary pays" is appropriate in building any new FMWD infrastructure. The member agencies recognize that some facilities might be exclusively beneficial to some member agencies or more beneficial to some member agencies than others. Those who perceive that such facilities would be more beneficial to them expressed a willingness to pay more for that benefit. They recognize, however, that through in-lieu means it is very likely that even a facility (such as a reservoir tank) that is built to the greater advantage of one or more agencies compared to all others could likely benefit the other agencies during severe water shortages. Accordingly, the district may want to determine some sort of funding formula that fairly distributes the cost of such facilities across all the member agencies in such a way that the greater the benefit, the greater the repayment through either a fixed or commodity charge. In this manner, one or two agencies might pay 70 percent of the cost of a new facility while the remaining six or seven would repay the remaining 30 percent on the theory that the new facility could benefit them in some way, some day, while the daily benefits of the new facility accrue to the member agency(ies) who paid the most.

A primary concern voiced by many member agencies was maintaining adequate fire flow. A worst-case scenario is a fire that rages through a neighborhood destroying property and there is inadequate fire flow available to stem the fire. Insurance companies that become aware of fire-flow issues could increase homeowner insurance rates or cancel policies altogether. While such an event is not a water-rate issue, clearly a homeowner who saved a few dollars on their water rate because the infrastructure was not built to provide such fire flow will have cost him or herself much more in insurance costs or actual losses than was saved.

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[2] Water from Metropolitan's Joseph Jensen Treatment Plant can be delivered to FMWD in limited quantities, but the water must first travel through the Eagle Rock control center and P-1. While this mode of operation would allow FMWD to receive water from a different MWD source, the point of delivery to FMWD remains at P-1. This does not add the security that would otherwise be available from a second delivery point – preferably at a high enough elevation to provide gravity flow throughout FMWD's service area.

When asked about reliability on the Metropolitan side of the FMWD service connection, all agencies indicated that they pretty much took Metropolitan's reliability for granted. Other than thinking about additional capacity at FMWD's P-1 pumping plant (at FMWD's only connection to Metropolitan), there were no concerns expressed about Metropolitan being able to deliver water to P-1. Some used the phrase, "taking for granted," to describe both Metropolitan and FMWD. That is good in the sense that both agencies are perceived as having done a good job, over time, meeting demands with a minimum of interruption. It is bad, however, because such long-term historic reliability puts these systems out of the minds of most people and they tend to focus on their own, local systems, rather than being supportive of improving external systems on which they depend, but don't necessarily think about. Given the option of spending ratepayer dollars for system improvements, most member agencies indicated that if those dollars were limited, they would more likely spend the money on their own systems. Given the "weak link" theory it would be important to seek some balance in spending limited infrastructure funds. An agency with a first-class system would be at risk if FMWD were incapable of delivering water into that system. Simultaneously, if FMWD's system is as reliable as it can be, but it is delivering water into an agency with broken infrastructure, the consumer still suffers.

There is general agreement that FMWD should pursue opportunities to increase storage within its service area. Such storage could be additional reservoir tanks as well as conjunctive use projects and/or other means of storing water within FMWD's service area. The agency managers are sophisticated in their knowledge of both Metropolitan's and FMWD's systems and they recognize that storing water outside the service area that can only be delivered through P-1 is less valuable than water stored within the service area – preferably at an elevation that would allow the water to be delivered by gravity flow in the event of massive power failures in the foothills that could result in pumps shutting down.

THUMBNAILS

Crescenta Valley Water District

Has its own Capital Improvement Program amounting to about $2 million/year. Experiencing limited growth – about 0.5 percent/year. Needs continuous flow from FMWD for blending with groundwater to meet water quality requirements. Feels it is the most exposed agency to FMWD system failures. Can receive five cfs from the City of Glendale and 2.2 cfs from LADWP (projected). Peak day use is about seven million gallons and recognizes that FMWD's and their own systems must work at peak capacity. Has about 17.5 million gallons of storage. Projects seven percent rate increases for the next five years without regard to FMWD's potential CIP. Within the FMWD family, CVWD's system is probably the most stressed. Extremely dependent on P-1 and P-2 with concerns about the integrity of electrical systems for those two locations.

Kinneloa Irrigation District

Self-sufficient. Has 516 AF in the Raymond Basin plus tunnel water and spreading credits (as much as 150 AF). Annual demand is about 800 AF and annual available supply is about 1100 AF. KID is not connected to FMWD and does not have a reliable source of supplemental water. Has an emergency connection to the City of Pasadena. New construction represents only six or seven homes each year. Service area exists proximate to Metropolitan main feeder from the F.E. Weymouth Treatment Plan en route to Eagle Rock and eventually to FMWD. A second FMWD connection could be easily constructed, but would be expensive if the cost is borne only by KID's 600 services. KID purchases water from others but is concerned that Metropolitan rates establish the value of water and tend to increase costs. Given a 200-acre-foot cushion comparing supply and demand and a potential increase of only four to five acre-feet a year for new construction, KID may not need to connect to FMWD/Metropolitan for decades. Nonetheless, KID feels part of the FMWD family and desires to see it continue to operate efficiently.

La Cañada Irrigation District

Sensitive to recent pipeline failure at Alta Canada. Is concerned about the age of FMWD's system as well as their own. Need better communication with FMWD and their programs. Feels they were somewhat misled several years ago regarding the electrical upgrade at the Berkshire (P-2) pump plant. Is willing to accept rate increases for CIP as long as projects are identified and prioritized. Sees weak links on the west side of FMWD's service area and supports a review of FMWD's distribution system. Could support additional redundancy in system and recognizes that because all water must go through P-1 that FMWD and its member agencies are vulnerable. Very appreciative of recent FMWD efforts to assist LCID and improving communications.

Las Flores Water Company

Eastside agency most dependent on FMWD – about 35 percent local groundwater/65 percent FMWD. Concerned that groundwater levels will drop in the Monk Hill Basin when Pasadena begins pumping. Has about 12 hours of storage available. Is maxed out on local supply and will depend on FMWD to meet demands resulting from growth. Area is built out with no substantial growth foreseen in the immediate future although there is the possibility of single-family homes converting to multiple-family condominiums or apartments. Dependent on P-1 and concerned about its integrity. Agency would be in some trouble were P-1 to fail during high-demand summer months. Fire flow is an important concern. Indicated that consumers are somewhat apathetic about water and water rates and indicated level of service from FMWD has been excellent. Operate two groundwater pumps in the Monk Hill Basin.

Lincoln Avenue Water Company

Local water provides about two-thirds of demand; one-third from FMWD (2384 AF Local/1055 AF Import). Regards MWD and FMWD as supplemental to groundwater but acknowledges that other agencies see MWD and FMWD as primary sources. Historically, FMWD has been viewed by some as a "paper agency" just passing water through its piping system to the member agencies. As such, it became easy to rely on FMWD. Notes investment inequities comparing the west side of the service area to the east side. Has many customers who would be sensitive to rate increases but is accepting of rate increases if there is a priority list of projects. Such projects need to demonstrate benefits. Would like to see FMWD communicate issues more effectively. LAWC has an emergency supply of water. Would like to increase the possibility of wheeling water between and among FMWD member agencies. Has interconnections with other proximate agencies.

Mesa Crest Water Company

Only private water company in FMWD's service area. Completely dependent on FMWD for all water. Summer reserve is 24-36 hours of water depending on demand (About 3.5 million gallons of storage). Delivers water to 710 connections and a 1,000-foot vertical gain. Generally takes 1.7 cfs, but could double that if necessary. Local golf course accounts for 12 percent of demand and can serve as a buffer if necessary by ceasing irrigation deliveries. Recognizes that agencies on FMWD's east side may become more dependent on FMWD once Pasadena begins pumping from Monk Hill and is concerned about maxing out FMWD's Metropolitan service connection. Is working on an interconnection with LCID that could be ready in one to one-and-a-half years. Earthquake damage is a major concern but comfortable with fire flow capacity. Rate increases are not a major issue as they are guaranteed a rate of return through the Public Utilities Commission and pass through FMWD increases. Feels the FMWD member agencies need to develop a more cooperative spirit among themselves. Golf course is owned by a single owner and represents the last large, developable tract in La Cañada Flintridge. If it is ever developed the land could support up to 200 new homes and increase water demands by 30 to 40 percent. There are no plans to do this, but remains a possibility. Expressed concern that when conservation is required, rates must increase to cover fixed costs.

Rubio Cañon Land and Water Company

Generally only takes water during the winter period. They have about three days worth of storage depending on demand. Seeks to minimize costs. Is currently working on interconnections with LFWC and LAWC. Has an emergency interconnection (1700 gpm) with the City of Pasadena and LFWC. Has Raymond Basin rights to 1221 acre-feet/year. Area is essentially built out with no meaningful increases in water demand foreseen in the immediate future. Comfortable with fire flow capacity.

Valley Water Company

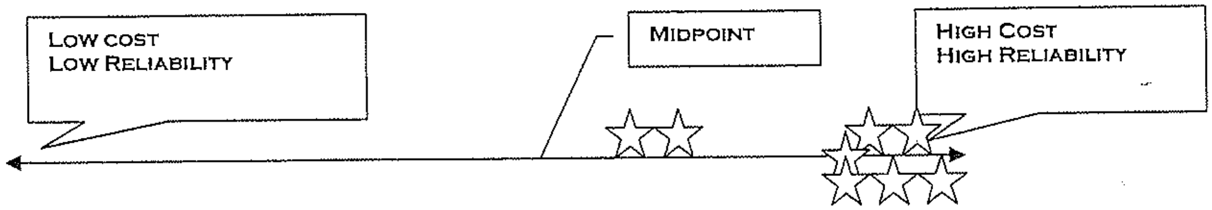
Is 70 percent dependent on FMWD-annual demand of about 4,000 AF. Has injection/replenishment capability. Has 797 AF of water rights in Raymond Basin and is seeking options to increase rights. Has reservoir storage of about five million gallons – about 15 hours of demand during summer conditions. Would welcome assistance in improving its system to the extent that such improvements could benefit FMWD as a whole. Is comfortable with "beneficiary pays" concept as long as benefits can be identified. Agrees with a second point of connection for FMWD with Metropolitan. Little growth in demand foreseen in immediate future. Service area is relatively affluent; however, any water rate increase must be clearly justified.

CONCLUSIONS/RECOMMENDATIONS

- FMWD should consider taking the lead on a series of table top exercises with member agencies in order to prepare for emergencies and the potential for drought conditions.
- Member agency interconnections need to be explored with an eye toward greater system flexibility
- Infrastructure financing methods should include federal and state grants and low-interest loans
- The agencies draw a distinction between supply reliability and the reliability of existing plumbing. Further discussions regarding reliability should separate those two concepts as each requires a different set of solutions.
- There likely will be little growth in water demands in FMWD's service area over the next decade
- Infrastructure improvements should be focused on reliability rather than growth
- Explore more interconnections across member agency boundaries given concerns over pressure differentials and water quality issues
- Consider a member agency manager retreat with general managers to discuss in detail issues within the district
- Ensure that CIP that emerges from Master Plan fully documents and describes needs and benefiting agencies
- Most member agencies indicated that FMWD may need one additional employee when the CIP is begun in order to manage the CIP and maintain and/or improve communications while allowing the general manager to participate in Metropolitan meetings and other events that may take him out of the district and away from day-to-day management of the CIP. Consider a new position – assistant general manager – that could also help the district with succession planning.
- Additional reservoir storage at elevation is a priority
- Member agencies are accepting of moderate rate increases associated with a CIP if they are convinced of the need for such projects. Consider a separate billing line on invoices (when the time is right) associate with the CIP
- Consider rate formulas that provide for different rate structures depending on the benefits of specific CIP projects. This could be shown as an infrastructure

improvement charge, a benefits charge or some other designation that explains rate differentials.

- Consider a rate process that provides for non-benefiting agencies to pay a share of CIP projects if it can be seen that such projects would or could benefit them in the future. Need to define "benefit."
- Be mindful of layering FMWD rate increases on top of member agency rate increases. For some consumers, this layering – on top of Metropolitan pass-throughs – could become onerous.
- The Master Plan must take into consideration all of the existing and planned interconnections between and among member agencies in order to avoid recommending redundant facilities that would not only be redundant to FMWD's system, but redundant to its member agencies as well. Such consideration needs to take into account multiple pressure zones, integrity of member agency pipelines and differing water treatment strategies that may conflict with one another.
- The Master Plan should take into consideration fire flows and any insurance costs that might be lowered by providing a more secure water supply or increased by failing to do the same.
- The Master Plan should take into account rate hike sensitivities that would include the individual agencies' needs for funds to upgrade and/or maintain their own systems. In other words, determining the need for additional funds for FMWD must consider the needs of the member agencies to deal with their own systems.
- Reliability defined: Reliability means making sure the member agencies are aware of upcoming scheduled outages and maintaining enough supply (through additional storage, intra-agency interconnections, inter-agency interconnections) to meet demand for one week assuming an outage at P-1 and the minimization of unscheduled interruptions within FMWD's distribution system. The continuum discussed earlier in this document would look something like the drawing below if the eight member agencies could each pick a point on that continuum:



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Appendix C

2006 and 2015 Monthly Member Agency Supply and Demand Projections for Normal and Dry Years

2006 MONTHLY WATER USE IN ACRE-FEET BY AGENCY FOR NORMAL PRECIPITATION

		Groundwater Production (a)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	328.9	346.3	328.1	309.4	264.6	250.9	247.9	232.5	218.7	278.5	243.7	244.6	3,294.0
La Canada ID	2,908	41.6	36.8	0.0	19.5	0.1	0.0	0.0	0.0	0.0	0.0	0.7	1.3	100.0
Valley WC	3,587	133.5	149.4	138.2	62.5	0.1	0.2	0.3	0.5	0.1	0.2	155.0	157.0	797.0
Mesa Crest WC	714	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,143	236.0	268.3	238.8	44.6	0.0	0.0	0.0	0.0	0.0	123.4	202.7	207.2	1,321.0
Lincoln Avenue WC	4,713	228.6	224.6	111.8	0.0	0.0	0.4	0.0	0.0	0.0	0.0	43.7	117.8	727.0
Las Flores WC	1,473	40.8	44.7	35.0	28.4	18.3	22.7	23.9	26.9	28.3	33.4	44.5	42.0	389.0
Total		1,009.3	1,070.1	851.9	464.5	283.0	274.2	272.1	259.9	247.1	435.5	690.4	770.0	6,628.0

		Local Water Production (b)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	5.3	5.5	5.2	5.3	4.1	5.5	5.4	4.8	2.5	3.4	5.3	5.1	57.4
La Canada ID	2,908	7.1	6.6	6.2	6.4	6.0	6.3	5.9	5.4	5.9	5.6	5.8	5.8	73.0
Valley WC	3,587	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Crest WC	714	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,143	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4
Lincoln Avenue WC	4,713	0.0	0.0	0.0	0.0	0.0	6.9	6.5	10.2	4.8	3.8	0.0	0.0	32.2
Las Flores WC	1,473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		29.8	12.1	11.4	11.7	10.1	18.7	17.8	20.4	13.2	12.8	11.1	10.9	180.0

		FMWD Demand (c)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	241.1	273.6	216.1	220.4	137.7	100.7	106.9	130.0	173.8	155.6	229.2	260.4	2,245.6
La Canada ID	2,908	291.8	306.3	306.9	275.8	191.8	140.8	156.7	173.1	206.3	219.8	261.0	291.6	2,822.0
Valley WC	3,587	309.3	322.7	276.6	370.1	343.5	279.5	291.7	297.1	355.9	368.6	191.3	244.7	3,651.0
Mesa Crest WC	714	87.7	89.6	77.1	64.7	41.0	31.5	33.9	36.8	44.0	47.9	64.3	74.5	693.0
Rubio Canon L&W	3,143	23.6	27.3	24.3	184.1	159.5	140.4	142.3	145.7	165.6	72.0	20.6	39.4	1,144.6
Lincoln Avenue WC	4,713	73.0	101.3	170.3	262.1	174.5	146.7	152.4	153.9	178.9	200.4	319.6	276.7	2,209.8
Las Flores WC	1,473	63.8	65.4	60.5	65.7	44.3	33.5	31.1	35.5	37.7	44.1	50.0	51.2	583.0
Total		1,090.2	1,186.3	1,131.9	1,442.9	1,092.2	873.2	914.9	972.2	1,162.2	1,108.5	1,136.1	1,238.6	13,349.0

		Total Demand												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	575.2	625.4	549.4	535.1	406.4	357.1	360.2	367.3	395.0	437.5	478.2	510.1	5,597.0
La Canada ID	2,908	340.5	349.7	313.1	301.7	197.9	147.1	162.6	178.5	212.2	225.4	267.5	298.7	2,995.0
Valley WC	3,587	442.8	472.2	414.8	432.6	343.5	279.8	291.9	297.6	356.0	368.8	346.3	401.7	4,448.0
Mesa Crest WC	714	87.7	89.6	77.1	64.7	41.0	31.5	33.9	36.8	44.0	47.9	64.3	74.5	693.0
Rubio Canon L&W	3,143	277.0	295.5	263.0	228.7	159.5	140.4	142.3	145.7	165.6	195.3	223.3	246.6	2,483.0
Lincoln Avenue WC	4,713	301.5	326.0	282.1	262.1	174.5	154.0	158.9	164.1	183.7	204.2	363.3	394.6	2,969.0
Las Flores WC	1,473	104.6	110.1	95.5	94.2	62.6	56.2	55.0	62.4	66.0	77.6	94.6	93.2	972.0
Total		2,129.3	2,268.5	1,995.1	1,919.1	1,385.3	1,166.1	1,204.8	1,252.4	1,422.5	1,556.8	1,837.5	2,019.5	20,157.0

(a) Annual quantity is limited to decreed right plus 400 acre-feet of recharge credit.
(b) Based on equivalent local diversions during the dry 2001-02 year.
(c) Includes FMWD supplies for groundwater recharge.

2006 MONTHLY WATER USE IN ACRE-FEET BY AGENCY FOR DRY PRECIPITATION

		Groundwater Production (a)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	340.2	338.1	300.1	295.7	268.1	270.0	218.4	192.1	198.0	194.5	340.5	338.3	3,294.0
La Canada ID	2,908	54.8	40.1	0.1	0.0	0.0	0.1	0.1	0.0	0.4	0.2	4.3	0.1	100.0
Valley WC	3,587	138.6	150.1	144.3	78.8	0.1	0.0	0.1	0.4	0.2	0.3	138.4	145.9	797.0
Mesa Crest WC	714	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,143	54.3	164.5	245.6	215.8	140.2	139.1	8.8	0.1	0.0	0.0	65.1	217.6	1,251.0
Lincoln Avenue WC	4,713	133.4	132.0	124.8	118.4	102.6	0.0	0.0	0.0	0.0	0.2	0.5	0.2	612.0
Las Flores WC	1,473	29.0	32.9	31.8	28.1	23.1	14.8	15.3	15.9	19.7	21.9	29.7	26.8	289.0
Total		750.3	857.5	846.6	736.7	534.0	424.0	242.6	208.5	218.3	217.1	578.4	729.0	6,343.0
		Local Water Production (b)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	4.7	4.7	4.5	4.6	4.5	4.5	4.5	4.1	4.4	4.2	3.3	4.0	52.0
La Canada ID	2,908	5.2	5.0	4.8	4.8	4.7	4.7	5.0	4.6	5.0	4.6	4.6	4.4	57.4
Valley WC	3,587	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Crest WC	714	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,143	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	1.6	0.0	0.0	9.1
Lincoln Avenue WC	4,713	2.1	0.0	0.0	0.0	0.0	0.9	7.1	11.1	30.1	8.2	0.0	0.0	59.5
Las Flores WC	1,473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		12.0	9.7	9.3	9.4	9.2	10.1	16.6	19.8	47.0	18.6	7.9	8.4	178.0
		FMWD Demand (c)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	263.6	318.8	276.7	265.8	157.3	103.2	158.2	192.4	215.5	264.1	162.1	197.3	2,575.0
La Canada ID	2,908	326.8	352.2	350.8	337.9	220.1	162.3	179.6	198.2	235.6	251.3	295.0	334.9	3,244.6
Valley WC	3,587	364.9	386.9	327.3	413.2	390.6	318.1	331.9	338.0	404.6	419.1	255.4	310.9	4,261.0
Mesa Crest WC	714	100.3	102.5	88.3	74.1	46.9	36.1	38.7	42.2	50.4	54.8	73.5	85.3	793.0
Rubio Canon L&W	3,143	254.2	164.7	47.4	38.9	37.5	17.3	149.8	162.2	176.9	216.0	183.7	57.2	1,505.9
Lincoln Avenue WC	4,713	175.6	204.3	166.3	151.9	77.4	158.0	156.8	158.2	159.4	202.3	374.3	406.8	2,391.5
Las Flores WC	1,473	89.9	92.3	76.8	79.0	48.0	49.1	47.2	55.0	55.4	66.3	77.9	79.2	816.0
Total		1,575.4	1,621.8	1,333.6	1,360.8	977.8	844.2	1,062.3	1,146.1	1,297.8	1,473.8	1,421.9	1,471.5	15,587.0
		Total Demand												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,111	608.5	661.6	581.2	566.1	429.9	377.8	381.1	388.6	417.9	462.9	505.9	539.6	5,921.0
La Canada ID	2,908	386.8	397.3	355.7	342.7	224.8	167.1	184.7	202.8	241.0	256.1	303.8	339.3	3,402.0
Valley WC	3,587	503.5	536.9	471.6	491.9	390.6	318.1	332.0	338.4	404.8	419.4	393.8	456.8	5,058.0
Mesa Crest WC	714	100.3	102.5	88.3	74.1	46.9	36.1	38.7	42.2	50.4	54.8	73.5	85.3	793.0
Rubio Canon L&W	3,143	308.6	329.2	293.0	254.8	177.7	156.4	158.6	162.3	184.4	217.6	248.8	274.8	2,766.0
Lincoln Avenue WC	4,713	311.1	336.3	291.0	270.4	180.0	158.9	163.9	169.3	189.5	210.7	374.9	407.1	3,063.0
Las Flores WC	1,473	119.0	125.2	108.6	107.1	71.1	63.9	62.5	70.9	75.0	88.2	107.5	106.0	1,105.0
Total		2,337.7	2,489.0	2,189.5	2,107.0	1,521.0	1,278.2	1,321.5	1,374.4	1,563.1	1,709.6	2,008.2	2,208.8	22,108.0

(a) Annual quantity is limited to decreed right plus 400 acre-feet of recharge credit.
(b) Based on equivalent local diversions during the dry 2001-02 year.
(c) Includes FMWD supplies for groundwater recharge.

2015 MONTHLY WATER USE IN ACRE-FEET BY AGENCY FOR NORMAL PRECIPITATION

		Groundwater Production (a)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	328.9	346.3	328.1	309.4	264.6	250.9	247.9	232.5	218.7	278.5	243.7	244.6	3,294.0
La Canada ID	2,948	41.6	36.8	0.0	19.5	0.1	0.0	0.0	0.0	0.0	0.0	0.7	1.3	100.0
Valley WC	3,643	133.5	149.4	138.2	62.5	0.1	0.2	0.3	0.5	0.1	0.2	155.0	157.0	797.0
Mesa Crest WC	750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,156	236.0	268.3	238.8	44.6	0.0	0.0	0.0	0.0	0.0	123.4	186.1	223.8	1,321.0
Lincoln Avenue WC	4,931	228.6	224.6	111.8	0.0	0.0	0.4	0.0	0.0	0.0	0.0	43.7	117.8	727.0
Las Flores WC	1,482	40.8	44.7	35.0	28.4	18.3	22.7	23.9	26.9	28.3	33.4	44.5	42.0	389.0
Total		1,009.3	1,070.1	851.9	464.5	283.0	274.2	272.1	259.9	247.1	435.5	673.8	786.6	6,628.0

		Local Water Production (b)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	5.3	5.5	5.2	5.3	4.1	5.5	5.4	4.8	2.5	3.4	5.3	5.1	57.4
La Canada ID	2,948	7.1	6.6	6.2	6.4	6.0	6.3	5.9	5.4	5.9	5.6	5.8	5.8	73.0
Valley WC	3,643	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Crest WC	750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,156	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4
Lincoln Avenue WC	4,931	0.0	0.0	0.0	0.0	0.0	6.9	6.5	10.2	4.8	3.8	0.0	0.0	32.2
Las Flores WC	1,482	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		29.8	12.1	11.4	11.7	10.1	18.7	17.8	20.4	13.2	12.8	11.1	10.9	180.0

		FMWD Demand (c)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	247.7	280.8	222.4	226.5	142.4	104.8	111.0	134.2	178.3	160.6	234.7	266.2	2,309.6
La Canada ID	2,948	326.7	342.2	339.0	306.7	212.1	155.9	173.3	191.4	228.1	243.0	288.4	322.3	3,129.0
Valley WC	3,643	348.8	364.9	313.6	408.7	374.1	304.5	317.7	323.7	387.6	401.5	222.2	280.5	4,048.0
Mesa Crest WC	750	92.1	94.1	81.0	68.0	43.0	33.1	35.6	38.7	46.3	50.3	67.5	78.3	728.0
Rubio Canon L&W	3,156	24.7	28.5	25.3	185.0	160.2	141.0	142.9	146.2	166.2	72.7	38.1	23.8	1,154.6
Lincoln Avenue WC	4,931	87.0	116.5	183.4	274.2	182.6	153.8	159.8	161.6	187.4	209.9	336.5	295.1	2,347.8
Las Flores WC	1,482	64.5	66.1	61.1	66.3	44.7	33.9	31.4	35.9	38.1	44.6	50.6	51.8	589.0
Total		1,191.5	1,292.9	1,225.9	1,535.5	1,159.0	926.9	971.8	1,031.7	1,232.0	1,182.7	1,238.1	1,318.0	14,306.0

		Total Demand												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	581.8	632.5	555.7	541.2	411.0	361.2	364.4	371.5	399.5	442.5	483.7	515.9	5,661.0
La Canada ID	2,948	375.4	385.6	345.2	332.6	218.2	162.2	179.2	196.8	234.0	248.6	294.9	329.4	3,302.0
Valley WC	3,643	482.3	514.3	451.8	471.2	374.2	304.7	318.0	324.2	387.8	401.8	377.2	437.6	4,845.0
Mesa Crest WC	750	92.1	94.1	81.0	68.0	43.0	33.1	35.6	38.7	46.3	50.3	67.5	78.3	728.0
Rubio Canon L&W	3,156	278.1	296.7	264.1	229.6	160.2	141.0	142.9	146.2	166.2	196.1	224.2	247.6	2,493.0
Lincoln Avenue WC	4,931	315.6	341.1	295.2	274.2	182.6	161.2	166.3	171.8	192.2	213.7	380.2	412.9	3,107.0
Las Flores WC	1,482	105.3	110.8	96.1	94.8	63.0	56.6	55.3	62.8	66.4	78.1	95.2	93.8	978.0
Total		2,230.5	2,375.2	2,089.2	2,011.7	1,452.1	1,219.9	1,261.7	1,312.0	1,492.3	1,631.0	1,923.0	2,115.5	21,114.0

(a) Annual quantity is limited to decreed right plus 400 acre-feet of recharge credit.
(b) Based on equivalent local diversions during the dry 2001-02 year.
(c) Includes FMWD supplies for groundwater recharge.

2015 MONTHLY WATER USE IN ACRE-FEET BY AGENCY FOR A DRY YEAR

		Groundwater Production (a)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	340.2	338.1	300.1	295.7	268.1	270.0	218.4	192.1	198.0	194.5	340.5	338.3	3,294.0
La Canada ID	2,948	54.8	40.1	0.1	0.0	0.0	0.1	0.1	0.0	0.4	0.2	4.3	0.1	100.0
Valley WC	3,643	138.6	150.1	144.3	78.8	0.1	0.0	0.1	0.4	0.2	0.3	138.4	145.9	797.0
Mesa Crest WC	750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,156	54.3	164.5	245.6	215.8	140.2	139.1	8.8	0.1	0.0	0.0	65.1	217.6	1,251.0
Lincoln Avenue WC	4,931	133.4	132.0	124.8	118.4	102.6	0.0	0.0	0.0	0.0	0.2	0.5	0.2	612.0
Las Flores WC	1,482	29.0	32.9	31.8	28.1	23.1	14.8	15.3	15.9	19.7	21.9	29.7	26.8	289.0
Total		750.3	857.5	846.6	736.7	534.0	424.0	242.6	208.5	218.3	217.1	578.4	729.0	6,343.0

		Local Water Production (b)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	4.7	4.7	4.5	4.6	4.5	4.5	4.5	4.1	4.4	4.2	3.3	4.0	52.0
La Canada ID	2,948	5.2	5.0	4.8	4.8	4.7	4.7	5.0	4.6	5.0	4.6	4.6	4.4	57.4
Valley WC	3,643	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Crest WC	750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubio Canon L&W	3,156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	1.6	0.0	0.0	9.1
Lincoln Avenue WC	4,931	2.1	0.0	0.0	0.0	0.0	0.9	7.1	11.1	30.1	8.2	0.0	0.0	59.5
Las Flores WC	1,482	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		12.0	9.7	9.3	9.4	9.2	10.1	16.6	19.8	47.0	18.6	7.9	8.4	178.0

		FMWD Demand (c)												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	270.7	326.5	283.4	272.4	162.3	107.6	162.7	196.9	220.3	269.5	168.0	203.6	2,644.0
La Canada ID	2,948	362.3	388.6	383.4	369.3	240.7	177.6	196.5	216.8	257.7	274.8	322.8	366.0	3,556.6
Valley WC	3,643	405.4	430.1	365.3	452.8	422.0	343.7	358.6	365.3	437.2	452.8	287.1	347.7	4,668.0
Mesa Crest WC	750	105.4	107.6	92.7	77.8	49.2	37.9	40.7	44.3	52.9	57.5	77.3	89.6	833.0
Rubio Canon L&W	3,156	255.5	166.0	48.6	39.9	38.2	17.9	150.4	162.8	177.7	216.9	184.7	58.3	1,516.9
Lincoln Avenue WC	4,931	190.0	219.9	179.8	164.5	85.8	165.3	164.4	166.1	168.2	212.1	391.7	425.7	2,533.5
Las Flores WC	1,482	90.7	93.1	77.5	79.7	48.5	49.5	47.6	55.4	55.8	66.8	78.5	79.8	823.0
Total		1,680.0	1,732.0	1,430.8	1,456.4	1,046.7	899.7	1,121.0	1,207.6	1,369.8	1,550.4	1,510.1	1,570.6	16,575.0

		Total Demand												
Agency	Number of Connections	July	August	September	October	November	December	January	February	March	April	May	June	Total
Crescenta Valley WD	8,205	615.6	669.3	588.0	572.7	434.9	382.2	385.5	393.1	422.8	468.3	511.8	545.9	5,990.0
La Canada ID	2,948	422.2	433.7	388.3	374.1	245.4	182.4	201.6	221.4	263.1	279.6	331.7	370.5	3,714.0
Valley WC	3,643	544.0	580.2	509.6	531.5	422.1	343.7	358.7	365.6	437.4	453.2	425.5	493.6	5,465.0
Mesa Crest WC	750	105.4	107.6	92.7	77.8	49.2	37.9	40.7	44.3	52.9	57.5	77.3	89.6	833.0
Rubio Canon L&W	3,156	309.8	330.5	294.2	255.8	178.4	157.0	159.2	162.9	185.2	218.5	249.8	275.8	2,777.0
Lincoln Avenue WC	4,931	325.5	351.9	304.5	282.9	188.3	166.2	171.5	177.2	198.3	220.5	392.2	425.9	3,205.0
Las Flores WC	1,482	119.7	126.0	109.3	107.8	71.6	64.3	62.9	71.4	75.5	88.7	108.2	106.7	1,112.0
Total		2,442.3	2,599.2	2,286.6	2,202.5	1,589.9	1,333.8	1,380.2	1,435.9	1,635.1	1,786.2	2,096.4	2,307.9	23,096.0

(a) Annual quantity is limited to decreed right plus 115 acre-feet of recharge credit.
(b) Based on equivalent local diversions during the dry 2003-04 year.
(c) Includes FMWD supplies for groundwater recharge.

Appendix D

Water Supply Reliability Discussion from 2005 MWD Urban Water Management Plan

II.2 Evaluating Supply Reliability

The Urban Water Management Plan Act requires that three fundamental planning analyses be performed to evaluate supply reliability as part of the development of a Plan. The first is a water supply reliability assessment, which requires development of a detailed evaluation of the supplies necessary to meet demands over at least a 20-year period in average, single year, and multi-year drought conditions. The second is a water shortage contingency plan that documents the stages of actions needed to address up to a 50 percent reduction in an agency's water supplies. Finally, the Act requires the development of a plan that defines the actions to be taken in the event of a catastrophic interruption in water supplies.

To complete these analyses, Metropolitan developed estimates of future demands and supplies from Metropolitan and local sources. Supply and demand analyses for the single and multiple year droughts were based on conditions for the SWP. For this source, the single driest year was 1977, and the three-year dry historical period was 1990-1992. The SWP provides the optimal basis for analysis because it is Metropolitan's largest and most variable supply. For the average year, the analysis used 83 years of historic hydrology (1922 to 2004) to develop estimates of supply and demands.

Estimating Demands on Metropolitan

Metropolitan derived its demand forecasts by first estimating total retail demands for the region and then factoring in the impacts of conservation. Details of this step are detailed in Appendix A.1 of this report. Next, it derived projections of local supplies using data on current and expected local supply programs and the IRP Local Resource Program Target. The difference between the resulting total demands, including conservation, and local supplies is the expected regional demand on Metropolitan supplies. These estimates of demands on Metropolitan were developed for a single dry year, multiple dry years, and average years. Tables II-4 through II-6 show these estimates. Metropolitan has shared these underlying supply assumptions with its member agencies.

Retail Demands
Retail M&I demands represent the full spectrum of water use within the region, including residential, commercial, industrial, institutional and un-metered uses. To forecast urban water demands, Metropolitan used the MWD-MAIN Water Use Forecasting System (MWD-Main), which is a combination of statistical and end-use methods that has been adapted to conditions in Southern California. The analysis based its population estimates on projections developed for the SCAG 2004 Regional Transportation Plan and SANDAG 2030 Forecast. Output from MWD-Main was then adjusted for expected conservation.

Conservation
The forecast of future conservation included a detailed accounting of water conservation that distinguished between:

- *Code-based Conservation* – Water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes.
- *Active Conservation* – Water saved directly as a result of conservation programs by water agencies (includes implementation of Best Management Practices).
- *Price-effect Conservation* – Water saved by retail customers attributable to the effect of changes in the real (inflation-adjusted) price of water.

After including the effects of conservation in the retail demands, the analysts calculated forecasts of local supplies.

Local Supplies
These forecasts of local supplies relied on information gathered from a number of sources including past urban water management plans, Metropolitan's annual local supply surveys, and communications between Metropolitan and member agency

staff. The 2005 RUWMP includes only existing projects, projects with firm contracts for LRP funding, and projects that have met specific environmental documentation and financing criteria. Appendix 5 provides lists of the projects meeting these criteria.

Firm Demands

After calculating the expected regional demands on Metropolitan supplies, projected firm demands were calculated based on Metropolitan's established reliability goal. For the purposes of reliability planning, the 1996 IRP established a reliability goal that states that full service demands at the retail level would be satisfied under all "foreseeable hydrologic" conditions through 2020. This goal allows for intermittent interruptions to non-firm, discounted rate supplies sold under the Seasonal Storage Program and the Interim Agricultural Water Program. Thus, firm demand on Metropolitan equals Full Service demands (Tier I and Tier II) plus 70% of the Interim Agricultural Water Program. For the purpose of analysis, "foreseeable hydrologic conditions" is understood to mean under "historical hydrology," which presently covers the range of historical hydrology spanning the years 1922 through 2004.. Tables II-4 through II-6 show estimates of firm demands on Metropolitan for single dry year, multiple dry years and average years.

Table II-4
Metropolitan Regional Water Demands
Single Dry Year
(Acre-Feet)

	2010	2015	2020	2025	2030
A. Total Demands[1]	**5,519,000**	**5,743,000**	**5,992,000**	**6,218,000**	**6,430,000**
Retail Agricultural	337,000	303,000	271,000	239,000	221,000
Retail Municipal and Industrial	4,951,000	5,186,000	5,457,000	5,715,000	5,947,000
Groundwater Replenishment	182,000	192,000	198,000	198,000	196,000
Seawater Barrier	49,000	62,000	66,000	66,000	66,000
B. Total Conservation [2]	**865,000**	**955,000**	**1,028,000**	**1,107,000**	**1,188,000**
Existing Active (through 2004) [3]	94,000	92,000	92,000	91,000	91,000
Code-based, Price-Effect, and Remaining IRP Target	521,000	613,000	686,000	766,000	847,000
Pre-1990 Conservation	250,000	250,000	250,000	250,000	250,000
C. Total Local Supplies	**2,159,000**	**2,414,000**	**2,552,000**	**2,575,000**	**2,593,000**
Groundwater	1,375,000	1,394,000	1,399,000	1,412,000	1,430,000
Surface Water	93,000	93,000	93,000	93,000	93,000
Los Angeles Aqueduct	96,000	95,000	95,000	95,000	95,000
Groundwater Recovery	87,000	115,000	115,000	115,000	115,000
Total Recycling	310,000	387,000	408,000	408,000	408,000
Desalination	28,000	128,000	150,000	150,000	150,000
Other Imported Supplies	170,000	202,000	292,000	302,000	302,000
D. Total Metropolitan Demands (D=A-B-C)	**2,495,000**	**2,376,000**	**2,411,000**	**2,535,000**	**2,647,000**
Full Service (Tier I and Tier II)	2,246,000	2,132,000	2,174,000	2,317,000	2,452,000
Replenishment Service [4]	144,000	153,000	159,000	159,000	145,000
Interim Agricultural Water Program	105,000	91,000	78,000	59,000	50,000
Firm Demands on Metropolitan [5]	**2,320,000**	**2,196,000**	**2,229,000**	**2,358,000**	**2,487,000**

Notes:

All units are acre-feet unless specified, rounded to the nearest hundred.

Totals may not sum due to rounding.

[1] Growth Projections: SCAG 2004 Regional Transportation Plan; SANDAG 2030 Forecast

[2] The 2030 savings target is derived from the 2003 IRP Update forecast projections for 2030; it is not an official target for 2030

[3] Includes code-based savings originated through an active implementation program

[4] Replenishment Service as defined in MWD Administrative Code Section 4114

[5] Firm demand on Metropolitan equals Full Service demands plus 70% of the Interim Agricultural Water Program demands

Table II-5
Metropolitan Regional Water Demand
Multiple Dry Year
(Acre-Feet)

	2010	2015	2020	2025	2030
A. Total Demands[1]	**5,547,000**	**5,810,000**	**6,057,000**	**6,298,000**	**6,518,000**
Retail Agricultural	337,000	306,000	274,000	243,000	222,000
Retail Municipal and Industrial	4,984,000	5,256,000	5,521,000	5,792,000	6,033,000
Groundwater Replenishment	178,000	189,000	196,000	197,000	197,000
Seawater Barrier	48,000	59,000	66,000	66,000	66,000
B. Total Conservation [2]	**865,000**	**955,000**	**1,028,000**	**1,107,000**	**1,188,000**
Existing Active (through 2004) [3]	94,000	92,000	92,000	91,000	91,000
Code-based, Price-Effect, and Remaining IRP Target		613,000	686,000	766,000	847,000
Pre-1990 Conservation	250,000	250,000	250,000	250,000	250,000
C. Total Local Supplies	**2,140,000**	**2,396,000**	**2,559,000**	**2,587,000**	**2,593,000**
Groundwater	1,378,000	1,409,000	1,412,000	1,425,000	1,431,000
Surface Water	78,000	79,000	79,000	79,000	79,000
Los Angeles Aqueduct	97,000	104,000	104,000	108,000	108,000
Groundwater Recovery	108,000	114,000	115,000	115,000	115,000
Total Recycling	300,000	375,000	407,000	408,000	408,000
Desalination	9,333	114,000	150,000	150,000	150,000
Other Imported Supplies	170,000	201,000	292,000	302,000	302,000
D. Total Metropolitan Demands (D=A-B-C)	**2,542,000**	**2,460,000**	**2,469,000**	**2,604,000**	**2,737,000**
Full Service (Tier I and Tier II)	2,318,000	2,238,000	2,254,000	2,405,000	2,549,000
Replenishment Service [4]	119,000	130,000	136,000	137,000	137,000
Interim Agricultural Water Program	105,000	92,000	79,000	62,000	51,000
Firm Demands on Metropolitan [5]	**2,392,000**	**2,302,000**	**2,309,000**	**2,448,000**	**2,585,000**

Notes:
All units are acre-feet unless specified, rounded to the nearest hundred.
Totals may not sum due to rounding.

[1] Growth Projections: SCAG 2004 Regional Transportation Plan; SANDAG 2030 Forecast

[2] The 2030 savings target is derived from the 2003 IRP Update forecast projections for 2030; it is not an official target for 2030

[3] Includes code-based savings originated through an active implementation program

[4] Replenishment Service as defined in MWD Administrative Code Section 4114

[5] Firm demand on Metropolitan equals Full Service demands plus 70% of the Interim Agricultural Water Program demands

Table II-6
Metropolitan Regional Water Demand
Average Year
(Acre-Feet)

	2010	2015	2020	2025	2030
A. Total Demands[1]	**5,493,000**	**5,721,000**	**5,964,000**	**6,190,000**	**6,395,000**
Retail Agricultural	326,000	294,000	263,000	233,000	215,000
Retail Municipal and Industrial	4,918,000	5,132,000	5,420,000	5,677,000	5,907,000
Groundwater Replenishment	200,000	213,000	215,000	214,000	207,000
Seawater Barrier	49,000	62,000	66,000	66,000	66,000
B. Total Conservation [2]	**865,000**	**955,000**	**1,028,000**	**1,107,000**	**1,188,000**
Existing Active (through 2004) [3]	94,000	92,000	92,000	91,000	91,000
Code-based, Price-Effect, and Remaining IRP Target	521,000	613,000	686,000	766,000	847,000
Pre-1990 Conservation	250,000	250,000	250,000	250,000	250,000
C. Total Local Supplies	**2,393,000**	**2,614,000**	**2,748,000**	**2,771,000**	**2,770,000**
Groundwater	1,416,000	1,430,000	1,431,000	1,444,000	1,442,000
Surface Water	100,000	99,000	99,000	99,000	99,000
Los Angeles Aqueduct	252,000	253,000	253,000	253,000	254,000
Groundwater Recovery	111,000	115,000	115,000	115,000	115,000
Total Recycling	316,000	387,000	408,000	408,000	408,000
Desalination	28,000	128,000	150,000	150,000	150,000
Other Imported Supplies	170,000	202,000	292,000	302,000	302,000
D. Total Metropolitan Demands (D=A-B-C)	**2,235,000**	**2,153,000**	**2,188,000**	**2,310,000**	**2,437,000**
Full Service (Tier I and Tier II)	1,967,000	1,887,000	1,931,000	2,071,000	2,213,000
Replenishment Service [4]	169,000	180,000	183,000	183,000	177,000
Interim Agricultural Water Program	99,000	86,000	74,000	56,000	47,000
Firm Demands on Metropolitan [5]	**2,036,000**	**1,947,000**	**1,983,000**	**2,110,000**	**2,246,000**

Notes:
All units are acre-feet unless specified, rounded to the nearest hundred.
Totals may not sum due to rounding.

[1] Growth Projections: SCAG 2004 Regional Transportation Plan; SANDAG 2030 Forecast

[2] The 2030 savings target is derived from the 2003 IRP Update forecast projections for 2030; it is not an official target for 2030

[3] Includes code-based savings originated through an active implementation program

[4] Replenishment Service as defined in MWD Administrative Code Section 4114

[5] Firm demand on Metropolitan equals Full Service demands plus 70% of the Interim Agricultural Water Program demands

II.3 Water Supply Reliability

After estimating demands for single dry year, multiple dry years, and average years the water reliability analysis requires urban water suppliers to identify projected supplies to meet these demands. Table II-7 summarizes the sources of supply for the single dry year (1977 hydrology), while Table II-8 shows the region's ability to respond in future years under a repeat of the 1990-92 hydrology. Table II-8 provides results for the average of the three dry years rather than a year-by-year detail, because most of Metropolitan's dry-year supplies are designed to provide equal amounts of water over each year of a three-year period. These tables show that the region can provide reliable water supplies under both the single driest year and the multiple dry year hydrologies. Table II-9 reports the expected situation on average over all of the historic hydrologies. Appendix A-3 contains detailed justifications for the sources of supply used for this analysis.

The reliability analyses in the IRP Update report showed that Metropolitan can maintain reliable supplies under the conditions that have existed in past dry periods throughout the period 2010 through 2025. As the tables provided below show, that level of reliability extends through 2030. Metropolitan has also identified buffer supplies, including additional SWP groundwater storage and transfers that could serve to supply the additional water needed.

Table II-7
Single Dry-Year
Supply Capability[1] & Projected Demands
(Repeat of 1977 Hydrology)
(Acre-Feet)

	2010	2015	2020	2025	2030
Current Supplies					
In-Basin Storage	1,149,000	1,161,000	1,113,000	1,066,000	1,017,000
California Aqueduct [2]	777,000	777,000	777,000	777,000	777,000
Colorado River Aqueduct [3]	722,000	699,000	699,000	699,000	699,000
Supplies Under Development					
In-Basin Storage	78,000	103,000	103,000	103,000	103,000
California Aqueduct	330,000	259,000	350,000	350,000	350,000
Colorado River Aqueduct	95,000	460,000	400,000	400,000	400,000
Transfers to Other Agencies	0	(35,000)	(35,000)	(35,000)	(35,000)
Metropolitan Supply Capability	***3,151,000***	***3,424,000***	***3,407,000***	***3,360,000***	***3,311,000***
Metropolitan Supply Capability w/CRA Maximum of 1.25 MAF [4]	***3,151,000***	***3,356,000***	***3,309,000***	***3,252,000***	***3,203,000***
Firm Demands on Metropolitan [5,6]	**2,320,000**	**2,196,000**	**2,229,000**	**2,358,000**	**2,487,000**
Potential Reserve & Replenishment Supplies	**831,000**	**1,160,000**	**1,080,000**	**894,000**	**716,000**

[1] Represents supply capability for resource programs under listed year type

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct

[3] Colorado River Aqueduct includes water management program supplies conveyed by the aqueduct

[4] Maximum CRA deliveries limited to 1.25 MAF including SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies.

[5] Based on SCAG 2004 RTP, SANDAG 2030 forecasts, projections of member agency existing and contracted active conservation and local supplies, remaining regional targets for active conservation, SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies.

[6] Includes projected firm sales plus 70% of projected IAWP agricultural sales

Table II-8
Multiple Dry-Year
Supply Capability[1] & Projected Demands
(Repeat of 1990-92 Hydrology)
(Acre-Feet)

	2010	2015	2020	2025	2030
Current Supplies					
In-Basin Storage	514,000	518,000	502,000	487,000	470,000
California Aqueduct [2]	912,000	912,000	912,000	912,000	912,000
Colorado River Aqueduct [3]	722,000	699,000	699,000	699,000	699,000
Supplies Under Development					
In-Basin Storage	78,000	103,000	103,000	103,000	103,000
California Aqueduct	330,000	215,000	299,000	299,000	299,000
Colorado River Aqueduct	95,000	460,000	400,000	400,000	400,000
Transfers to Other Agencies	0	(35,000)	(35,000)	(35,000)	(35,000)
Metropolitan Supply Capability	***2,651,000***	***2,872,000***	***2,880,000***	***2,865,000***	***2,848,000***
Metropolitan Supply Capability w/CRA Maximum of 1.25 MAF [4]	***2,651,000***	***2,804,000***	***2,782,000***	***2,757,000***	***2,740,000***
Firm Demands on Metropolitan [5,6]	***2,392,000***	***2,302,000***	***2,309,000***	***2,448,000***	***2,585,000***
Potential Reserve & Replenishment Supplies	**259,000**	**502,000**	**473,000**	**309,000**	**155,000**

[1] Represents supply capability for resource programs under listed year type

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct

[3] Colorado River Aqueduct includes water management program supplies conveyed by the aqueduct

[4] Maximum CRA deliveries limited to 1.25 MAF including SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies

[5] Based on SCAG 2004 RTP, SANDAG 2030 forecasts, projections of member agency existing and contracted active conservation and local supplies, remaining regional targets for active conservation, SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies

[6] Includes projected firm sales plus 70% of projected IAWP agricultural sales

Table II-9
Average Year
Supply Capability[1] & Projected Demands
(Average of 1922 – 2004 Hydrologies)
(Acre-Feet)

	2010	2015	2020	2025	2030
Current Supplies					
In-Basin Storage	0	0	0	0	0
California Aqueduct[2]	1,772,000	1,772,000	1,772,000	1,772,000	1,772,000
Colorado River Aqueduct[3]	711,000	678,000	677,000	677,000	677,000
Supplies Under Development					
In-Basin Storage	0	0	0	0	0
California Aqueduct	185,000	185,000	240,000	240,000	240,000
Colorado River Aqueduct	0	0	0	0	0
Transfers to Other Agencies	0	(35,000)	(35,000)	(35,000)	(35,000)
Metropolitan Supply Capability	***2,668,000***	***2,600,000***	***2,654,000***	***2,654,000***	***2,654,000***
Metropolitan Supply Capability w/CRA Maximum of 1.25 MAF [4]	***2,668,000***	***2,600,000***	***2,654,000***	***2,654,000***	***2,654,000***
Firm Demands on Metropolitan [5,6]	***2,036,000***	***1,947,000***	***1,983,000***	***2,110,000***	***2,246,000***
Potential Reserve & Replenishment Supplies	**632,000**	**653,000**	**671,000**	**544,000**	**408,000**

[1] Represents supply capability for resource programs under listed year type

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct

[3] Colorado River Aqueduct includes water management program supplies conveyed by the aqueduct

[4] Maximum CRA deliveries limited to 1.25 MAF including SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies

[5] Based on SCAG 2004 RTP, SANDAG 2030 forecasts, projections of member agency existing and contracted active conservation and local supplies, remaining regional targets for active conservation, SDCWA/IID Transfer supplies and Coachella and All-American Canals lining supplies

[6] Includes projected firm sales plus 70% of projected IAWP agricultural sales

II.4 Water Shortage Contingency Analysis

In addition to the Water Supply Reliability analysis addressing average year and drought conditions, the Act requires agencies to document the stages of actions that it would undertake in response to water supply shortages, including up to a 50% reduction in its water supplies. Metropolitan has captured this planning in its Water Surplus and Drought Management Plan (WSDM Plan) which guides Metropolitan's planning and operations during both shortage and surplus conditions.

Water Surplus and Drought Management Plan

In April of 1999, Metropolitan's Board of Directors adopted the WSDM Plan.[2] It provides policy guidance for managing regional water supplies to achieve the reliability goals of Southern California's IRP. It identifies the expected sequence of resource management actions that Metropolitan will execute during surpluses and shortages to minimize the probability of severe shortages and eliminate the possibility of extreme shortages and shortage allocations. Unlike Metropolitan's previous shortage management plans, the WSDM Plan recognizes the link between surpluses and shortages, and it integrates planned operational actions with respect to both conditions.

Through effective management of its water supply, Metropolitan fully expects to be 100 percent reliable in meeting all non-discounted non-interruptible demands throughout the next twenty five years. The benefits of Metropolitan's contingency planning approach have been evident in recent years. Of particular note are the region's successes in dealing with operational constraints such as the rehabilitation of the CRA in 2003, the disruption to Delta diversions caused by the Jones Tract flooding in 2004, and the strong position of local storage despite five years of dry conditions.

WSDM Plan Development
Metropolitan and its member agencies jointly developed the WSDM Plan during 1998 and 1999. This planning effort included more than a dozen half-day and full-day workshops and more than three dozen meetings between Metropolitan and member agency staff. The result of the planning effort is a consensus plan that addresses a broad range of regional water management actions and strategies.

WSDM Plan Principles and Goals
The guiding principle of the WSDM plan is to manage Metropolitan's water resources and management programs to maximize management of wet year supplies and minimize adverse impacts of water shortages to retail customers. From this guiding principle came the following supporting principles:

- Encourage efficient water use and economical local resource programs.
- Coordinate operations with member agencies to make as much surplus water as possible available for use in dry years.
- Pursue innovative transfer and banking programs to secure more imported water for use in dry years.

Increase public awareness about water supply issues.

The WSDM plan also declared that if mandatory import water allocations be necessary, they would be calculated on the basis of need, as opposed to any type of historical purchases. The WSDM plan contains the following considerations that would go into an equitable allocation of imported water:

- Impact on retail consumers and regional economy
- Investments in local resources, including recycling and conservation
- Population growth
- Changes and/or losses in local supplies

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[2] Metropolitan Water District of Southern California. *Water Surplus and Drought Management Plan*, Report No. 1150, August, 1999.

- Participation in Metropolitan's Non-firm (interruptible) programs
- Investment in Metropolitan's facilities

Surplus and Shortage Stages

The WSDM Plan distinguishes between Surpluses, Shortages, Severe Shortages, and Extreme Shortages. Within the WSDM Plan, these terms have specific meanings relating to Metropolitan's ability to deliver water to its customers.

Surplus: Metropolitan can meet full-service and interruptible program demands, and it can deliver water to local, regional and out-of-region storage.

Shortage: Metropolitan can meet full-service demands and partially meet or fully meet interruptible demands, using stored water or water transfers as necessary.

Severe Shortage: Metropolitan can meet full-service demands only by using stored water, transfers, and possibly calling for extraordinary conservation. In a Severe Shortage, Metropolitan may have to curtail Interim Agricultural Water Program deliveries.

Extreme Shortage: Metropolitan must allocate available supply to full-service customers.

The WSDM Plan also defines five surplus management stages and seven shortage management stages to guide resource management activities. These stages are not defined merely by shortfalls in imported water supply, but also by the water balances in Metropolitan's storage programs. Thus, a ten percent shortfall in imported supplies could be a "stage one" shortage if storage levels are high. If storage levels are already depleted, the same shortfall in imported supplies could potentially be defined as a more severe shortage. Each year, Metropolitan evaluates the level of supplies available and existing levels of water in storage to determine the appropriate management stage for that year. Each stage is associated with specific resource management actions designed to (1) avoid an Extreme Shortage to the maximum extent possible and (2) minimize adverse impacts to retail customers if an Extreme Shortage occurs. The current sequencing outlined in the WSDM Plan reflects anticipated responses based on detailed modeling of Metropolitan's existing and expected resource mix.

Surplus Stages
Metropolitan's supply situation is considered to be in surplus as long as net annual deliveries can be made to water storage programs. Deliveries for storage in the Diamond Valley Lake and in the SWP terminal reservoirs continue through each surplus stage provided there is available storage capacity. Withdrawals from Diamond Valley Lake for regulatory purposes or to meet seasonal demands may occur in any stage. Deliveries to other storage facilities may be interrupted, depending on the amount of the surplus.

Shortage Actions
When Metropolitan must make net withdrawals from storage to meet demands, it is considered to be in a shortage condition. Under most of these stages, it is still able to meet all end-use demands for water. For shortage stages 1 through 4, Metropolitan will meet demands by withdrawing water from storage. At shortage stages 5 through 7, Metropolitan may undertake additional shortage management steps, including issuing public calls for extraordinary conservation, considering curtailment of Interim Agricultural Water Program deliveries in accordance with their discounted rates, exercise water transfer options, or purchase water on the open market.

At shortage stage 7 Metropolitan will develop a plan to allocate available supply fairly and efficiently to full-service customers. The allocation plan will be based on the Board-adopted principles for allocation. Metropolitan intends to enforce these allocations using rate surcharges. Under the current WSDM Plan, the surcharges will be set at a minimum of $175 per af for any deliveries exceeding a member agency's allotment.

Any deliveries exceeding 102% of the allotment will be assessed a surcharge equal to three times Metropolitan's full-service rate.

Figure II-1 shows the actions under surplus and shortage stages when an allocation plan would be necessary to enforce mandatory cutbacks. The overriding goal of the WSDM Plan is to never reach Shortage Stage 7, an Extreme Shortage. Given present resources, Metropolitan fully expects to achieve this goal over the next twenty five years.

Annual Reporting Schedule on Supply/Demand Conditions

Managing Metropolitan's water supply resources to minimize the risk of shortages requires timely and accurate information on changing supply and demand conditions throughout the year. To facilitate effective resource management decisions, the WSDM Plan includes a monthly schedule for providing supply/demand information to Metropolitan's senior management and Board of Directors, and for making resource allocation decisions. Table II-10 shows this schedule.

Figure II-1 Resource Stages, Anticipated Actions, And Supply Declarations

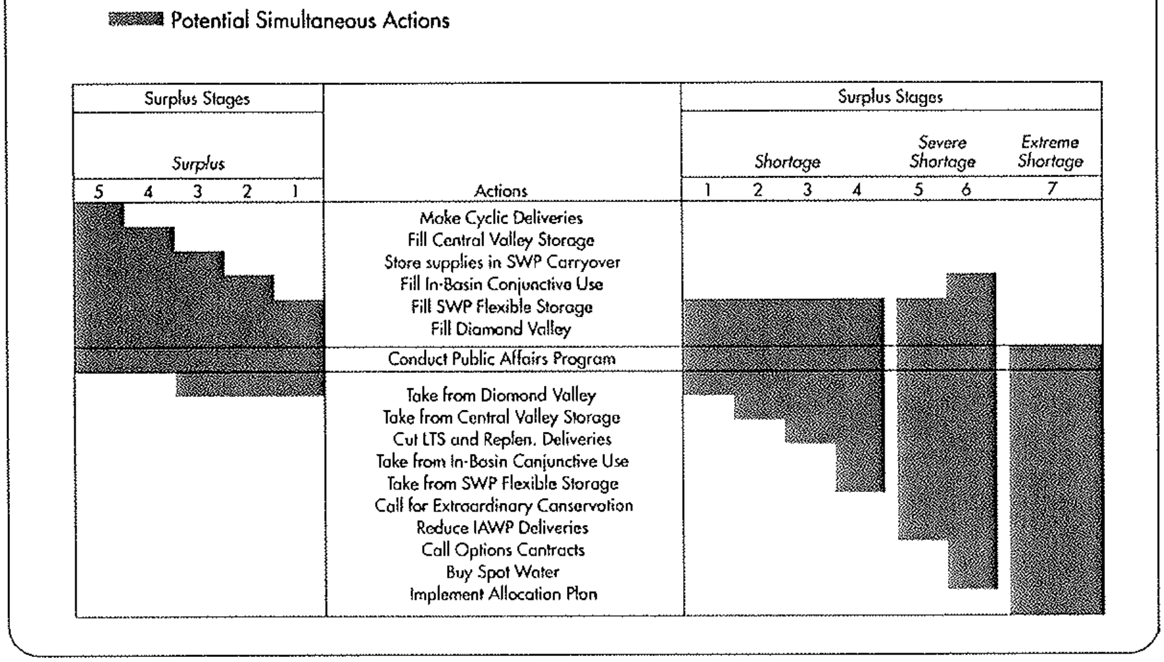

Table II-10
Schedule of Reporting and Resource Allocation Decision-Making

Month	Informational Report/Management Decision
Jan.	Initial supply/demand forecasts for year
Feb. - Mar.	Update supply/demand forecasts for year
Apr. - May	Finalize supply/demand forecasts Management decisions re: Contractual Groundwater and Option Transfer Programs Board decisions re: Need for Extraordinary Conservation
Oct.	Report on Supply and Carryover Storage
Nov.	Management decisions re: Long-Term Seasonal and Replenishment Groundwater Programs, Interruptible Agricultural Water Program

II.5 Catastrophic Supply Interruption Planning

The third type of planning needed to evaluate supply reliability is a catastrophic supply interruption plan that documents the actions necessary for a catastrophic interruption in water supplies. For Metropolitan this planning is captured in the analysis that went into developing the Emergency Storage Requirements.

Emergency Storage Requirements

Metropolitan established its criteria for determining emergency storage requirements in the October 1991 Final Environmental Impact Report for the Eastside Reservoir, which is now named Diamond Valley Lake. These criteria were again discussed in Southern California's 1996 Integrated Resources Plan. Metropolitan's Board has approved both of these documents.

These emergency storage requirements are based on the potential of a major earthquake damaging the aqueducts that transport Southern California's imported water supplies (SWP, CRA, and Los Angeles Aqueduct). The adopted criteria assume that damage from such an event could render the aqueducts out of service for six months. Therefore, Metropolitan has based its planning on a 100 percent reduction in its supplies for a period of six months, which is a greater shortage than required by the Act.

To safeguard the region from catastrophic loss of water supply, Metropolitan has made substantial investments in emergency storage. The emergency plan outlines that under such a catastrophe, interruptible service deliveries would be suspended, and firm supplies to member agencies would be restricted by a mandatory cutback of 25 percent from normal-year demand levels. At the same time, water stored in surface reservoirs and groundwater basins under Metropolitan's interruptible program would be made available, and Metropolitan would draw on its emergency storage, as well as other available storage. Metropolitan has reserved approximately one-third of Diamond Valley Lake storage to meet such an emergency, while the remainder is available for dry-year and seasonal supplies. In addition, Metropolitan has access to emergency storage at its other reservoirs, at the SWP terminal reservoirs, and in its groundwater conjunctive use storage accounts. With few exceptions, Metropolitan can deliver this emergency supply throughout its service area via gravity, thereby eliminating dependence on power sources that could also be disrupted by a major earthquake. The WSDM Plan shortage stages will guide Metropolitan's management of available supplies and resources during the emergency to minimize the impacts of the catastrophe.

In addition to the criteria used to develop the emergency storage requirements, Metropolitan cooperated with DWR and others in 2005 on a preliminary study of the potential effects of extensive levee failures in the Delta.[3] This study was limited in scope, and it investigated only two of a potential range of scenarios. Metropolitan's analysis showed that its investment in local storage and water banking programs south of the Delta would provide the resources necessary to continue operating under the scenarios investigated. In particular, Metropolitan's analysis showed that it would be able to supply all firm requirements to its member agencies under both scenarios, but that it would need to interrupt replenishment deliveries to the area's groundwater basins and curtail water supplies to one third of the interruptible agriculture within its service territory. Metropolitan's analysis further suggested that the scenarios investigated were not the worst-case situation. Under more extreme hydrologies, Metropolitan might have to reduce firm deliveries to Metropolitan's member agencies by as much as 10 percent.

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[3] Jack R. Benjamin & Associates, Inc. *Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento-San Joaquin Delta,* June, 2005.

Electrical Outages

Metropolitan has also developed contingency plans that enable it to deal with both planned and unplanned electrical outages. These plans include the following key points:

- In event of power outages, water supply can be maintained by gravity feed from Diamond Valley Lake.
- Maintaining water treatment operations is a key concern. As a result, all Metropolitan treatment plants have backup generation sufficient to continue operating in event of supply failure on the main electrical grid.
- Valves at Lake Skinner can be operated by the backup generation at the Lake Skinner treatment plant.
- Metropolitan owns mobile generators that can be transported quickly to key locations if necessary.

II.6 Other Supply Reliability Risks

In its IRP Update, Metropolitan identified two risks to its future supply reliability:

1. Implementation Risk. For local programs, Metropolitan has taken a region-wide, competitive approach to securing new supplies. This approach encourages innovation, and as a result some projects could either fail to meet their expected contribution to the IRP goals, or they could fail to do so in the expected timeframe. In addition, programs related to imported water supplies may not perform as expected.
2. Water Quality Issues. Concerns relating to water quality could pose an increasing challenge for water supply reliability. Water quality issues might threaten existing supplies through contamination, or water quality standards may become more stringent because of changing water quality regulation or the discovery of a previously unknown risk. These events may lead to the loss of a water supply source or o reduction in a source's usefulness because of a need to blend supplies to meet water quality standards.

The amount of water at risk because of these concerns cannot be quantified with current knowledge. To reduce the likelihood of such shortfalls, the IRP Update instituted a planning buffer of up to ten percent of regional demands. This buffer calls for the identification of an additional 500 taf of contingency supplies above that needed to meet demands in 2025. The buffer supplies would include an equal proportion of local and imported supplies. Projects identified as buffer supplies may not be implemented or may only be partially implemented, depending on future conditions and future Board actions. However, identifying these supplies will allow a more speedy response to events that might otherwise compromise regional reliability.

Climate Change

Another potential risk to future water supply reliability is posed by climate change. In recent years, as the science of climate change has become more broadly accepted and potential widespread implications to water resources have been identified, the issue has come to the forefront. As a major steward of the region's water supply resources, Metropolitan is committed to performing its due diligence with respect to climate change.

Current scientific research suggests that increasing concentrations of atmospheric greenhouse gases are producing global-scale temperature and precipitation changes. Global climate models predict that by the end of the century, average winter temperatures could increase by more than 7° Fahrenheit, and summer temperatures by as much as 18° Fahrenheit. The results of precipitation studies have been less definitive and vary widely between models and scenarios, predictions range from slight increases in precipitation to decreases of up to 30 percent.

Potential Impacts
While uncertainties remain regarding the exact timing, magnitude, and regional impacts of these temperature and precipitation changes, researchers have identified several areas of concern for California water planners. These include:

- Reduction in Sierra Nevada snowpack
- Increased intensity and frequency of extreme weather events, and
- Rising sea levels resulting in
  - increased risk of damage from storms, high-tide events, and the erosion of levees, and
  - potential pumping cutbacks on the State Water Project (SWP) and Central Valley Project (CVP).

Other important issues of concern due to global climate change include:

- Effects on local supplies such as groundwater
- Changes in urban and agricultural demand levels and patterns
- Impacts to human health from water-borne pathogens and water quality degradation
- Declines in ecosystem health and function
- Alterations to power generation and pumping regimes

Metropolitan's Activities

An extended Colorado River drought put climate change on Metropolitan's radar screen in the mid-1990s. In 2000, Metropolitan's Board received a briefing on the potential impacts of climate change on water supply by leading experts in the field. Metropolitan then hosted a California Water Plan meeting on climate change and held a Drought Preparedness Workshop on similar issues. In March 2002, the Board adopted policy principles on global climate change as related to water resource planning. The Principles stated in part that 'Metropolitan supports further research into the potential water resource and quality effects of global climate change, and supports flexible, "no regret" solutions that provide water supply and quality benefits while increasing the ability to manage future climate change impacts.'

In support of the policy principles, Metropolitan has participated in or attended numerous regional, state and national climate change studies and workshops. These workshops include those held by Universities, state agencies such as the California Energy Commission (CEC) and DWR, and national workshops such as those held by the American Water Works Association Research Foundation (AWWARF) and the National Center for Atmospheric Research. Most recently, Metropolitan helped sponsor and participated in a large international conference held in Orange County by GEWEX (the Global Energy and Water Experiment). Metropolitan's Chairman of the Board gave the Keynote address, discussing climate change information specifically relevant to water agencies.

Metropolitan's Integrated Resources Planning was recently featured as a regional utility case study for adapting to climate change. The case study, in AWWARF's *Climate Change and Water Resources: A Primer for Municipal Water Providers*, highlights several examples of how Metropolitan, in conjunction with its member agencies, is expanding its supply portfolio to maintain reliability and flexibility. This portfolio includes conservation and recycling, groundwater conjunctive use, transfer programs, and storage and conveyance facilities such as Diamond Valley Lake and the nearly completed Inland Feeder.

Looking Ahead

As the water industry begins to address the potential impacts of climate change, several challenges and uncertainties require additional work. Among these challenges is the need to gain understanding of the impact of climate change on precipitation. While many climate models show precipitation decreasing in response to climate change, others show precipitation increasing. This discrepancy has major implications in terms of water supply impacts. Another challenge is translating the global climate impacts to regional impacts, a process called "downscaling." More research is needed to generate reliable watershed-level climate and hydrological information that will be useful to water agencies. A major challenge for Metropolitan in assessing potential impacts is that our region's water supplies are derived from four geographically unique watersheds, managed by numerous federal, state and regional agencies.

Appendix E

Net Positive Suction Head Available at Pumping Plant P-1

Table 1 Net Positive Suction Head Available (NPSHA) Calculation

	24" Pipe Section		36" Pipe Section		39" Pipe Section		36.5" Pipe Section		Total Friction Headloss (ft)	Minor Loss (Assuming 15% of the Friction Loss) (ft)	Total Loss (ft)	Total Suction Head(2) (ft)
	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5	Hazen Williams Coeff. C	132.5				
	Pipe Length (ft)	14	Pipe Length (mi)	239.55	Pipe Length (mi)	6475.7	Pipe Length (mi)	35.88				
	Total Length (ft)	14	Total Length (ft)	239.55	Total Length (ft)	6475.7	Total Length (ft)	35.88				
Assumed	D (inch)	24	D (inch)	36	D (inch)	39	D (inch)	36.5				
Q (cfs)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)	V (ft/s)	hf (ft)(1)				
20	6.37	0.07	2.83	0.16	2.41	2.99	2.75	0.02	3.25	0.49	3.7	59.2
25	7.96	0.10	3.54	0.25	3.01	4.52	3.44	0.03	4.91	0.74	5.6	57.3
30	9.55	0.15	4.24	0.35	3.62	6.34	4.13	0.05	6.88	1.03	7.9	55.0
35	11.14	0.19	4.95	0.46	4.22	8.43	4.82	0.06	9.15	1.37	10.5	52.4
40	12.73	0.25	5.66	0.59	4.82	10.79	5.50	0.08	11.71	1.76	13.5	49.4
45	14.32	0.31	6.37	0.73	5.42	13.42	6.19	0.10	14.56	2.18	16.7	46.2
50	15.92	0.37	7.07	0.89	6.03	16.31	6.88	0.12	17.70	2.65	20.3	42.6

Static suction head

29.5

Atmospheric Head

34 ft

Vapor Head

0.59 ft

(1) Hazen-Williams Head Loss hf =(3.022) (v ^1.85) L / (C^1.85 D ^1.165), where v = velocity (ft/s), L = total length (ft),C = Hazen-Williams Coefficient, and D = pipe diameter (ft),

(2) Static suction head =29.5 ft, atmospheric head=34 ft, and vapor head=0.59 ft

Appendix F

Cost Estimates for Second MWD Connection and Supporting Facilities

CAPITAL COSTS AND ECONOMIC EVALUATION FOR AN ADDITIONAL 24-INCH MWD CONNECTION TO WESTSIDE

Item	Quantity	Units	Unit Cost	Total
Administrative requirements				
Project manager	50	wk	1,000	50,000
Field engineer	32	wk	1,300	41,600
Field office	8	m	5,000	40,000
Mobilization/demobilization	1	ls	100,000	100,000
MWD Connection	1	ls	750,000	750,000
Pump Station				
Pumps	1,700	hp	2,000	3,400,000
Land	1	ls	100,000	100,000
Site work	1	ls	50,000	50,000
Pipeline from MWD				
24" Steel	27,000	ft	240	6,480,000
Channel crossing	2	ea	50,000	100,000
Appurtenances (10% of pipeline cost)	10%			648,000
Subtotal				11,759,600
Contingency	25%			2,939,900
Construction Total				14,699,500
Construction management	8%			1,176,000
Project administration during construction	5%			735,000
Construction Total				16,610,500

CAPITAL COSTS AND ECONOMIC EVALUATION FOR A NEW RESERVOIR

Item	Quantity	Units	Unit Cost	Total
Administrative requirements				
Project manager	12	wk	1,000	12,000
Field engineer	12	wk	1,300	15,600
Mobilization/demobilization	1	ls	25,000	25,000
Reservoir				
Tank	1,000,000	gal	1	1,000,000
Land	1	ls	100,000	100,000
Site work	1	ls	50,000	50,000
Pipeline between reservoir sites				
18" Steel	1,200	ft	180	216,000
Appurtenances (10% of pipeline cost)	10%			21,600
Channel Crossing	1	ls	25,000	25,000
Subtotal				1,465,200
Contingency	25%			366,300
Construction Total				1,831,500
Construction management	8%			146,500
Project administration during construction	5%			91,600
Construction Total				2,069,600

CAPITAL COSTS AND ECONOMIC EVALUATION FOR LOOPING 18-INCH CONNECTION TO LCID

Item	Quantity	Units	Unit Cost	Total
Administrative requirements				
Project manager	20	wk	1,000	20,000
Field engineer	16	wk	1,300	20,800
Field office	4	m	5,000	20,000
Mobilization/demobilization	1	ls	100,000	100,000
Pipeline from Reservoir				
18" Steel	3,200	ft	180	576,000
Appurtenances (10% of pipeline cost)	10%			57,600
Subtotal				794,400
Contingency	25%			198,600
Construction Total				993,000
Construction management	8%			79,400
Project administration during construction	5%			49,700
Construction Total				1,122,100

Appendix G

Inventory of FMWD Facilities and Survivor Curves Analysis of Remaining Service Lives

											Less Than 10 Years RL	
Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type		RCN	Straight Line Remaining Life	ISC Remaining Life
Operations Center												
Structure			1997	8.5	40	31.5	31.8	R3	$186,426	$250,828	$0	$0
Main Pumping Plant												
Structure			1958	47.5	40	0	10.1	S1	$35,019	$310,969	$310,969	$0
Pump Unit 1-E			1978	27.5	**25**	0	7.0	S1	$25,604	$81,481	$81,481	$81,481
Pump Unit 2-E			1978	27.5	**25**	0	7.0	S1	$21,973	$69,925	$69,925	$69,925
Pump Unit 3-E			1981	24.5	25	0.5	8.2	S1	$30,411	$75,841	$75,841	$75,841
Pump Unit 4-E			1979	26.5	25	0	7.4	S1	$31,782	$94,726	$94,726	$94,726
Pump Unit 1-W			1993	12.5	25	12.5	14.5	S1	$35,951	$59,528	$0	$0
Pump Unit 2-W			1978	27.5	25	0	7.0	S1	$32,854	$104,553	$104,553	$104,553
Pump Unit 3-W			1979	26.5	25	0	7.4	S1	$29,526	$88,002	$88,002	$88,002
Pump Unit 4-W			1992	13.5	25	11.5	13.9	S1	$26,367	$44,382	$0	$0
Flow Meter	24 in		1998	7.5	**30**	22.5	22.8	R3	$3,048	$3,203	$0	$0
Flow Meter	30 in		1998	7.5	**30**	22.5	22.8	R3	$3,905	$4,103	$0	$0
By-pass Meter	16 in		1991	14.5	**30**	15.5	16.6	R3	$1,794	$2,381	$0	$0
Berkshire Pumping Plant												
Structure			1958	47.5	40	0	10.1	S1	$15,548	$138,065	$138,065	$0
Pump Unit 1-B			1992	13.5	25	11.5	13.9	S1	$29,063	$48,918	$0	$0
Pump Unit 2-B			1994	11.5	25	13.5	15.2	S1	$26,959	$39,219	$0	$0
Pump Unit 3-B			1993	12.5	25	12.5	14.5	S1	$22,199	$36,758	$0	$0
Pump Unit 4-B			1978	27.5	25	0	7.0	S1	$29,768	$94,731	$94,731	$94,731
Gate Valve	24 in		1999	6.5	**25**	18.5	18.9	S1	$2,732	$3,583	$0	$0
Meter	24 in		1999	6.5	**30**	23.5	23.8	R3	$8,633	$9,071	$0	$0
Pump House			2005	0.5	**40**	39.5	39.5	S1	$25,345	$25,692	$0	$0
Electrical			2005	0.5	**25**	24.5	18.9	S1	$52,838	$53,450	$0	$0
Reservoirs - La Canada East												
Reservoir			1953	52.5	**60**	7.5	20.4	R2	$74,739	$789,427	$789,427	$0
Reservoirs - La Canada West												
Reservoir			1986	19.5	60	40.5	43.2	R2	$705,166	$1,295,359	$0	$0
Reservoirs - La Crescenta												
Reservoir			1953	52.5	**60**	7.5	20.4	R2	$132,869	$1,403,427	$1,403,427	$0
Reservoirs - Altadena North												
Reservoir			1953	52.5	**60**	7.5	20.4	R2	$96,295	$1,017,111	$1,017,111	$0
Rehab			1993	12.5	**60**	47.5	49.0	R2	$183,129	$243,691	$0	$0
Reservoirs - Altadena South												
Reservoir			1991	14.5	60	45.5	47.3	R2	$658,505	$959,373	$0	$0

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type	RCN		Straight Line Remaining Life	ISC Remaining Life
Distribution Mains - Main-Arroyo												
Pipe	36 in	242 ft	1955	50.5	60	9.5	21.6	R2	$5,208	$52,657	$52,657	$0
Manhole		1 ea	1955	50.5	60	9.5	21.6	R2	$850	$8,594	$8,594	$0
Valve - Butterfly	8 in	1 ea	2000	5.5	25	19.5	19.8	S1	$1,130	$15,580	$0	$0
Valve - Butterfly	6 in	1 ea	2000	5.5	25	19.5	19.8	S1	$1,250	$17,235	$0	$0
Valve - Check	6 in	1 ea	2000	5.5	25	19.5	19.8	S1	$1,300	$17,924	$0	$0
Meter		1 ea	1982	23.5	**30**	6.5	9.8	R3	$28,558	$46,184	$46,184	$46,184
Pipe	39 in	1,146 ft	1955	50.5	60	9.5	21.6	R2	$24,672	$249,457	$249,457	$0
Pipe	39 in	1,200 ft	1955	50.5	60	9.5	21.6	R2	$25,824	$261,109	$261,109	$0
Pipe	39 in	1,200 ft	1955	50.5	60	9.5	21.6	R2	$25,824	$261,109	$261,109	$0
Pipe	39 in	1,200 ft	1955	50.5	60	9.5	21.6	R2	$25,824	$261,109	$261,109	$0
Pipe	39 in	1,200 ft	1955	50.5	60	9.5	21.6	R2	$25,925	$262,131	$262,131	$0
Pipe	39 in	571 ft	1955	50.5	60	9.5	21.6	R2	$12,287	$124,231	$124,231	$0
Valve - Butterfly	4 in	1 ea	2000	5.5	25	19.5	19.8	S1	$1,200	$16,545	$0	$0
Valve - Butterfly	36 in	1 ea	2000	5.5	25	19.5	19.8	S1	$808	$11,141	$0	$0
Valve - Butterfly		1 ea	2000	5.5	25	19.5	19.8	S1	$10,950	$150,982	$0	$0
Valve - Blowoff	4 in	1 ea	2000	5.5	25	19.5	19.8	S1	$1,300	$17,924	$0	$0
Valve - AV	4 in	1 ea	2000	5.5	25	19.5	19.8	S1	$300	$4,136	$0	$0
Pipe, Suction	36 in	90 ft	2000	5.5	60	54.5	55.1	R2	$2,350	$32,402	$0	$0
Distribution Mains - Westside												
Pipe	36 in	867 ft	1955	50.5	60	9.5	21.6	R2	$16,191	$163,705	$163,705	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
AV Structure	3 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,033	$3,033	$3,033
Pipe	30 in	1,329 ft	1955	50.5	60	9.5	21.6	R2	$24,803	$250,787	$250,787	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Valve - Gate	4 in	1 ea	1990	15.5	25	9.5	12.7	S1	$680	$1,057	$1,057	$0
Valve - AV	3 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Valve - Blowoff	8 in	1 ea	1990	15.5	25	9.5	12.7	S1	$1,173	$1,821	$1,821	$0
Pipe	30 in	337 ft	1988	17.5	60	42.5	44.8	R2	$14,535	$23,790	$0	$0
Manhole		1 ea	1978	27.5	60	32.5	36.9	R2	$1,500	$4,213	$0	$0
Pipe	30 in	999 ft	1955	50.5	60	9.5	21.6	R2	$18,646	$188,529	$188,529	$0
Valve - Butterfly	30 in	1 ea	1985	20.5	25	4.5	10.0	S1	$17,213	$29,779	$29,779	$29,779
Valve - AV	4 in	1 ea	1991	14.5	25	10.5	13.3	S1	$853	$1,298	$0	$0
Pipe	30 in	1,459 ft	1972	33.5	60	26.5	32.6	R2	$87,041	$412,537	$0	$0
Valve - Gate	4 in	1 ea	1972	33.5	25	0	4.9	S1	$450	$2,133	$2,133	$2,133
Valve - AV	0.75 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Structure		1 ea	1997	8.5	26	17.5	18.7	R2	$2,387	$318	$0	$0
Blowoff Structure	6 in	1 ea	1972	33.5	25	0	3.7	R2	$1,000	$458	$458	$458
Pipe	30 in	1,433 ft	1955	50.5	60	9.5	21.6	R2	$26,747	$270,438	$270,438	$0
Valve - Plug	30 in	1 ea	1955	50.5	25	0	0.0	S1	$2,500	$25,278	$25,278	$25,278
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$300	$3,033	$3,033	$3,033

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type		RCN	Straight Line Remaining Life	ISC Remaining Life
Valve - Plug	4 in	1 ea	1955	50.5	25	0	0.0	S1	$100	$1,011	$1,011	$1,011
Valve - AV	4 in	1 ea	1991	14.5	25	10.5	13.3	S1	$853	$1,298	$0	$0
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$300	$3,033	$3,033	$3,033
Valve - AV	4 in	1 ea	1991	14.5	25	10.5	13.3	S1	$853	$1,298	$0	$0
Pipe	30 in	1,300 ft	1955	50.5	60	9.5	21.6	R2	$24,271	$245,407	$245,407	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	30 in	1,300 ft	1955	50.5	60	9.5	21.6	R2	$24,271	$245,407	$245,407	$0
Pipe	30 in	246 ft	1955	50.5	60	9.5	21.6	R2	$4,583	$46,344	$46,344	$0
Pipe	24 in	699 ft	1955	50.5	60	9.5	21.6	R2	$10,611	$107,287	$107,287	$0
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
AV Structure	3 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	214 ft	1955	50.5	60	9.5	21.6	R2	$3,006	$30,390	$30,390	$0
Valve - Butterfly	24 in	1 ea	1955	50.5	25	0	0.0	S1	$11,564	$116,924	$116,924	$116,924
Pipe	24 in	ft	1955	50.5	60	9.5	21.6	R2	$7,581	$76,651	$76,651	$0
Pipe	24 in	ft	1955	50.5	60	9.5	21.6	R2	$15,529	$157,017	$157,017	$0
Pipe	24 in	ft	1955	50.5	60	9.5	21.6	R2	$15,393	$155,635	$155,635	$0
Valve - Butterfly	4 in	1 ea	1981	24.5	25	0.5	8.2	S1	$393	$748	$748	$748
AV Structure	4 in	1 ea	1976	29.5	25	0	5.0	R2	$525	$1,665	$1,665	$1,665
Vault Structure		1 ea	1981	24.5	40	15.5	20.2	R2	$628	$1,273	$0	$0
Pipe	30 in	ft	1953	52.5	60	7.5	20.4	R2	$8,553	$97,287	$97,287	$0
Pipe	24 in	ft	1955	50.5	60	9.5	21.6	R2	$7,666	$77,511	$77,511	$0
Valve - Gate	8 in	1 ea	1988	17.5	25	7.5	11.6	S1	$2,235	$3,658	$3,658	$0
Distribution Mains - La Crescenta												
Pipe	24 in	1,077 ft	1955	50.5	60	9.5	21.6	R2	$18,848	$190,569	$190,569	$0
Pipe	24 in	1,300 ft	1955	50.5	60	9.5	21.6	R2	$22,750	$230,028	$230,028	$0
Pipe	24 in	700 ft	1955	50.5	60	9.5	21.6	R2	$12,250	$123,861	$123,861	$0
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Valve - AV	3 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Pipe	24 in	1,270 ft	1955	50.5	60	9.5	21.6	R2	$22,225	$224,719	$224,719	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	1,530 ft	1955	50.5	60	9.5	21.6	R2	$26,775	$270,725	$270,725	$0
Pipe	24 in	900 ft	1955	50.5	60	9.5	21.6	R2	$15,750	$159,250	$159,250	$0
Valve - Plug	24 in	1 ea	1955	50.5	25	0	0.0	S1	$1,970	$19,919	$19,919	$19,919
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Valve - AV	3 in	1 ea	1972	33.5	25	0	4.9	S1	$400	$1,896	$1,896	$1,896
Pipe	24 in	1,200 ft	1955	50.5	60	9.5	21.6	R2	$21,000	$212,333	$212,333	$0
Pipe	24 in	914 ft	1988	17.5	60	42.5	44.8	R2	$21,075	$34,494	$0	$0
Pipe	24 in	670 ft	1971	34.5	60	25.5	31.9	R2	$40,826	$201,911	$0	$0
Valve - Butterfly	24 in	1 ea	1970	35.5	25	0	4.2	S1	$2,033	$10,753	$10,753	$10,753
Pipe	24 in	319 ft	1955	50.5	60	9.5	21.6	R2	$5,477	$55,381	$55,381	$0
Pipe	24 in	1,700 ft	1998	7.5	60	52.5	53.3	R2	$54,403	$74,335	$0	$0
Valve - Gate	8 in	1 ea	1998	7.5	25	17.5	18.1	S1	$5,212	$7,121	$0	$0
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type	RCN		Straight Line Remaining Life	ISC Remaining Life
Valve - AV	3 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$250	$2,528	$2,528	$2,528
AR Structure	0.75 in	1 ea	1955	50.5	25	0	0.0	R2	$200	$2,114	$2,114	$2,114
Enclosure		1 ea	1997	8.5	26	17.5	18.7	R2	$1,034	$1,391	$0	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	535 ft	1955	50.5	60	9.5	21.6	R2	$9,186	$92,880	$92,880	$0
Pipe	24 in	1,865 ft	1955	50.5	60	9.5	21.6	R2	$32,022	$323,779	$323,779	$0
Valve - Plug	24 in	1 ea	1955	50.5	25	0	0.0	S1	$1,465	$14,808	$14,808	$14,808
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
AV Structure	3 in	1 ea	1972	33.5	25	0	3.7	R2	$400	$2,166	$2,166	$2,166
Valve - Gate	8 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Valve - AV	4 in	1 ea	1981	24.5	25	0.5	8.2	S1	$792	$1,509	$1,509	$1,509
Structure		1 ea	1964	41.5	60	18.5	27.1	R2	$13,315	$101,927	$0	$0
Pipe	24 in	1,250 ft	1955	50.5	60	9.5	21.6	R2	$21,463	$217,010	$217,010	$0
AR Structure		1 ea	1955	50.5	25	0	0.0	R2	$275	$2,907	$2,907	$2,907
Pipe	24 in	1,150 ft	1955	50.5	60	9.5	21.6	R2	$19,746	$199,649	$199,649	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	1,000 ft	1955	50.5	60	9.5	21.6	R2	$17,170	$173,608	$173,608	$0
Valve - AR	0.75 in	1 ea	1955	50.5	25	0	0.0	S1	$200	$2,022	$2,022	$2,022
Pipe	24 in	1,084 ft	1955	50.5	60	9.5	21.6	R2	$18,612	$188,191	$188,191	$0
Distribution Mains - Altadena												
Pipe	24 in	1,077 ft	1955	50.5	60	9.5	21.6	R2	$15,135	$153,030	$153,030	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	1,229 ft	1955	50.5	60	9.5	21.6	R2	$17,292	$174,842	$174,842	$0
Pipe	24 in	1,200 ft	1972	33.5	60	26.5	32.6	R2	$87,132	$412,970	$0	$0
Valve - Gate	6 in	1 ea	1972	33.5	25	0	4.9	S1	$600	$2,844	$2,844	$2,844
Valve - AV	3 in	1 ea	1976	29.5	25	0	6.3	S1	$450	$1,365	$1,365	$1,365
Valve - AR	1 in	1 ea	1972	33.5	25	0	4.9	S1	$375	$1,777	$1,777	$1,777
Valve - Butterfly	24 in	1 ea	1972	33.5	25	0	4.9	S1	$2,033	$9,633	$9,633	$9,633
Pipe	24 in	369 ft	1955	50.5	60	9.5	21.6	R2	$5,192	$52,495	$52,495	$0
Valve - Butterfly	4 in	1 ea	1998	7.5	25	17.5	18.1	S1	$1,849	$2,526	$0	$0
AR Structure	0.75 in	1 ea	1998	7.5	25	17.5	18.5	R2	$176	$232	$0	$0
AV Structure		1 ea	1997	8.5	26	17.5	17.7	R2	$1,034	$1,391	$0	$0
Pipe	24 in	1,250 ft	1955	50.5	60	9.5	21.6	R2	$17,588	$177,829	$177,829	$0
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Valve - AV	3 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Pipe	24 in	1,250 ft	1955	50.5	60	9.5	21.6	R2	$17,588	$177,829	$177,829	$0
Valve - Plug	24 in	1 ea	1955	50.5	25	0	0.0	S1	$1,465	$14,808	$14,808	$14,808
Blowoff Structure	6 in	1 ea	1955	50.5	25	0	0.0	R2	$300	$3,171	$3,171	$3,171
Pipe	24 in	1,250 ft	1955	50.5	60	9.5	21.6	R2	$17,588	$177,829	$177,829	$0
Pipe	24 in	1,250 ft	1955	50.5	60	9.5	21.6	R2	$17,588	$177,829	$177,829	$0

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type	RCN		Straight Line Remaining Life	ISC Remaining Life
Pipe	24 in	1,300 ft	1955	50.5	60	9.5	21.6	R2	$18,291	$184,942	$184,942	$0
Pipe	24 in	674 ft	1955	50.5	60	9.5	21.6	R2	$9,483	$95,885	$95,885	$0
Valve - Gate	4 in	1 ea	1955	50.5	25	0	0.0	S1	$350	$3,539	$3,539	$3,539
Vavle - AV	3 in	1 ea	1991	14.5	25	10.5	13.3	S1	$682	$1,037	$0	$0
Pipe	24 in	941 ft	1955	50.5	60	9.5	21.6	R2	$13,233	$133,799	$133,799	$0
Connections - La Canada												
Valve - Plug	12 in	1 ea	1955	50.5	25	0	0.0	S1	$396	$4,008	$4,008	$4,008
Pipe	12 in	750 ft	1955	50.5	**60**	9.5	21.6	R2	$4,500	$45,500	$45,500	$0
Meter	in	1 ea	1998	7.5	**30**	22.5	10.4	R3	$2,815	$2,958	$0	$0
Vault		1 ea	1955	50.5	40	0	4.3	R2	$400	$4,229	$4,229	$4,229
Vault		1 ea	1955	50.5	40	0	4.3	R2	$1,500	$15,857	$15,857	$15,857
Meter		1 ea	1987	18.5	**30**	11.5	13.3	R3	$6,692	$10,111	$0	$0
Valve - Gate		1 ea	1988	17.5	25	7.5	11.6	S1	$3,762	$6,293	$6,293	$0
Connections - Lincoln Ave												
Valve	16 in	1 ea	1978	27.5	40	12.5	18.8	S1	$2,199	$5,622	$0	$0
Pipe	16 in	600 ft	1978	27.5	**60**	32.5	36.9	R2	$22,200	$56,747	$0	$0
Vault		1 ea	1978	27.5	40	12.5	17.5	R2	$1,299	$3,583	$0	$0
Valve	16 in	1 ea	1978	27.5	25	0	7.0	S1	$2,199	$5,622	$5,622	$5,622
Valve - Control	16 in	1 ea	1995	10.5	25	14.5	15.9	S1	$15,697	$22,601	$0	$0
Meter		1 ea	2001	4.5	**30**	25.5	25.6	R3	$7,354	$7,390	$0	$0
Connections - Los Flores												
Valve - Plug	12 in	1 ea	1955	50.5	25	0	0.0	S1	$396	$4,008	$4,008	$4,008
Pipe	12 in	480 ft	1955	50.5	**60**	9.5	21.6	R2	$2,717	$27,473	$27,473	$0
Meter	10 in	1 ea	2001	4.5	**30**	25.5	25.6	R3	$2,532	$2,544	$0	$0
Vault		1 ea	1981	24.5	40	15.5	20.2	R2	$1,994	$4,042	$0	$0
Valve	8 in	1 ea	1974	31.5	25	0	5.6	S1	$675	$2,624	$2,624	$2,624
Valve	8 in	1 ea	1974	31.5	25	0	5.6	S1	$1,871	$7,275	$7,275	$7,275
Valve - Flow Control		1 ea	1996	9.5	25	15.5	16.6	S1	$14,701	$20,644	$0	$0
Connections - Rubio Canon												
Valve	16 in	1 ea	1980	25.5	25	0	7.8	S1	$1,252	$2,638	$2,638	$2,638
Pipe			1980	25.5	**60**	34.5	38.5	R2	$783	$1,648	$0	$0
Pipe	16 in	358 ft	1955	50.5	**60**	9.5	21.6	R2	$2,674	$27,037	$27,037	$0
Valve	10 in	1 ea	1982	23.5	25	1.5	8.7	S1	$1,546	$2,665	$2,665	$2,665
Vault			1981	24.5	40	15.5	20.2	R2	$1,586	$3,214	$0	$0
Meter	10 in	1 ea	2002	3.5	**30**	26.5	26.6	R3	$2,708	$2,708	$0	$0
Valve	10 in	1 ea	1977	28.5	25	0	6.6	S1	$2,206	$6,197	$6,197	$6,197
Vault		1 ea	1977	28.5	40	11.5	17.5	R2	$2,315	$6,898	$0	$0
Meter	8	1 ea	1981	24.5	**30**	5.5	9.1	R3	$1,056	$1,722	$1,722	$1,722
Meter	6	1 ea	1997	8.5	**30**	21.5	20.9	R3	$1,566	$1,645	$0	$0

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type		RCN	Straight Line Remaining Life	ISC Remaining Life
Connections - Valley Water												
Valve - Gate	6 in	1 ea	1981	24.5	25	0.5	8.2	S1	$603	$1,148	$1,148	$1,148
Meter	4 in	1 ea	1989	16.5	**30**	13.5	14.9	R3	$1,645	$2,523	$0	$0
Regulator	4 in	1 ea	1955	50.5	**30**	0	0.0	S1	$275	$2,781	$2,781	$2,781
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$220	$2,224	$2,224	$2,224
Meter	4 in	1 ea	1989	16.5	**30**	13.5	14.9	R3	$1,513	$2,319	$0	$0
Regulator	4 in	1 ea	1955	50.5	**30**	0	0.0	S1	$275	$2,781	$2,781	$2,781
Vault		1 ea	1955	50.5	**40**	0	4.3	R2	$188	$1,987	$1,987	$1,987
Valve - Control		1 ea	2003	2.5	25	22.5	22.5	S1	$1,762	$2,167	$0	$0
Valve - Gate	6 in	1 ea	1955	50.5	25	0	0.0	S1	$220	$2,224	$2,224	$2,224
Meter	4 in	1 ea	1989	16.5	**30**	13.5	14.9	R3	$1,162	$1,781	$0	$0
Regulator	4 in	1 ea	1955	50.5	**30**	0	0.0	S1	$246	$2,487	$2,487	$2,487
Vault		1 ea	1955	50.5	25	0	0.0	R2	$1,725	$18,239	$18,239	$18,239
Valve	16 in	1 ea	1981	24.5	25	0.5	8.2	S1	$1,200	$2,285	$2,285	$2,285
Vault		1 ea	1955	50.5	40	0	4.3	R2	$1,017	$10,751	$10,751	$10,751
Pipe	16 in	ft	1955	50.5	**60**	9.5	21.6	R2	$8,207	$82,979	$82,979	$0
Vault		1 ea	1984	21.5	40	18.5	22.3	R2	$2,091	$3,852	$0	$0
Valve	16 in	1 ea	1955	50.5	25	0	0.0	S1	$1,389	$14,044	$14,044	$14,044
Valve - Butterfly	16 in	1 ea	1993	12.5	25	12.5	14.5	S1	$4,632	$6,820	$0	$0
Valve - Rexa		1 ea	1993	12.5	25	12.5	14.5	S1	$11,448	$16,857	$0	$0
Vault		1 ea	1955	50.5	40	0	4.3	R2	$1,236	$13,066	$13,066	$13,066
Meter	10 in	1 ea	1993	12.5	**30**	17.5	18.3	R3	$4,697	$4,837	$0	$0
Meter	10 in	1 ea	1993	12.5	**30**	17.5	18.3	R3	$4,920	$5,067	$0	$0
Meter	8 in	1 ea	1997	8.5	**30**	21.5	21.8	R3	$2,101	$2,208	$0	$0
Meter		1 ea	2002	3.5	**30**	26.5	26.6	R3	$7,627	$7,627	$0	$0
Connections - Crescenta Valley												
Valve - Gate	10 in	1 ea	1955	50.5	25	0	0.0	S1	$179	$1,807	$1,807	$1,807
Pipe	10 in	75 ft	1955	50.5	**60**	9.5	21.6	R2	$358	$3,617	$3,617	$0
Meter	10 in	1 ea	1990	15.5	**30**	14.5	15.7	R3	$7,227	$8,404	$0	$0
Valve - Butterfly	10 in	1 ea	1990	15.5	25	9.5	12.7	S1	$1,635	$2,538	$2,538	$0
Valve	12 in	1 ea	1955	50.5	25	0	0.0	S1	$220	$2,228	$2,228	$2,228
Pipe	12 in	115 ft	1955	50.5	60	9.5	21.6	R2	$652	$6,596	$6,596	$0
Meter		1 ea	2002	3.5	**30**	26.5	26.6	R3	$2,708	$2,708	$0	$0
Valve	16 in	1 ea	1955	50.5	25	0	0.0	R2	$436	$4,407	$4,407	$4,407
Meter	6 in	1 ea	1999	6.5	**30**	23.5	23.7	R3	$1,306	$1,373	$0	$0
Meter	8 in	1 ea	1999	6.5	**30**	23.5	23.7	R3	$1,657	$1,741	$0	$0
Connections - Mesa Crest												
Valve	12 in	1 ea	1955	50.5	25	0	0.0	S1	$396	$4,008	$4,008	$4,008
Meter		1 ea	1988	17.5	**30**	12.5	14.1	R3	$3,662	$3,680	$0	$0
Meter		1 ea	2001	4.5	**30**	25.5	25.6	R3	$2,542	$2,554	$0	$0
Interconnections - Pasadena												

Description	Dimensions	Quantity	Year Installed	Age	Life Expactancy	Remaining Life - Straight Line	Remaining Life - ISC	ISC - Type		RCN	Straight Line Remaining Life	ISC Remaining Life
Structures		1 ea	1987	18.5	25	6.5	10.5	R2	$72,029	$124,440	$124,440	$0
Vaults		1 ea	1990	15.5	25	9.5	12.5	R2	$1,013	$1,630	$1,630	$0
Valve - Control		1 ea	1992	13.5	25	11.5	13.9	S1	$58,555	$89,106	$0	$0
Structures		1 ea	1989	16.5	25	8.5	11.8	R2	$18,804	$31,153	$31,153	$0
Valves - Control		1 ea	1992	13.5	25	11.5	13.9	S1	$13,476	$20,508	$0	$0
Interconnections - LCID												
Pipe			1987	18.5	60	41.5	44.0	R2	$5,528	$9,248	$0	$0
Valve - Butterfly		1 ea	1987	18.5	25	6.5	11.0	S1	$309	$516	$516	$0
Valve - Butterfly		1 ea	1987	18.5	25	6.5	11.0	S1	$309	$516	$516	$0
Valve - Butterfly		1 ea	1987	18.5	25	6.5	11.0	S1	$309	$516	$516	$0
										$17,933,124	$12,931,430	$1,144,004

Stormwater Calculation[1]

1. Football Field (Including Endzones)	57,600
2. Add Soccer Field	20,000
3. Track (Assuming 20ft. wide by 1mi. length)	105,600
4. Add Softball Field	40,000
5. Add Baseball Field	95,000
6. Total Area (Feet)	318,200
7. Gal/ft^2 for Every Inch of Rainfall	0.6230
8. For One Inch Rainfall, Gallons for Total Area	198,238.60
9. Los Angeles Civic Center Average Annual Precipitation (Inches)	14.41
10. Mt. Wilson Average Annual Precipitation (Inches)	34.58
11. Mid-way Between Rainfall	24.50
12. Total Estimated Gallons of Captured Rainfall	**4,855,855**
13. Total Estimated Acre-Feet of Captured Rainfall	**14.90**

Urban Runoff Calculation[1]

1. Football Field (Including Endzones)	57,600
2. Add Soccer Field	20,000
3. Track (Assuming 20ft. wide by 1 mi. length)	105,600
4. Add Softball Field	40,000
5. Add Baseball Field	95,000
6. Total Area (Feet)	318,200
7. Gallons per 1000ft/year for Natural Turf	9,546,000
8. Total Estimated Gallons of Dry Weather Runoff	**7,546,000**
9. Total Estimated Acre-Feet of Dry Weather Runoff	**23.16**

[1] Tables are provided from Foothill Municipal Water District, Update to Incorporate a Watershed Approach

Instructions

http://www.ehow.com/how_2311291_calculate-rainfall-harvesting.html

1. How to Calculate Rainfall for Harvesting

1

The first thing to do is to figure the area of the structure. Begin by using the measuring tape, and measure your roof from one eave to the next. You can do this on the ground because it doesn't matter whether your roof is flat or sloped. So let's say the measurement is 30 feet X 50

2

You now have the measurements necessary to find the square footage of your roof.Multiply 30 feet times 50 feet. That's 1,500 square feet. And that is your catchment area. Write that down.

3

Now, check the rain gauge. For simplicity, let's say that it rained one inch. Write down the

4

An inch of rainfall on a square foot of surface area yields .623 gallons.

5

Now, multiply .623 gallons by the number of surface square feet. In this case it would be 30 feet X 50 feet= 1,500 square feet X 1 inch X .623 gallons per square foot per inch of rainfall.

6

Let's say instead it rained 2.5 inches. Then the calculation would read 30 feet X 50 feet=1,500 square feet X 2.5 inches X .623 gallons per square foot per inch of rainfall.The total number of

Read more: How to Calculate Rainfall for Harvesting | eHow.com
http://www.ehow.com/how_2311291_calculate-rainfall-harvesting.html#ixzz27bUO1JT9

http://www.fmlink.com/article.cgi?type=Sustainability&title=Natural%20Landscaping%20and%20Artificial%20Turf%3A%20Achieving%20Water%20Use%20and%20Pesticide%20Reduction&pub=BuildingGreen&id=40602&mod

How to calculate dry weather runoff

Irrigation on lawn is for every 1000 square feet, 10,000 gallons of water in summer. (Assume annual use is 30,000 gallons per 1000 square feet.)

Artificial turf on football field is a 2 million gallon annual savings

The State Water Project

Final Delivery Reliability Report

2011

June 2012

State of California
Natural Resources Agency
Department of Water Resources

State of California
Edmund G. Brown Jr., Governor

California Natural Resources Agency
John Laird, Secretary for Natural Resources

Department of Water Resources
Mark W. Cowin, Director

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Prepared by AECOM

Director's Message

The *State Water Project Delivery Reliability Report 2011* (2011 Report) is the latest update to a biannual report that describes the existing and future conditions for State Water Project (SWP) water supply that are expected if no significant improvements are made to convey water past the Sacramento–San Joaquin Delta (Delta) or to store the more variable runoff that is expected with climate change.

This report is presented in a different format than previous versions. The four previous reports were written for a dual audience—both the general public and those interested in a greater level of technical detail, such as the SWP contractors. By contrast, this report is written primarily with the public in mind. As a result, it not only provides updated information about the SWP's water delivery reliability, but is also designed to educate Californians about the SWP and its operations. This report presents a concise description of the historical events leading to the construction of the SWP and describes the SWP's facilities and operations. It then defines and explains the concept of water delivery reliability and the types of SWP water available to contractors, and describes various factors that affect the reliability of water deliveries. Because of the public interest in water project pumping from the Delta and the dependence of SWP water supply on Delta pumping, a new chapter has been added that focuses specifically on SWP pumping (exports) at the Harvey O. Banks Pumping Plant in the Delta.

The 2011 Report shows that the SWP continues to be subject to reductions in deliveries similar to those contained in the *State Water Project Delivery Reliability Report 2009* (2009 Report), caused by the operational restrictions of biological opinions (BOs) issued in December 2008 and June 2009 by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to govern SWP and Central Valley Project operations. Federal court decisions have remanded the BOs to USFWS and NMFS for further review and analysis. We expect that the current BOs will be replaced sometime in the future. The operational rules defined in the 2008 and 2009 BOs, however, continue to be legally required and are the rules used for the analyses supporting the 2011 Report.

The following "Summary" includes key findings of the analyses in the 2011 Report. A technical addendum is also available which provides detail on the assumptions of the analyses and the results for the 2011 Report. The results of the studies, as presented in this report and the technical addendum, are designed to assist water planners and managers in updating their water management and infrastructure development plans. These results emphasize the need for local agencies to develop a resilient and robust water supply, and a distribution and management system to maximize the efficient use of our variable supply. They also illustrate the urgent need to improve the method of conveying water past the Delta in a more sustainable manner that meets the dual goals of increasing water delivery reliability and improving conditions for endangered and threatened fish species.

Mark Cowin
Director
California Department of Water Resources
June 2012

Summary





This report is intended to inform the public about key factors important to the operation of the SWP and the reliability of its water deliveries.

California faces a future of increased population growth coupled with the potential for water shortages and pressures on the Delta. For many SWP water contractors, water provided by the SWP is a major component of all the water supplies available to them. SWP contractors include cities, counties, urban water agencies, and agricultural irrigation districts. These local utilities and other public and private entities provide the water that Californians use at home and work every day and that helps to nourish the state's bountiful crops. Thus, the availability of water to the SWP becomes a planning issue that ultimately affects the amount of water that local residents and communities can use.

The availability of these water supplies may be highly variable. A wet water year may be followed by a dry or even critical year. Knowing the probability that they will receive a certain amount of SWP water in a given year—whether it be a wet water year, a critical year, or somewhere in between—gives contractors a better sense of the degree to which they may need to implement increased conservation measures or plan for new facilities.

The Delta is the key to the SWP's ability to deliver water to its agricultural and urban contractors. All but three of the 29 SWP contractors receive water deliveries from the Delta (pumped by either the Harvey O. Banks or Barker Slough Pumping Plant).

Yet the Delta faces numerous challenges to its long-term sustainability. Among these are continued subsidence of Delta islands, many of which are already below sea level, and the related threat of a catastrophic levee failure as water pressure increases on fragile levees. Climate change poses the threat of increased variability in floods and droughts, and sea level rise complicates efforts to manage salinity levels and preserve water quality in the Delta so that the water remains suitable for urban and agricultural uses.

Protection of endangered and threatened fish species, such as the delta smelt, is also an important factor of concern for the

Delta. Ongoing regulatory restrictions, such as those imposed by federal biological opinions on the effects of SWP and CVP operations on these species, also contribute to the challenge of determining the SWP's water delivery reliability.

The analyses in this report factor in all of the regulations governing SWP operations in the Delta and upstream, and assumptions about water uses in the upstream watersheds.

Modeling was conducted that considered the amounts of water that SWP contractors use and the amounts of water they choose to hold for use in a subsequent year.

Many of the same specific challenges to SWP operations described in the *State Water Project Delivery Reliability Report 2009* (2009 Report) remain in 2011. Most notably, the effects on SWP pumping caused by issuance of the 2008 and 2009 federal biological opinions, which were reflected in the 2009 Report, continue to affect SWP delivery reliability today. The analyses in this report factor in climate change and the effects of sea level rise on water quality, but do not incorporate the probability of catastrophic levee failure. The resulting differences between the 2009 and 2011 Reports can be attributed primarily to updates in the modeling assumptions and inputs.

As noted in the discussion of SWP exports in Chapter 5 of this report, Delta exports (that is, SWP water of various types pumped by and transferred to contractors from the Banks Pumping Plant) have decreased since 2005, although the bulk of the change occurred by 2009 as the federal BOs went into effect, restricting operations. These effects are also reflected in the SWP delivery estimates provided in Chapters 6 and 7 of this report. Chapters 6 and 7 characterize the SWP's water delivery reliability under existing conditions and future conditions, respectively. The following are a few of the key points from Chapters 5, 6, and 7:

- Estimates of average annual SWP exports under conditions that exist for 2011 are 2,607 thousand acre-feet (taf), 350 taf or 12% less than the estimate under 2005 conditions.
- The estimated average annual SWP exports decrease from 2,607 taf/year to 2,521 taf/year (86 taf/year or about 3%) between the existing- and future-conditions scenarios.
- The estimates in this report for Table A water supply deliveries are not significantly different from those in the 2009 Report. The average annual delivery estimated for existing conditions (2,524 taf/year) is 2% greater, and the estimated amount for future conditions (2,466 taf/year) is 1% less than the corresponding estimates in the 2009 Report.
- The likelihood of SWP Article 21 deliveries (supplemental deliveries to Table A water) being equal to or less than 20 taf/year has increased relative to that estimated in the 2009 Report. However, both this report and the 2009 Report show a high likelihood that Article 21 water deliveries will be equal to or less than 20 taf/year, ranging between 71% and 78% for both existing and future conditions.

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Chapter 1

Water Delivery Reliability: A Concern for Californians

California's water supplies are crucial to maintaining a high quality of life for the state's residents. The State Water Project (SWP), operated by the California Department of Water Resources (DWR), is an integral part of the effort to ensure that business and industry, urban and suburban residents, and farmers throughout much of California have sufficient water at all times. This *State Water Project Delivery Reliability Report 2011* describes the expected existing and future SWP water deliveries.

The term "water delivery reliability," as used in this report, is defined as the annual amount of SWP water that can be expected to be delivered with a certain frequency. To put this another way: What is the likelihood, or probability, that a certain amount of water will be delivered by the SWP in a year?

Reasons to Assess SWP Water Delivery Reliability

Let's look at two important factors that underscore the importance of assessing the SWP's water delivery reliability: the effects of population growth on California's water supply, and State legislation intended to help maintain a reliable water supply.

Population Growth, Land Use, and Water Supply

Water and development have had a close yet complex relationship since California's early days. Indeed, the SWP was established in the wake of a second economic "gold rush" that began after the end of World War II. Increased statewide population and commerce made it clear to water managers that local water supplies (including groundwater) would not be sufficient to meet their communities' future needs.

Population growth and resulting development in California since World War II have been substantial, fueling the need for increased water supply.

California's population has grown rapidly in recent years, with resulting changes in land use. This growth is expected to continue. From 1990 to 2005, California's population increased from about 30 million to about 36.5 million. Based on this trend, California's population has been projected to be more than 47.5 million by 2020. The "current trends" scenario depicted in the *California Water Plan 2009* for year-2050 conditions assumed a population of nearly 60 million—double the 1990 population.

The amount of water available in California—or in different parts of the state—can vary greatly from year to year. Some areas may receive 2 inches of rain a year, while others are deluged with 100 inches or more. As land uses have changed, population centers have grown up in many locations where there is not a sufficient local water supply. Thus, Californians have always been faced with the problem of how best to conserve, control, and move water from areas of abundant water to areas of water need and use.

To help assure that their water supply is sufficient to meet their demands, water districts develop "water management portfolios" that reflect diversity in water sources and locations. Components of a sustainable water portfolio include conservation, improved efficiency in use, rainwater and runoff capture, use of groundwater aquifers for storage and treatment, improved water treatment, desalination, and a water recycling program.

Legislation on Ensuring a Reliable Water Supply

The laws described below impose specific requirements on both urban and agricultural water suppliers. These laws increase the importance to water suppliers of estimates of SWP water delivery reliability.

California Urban Water Management Planning Act

The California Urban Water Management Planning Act was enacted in 1983. As amended, this law (California Water Code, Sections 10610–10656) requires urban water suppliers to adopt water management plans every 5 years and submit those plans to DWR. Adoption of the most recent (2010) round of urban water management plans was required by July 1, 2011; the plans were due to DWR by August 1, 2011.

In their water management plans, urban water suppliers must assess whether their current and planned water supplies will be enough to meet the water demands expected during the next 20 years. The plans also consider various drought scenarios and the proper ways to respond in case of an unexpected water shortage.

DWR is required to review local water management plans and report on the status of these plans. DWR published a guidebook to preparing urban water management plans in March 2011. Guidance documents are available at http://www.water.ca.gov/urbanwatermanagement.

Water Conservation Act

The Water Conservation Act of 2009 (Senate Bill X7.7, Steinberg), enacted in November 2009, includes distinct requirements related to both urban and agricultural water use.

This law requires that the State of California reduce urban per capita water use statewide by 10% by the end of 2015 and 20% by the end of 2020. DWR is required to report on progress toward meeting these urban per capita water use goals.

In addition, agricultural water suppliers must adopt agricultural water management plans by the end of 2012, then update the plans by the end of 2015 and every 5 years thereafter.

Through its Agricultural Water Management Planning & Implementation Program (http://www.water.ca.gov/wateruseefficiency/agricultural/agmgmt.cfm), DWR helps water districts develop agricultural water management plans and implement cost-effective, efficient water management practices. DWR is currently preparing a guidebook for developing agricultural water management plans.

Background of This Report

This *State Water Project Delivery Reliability Report 2011* is the fifth in a series of reports on the SWP's water delivery reliability. DWR is legally required to prepare and distribute this report every 2 years to all SWP contractors (recipients of SWP water), city and county planning departments, and regional and metropolitan planning departments in the SWP's service area. Reports were previously produced for 2002, 2005, 2007, and 2009.

The requirement for a biennial water delivery reliability report was established in a settlement agreement among the Planning and Conservation League, DWR, SWP contractors, and others that was approved by the 3rd Circuit Court of Appeals in May 2003. The settlement agreement was reached in the aftermath of the "Monterey Amendments" case, which resolved a dispute about the environmental analysis of amendments to the long-term water supply contracts for the SWP that were entered into by DWR and most of the SWP contractors in the 1990s. The terms of the SWP contracts were amended after water shortages during the 1987–1992 drought drastically reduced SWP water deliveries to SWP contractors in the San Joaquin Valley and Southern California.

Attachment B to the settlement agreement specifies that each SWP delivery reliability report must include all of the following information:

- the overall water delivery capacity of the SWP facilities at the time of the report;
- the allocation of that SWP water to each SWP contractor;
- a discussion of the range of hydrologic conditions, which must include the historic extended dry cycle and long-term average; and
- the total amount of SWP water delivered to all contractors and the amount of SWP water delivered to each contractor during each of the 10 years immediately preceding the report.

DWR's water delivery reliability reports are used by various entities for water planning purposes. The reports must be presented in a format understandable by the public. The information presented in the reports is intended to help local agencies, cities, and counties that use SWP water to develop adequate, affordable water supplies for their communities.

Contents and Use of This Report

The following topics are addressed in this *State Water Project Delivery Reliability Report 2011*:

- The Summary at the front of this report briefly summarizes the updated findings on water delivery reliability detailed in previous chapters.
- Chapter 1, "Water Delivery Reliability: A Concern for Californians," summarizes important issues (including selected State legislation) that underlie the need to assess the SWP's water delivery reliability, provides background on DWR's water delivery reliability reports, and defines key terms.
- Chapter 2, "A Closer Look at the State Water Project," describes the SWP's purpose, background, and facilities. This chapter also introduces factors that interact in the Sacramento–San Joaquin Delta (Delta) to affect SWP operations: precipitation and snowmelt patterns, variable river inflows, operations of the federal Central Valley Project (CVP), Delta water quality concerns, regulatory requirements, and the Delta's physical conditions.
- Chapter 3, "SWP Contractors and Water Contracts," lists the SWP water contractors and shows where they are located, and describes the different types of SWP water allocations.
- Chapter 4, "Factors that Affect Water Delivery Reliability," explains generally how water delivery reliability is calculated. The chapter then describes a variety of factors that make forecasting water delivery

reliability inherently challenging. Among these complicating factors are climate change, environmental and policy planning efforts pertaining to the Delta, and the potential for levee breaches in the Delta.

- Chapter 5, "SWP Delta Exports," discusses how the delivery estimates for the SWP have been reduced as a result of more restrictive operational rules. This chapter also presents the results of DWR's modeling of SWP exports from the Harvey O. Banks Pumping Plant for existing conditions (2011) and future conditions (2031).
- Chapter 6, "Existing SWP Water Delivery Reliability (2011)," estimates the SWP's delivery reliability for existing conditions (2011) and compares these estimates with the existing-condition results presented in the *State Water Project Delivery Reliability Report 2009*.
- Chapter 7, "Future SWP Water Delivery Reliability (2031)," estimates the SWP's delivery reliability for conditions 20 years in the future (2031), reflecting potential hydrologic changes that could result from climate change. This chapter also compares these estimates with the future-condition results presented in the *State Water Project Delivery Reliability Report 2009*.
- Appendix A, "Historical SWP Delivery Tables for 2001–2010," presents the historical deliveries for SWP contractors over the last 10 years.

In addition, a technical addendum has been prepared for this report and includes more specific details of the technical analyses and results. Urban and agricultural water suppliers can use the information in this report and the technical addendum when they prepare or amend their water management plans. These details will help them decide whether they need new facilities or programs to meet future water demands. The technical addendum is available upon request and is posted online, along with this report, at http://baydeltaoffice.water.ca.gov.

Urban water suppliers can also use this information when, as required by the California Environmental Quality Act, they analyze whether enough water is available for proposed subdivisions or development projects.

Chapter 2

A Closer Look at the State Water Project

Northern California typically receives abundant rainfall and runoff from mountain snowpack. However, a larger percentage of California's population lives in Southern California and most irrigated farmland lies in Central California. These regions are mostly arid, and local water suppliers cannot fully meet the needs of many of their communities. These areas rely on additional imported water, especially to meet shortages during dry years and the demands of increasing populations. The SWP was constructed to help meet these needs.

Purpose and Background of the SWP

The SWP is the largest state-built, multipurpose, user-financed water project in the United States. More than two-thirds of California's residents—25 million people—receive at least part of their water from the SWP. Project water also supplies thousands of industries and irrigates about 750,000 acres of California farmland. Of the SWP's contracted water supply, 70% goes to urban users and 30% goes to agricultural users.

The primary purpose of the SWP is to provide a water supply—that is, to divert and store water during wet periods in Northern and Central California and distribute it to areas of need in Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California. Other SWP purposes include flood control, power generation, recreation, fish and wildlife enhancement, and water quality improvement in the Delta.

These purposes have been discussed at length for many decades. The concept of a statewide water development project was first raised in 1919 when Lt. Robert B. Marshall of the U.S. Geological Survey proposed transporting water from the Sacramento River system to the San Joaquin Valley, then moving it over the Tehachapi Mountains into Southern California.

In the 1930s, State Engineer Edward Hyatt proposed the "State Water Plan," which identified the facilities needed and economic means to transfer water from north to south. The California Legislature authorized the project in the Central Valley Act of 1933, and a $170 million bond act was approved by California voters in December 1933. However, the Great Depression precluded the State from obtaining the necessary funding. The U.S. government funded the construction of major components of the plan, which became the federal CVP. (See "The Central Valley Project and Its Relationship to the SWP" later in this chapter.)

As California's population grew after World War II, investigations of statewide water resources resumed. In 1945, DWR's predecessor, the Division of Water Resources of the Department of Public Works, conducted a variety of studies that culminated in the Feather River Project, presented to the State Legislature in 1951 by State Engineer A. D. Edmonston. A revised project proposal was presented in 1955. The Legislature appropriated funds for detailed studies of the Feather River Project, which evolved to become the SWP.

In 1959, the Legislature passed the California Water Resources Development Bond Act. This law, also known as the Burns-Porter Act, authorized $1.75 billion in bonds to build the SWP's initial facilities, contingent on voter approval. After California voters approved the Burns-Porter Act in November 1960, construction of the SWP by DWR began in the early 1960s, with water deliveries following.

SWP Facilities

Today, the SWP includes 33 storage facilities, 21 reservoirs and lakes, 20 pumping plants, four pumping-generating plants, five hydroelectric power plants, and about 700 miles of canals and pipelines. Figure 2-1 shows the primary SWP facilities.

Facilities North of the Delta

The SWP's watershed encompasses the mountains and waterways around the Feather River in Plumas County. Rain and melting snow run off mountainsides and into waterways that flow into Lake Oroville, where the SWP officially begins. With a capacity of about 3.5 million acre-feet, Lake Oroville is the SWP's largest storage facility. The water management facilities of Lake Oroville are designed to maximize energy production and include six power generating units and six pumping/generating units. Three hydroelectric power plants operate at Oroville.

Oroville Dam.

When water is needed, Oroville Dam releases water into the Feather River, which converges with the Sacramento River north of the city of Sacramento. Releases from Shasta and Folsom Reservoirs, facilities of the federal CVP, also flow into the Sacramento River. The Sacramento River flows into the Delta, where it mixes with water from the San Francisco Bay and is influenced by the tides. From the Delta, some of this water is pumped by the Barker Slough Pumping Plant into the North Bay Aqueduct for municipal use by Napa and Solano Counties.

Figure 2-1. Primary State Water Project Facilities

Facilities in the Delta and Central California

The SWP's primary pumping plant, the Harvey O. Banks Pumping Plant, is located in the south Delta in Alameda County. The pumps at the Banks Pumping Plant lift Delta water stored in the Clifton Court Forebay into the California Aqueduct, which at 444 miles long is the longest water conveyance system in California. At Bethany Reservoir, some SWP water is diverted from the California Aqueduct into the South Bay Aqueduct, which serves urban and agricultural uses in Alameda and Santa Clara Counties.

Harvey O. Banks Pumping Plant.

Water in the California Aqueduct flows into the San Luis Joint-Use Complex located in Merced County, which is jointly owned by the SWP and the CVP. Among the facilities at the complex is San Luis Reservoir, which is the world's largest offstream reservoir, with storage space for more than 2 million acre-feet of water. (An "offstream reservoir" is a water body that does not impede and store natural flows directly within a stream course, but instead is located "offstream"; stored water is diverted elsewhere and conveyed to the offstream reservoir by a pipeline or aqueduct.) Generally, water is pumped into San Luis Reservoir from late fall through early spring and is stored temporarily before being released back to the California Aqueduct to meet the higher summertime water demands of SWP (and CVP) contractors.

Facilities in the San Joaquin Valley and Southern California

After leaving the San Luis Joint-Use Complex, water travels through the central San Joaquin Valley via a jointly owned federal/State portion of the California Aqueduct. Along the way, deliveries are made to San Joaquin Valley contractors of both the SWP and the CVP. Near Kettleman City in Kings County, the SWP's Coastal Branch Aqueduct branches off to serve SWP contractors in San Luis Obispo and Santa Barbara Counties. The California Aqueduct continues southeast until, at the base of the Tehachapi Mountains, it reaches the A. D. Edmonston Pumping Plant, the SWP's largest pumping station.

A. D. Edmonston Pumping Plant.

The Edmonston Pumping Plant, located in Kern County, is an engineering marvel. It is the highest single-lift pumping plant in the world. The 14 pumps at this facility, each weighing more than 400 tons and powered by 80,000-horsepower motors, raise water from the California Aqueduct 1,926 feet—more than one and one-half times the height of New York's Empire State Building—to enter 10 miles of tunnels and siphons that cross the Tehachapi Mountains.

After crossing the mountains, the water splits into two branches, the West Branch and East Branch, and is delivered to SWP contractors in Southern California. The southernmost SWP facility, located at the end of the East Branch, is Lake Perris in Riverside County.

The Delta and Factors Affecting SWP Operations and Deliveries

The Delta forms the eastern portion of the San Francisco estuary. It is composed of 738,000 acres of land interlaced with hundreds of miles of waterways that receive runoff from about 40% of the state's land area. The Delta is one of the few estuaries in the world that is used as a major source of drinking water supply. The Delta is important not only to SWP operations, but to California's economy. About $400 billion of California's $1.5 trillion economy is supported by water from the Delta, as noted by DWR and the California Department of Fish and Game (DFG) in the 2008 report, *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta*.

Numerous competing demands converge in the Delta—especially the need to provide water for both agricultural and urban uses and the desire to protect habitat for endangered species.

In the SWP conveyance system, the Delta is the critical link between the water supplies in the Sacramento Valley and the water demands of, and deliveries to, the rest of the Central Valley and Southern California. Physically, the Delta is the focal point for water distribution in California because most of the SWP contractors are located at points south of the Delta.

However, the Delta has long been an area of numerous competing demands; for example, the Delta provides water for millions of Californians, but also serves as important habitat for hundreds of animal, plant, and fish species, some of which are listed under the federal Endangered Species Act (ESA) and/or California Endangered Species Act (CESA) as threatened or endangered. It also supports a local population of more than 500,000 and millions of visitors who use the Delta's recreational areas, navigable waterways, and marinas. Further, not only do SWP and CVP contractors use Delta water for agriculture, but local farmers within the Delta itself use its water to irrigate their crops planted on the numerous Delta islands.

The SWP's ability to pump water from the Delta is not affected only by the physical size and capacity of the pumps at the Banks Pumping Plant. As described below, the Delta is affected by numerous factors that interact to affect SWP operations and water deliveries:

- Delta inflows (i.e., the combined total of water flowing into the Delta from the Sacramento River, San Joaquin River, and other rivers and waterways),
- beneficial uses and water rights,
- Delta water quality standards,
- regulatory requirements,
- concurrent CVP operations and pumping, and
- physical factors.

Delta Inflows

Delta inflow varies considerably from year to year. Levels of development upstream of the Delta along the rivers and their watersheds—in the areas from which the water originates—affect Delta inflows. For example, in an above-normal year, nearly 85% of the total Delta inflow comes from the Sacramento River, more than 10% comes from the San Joaquin River, and the rest comes from three eastside streams (the Mokelumne, Cosumnes, and Calaveras Rivers) (Figure 2-2).

The type of water year is also an important factor affecting the volume of Delta inflows. When hydrology is analyzed, water years are designated by DWR as "wet," "above normal," "below normal," "dry," or "critical" based on the amount of rain and snow that fell during the preceding period of October 1–September 30. DWR hydrologists and meteorologists measure snowpack in the northern Sierra Nevada on or about the first of January, February, March, April, and May, in the watersheds where most of the state's water supply originates, to forecast snowmelt runoff—and thus available water supply—for the coming spring and summer.

All other factors (such as upstream development) being equal, much less water will flow into the Delta during a dry or critical water year—that is, during a drought—than during a wet or above normal water year. Fluctuations in inflows are a substantial overall concern for the Delta, and a specific concern for the SWP; such fluctuations affect Delta water quality and fish habitat, which in turn trigger regulatory requirements that constrain SWP Delta pumping. For example:

- As discussed below under "Delta Water Quality Standards," lower inflows can cause Delta water to become increasingly saline and trigger additional upstream reservoir releases and/or reduced Delta pumping to meet regulatory requirements.
- Conditions for fish in the Delta are less suitable in drier years, as seen during California's 1987–1992 drought, which can also trigger regulatory requirements that reduce SWP pumping.

Delta inflows will also vary by time of year because the amount of precipitation varies by season. About 80% of annual precipitation occurs between November and March, and very little rain typically falls from June through September. A seasonal mismatch of water supply and demand typically exists; runoff is greatest in winter and spring, but water demands peak in summer. Upstream reservoirs dampen this variability by reducing flood flows and storing water to be released later in the year to meet water demands and flow and water quality requirements.

Delta Water Quality Standards

Water quality standards for the Delta also affect SWP operations. The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) defines "beneficial uses" of waters of the State (both surface water and groundwater) that must be protected against quality degradation. These beneficial uses include domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. The criteria based on those uses, called "water quality objectives," are found in the water quality control plans adopted by the State Water Resources Control Board and the nine regional water quality control boards. The SWP and CVP must meet specific criteria for salinity during certain times of the year at various locations in the Delta, as described further under "Factors that Can Influence the SWP's Water Delivery Reliability" in Chapter 4.

Salinity levels can be affected by the water year type: Inflows into the Delta decline in dry and

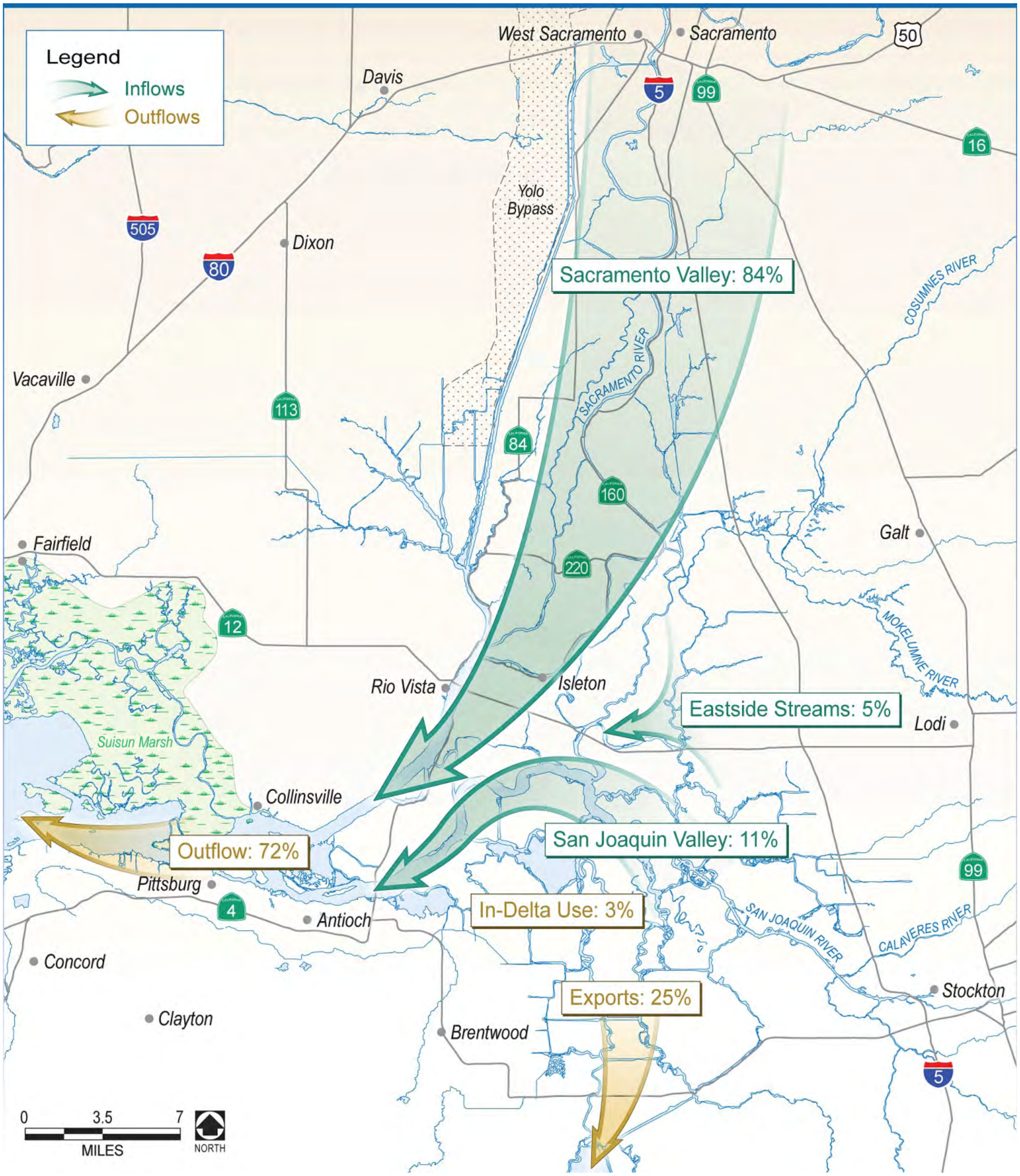


Figure 2-2. Water Year 2000 (Above-Normal) Delta Water Balance (Percent of Total)

critical water years, but daily tidal inflow of salty water into the Delta from the Pacific Ocean remains generally the same, thus increasing Delta salinity. Excessive salinity may adversely affect crop yields and require more water for salt leaching, may require additional municipal and industrial treatment, may increase salinity levels in agricultural soils and groundwater, and is the primary water quality constraint to recycling wastewater. Salty water is both undrinkable and unusable for irrigation (and thus unsuitable for SWP and CVP contractors and farmers in the Delta), and is harmful to fish inhabiting the Delta, including endangered and threatened species. Climate change is also causing sea level rise, which is projected to substantially increase Delta salinities. Generally, Delta water quality is best during winter and spring and poorer through the summer irrigation season and early fall.

SWP operations are closely regulated by the water quality standards contained in State Water Resources Control Board Water Right Decision 1641 (D-1641). D-1641 was issued in December 1999 (with a revised version issued in March 2000) to implement the 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta* (1995 WQCP). The 1995 WQCP established beneficial uses of Delta water, associated water quality objectives for the reasonable protection of beneficial uses, and an implementation program to achieve the water quality objectives.

D-1641 assigned primary responsibility for meeting many of the water quality objectives established in the 1995 WQCP to the SWP (thus, to DWR) and the CVP (thus, to Reclamation). To meet these objectives, D-1641 limits or curtails SWP and CVP pumping operations in certain parts of the year. For example, D-1641 imposed limits on the ratio of SWP and CVP exports to total inflow into the Delta. This “export-inflow ratio” varies by time of year.

Regulatory Requirements

The Delta provides important habitat for fish species listed as threatened or endangered under either the federal ESA or the CESA, or both. Several resource agencies have taken actions under their authorities to protect these species. Regulatory requirements based on recent biological opinions (BOs) issued by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for CVP and SWP operations are a particularly important factor affecting SWP operations. DFG also regulates the protection of species under the CESA, and has issued consistency determinations in the past when it has found federal BOs to be consistent with CESA for State-listed species.

Delta smelt.

A BO is a determination by USFWS or NMFS on whether a proposed federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of designated critical habitat. If jeopardy is determined, certain actions are required to protect species of concern. Usually BOs apply specifically to federal actions, but DWR coordinates with Reclamation in the agencies’ operation of the SWP and federal CVP. Since the passage of the federal ESA in 1973, various BOs have been issued by USFWS and NMFS for the effects on federally listed endangered species of these coordinated operations.

NMFS administers the ESA for marine fish species, including anadromous salmonids (those that spend a part of their life cycle in the sea and return to freshwater streams to spawn), such as

Central Valley steelhead, winter-run and spring-run Chinook salmon, and green sturgeon. USFWS administers the ESA for nonanadromous and nonmarine fish species, such as delta smelt and longfin smelt. Both anadromous and nonanadromous fish species are found in the Delta and are federally listed under the ESA.

If USFWS or NMFS finds that a proposed action is likely to jeopardize a listed species or adversely modify its critical habitat, the agency is required to identify "reasonable and prudent alternatives" (defined in Title 50, Section 402.02 of the Code of Federal Regulations) that it has determined would enable the project to go forward in compliance with the ESA.

Especially important to the SWP are the BOs issued by USFWS and NMFS in 2008 and 2009, respectively, for the coordinated operations of the CVP and SWP. Both of these BOs, which DFG found consistent with the CESA for State-listed species, have directly and substantially affected SWP operations and pumping levels in recent years: They incorporate terms that directly or indirectly limit the amount of CVP and SWP Delta pumping under certain conditions. Relative to prior years, SWP water deliveries estimated in the *State Water Project Delivery Reliability Report 2009*—the last edition of this report—were, in general, reduced by the operational restrictions of these BOs.

Concurrent Central Valley Project Operations and Pumping

CVP operations also affect the Delta as Reclamation diverts water for agricultural and urban uses. To make the most efficient use of the common water supply available to the CVP and SWP, Reclamation and DWR must work as closely as possible to coordinate their respective reservoir releases and Delta pumping operations. The CVP and SWP operate in conjunction according to the Coordinated Operation Agreement signed in 1986 by the two agencies.

Subsidence (sinking) of islands in the Delta places even more pressure on already fragile Delta levees.

The two projects share some of their facilities in the San Joaquin Valley—most notably the San Luis Unit, for which the major storage reservoir is San Luis Reservoir, and more than 100 miles of the California Aqueduct. In addition, the CVP and SWP are allowed to use each other's export pumping facilities in the south Delta—to pump water for each other—when operation of one set of pumps is affected by facility maintenance, capacity limitations, or fish protection requirements. Use of this "joint point of diversion" is subject to an operations plan that protects fish and wildlife and other legal users of water.

Physical Factors

The stability and reliability of SWP water deliveries can be threatened by physical factors affecting facilities or water quality anywhere in the SWP system. The Delta is particularly vulnerable. Delta islands have been subsiding and in some places the land has sunk to 20 feet below sea level. This places extra pressure on the Delta's levees because it means they must hold back water constantly rather than only during peak-flow periods.

Climate change is causing sea level to rise, increasing pressure on Delta levees even further. Delta levees are also vulnerable because they were built 150 years ago and could be affected if an earthquake were to strike anywhere near the Delta.

THE CENTRAL VALLEY PROJECT AND ITS RELATIONSHIP TO THE SWP

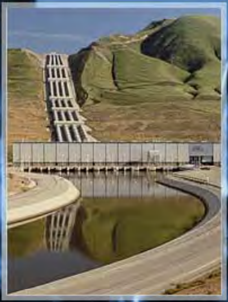
The federal Central Valley Project, operated by the U.S. Bureau of Reclamation, was originally conceived as a State of California project to protect the Central Valley from water shortages and floods. During the Great Depression, however, the State was unable to sell bonds to finance project construction, and beginning in the late 1930s, the U.S. government constructed the CVP as a public works project.

The CVP operates 18 dams and reservoirs, 11 powerplants, and 500 miles of canals and other facilities between the Cascade Range near Redding and the Tehachapi Mountains near Bakersfield. It serves agricultural, municipal, and industrial needs in the Central Valley and urban centers in parts of the San Francisco Bay Area, and is the primary water source for many Central Valley wildlife refuges. In an average year the CVP delivers about 7 million acre-feet of water for agriculture, urban, and wildlife use, irrigating about one-third (3 million acres) of California's agricultural lands and supplying water for nearly 1 million households (Reclamation 2009).

The CVP and SWP share some of their facilities, especially the San Luis Unit, and their respective operations staffs work closely together. The Coordinated Operations Agreement between the CVP and SWP, signed in 1986, outlines the shared responsibilities of each project to meet Delta water quality and flow objectives and provides for equitable sharing of surplus water that enters the Delta.

Chapter 3

SWP Contractors and Water Contracts



During the 1960s, as the SWP was created, long-term contracts were signed by DWR and 29 urban and agricultural water suppliers in various locations within California. The contracts are essentially uniform and will expire in 2035. These urban and agricultural water suppliers are referred to in this report as the "SWP contractors" or "contractors." This chapter introduces the SWP contractors, explains the basics of SWP water contracts, and describes the various types of project water, especially "Table A" water. The discussion also outlines some of the factors that influence delivery of Table A water.

About the SWP Contractors

The SWP contractors are located along the Feather River north of the Delta, in the north and south San Francisco Bay Area, along the Central Coast, in the San Joaquin Valley, and in Southern California. They include cities, counties, urban water agencies, and agricultural irrigation districts. Most contractors use the project water they receive for municipal purposes; several use the water for agriculture. The SWP contractors mostly use project water to supplement local supplies, including groundwater, or other imported water. The 29 SWP contractors are listed below and their locations are shown in Figure 3-1.

Feather River Area Contractors

- Butte County
- Yuba City
- Plumas County Flood Control and Water Conservation District

North Bay Area Contractors

- Napa County Flood Control and Water Conservation District
- Solano County Water Agency

South Bay Area Contractors

- Alameda County Flood Control and Water Conservation District, Zone 7
- Alameda County Water District
- Santa Clara Valley Water District

San Joaquin Valley Area Contractors

- Dudley Ridge Water District
- Empire West Side Irrigation District
- Kern County Water Agency
- Kings County
- Oak Flat Water District
- Tulare Lake Basin Water Storage District

Figure 3-1. State Water Project Contractors

Central Coastal Area Contractors

- San Luis Obispo County Flood Control and Water Conservation District
- Santa Barbara County Flood Control and Water Conservation District

Southern California Area Contractors

- Antelope Valley–East Kern Water Agency
- Castaic Lake Water Agency
- Coachella Valley Water District
- Crestline–Lake Arrowhead Water Agency
- Desert Water Agency
- Littlerock Creek Irrigation District
- Metropolitan Water District of Southern California
- Mojave Water Agency
- Palmdale Water District
- San Bernardino Valley Municipal Water District
- San Gabriel Valley Municipal Water District
- San Gorgonio Pass Water Agency
- Ventura County Watershed Protection District

How Water Contracts Work

Under the terms of their long-term water supply contracts with DWR, the 29 SWP contractors receive specified amounts of water from the SWP each year, called "annual allocations."

The SWP's long-term water supply contracts define the terms and conditions governing water delivery and repayment of project costs. In return for the allocated water, the SWP contractors repay principal and interest on both the bonds that initially funded construction of the SWP and the bonds that paid for additional facilities. The contractors also pay all costs, including labor and power, to maintain and operate project facilities. They also pay transportation charges based on the distance between the Delta and each contractor's water delivery point.

The contractors also contribute mitigation costs for any environmental impacts of SWP operations on fish and wildlife.

"Table A" Water

Table A is an exhibit to the SWP's water supply contracts. This section explains Table A water and outlines the primary factors that influence the amount of such water actually delivered to SWP contractors.

What Is Table A Water?

The water supply–related costs of the SWP are paid for by SWP contractors. All water contracts signed in the 1960s included an estimate of the date that SWP water would first be delivered and a schedule of the amount of water the contractor could expect to be delivered annually. That amount of water, known as the contractor's annual Table A amount, was designed to increase gradually until the designated maximum for that SWP contractor was reached.

The total combined maximum Table A amount for all SWP contractors was initially 4,230 thousand acre-feet per year (taf/year), assuming full development of the SWP. At that time, this amount was referred to as the "maximum project yield." As a result of amendments to the water supply contracts in the 1990s, the current combined maximum Table A amount is 4,172 taf/year. Of this amount, 4,133 taf/year is the maximum Table A water available for delivery from the Delta. It is recognized that deliveries will be less than the established maximum Table A amount in some years and more than this amount in other years.

The maximum Table A amount is the basis for apportioning water supply and costs to the SWP contractors. Once the total amount of water to be delivered is determined for the year, all available water is allocated in proportion to each contractor's annual maximum SWP Table A amount. To reiterate, however, in some years the SWP cannot deliver the maximum amount of 4,172 taf, but in other years, project supply exceeds that amount. Additionally, in some years contractors receive other classifications of water from the SWP, such as Article 21 water and turnback pool water. (See "Other Types of SWP Water" later in this chapter.)

The established maximum Table A amounts for the 29 SWP contractors vary widely (Table 3-1). The median is 42 taf; thus, the maximum allocations of Table A water for half of the SWP contractors exceed this amount, and for the other half they are less. As shown in Table 3-1, the largest Table A amount is held by the Metropolitan Water District of Southern California at 1,911,500 acre-feet; the smallest is held by the Littlerock Creek Irrigation District at 2,300 acre-feet.

The Table A amounts determine the maximum water a contractor may request each year from DWR. Table A amounts may also be used as a factor to allocate other available water supplies to each contractor. "Table A" or "Table A water" represents a portion or all of the annual Table A requested by the SWP water contractors and approved for delivery by DWR, based on hydrologic conditions, current reservoir storage, and combined requests from the SWP water contractors. DWR is not always able to deliver the quantity of water requested by contractors. In these cases, and under certain conditions, a lesser amount is allocated and delivered according to the long-term water supply contracts by prorating the amount in proportion to each SWP water contractor's maximum Table A amount.

As discussed below, the water year type and the contractors' demand levels are among the factors involved in determining the amount of Table A water that will be delivered by DWR to each contractor. At various times of the year, DWR issues projections of anticipated Table A allocations based on then-current conditions, and updates those projections as warranted. The deliveries of Table A water to each of the SWP contractors in the last 10 years are shown in Appendix A.

Factors Influencing Percentages of Table A Water Delivery Amounts

The percentage of its maximum Table A amount that an SWP contractor will receive in any given year will vary depending on a variety of factors. The discussion below presents basic questions underlying these factors, which are described in greater detail later in this report.

Winter snowpack is an important factor determining annual Table A water deliveries.

Physical Availability of Water from Precipitation and Runoff

The amount and timing of precipitation and ensuing runoff to streams are important in determining how much water will be physically available to the SWP to pump and export from the Delta. The type of precipitation matters as well, along with anticipated patterns of use and consumption of the source water by entities other than the SWP.

The answers to the following questions influence the amount of water delivered to contractors each year:

- How much rain and snow fell within the last year?
- Which parts of California received the precipitation, and how much runoff resulted?

Table 3-1. Maximum Annual SWP Table A Water Delivery Amounts for SWP Contractors

Contractor	Maximum Table A Delivery Amounts (acre-feet)
Feather River Area Contractors	
Butte County	27,500
Yuba City	9,600
Plumas County Flood Control and Water Conservation District	2,700
Subtotal	**39,800**
North Bay Area Contractors	
Napa County Flood Control and Water Conservation District	29,025
Solano County Water Agency	47,506
Subtotal	**76,531**
South Bay Area Contractors	
Alameda County Flood Control and Water Conservation District, Zone 7	80,619
Alameda County Water District	42,000
Santa Clara Valley Water District	100,000
Subtotal	**222,619**
San Joaquin Valley Area Contractors	
Dudley Ridge Water District	50,343
Empire West Side Irrigation District	2,000
Kern County Water Agency	982,730
Kings County	9,305
Oak Flat Water District	5,700
Tulare Lake Basin Water Storage District	88,922
Subtotal	**1,139,000**
Central Coastal Area Contractors	
San Luis Obispo County Flood Control and Water Conservation District	25,000
Santa Barbara County Flood Control and Water Conservation District	45,486
Subtotal	**70,486**
Southern California Area Contractors	
Antelope Valley–East Kern Water Agency	141,400
Castaic Lake Water Agency	95,200
Coachella Valley Water District	138,350
Crestline–Lake Arrowhead Water Agency	5,800
Desert Water Agency	55,750
Littlerock Creek Irrigation District	2,300
Metropolitan Water District of Southern California	1,911,500
Mojave Water Agency	82,800
Palmdale Water District	21,300
San Bernardino Valley Municipal Water District	102,600
San Gabriel Valley Municipal Water District	28,800
San Gorgonio Pass Water Agency	17,300
Ventura County Watershed Protection District	20,000
Subtotal	**2,623,100**
TOTAL TABLE A AMOUNTS	**4,171,536**

- Did rain come as a short intense storm or a long wet spell?
- Did more of the precipitation occur as snow in colder storms, or were storms warmer, resulting in more rain that produced higher peak runoff?
- Was snowmelt fast or gradual, and when did the bulk of the runoff occur?

For example, if substantial snowfall occurs late in the wet season, Sierra Nevada rivers can be full of melting snow later than usual in the year, as occurred in 2011. This allows the SWP's Delta pumping to continue at or near capacity for an extended duration, increasing the percentage of Table A water delivered. Conversely, if rain falls on snow early in the year, the resulting early snowmelt results in less water available for Delta pumping later in the year. Other factors affecting SWP delivery reliability are discussed in Chapter 4.

Local Facilities and Demands

A contractor's local diversion, storage, and conveyance facilities are important considerations in receiving water and in storing the water it receives. A contractor's water demands can also be affected by local weather patterns and water conservation measures. In some years, some contractors may rely more on water from sources such as groundwater or the Colorado River, while in other years they may rely more on the SWP.

The pattern of water demand on a water system can greatly affect the system's reliability. For example, if the demand occurs for only 3 months in summer, a water system with sufficient annual supply but insufficient water storage may not be able to reliably meet its customers' demands. If, however, the demand is distributed over the year, the system can more easily meet the demand because the need for water storage is reduced or storage could be increased.

Other Types of SWP Water

Regardless of water year type, Table A water is given first priority for delivery over other types of SWP water. Contractors have several options for what to do with the water that is allocated to them: use it, store it for later use, or transfer it to another contractor. Each long-term water contract describes several types of SWP water that are available to SWP contractors to supplement Table A water: "Article 21" water, carryover water, and turnback pool water. These other types of project water are discussed below and the related deliveries that occurred in each of the last 10 years are shown in Appendix A.

Article 21 Water

Article 21 water (so named because it is described in Article 21 of the water contracts) is water that SWP contractors may receive on a short-term basis in addition to their Table A water, if they request it. Because most SWP contactors often cannot meet their full demands with Table A water, Article 21 water should not be viewed as "surplus" or "extra" water. In fact, Article 21 water is used by many SWP contractors to help meet demands when allocations are less than 100%. Article 21 water is available to an SWP contractor only if the following conditions are met:

- "Excess water" is flowing through the Delta—that is, when releases from SWP and CVP reservoirs and unregulated flows into the Delta exceed Sacramento Valley water diversions, Delta exports, and flows needed to meet Delta water quality and flow requirements. If this scenario occurs, it is usually during December through May.
- The contractor is able to use the surplus water, such as by offsetting the use of groundwater that would otherwise occur, or can store it in its own system. (That is, the water will not be stored in an SWP facility, such as San Luis Reservoir.)

- Delivering this water would not interfere with Table A allocations, other SWP deliveries, or SWP operations.

SWP contractors requesting Article 21 water receive this water in the same proportion as their Table A water. Article 21 water becomes available only during wet months of the year, generally December through March. Unless the SWP contractor has facilities to routinely store or manage the Article 21 water it receives, such water is not likely to contribute significantly to local water supply reliability.

Carryover Water

"Carryover water" is SWP water that is allocated to an SWP contractor and approved for delivery to that contractor in a given year, but not used by the end of the year. (Note that SWP water deliveries are managed by calendar year, January 1–December 31, while hydrology is measured by water year, October 1–September 30.) This water is exported from the Banks Pumping Plant, but instead of being delivered to the contractor, it is stored in the SWP's share of San Luis Reservoir, when space is available, for the contractor to use in the following year.

Carryover water is like a water savings account that allows water managers flexibility in tough times—such as if the next year is a drought year and the contractor's allocation of SWP water is small. Carryover water was designed to encourage the most effective and beneficial use of water and to avoid obligating the contractors to use or lose the water by December 31 of each year.

With advance notice, SWP contractors can carry over water when they submit their initial request for Table A water, or within the last 3 months of the delivery year. They might do this for various reasons, such as local wet conditions or exchange and transfer arrangements. Storage for carryover water no longer becomes available to the contractors if it interferes with storage of SWP water for project needs.

Carryover water is stored in San Luis Reservoir.

Turnback Pool Water

SWP contractors may offer the portion of their allocated Table A water within the current year that exceeds their needs in a "turnback pool," where another contractor may purchase this water. DWR sets the price for water offered in turnback pools, which are established in February and March. Contractors that sell their extra Table A water in a turnback pool receive payments from contractors that buy water through the turnback pool.

Historical SWP Deliveries (2001–2010)

Please see Appendix A for tables listing annual historical deliveries from the Delta by various water classifications for each SWP contractor for 2001–2010. Similar delivery tables for years 1999–2008 are included in the 2009 Report.

Figure 3-2 shows that deliveries of SWP Table A water from the Delta for 2001–2010 range from an annual minimum of 1,049 taf to a maximum of 2,963 taf, with an average of 2,087 taf. Historical deliveries of SWP Table A water from the Delta over this 10-year period are less than the maximum of 4,133 taf/year.

Total historical SWP deliveries from the Delta, including Table A, Article 21, turnback pool, and carryover water, range from 1,236 to 3,727 taf/year, with an average of 2,524 taf/year for the period of 2001–2010 (Figure 3-3).

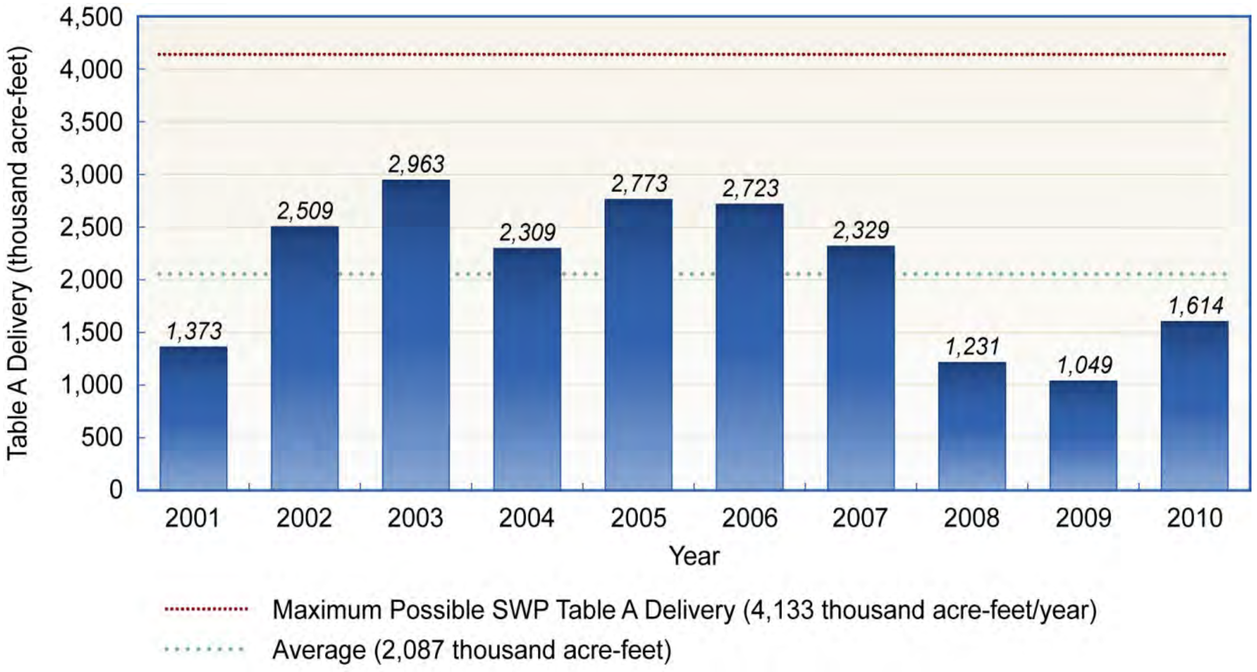
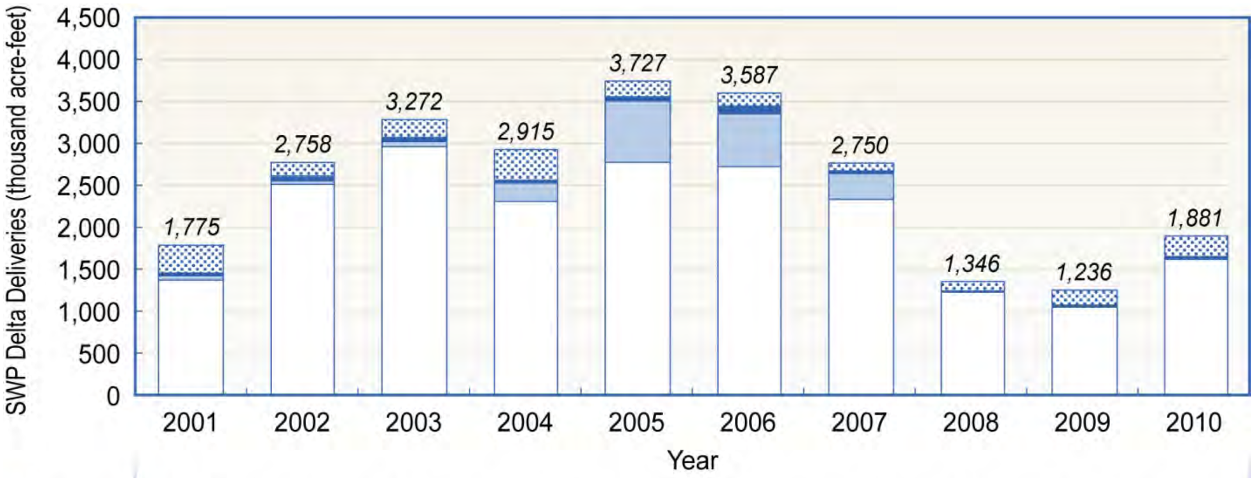


Figure 3-2. Historical Deliveries of SWP Table A Water from the Delta, 2001–2010



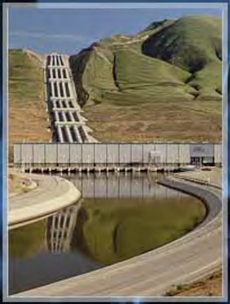
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
▨ Carryover	335	161	220	370	185	160	94	110	180	248
■ Turnback	18	45	30	17	38	73	16	3	2	11
▤ Article 21	48	43	60	218	731	631	310	3	6	8
☐ Table A	1,373	2,509	2,963	2,309	2,773	2,723	2,329	1,230	1,049	1,614

Note: Due to rounding, the total delivery may not equal the sum of individual delivery type line items.

Figure 3-3. Total Historical SWP Deliveries from the Delta, 2001–2010 (by Delivery Type)

Chapter 4

Factors that Affect Water Delivery Reliability



This chapter explains the concept of SWP water delivery reliability and how it is calculated by DWR. Some of the factors that influence the percentages of SWP Table A deliveries were introduced in Chapter 3, “SWP Contractors and Water Contracts.” This chapter builds on that discussion, describing the most important factors that combine to affect SWP water delivery reliability. Among these natural and human-created factors are the availability of source water, regulatory restrictions on SWP operations, and the effects of climate change.

Uncertainty also exists because of the potential for an emergency such as an earthquake striking in or near the Delta, which, if substantial enough, could interrupt SWP exports from the Delta. This chapter describes various statewide efforts by DWR and other agencies to reduce risks to the Delta and enhance emergency response capabilities.

What Water Delivery Reliability Means to SWP Contractors

Water delivery reliability is the annual amount of SWP water that can be expected to be delivered to SWP contractors with a certain frequency. But what does that actually mean in practice?

In essence, it is a matter of probability—specifically, the likelihood that a contractor will receive a certain amount of water from the SWP in a particular year. From the contractor’s perspective, water delivery reliability indicates an acceptable or desirable level of dependability of water deliveries to the people receiving the water. This information is vitally important to SWP contractors for their long-term water planning and operations. Will farmers have the amount of water they will need to plant permanent crops? Will urban and suburban water districts have sufficient water to serve planned development, or will they need to call for greater conservation measures by residents and businesses? These are examples of critical questions to which SWP contractors must have answers to serve their customers.

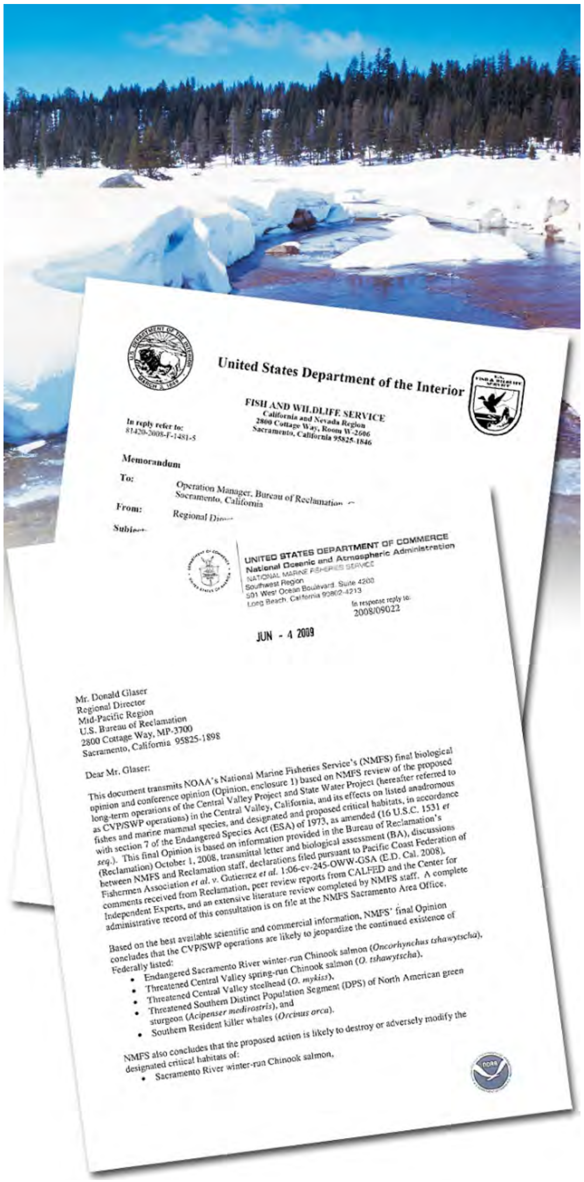
Usually, a local water agency, in coordination with the public it serves, determines the level of water delivery reliability that it considers acceptable. The water agency then plans for new facilities, programs, or additional sources of water to meet or maintain this level of reliability.

Calculating SWP Water Delivery Reliability

DWR calculates the water delivery reliability of the SWP using the CalSim-II computer model, which simulates existing and future operations of the SWP. No model or tool can predict what actual, natural water supplies will be for any year or years, but a system of probability can be used to calculate water delivery reliability. The analyses of SWP delivery reliability contained in Chapters 6 and 7 of this report are based on modeling conducted using 82 years of historical data (water years 1922–2003) for rainfall and runoff. Those data were adjusted to reflect current and future levels of development in the source areas. The resulting data were then used to forecast the amount of water available to the SWP under current and future conditions (with the effects of climate change factored into the modeling for future conditions). The annual amounts of estimated SWP water deliveries are ranked from smallest to largest and the probability that various quantities of SWP Table A water will be delivered to each SWP contractor is estimated.

Factors that Can Influence the SWP's Water Delivery Reliability

Forecasting water delivery reliability is a difficult task because California is such a large state with numerous microclimates. In a typical year, some areas receive as little as 2 inches of rain, while others receive more than 100 inches. In addition, the determinants of water delivery for a specific water supply system continually change over time and can be difficult to determine and/or model. For example, water use in Sacramento River watersheds has increased over time. The historical data upon which a water supply forecast is based must be adjusted to reflect the current and, if necessary, future use in these watersheds.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
California and Nevada Region
2800 Cottage Way, Room W-2606
Sacramento, California 95825-1846

In reply refer to:
81420-2008-F-1481-5

Memorandum

To: Operation Manager, Bureau of Reclamation
Sacramento, California

From: Regional Di

Subj

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

In response reply to:
2008/09022

JUN - 4 2009

Mr. Donald Glaser
Regional Director
Mid-Pacific Region
U.S. Bureau of Reclamation
2800 Cottage Way, MP-3700
Sacramento, California 95825-1898

Dear Mr. Glaser:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion and conference opinion (Opinion, enclosure 1) based on NMFS review of the proposed long-term operations of the Central Valley Project and State Water Project (hereafter referred to as CVP/SWP operations) in the Central Valley, California, and its effects on listed anadromous fishes and marine mammal species, and designated and proposed critical habitats, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). This final Opinion is based on information provided in the Bureau of Reclamation's (Reclamation) October 1, 2008, transmittal letter and biological assessment (BA), discussions between NMFS and Reclamation staff, declarations filed pursuant to Pacific Coast Federation of Fishermen Association *et al.* v. Gutierrez *et al.* 1:06-cv-245-OWW-GSA (E.D. Cal. 2008), comments received from Reclamation, peer review reports from CALFED and the Center for Independent Experts, and an extensive literature review completed by NMFS staff. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, NMFS' final Opinion concludes that the CVP/SWP operations are likely to jeopardize the continued existence of Federally listed:

- Endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*),
- Threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*),
- Threatened Central Valley steelhead (*O. mykiss*),
- Threatened Southern Distinct Population Segment (DPS) of North American green sturgeon (*Acipenser medirostris*), and
- Southern Resident killer whales (*Orcinus orca*).

NMFS also concludes that the proposed action is likely to destroy or adversely modify the designated critical habitats of:

- Sacramento River winter-run Chinook salmon,

Natural factors such as snowmelt and human influences such as federal biological opinions can both influence the SWP's water delivery reliability.

The following factors affect the ability to estimate existing and especially future water delivery reliability:

- water availability at the source,
- water rights with priority over the SWP,
- regulatory restrictions on SWP Delta exports (imposed by federal biological opinions [BOs] and State water quality plans),
- climate change,

- ongoing environmental and policy planning efforts, and
- Delta levee failure.

Water Availability at the Source

This factor affects the SWP's water delivery reliability because it is inherently variable; availability of water at the source depends on the amount and timing of rain and snow that fall in any given year, the amount and timing of runoff, and the level of development (that is, the use of water) in the SWP's source areas. The location, amount, and form of precipitation in California in any given year cannot be accurately predicted, introducing the greatest uncertainty to the availability of future SWP source water and hence future SWP deliveries.

Generally, during a single dry year or two, surface water and groundwater storage can supply most water deliveries, but dry years can result in critically low water reserves.

DWR measures the water content of snowpack in the northern Sierra Nevada to forecast snowmelt runoff.

Greater reliance on groundwater during dry years results in high costs for many users and increases groundwater overdraft. Further, the ability of some contractors to use local groundwater may be limited; some groundwater basins may be contaminated by toxins such as methyl tertiary butyl ether (commonly known as MBTE), an ingredient in gasoline, and other aquifers may be too deep to reach economically. This makes the availability of the SWP's surface water to contractors especially important.

DWR manually measures snowpack in the northern Sierra Nevada monthly between early January and early May to forecast snowmelt runoff. These surveys and real-time electronic measurements taken throughout the winter measure the snowpack's water content. The size of the snowpack in the Feather River watershed on April 1—when snowpack water content normally is at its peak before the spring runoff—and the storage in Lake Oroville are key components of the SWP's delivery capabilities from April through September.

However, in some years, even measurements taken in the northern Sierra Nevada earlier in the year can demonstrate an apparent trend in water delivery reliability for the rest of the year (assuming that the weather follows typical patterns in spring). For example, manual readings conducted by DWR on December 28, 2010, off U.S. Highway 50 near Echo Summit showed snow-water equivalents in the state's northern mountains at 169% of normal for that date and 57% of the normal value for April 1. By contrast, the readings taken on the same date in 2009 had indicated snow-water equivalents in the northern mountains at 77% of normal for the date and 26% of the normal value for April 1. These findings indicated the potential for SWP deliveries in 2011 to increase relative to deliveries that occurred in 2010, a below-normal water year.

Water Rights with Priority Over the SWP

California's water rights system affects the SWP indirectly. There are two types of legally protected rights to surface water in California:

- *Appropriative* water rights allow the user to divert surface water for beneficial use. The user must first have obtained a permit from the State Water Resources Control Board (State Water Board), unless the appropriative water right predates 1914. Appropriative water rights may be lost if the water has gone unused for 5 years. The SWP diverts water from the Delta under appropriative water rights.
- *Riparian* water rights apply to lands traversed by or bordering on a natural watercourse. No permit is required to use this water, which must be used on riparian (adjacent) land and cannot be stored for later use.

Generally, the priority of an appropriative water right in California is "first in time, first in right"; therefore, an appropriative water right is subordinate to all prior water rights, whether appropriative or riparian. This means that if another entity with a prior water right increases its use of one of the SWP's sources of water supply—the Delta, the upstream Sacramento or San Joaquin River, or a tributary to either river—the overall amount of water available to the SWP will decrease. Thus, water users with prior water rights are assigned top priority for water in DWR's modeling of the SWP's water delivery reliability, even ahead of SWP Table A water deliveries.

Regulatory Restrictions on SWP Delta Exports

Multiple needs converge in the Delta: the need to protect a fragile ecosystem, to support Delta recreation and farming, and to provide water for agricultural and urban needs throughout much of California. Various regulatory requirements are placed on the SWP's Delta operations to protect special-status species such as delta smelt and spring- and winter-run Chinook salmon. As a result, as described below, restrictions on SWP operations imposed by State and federal agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year.

Biological Opinions on Effects of Coordinated SWP and CVP Operations

Several fish species listed under the federal Endangered Species Act (ESA) as endangered or threatened are found in the Delta. The continued viability of populations of these species in the Delta depends in part on Delta flow levels. For this reason, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have issued several BOs since the 1990s on the effects of coordinated SWP/CVP operations on several species.

These BOs affect the SWP's water delivery reliability for two reasons. Most obviously, they include terms that specifically restrict SWP pumping levels in the Delta at certain times under certain conditions. In addition, the BOs' requirements are based on physical and biological phenomena that occur daily while DWR's water supply models are based on monthly data.

The first BOs on the effects of SWP (and CVP) operations were issued in February 1993 (NMFS BO on effects of project operations on winter-run Chinook salmon) and March 1995 (USFWS BO on project effects on delta smelt and splittail). Among other things, the BOs contained requirements for Delta inflow, Delta outflow, and reduced export pumping to meet specified incidental take limits. These fish protection requirements imposed substantial constraints on Delta water supply operations. Many were incorporated into the 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta* (1995 WQCP), as described in the "Water Quality Objectives" section later in this chapter.

The terms of the USFWS and NMFS BOs have become increasingly restrictive in recent years. In December 2008, USFWS issued a new BO covering effects of the SWP and CVP on delta smelt, and in June 2009, NMFS issued a BO covering effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. These BOs replaced BOs issued earlier by the federal agencies.

The USFWS BO includes additional requirements in all but 2 months of the year. The BO calls for "adaptively managed" (adjusted as necessary based on the results of monitoring) flow restrictions in the Delta intended to protect delta smelt at various life stages. USFWS determines the required target flow, with the reductions accomplished primarily by reducing SWP and CVP exports. Because this flow restriction is determined based on fish location and decisions by USFWS staff, predicting the flow restriction and corresponding effects on export pumping with any great certainty poses a challenge. The USFWS BO also includes an additional salinity requirement in the Delta for September and October in wet and above-normal water years, calling for increased releases from SWP and CVP reservoirs to reduce salinity. Among other provisions included in the NMFS BO, limits on total Delta exports have been established for the months of April and May. These limits are mandated for all but extremely wet years.

The 2008 and 2009 BOs were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third consecutive dry year. NMFS calculated that implementing its BO would reduce SWP and CVP Delta exports by a combined 5% to 7%, but DWR's initial estimates showed an impact on exports closer to 10% in average years, combined with the effects of pumping restrictions imposed by BOs to protect delta smelt and other species. The 2008 USFWS and 2009 NMFS BOs have been subject to considerable litigation. Recent decisions by U.S. District Judge Oliver Wanger changed specific operational rules for the fall/winter of 2011–2012, and both the USFWS BO and NMFS BO have been remanded to the agencies for further review and analysis. However, the operational rules specified in the 2008 and 2009 BOs continue to be legally required and are the rules used in the analyses presented in Chapters 5, 6, and 7 of this report. Chapter 5 presents a comparison of monthly Delta exports as estimated for this 2011 Report with those estimated for the 2005 Report, illustrating how the 2008 and 2009 BOs have affected export levels from the Delta.

The California Department of Fish and Game (DFG) issued consistency determinations for both BOs under Section 2080.1 of the California Fish and Game Code. The consistency determinations stated that the USFWS BO and the NMFS BO would be consistent with the California Endangered Species Act (CESA). Thus, DFG allowed incidental take of species listed under both the federal ESA and CESA to occur during SWP and CVP operations without requiring DWR or the U.S. Bureau of Reclamation to obtain a separate State-issued permit.

Specific restrictions on Delta exports associated with the USFWS and NMFS BOs and their effects on SWP pumping levels are described further in Chapter 5, "SWP Delta Exports," of this report.

Water Quality Objectives

Because the Delta is an estuary, salinity is a particular concern. In the 1995 WQCP, the State Water Board set water quality objectives to protect beneficial uses of water in the Delta and Suisun Bay. The objectives must be met by the SWP (and federal CVP), as specified in the water right permits issued to DWR and the U.S. Bureau of Reclamation. Those objectives—minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity levels—are enforced through the provisions of the State Water Board's Water Right Decision 1641 (D-1641), issued in December 1999 and updated in March 2000.

DWR and Reclamation must monitor the effects of diversions and SWP and CVP operations to ensure compliance with existing water quality standards. Monitoring stations are shown in Figure 4-1.

Among the objectives established in the 1995 WQCP and D-1641 are the "X2" objectives. D-1641 mandates the X2 objectives so that the State Water Board can regulate the locations of the Delta estuary's salinity gradient during the months of February–June. X2 is the position in the Delta where the electrical conductivity (EC) level, or salinity, of Delta water is 2 parts per thousand. The location of X2 is used as a surrogate measure of Delta ecosystem health. For the X2 objective to be achieved, the X2 position must remain downstream of Collinsville in the Delta (shown in Figure 4-1) for the entire 5-month period, and downstream of other specific locations in the Delta on a certain number of days each month from February through June. This means that Delta outflow must be at certain specified levels at certain times—which can limit the amount of water the SWP may pump at those times at its Harvey O. Banks Pumping Plant in the Delta. Because of the relationship between seawater intrusion and interior-Delta water quality, meeting the X2 objective also improves water quality at Delta drinking-water intakes; however, meeting the X2 objectives can require a relatively large volume of water for outflow during dry months that follow months with large storms.

The 1995 WQCP and D-1641 also established an export/inflow (E/I) ratio. The E/I ratio, presented in Table 3 of the 1995 WQCP (SWRCB 1995:18–22), is designed to provide protection for the fish and wildlife beneficial uses in the Bay-Delta estuary (SWRCB 1995:15). The E/I ratio limits the fraction of Delta inflows that are exported. When other restrictions are not controlling, Delta exports are limited to 35% of total Delta inflow from February through June and 65% of inflow from July through January.

Climate Change

The *California Water Plan Update 2009* identified climate change as a key consideration in planning for the State's water management. California's reservoirs and water delivery systems were developed based on historical hydrology; future weather patterns have long been assumed to be similar to those in the past. However, as climate change continues to affect California, past hydrology is no longer a reliable guide to future conditions. This section discusses effects on the SWP that could result from specific aspects of climate change.

Decreased Water Availability with Reduced Snowpack

As the effects of climate change continue, mean temperatures are predicted to increase, both globally and regionally. Climate projections used to assess the reliability of California's future water supply forecast average air temperature increases for the Sacramento region of 1.3 to 4.0 degrees Fahrenheit by the middle of the 21st century and 2.7 to 8.1 degrees by the end of the century (California Climate Change Center 2009a:8). Climate change is anticipated to bring warmer storms that result in less snowfall at lower elevations, reducing total snowpack. Loss of snowpack is projected to be greater in the northern Sierra Nevada—and thus closer to the Feather River watershed, the origin of SWP water—than in the southern Sierra Nevada because of the relative proportions of land at low and middle elevations.

Snowmelt provides an average of 15 million acre-feet of water for California per year, slowly released from about April to July each year (DWR 2006:2-22). Much of the state's water infrastructure, including the SWP, was designed to capture slow spring runoff and deliver it during the drier summer and fall months. However, during the 20th century, the average early-spring

Figure 4-1. Delta Salinity Monitoring Locations of Importance to the SWP

snowpack in the Sierra Nevada decreased by about 10%, resulting in the loss of 1.5 million acre-feet of snowpack storage (DWR 2008:3). Using historical data and modeling, DWR projects that by 2050 the Sierra snowpack will be reduced from its historical average by 25% to 40% (DWR 2008:4). Increased precipitation falling as rain instead of snow during winter could result in a larger number of "rain-on-snow" events. This would cause the snow to melt earlier in the year and over fewer days than historically, thus adversely affecting availability of water for pumping by the SWP during summer.

Such reductions in snowpack could have dire consequences. Under climate change and in some years, water levels in Lake Oroville, the SWP's main supply reservoir, could fall below the lowest release outlets, making the system vulnerable to operational interruption. DWR expects that a water shortage worse than the one during the 1977 drought could occur in 1 out of every 6–8 years by the middle of the 21st century and in 1 out of every 3–4 years at the end of the century (California Climate Change Center 2009a:46). In those years, it is estimated that an additional 575,000–850,000 acre-feet per year of water would be needed to meet current regulatory requirements and to maintain minimum system operations. This could preclude the SWP from pumping as much water as it would otherwise.

Climate change is also expected to reduce the SWP's median reservoir carryover storage. Carryover water is like a water savings account for water managers to use during shortage periods. Thus, a climate change–generated reduction in the amount of carryover water available to SWP contractors would reduce the system's flexibility during dry and critical water years.

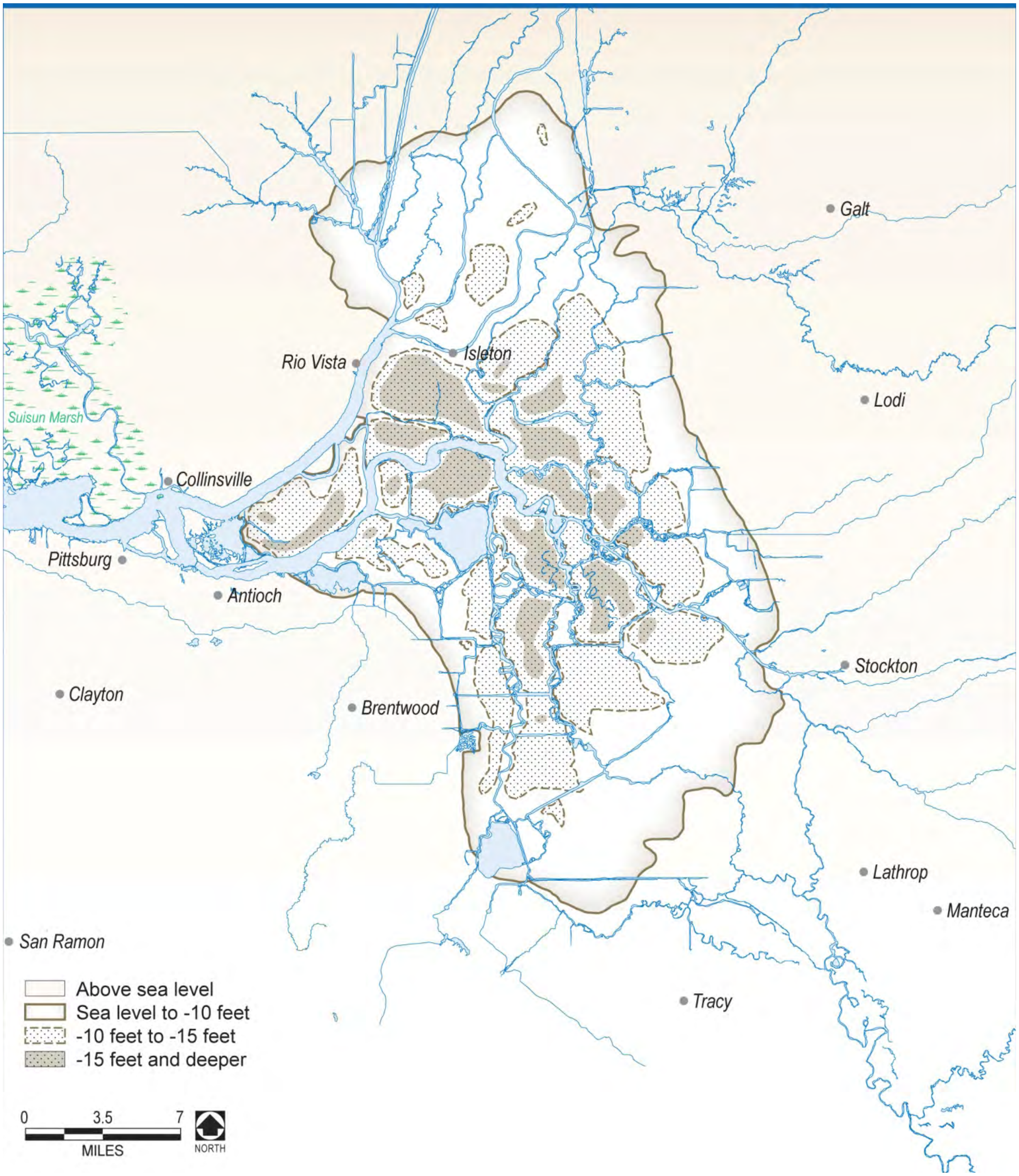
Increased SWP Water Demands

Even as water shortages may result from reduced snowpack, climate change may also cause water demand by SWP contractors to increase. Warmer temperatures may increase rates of evapotranspiration (loss of water from soil by evaporation and plant transpiration) and may extend growing seasons. A larger amount of water may be needed for irrigation of certain crops, urban landscaping, and environmental needs. Warmer temperatures will also increase evaporation from surface reservoirs. Reduced soil moisture and surface flow will disproportionately affect the environment and other water users that rely heavily on annual rainfall such as rainfed agriculture, livestock grazing on nonirrigated rangeland, and recreation.

Sea Level Rise

During the last century, sea level rose 7 inches along California's coast. Estimates of future sea level rise range from 4 to 16 inches by the middle of the 21st century and 7–55 inches by 2100 (DWR 2009b:4-37). The increases in sea level that are expected to continue could affect SWP water delivery reliability in several ways:

- Most of the land in the Delta is below sea level—by as much as 20 feet—as a consequence of ongoing subsidence (Figure 4-2). Increases in sea level could place more pressure on the Delta's already fragile levee system and, as a consequence, cause levee breaches that could threaten SWP Delta exports.
- As salty water from the Pacific Ocean moves farther upstream into the Delta, DWR could be required to increase the amounts of freshwater released from Lake Oroville to maintain compliance with Delta water quality standards.
- Sea level rise is expected to cause salt water to flow farther inland. The resulting increase in saltwater intrusion into coastal aquifers would make increasing amounts of groundwater unsuitable for water supply or irrigation (California Climate Change Center 2009b:80–81). The reduced availability of groundwater would likely contribute to further increases in demands for surface water from the SWP, especially by the coastal SWP contractors.



Source: DWR 1995:28

Figure 4-2. Areas of the Delta that Have Subsided to Below Sea Level

Adapting to Climate Change Effects in Forecasting Water Delivery Reliability

Chapter 7, "Future SWP Water Delivery Reliability (2031)," of this report estimates the SWP's delivery reliability for conditions 20 years in the future (2031), reflecting potential hydrologic changes that could result from climate change. Further details on these future projections are included in a technical addendum to this report (posted on the Internet and available upon request).

For purposes of this report and the technical addendum, the 2031 delivery estimates are based on a single median-impact future climate projection. To identify this projection, DWR analyzed the 12 climate projections for midcentury that were used in *Using Future Climate Projections to Support Water Resources Decision Making in California* (California Climate Change Center 2009a). The resulting water supply effects were examined to determine which one most closely represented the "central" or "median" projection. The analysis examined the following projected climate and hydrology variables and their effects on SWP exports: temperature, precipitation, total inflow to major reservoirs, shifts in timing of runoff, and Delta exports.

Ongoing Environmental and Policy Planning Efforts

As discussed earlier, the Delta is an essential part of the conveyance system for the SWP. SWP pumping at the Banks Pumping Plant is regulated to protect the many uses of the Delta. However, today's uses in the Delta are not sustainable over the long term under current management practices and regulatory requirements. As discussed below, two large-scale plans for the Delta that are in development could affect SWP water delivery reliability: the Delta Plan and the Bay Delta Conservation Plan (BDCP).

Delta Plan

After years of concern about the Delta amid rising water demand and habitat degradation, the Delta Stewardship Council was created in legislation to achieve State-mandated coequal goals for the Delta. As specified in Section 85054 of the California Water Code:

> "Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The draft Delta Plan seeks to reduce reliance on Delta water supplies. In a series of policies and recommendations, the draft plan aims to encourage farms and cities to increase conservation and become more self-sufficient, particularly in the event of a disaster in the Delta. It calls for agricultural water agencies to change pricing to encourage conservation. It also urges the State Water Board to set enforceable flow objectives for the Delta and its tributaries that take into account wildlife and habitat needs. In the future, government projects in the Delta must prove they are consistent with the Delta Plan.

The Delta Stewardship Council is preparing the draft Delta Plan and environmental impact report. Scheduled for adoption and implementation in 2012, the Delta Plan is intended to serve as California's guiding policy document for the Delta and Suisun Marsh for the next 88 years (that is, through the year 2099), with frequent updates.

Bay Delta Conservation Plan

The BDCP is being prepared by a group of local water agencies, environmental and conservation organizations, State and federal agencies, and other interest groups. An outgrowth of the CALFED Bay-Delta Plan's Ecosystem Restoration Program Conservation Strategy, the BDCP has been in development since 2006. The heart of the BDCP is a long-term conservation strategy that sets forth actions needed for a healthy Delta. The BDCP would do all of the following:

- identify conservation strategies to improve the overall ecological health of the Delta;
- identify ecologically friendly ways to move freshwater through and/or around the Delta;
- address toxic pollutants, invasive species, and impairments to water quality; and
- establish a framework and funding to implement the plan over time.

A draft environmental impact report is planned to be released for public review in mid-2012. The report is targeted to be final in 2013, after which a decision to proceed with the program would be made. Upon adoption, the BDCP would provide the basis for issuance of endangered species permits for the continued operation of the SWP and CVP. The plan would be implemented over a 50-year period.

Delta Levee Failure

The fragile Delta faces a multitude of risks that could affect millions of Californians. Foremost among those risks, as they could affect the SWP's water delivery reliability, are the potential for levee failure and the ensuing flooding and water quality issues.

The Delta Risk Management Strategy (DRMS) was initiated in response to Assembly Bill 1200 (2005), which directed DWR to use 50-, 100-, and 200-year projections to evaluate the potential impacts on Delta water supplies associated with continued land subsidence, earthquakes, floods, and climate change. The discussions below describe DRMS Phase 1, which evaluated the risks, and DRMS Phase 2, which is proposing various solutions. Also discussed are other efforts currently being undertaken by DWR and other agencies to reduce risks to the Delta, enhance emergency response capabilities, and reduce the risk of interruption of Delta water exports by the SWP and CVP.

Effects of Emergencies on Water Supplies: Delta Risk Management Strategy, Phase 1

Phase 1 of the DRMS, completed in 2008, assessed the performance of Delta and Suisun Marsh levees under various stressors and hazards and evaluated the consequences of levee failures to California as a whole.

The Delta is protected by levees built about 150 years ago. The levees are vulnerable to failure because most original levees were simply built with soils dredged from nearby channels, and were never engineered. Most islands in the Delta have flooded at least once over the past 100 years. For example, on June 3, 2004, a huge dry-weather levee failure occurred without warning on Upper Jones Tract in the south Delta, inundating 12,000 acres of farmland with about 160,000 acre-feet of water. Because many Delta islands are below sea level, deep and prolonged flooding could occur during a levee failure event, which could disrupt the quality and use of Delta water.

Levee failure can result from the combination of high river inflows, high tide, and high winds; however, levees can also fail in fair weather—even in the absence of a flood or seismic event—in a so-called "sunny day event." Damage caused by rodents, piping (in which a pipe-like opening develops below the base of the levee), or foundation movement could cause sunny-day levee breaches.

Many vulnerable Delta levees require installation of rock revetments, riprap, or other engineered structures along eroding banks to reduce erosion and protect levee foundations.

A breach of one or more levees and island flooding may affect Delta water quality and SWP operations. Depending on the hydrology and the size and locations of the breaches and flooded islands, a large amount of salt water may be pulled into the interior Delta from Suisun and San Pablo Bays. When islands are flooded, DWR may need to drastically decrease or even cease SWP Delta exports to evaluate the distribution of salinity in the Delta and avoid drawing saltier water toward the pumps.

Delta levees are prone to failure, increasing risks to State water supplies.

An earthquake could also put Delta levees, and thus SWP water supplies, at risk. In 2008, the 2007 Working Group on California Earthquake Probabilities estimated a probability of 63% that a magnitude 6.7 or greater earthquake would strike the San Francisco Bay Area in the next 30 years (Working Group 2008:6). An earthquake could severely damage Delta levees, causing islands to flood with salty water. The locations most likely to be affected by an earthquake are the west and southwest portions of the Delta because these areas are closer to potential earthquake sources. Flooding of the west and southwest Delta is also more likely to interfere with conveyance of freshwater to export pumps (DWR 2007:17).

Modeling of the effects of earthquakes on Delta islands was conducted by DWR for the DRMS Phase 1 report. Described in the *California Water Plan Update 2009*, the assessment found a 40% probability that a major earthquake occurring between 2030 and 2050 would cause 27 or more islands to flood at the same time. If 20 islands were flooded as a result of a major earthquake, the export of freshwater from the Delta could be interrupted by about a year and a half (DWR 2009b:5-15). Water supply losses of up to 8 million acre-feet would be incurred by SWP (and CVP) contractors and local water districts.

Managing and Reducing Risks: Delta Risk Management Strategy, Phase 2

The Phase 2 report for the DRMS, issued in June 2011, evaluates alternatives to reduce the risk to the Delta and the state from adverse consequences of levee failure (DWR 2011b). "Building blocks" (individual improvements or projects, such as improving levees or raising highways) and trial scenarios (various combinations of building blocks) were developed for the DRMS Phase 2 report. The building blocks fall into three main categories:

- conveyance improvements/ flood risk reduction and life safety,
- infrastructure risk reduction, and
- environmental risk mitigation.

The first of these categories is most relevant to the SWP in terms of reducing the risk of disruption of SWP Delta exports, but the environmental risk mitigation category includes a building block (Building Block 3.6) calling for reduction of water exports from the Delta.

Four trial scenarios were developed to represent a range of possible risk reduction strategies:

- *Trial Scenario 1—Improved Levees:* Improve the reliability of Delta levees against flood-induced failures by providing up to 100-year flood protection.
- *Trial Scenario 2—Armored Pathway (Through-Delta Conveyance):* Improve the reliability of water conveyance by creating a route through the Delta that has high reliability and the ability to minimize saltwater intrusion into the south Delta.
- *Trial Scenario 3—Isolated Conveyance Facility:* Provide high reliability for conveyance of export water by building an isolated conveyance facility on the east side of the Delta.
- *Trial Scenario 4—Dual Conveyance:* Improve reliability and flexibility for conveyance of export water by constructing an isolated conveyance facility and a through-Delta conveyance. (This scenario would be much like a combination of Trial Scenarios 2 and 3.)

The findings of the DRMS Phase 2 report on these scenarios, as they apply to seismic risk and potential for disruption of SWP Delta exports, are as follows:

- Trial Scenario 1 (Improved Levees) would not reduce the risk of potential water export interruptions, nor would it change the seismic risk of most levees.
- Trial Scenario 2 (Armored Pathway [Through-Delta Conveyance]) would have the joint benefit of reducing the likelihood of levee failures from flood events and earthquakes and of significantly reducing the likelihood of export disruptions.
- The effects of Trial Scenario 3 (Isolated Conveyance) would be similar to those for the Armored Pathway scenario, but Trial Scenario 3 would not reduce the seismic risk of levee failure on islands that are not part of the isolated conveyance facility.
- Trial Scenario 4 (Dual Conveyance) would avoid the vulnerability of water exports associated with Delta levee vulnerability and would offer flexibility in water exports from the Delta and/or the isolated conveyance facility. However, seismic risk would not be reduced on islands not part of the export conveyance system or infrastructure pathway.

As noted in the discussion of the “enhanced emergency preparedness/response” building block in the DRMS Phase 2 report, analyses on resuming water exports after a levee failure were conducted by the Metropolitan Water District of Southern California, an SWP contractor. The studies found that a promising way to resume water exports would be to place structural barriers at selected channel locations in the Delta and complete strategic levee repairs, thus isolating an emergency freshwater conveyance “pathway” through channels that may be surrounded by islands flooded with saline water (Moffatt and Nichol 2007, cited in DWR 2011b:5-1).

Delta Flood Emergency Preparedness, Response, and Recovery Program and Delta Multi-Hazard Coordination Task Force

In the last 5 years, DWR has worked to improve its ability to respond quickly and effectively to simultaneous levee failures on multiple islands within the Delta. The *Delta Emergency Operations Plan Concept Paper* released in April 2007 (DWR 2007) was the initial product of this effort. To enhance the State’s ability to prepare for, respond to, and recover from a catastrophic Delta levee failure, DWR subsequently began development of the Delta Flood Emergency Preparedness, Response, and Recovery Program. This program is intended to supplement DWR’s emergency operations plan. The goal is to protect lives, property, and critical infrastructure in the Delta while minimizing impacts on the ecosystem. The program consists of three components:

- develop DWR’s Delta response and recovery plan,
- coordinate DWR’s plan with other Delta flood emergency response agencies, and

- design and implement flood emergency response facilities within the Delta.

The flood emergency response plan for the Delta will describe the actions DWR will take before, during, and after a levee-endangering event or levee failure in the Delta. The Delta Flood Emergency Preparedness, Response, and Recovery Program is conducting an extensive effort to model water quality implications of levee failure and salinity changes associated with different levee repair strategies. DWR is coordinating this effort with the U.S. Army Corps of Engineers and expects to reach out to the five Delta counties during plan development.

DWR is also a member of the Sacramento–San Joaquin Delta Multi-Hazard Coordination Task Force, which was created in 2008 in the wake of passage of the Sacramento–San Joaquin Delta Emergency Preparedness Act of 2008. The task force is led by the California Emergency Management Agency (CalEMA); in addition to DWR, the Delta Protection Commission and representatives from each of the five Delta counties also participate in task force activities. An Emergency Preparedness and Response White Paper was prepared for the Delta Stewardship Council on November 8, 2010, describing the operations of this task force.

The Sacramento–San Joaquin Delta Multi-Hazard Coordination Task Force was created to make recommendations to CalEMA on creating a framework for an interagency unified command system, coordinate the development of a draft emergency preparedness and response strategy for the Delta region, and develop and conduct an all-hazards emergency response exercise in the Delta. The task force's draft emergency preparedness and response strategy includes a process for allocating scarce resources and a statement of priorities agreed to by the members of the task force. The original deadline for the task force's report has been legislatively extended to January 1, 2013.

Chapter 5

SWP Delta Exports





The purpose of this chapter is to illustrate the effects of factors described in Chapter 4, "Factors that Affect Water Delivery Reliability," on SWP water supplies transferred through the Delta and pumped at the Harvey O. Banks Pumping Plant in the south Delta. These supplies are referred to as "Delta exports." Past SWP delivery reliability reports characterized SWP deliveries in their entirety but did not focus specifically on Delta exports. This chapter describes SWP Delta exports to illustrate how regulatory requirements and climate change have affected or will affect the SWP's Delta water supplies, and to describe the general pattern of monthly SWP exports from the Delta.

This chapter focuses only on Delta exports that are associated with the SWP, not on CVP water that may have been exported through the Banks Pumping Plant via the CVP/SWP joint point of diversion.

This chapter briefly explains the difference between Delta exports and SWP deliveries, then describes trends in projected average annual exports and SWP Table A water deliveries under various recent existing-conditions scenarios. In addition, monthly exports estimated for this *State Water Project Delivery Reliability Report 2011* (2011 Report) are compared with those estimated for the *State Water Project Delivery Reliability Report 2005* (2005 Report) to illustrate the effect of regulatory restrictions.

This chapter also summarizes the primary factors influencing the SWP's Delta export operations and deliveries, presents estimates of exports for the existing-conditions and future-conditions scenarios, and characterizes the likelihood of such exports. Estimated SWP Delta exports by water year type are depicted relative to exports that were estimated for the existing-conditions and future-conditions scenarios in the *State Water Project Delivery Reliability Report 2009* (2009 Report).

SWP Delta Exports versus SWP Deliveries

SWP Delta exports and SWP deliveries are characterized in separate chapters (this chapter for Delta exports, Chapters 6 and 7 for SWP deliveries) because these two terms are not one and the same.

Water pumped from the Delta is the primary source of SWP supply for 24 of the

29 SWP water contractors listed in Chapter 3, "SWP Contractors and Water Contracts." (Occasionally, during very wet periods, flood flows can enter the aqueduct and contribute to SWP supply south of the Delta.) As used in this report, "Delta exports" are the water supplies that are transferred ("exported") directly to SWP contractors or to San Luis Reservoir storage via the Banks Pumping Plant.

SWP Delta exports do not include deliveries of SWP water to the two North Bay Area contractors, which receive SWP water pumped by the Barker Slough Pumping Plant and conveyed by the North Bay Aqueduct. (Water conveyed to the SWP's three Feather River Area contractors is not transferred through the Delta and is not the focus of this chapter or of Chapters 6 and 7.)

By contrast, SWP Table A water deliveries from the Delta include both water pumped by the Banks Pumping Plant and conveyed by the California Aqueduct and water pumped by the Barker Slough Pumping Plant and conveyed by the North Bay Aqueduct. Thus, Table A water deliveries, as described in Chapters 6 and 7, also include deliveries to the two North Bay Area contractors, for a total of 26 SWP contractors.

SWP Delta exports include nearly all types of SWP water, not merely Table A water (see the explanation of SWP water types in Chapter 3). As allowed under the SWP's water supply contracts, the amount pumped from the Delta can be exported in the same year as Table A water, or can be exported as Article 21 water if available. A contractor can opt to have exported Table A water held in San Luis Reservoir as carryover water—that is, as part of the contractor's supply for a subsequent year or made available to another SWP contractor as turnback pool water. Article 21 water must be delivered immediately to SWP contractors when exported and cannot be stored in SWP facilities.

Recent Trends in SWP Delta Exports and Table A Deliveries

SWP Delta exports and Table A deliveries estimated for this 2011 Report are reduced by the operational restrictions imposed on the SWP by the biological opinions (BOs) issued by the U.S. Fish and Wildlife Service (USFWS) in December 2008 and the National Marine Fisheries Service (NMFS) in June 2009. This same scenario occurred in the 2009 Report. By contrast, the *State Water Project Delivery Reliability Report 2007* (2007 Report) incorporated interim, less restrictive operational rules established by U.S. District Judge Oliver Wanger in December 2007 while the USFWS and NMFS BOs were rewritten. The 2005 Report was based on much less restrictive operational rules contained in the BOs that had been issued in late 2004 and 2005.

Overall trends in both SWP Delta exports and Table A deliveries under existing conditions are summarized below. (For further detail on estimated SWP Table A deliveries for the existing-conditions and future-conditions scenarios, respectively, see Chapters 6 and 7.)

Annual Exports and Table A Deliveries—2005–2011 Scenarios

Figure 5-1 illustrates the effect of the operational restrictions imposed by the USFWS and NMFS BOs on estimated average annual Delta exports and Table A water deliveries. The figure depicts the average values estimated for existing conditions in the 2005, 2007, 2009, and 2011 Reports.

As shown in Figure 5-1, estimated average annual Delta exports and SWP Table A water deliveries have generally decreased since 2005, when rules affecting SWP pumping operations began to become more restrictive. Under existing conditions, average annual Delta exports have decreased since 2005 from 2,958 thousand acre-feet per year (taf/year) to 2,607 taf/year in 2011, a decrease of 351 taf or 11.9%; average annual Table A deliveries have decreased since 2005 from 2,818 taf/year to

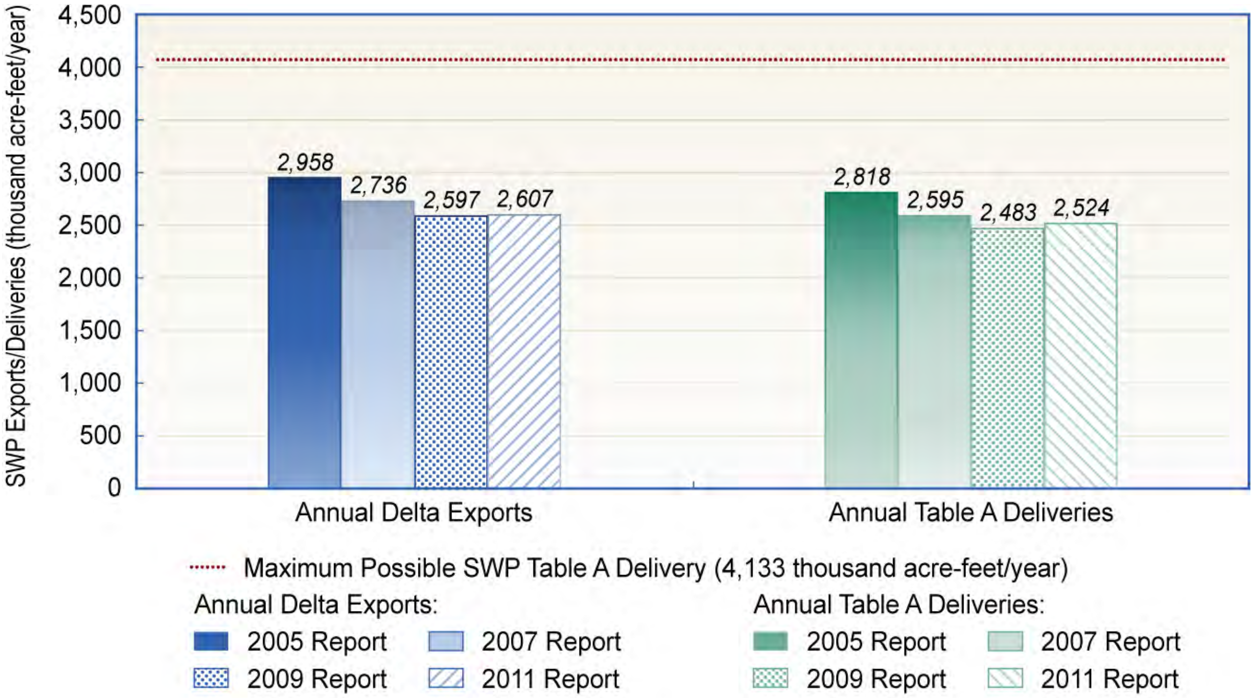


Figure 5-1. Trends in Estimated Average Annual Delta Exports and SWP Table A Water Deliveries (Existing Conditions)

2,524 taf/year in 2011, a decrease of 294 taf or 10.4%. The reasons for these decreases are described under "Primary Factors Affecting SWP Delta Export Operations and Table A Water Deliveries," below.

Monthly Delta Exports—2011 Scenario versus 2005 Scenario

Figure 5-2 illustrates the effects of the operational restrictions imposed by the BOs on SWP Delta exports since 2005 by comparing monthly existing-conditions exports estimated for this 2011 Report with those estimated for the 2005 Report. The bar charts show the average exports for each month under each scenario estimated for both reports.

As shown in Figure 5-2, average monthly SWP Delta exports estimated for the 2011 Report are lower than those estimated for the 2005 Report both in the first half of the year and from October through December. The reductions in exports for January through June are substantial, ranging from 22% in June to 58% in April. Exports for July and August as estimated for the 2011 Report exceed those estimated for the 2005 Report, but the increases (17% in August and approximately 45% in July) are generally smaller than the reductions seen earlier in the year.

Compiling the monthly average values for exports for the entire year under each scenario reveals that, as indicated previously in the description of annual exports, the average annual exports estimated for the 2011 Report are 11.9% less than those estimated for the 2005 Report.

Primary Factors Affecting SWP Delta Export Operations and Table A Water Deliveries

Under current operational constraints on the SWP, maximum exports from the Banks Pumping Plant are generally limited to 6,680 cubic feet per second, except between December 15 and March 15, when exports can be increased by one-third of the San Joaquin River

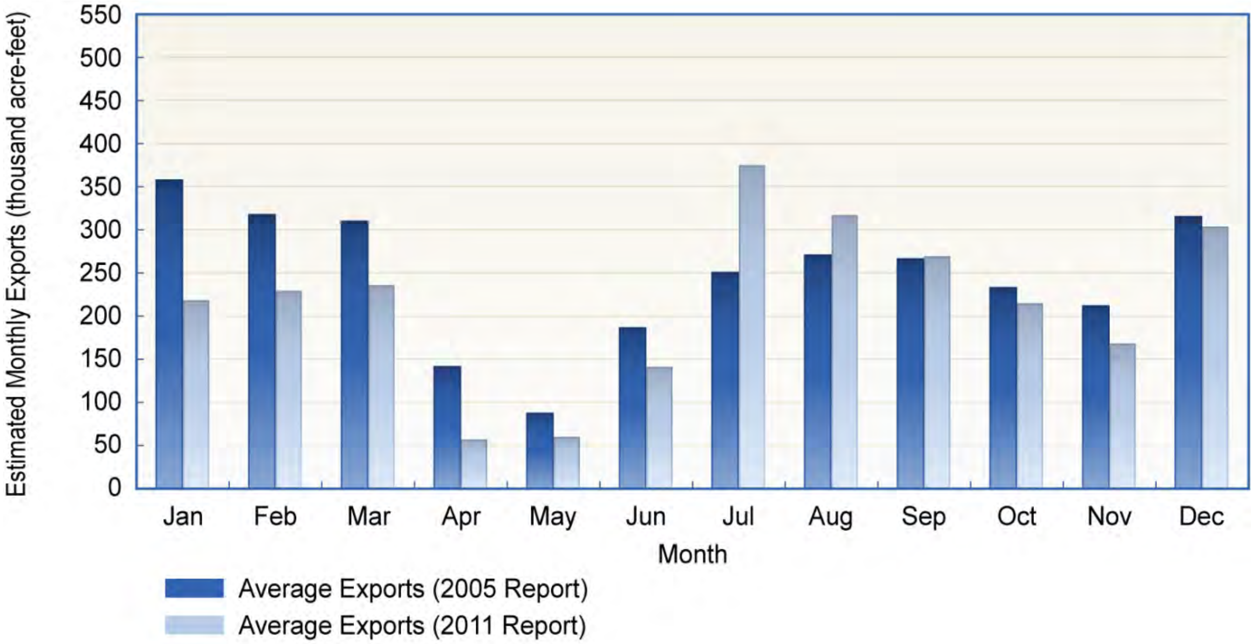


Figure 5-2. Estimated Monthly SWP Delta Exports (Existing Conditions), 2011 Scenario versus 2005 Scenario

flow at the Vernalis gauge (when the Vernalis flow is greater than 1,000 cubic feet per second). As explained previously in Chapter 4, regulatory restrictions on the SWP's Delta operations have been among the major factors affecting SWP water delivery reliability. Several of those influence SWP exports from the Banks Pumping Plant and, at times, impose particular limitations on exports. These limits are summarized here to illustrate how they affect the values shown in Figure 5-2:

- *2008 USFWS and 2009 NMFS BOs:* These BOs are much more restrictive than the BOs they replaced. The USFWS BO includes flow restrictions to protect delta smelt, with requirements in all but 2 months of the year. The NMFS BO contains similar limits for January through mid-June, but the greatest restriction imposes limits on total Delta exports in the months of April and May in most years to protect salmon and steelhead.
- *X2:* The "X2" objective mandated by the State Water Resources Control Board (State Water Board) regulates Delta salinity levels in the months of February–June. For the X2 position to be located in the appropriate location to achieve the State Water Board's salinity objective, Delta outflow must be at certain specified levels at certain times between February and June—which can constrain SWP pumping at the Banks Pumping Plant at those times.
- *Export/inflow ratio:* The 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta* and State Water Board Decision 1641 (D-1641) limits Delta exports to 35% of total Delta inflow from February through June. Thus, even if substantial runoff occurs during those months (such as during a year with considerable rain-on-snow events, projected to be more likely as the effects of climate change increase), the SWP is limited in its ability to benefit from the availability of that extra water in the Delta by increasing its pumping beyond this limit. Allowable exports increase to 65% of inflow from July through January.
- *Spring Export Limitations:* Spring is an important time in the life cycles of fish

> protected by the USFWS and NMFS BOs. As a result, requirements for Delta exports exist in several places. D-1641 limits SWP and CVP exports to 100% of the base flow of the San Joaquin River for 31 days during the April/May period. The NMFS BO limits the combined exports during all of April and May to a given percentage of the flow: 25% during above-normal and wet years to 100% in critical years. Finally, the previously mentioned flow requirements contained in the USFWS BO to protect delta smelt can also restrict exports during this time.

Figure 5-2 shows reductions in the values estimated for the 2011 Report during January through June and October through December that result from these restrictions. The period of July through September is the time when exports are less restricted. As a result—and to recover some of the water supply lost during the other months—the exports estimated for the 2011 Report for July–September are higher than those estimated for the 2005 Report.

Another factor described in Chapter 4, climate change, is expected to affect the Delta—and SWP exports from the Banks Pumping Plant—under future conditions. The effects of climate change on SWP operations have been factored into DWR's modeling for future conditions.

Estimated SWP Export Amounts—Existing Conditions and Future Conditions

This section provides estimates of average, maximum, and minimum annual Delta exports for both existing (2011) and future (2031) conditions. (Discussions of the assumptions used to develop both existing and future scenarios for this report are included in Chapters 6 and 7, respectively.) This section also summarizes SWP Delta exports by month and by water year type, demonstrating the effects of the USFWS and NMFS BOs and other factors influencing SWP Delta exports.

Average, Maximum, and Minimum Annual Delta Exports

Table 5-1 presents the estimated average, maximum, and minimum annual SWP Delta exports for the existing-conditions and future-conditions scenarios.

Table 5-1. Estimated Average, Maximum, and Minimum Annual SWP Exports (Existing and Future Conditions)

	Existing	Future
Average	2,607	2,521
Maximum	4,066	4,106
Minimum	876	810

Table 5-2. Average Estimated SWP Exports by Month (Existing and Future Conditions)

Month	Estimated SWP Exports (thousand acre-feet)		Difference, Existing vs. Future Conditions (thousand acre-feet and %)
	Existing	Future	
January	214	217	+4 (+2%)
February	228	217	-10 (-5%)
March	232	228	-5 (-2%)
April	60	65	+5 (+8%)
May	65	67	+2 (+4%)
June	145	131	-14 (-9%)
July	365	352	-12 (-3%)
August	316	311	-6 (-2%)
September	268	271	+3 (+1%)
October	223	186	-37 (-16%)
November	174	169	-5 (-3%)
December	317	305	-12 (-4%)

Exports by Month

Table 5-2, above, shows the average estimated SWP exports from the Delta by month under existing and future conditions. As shown in the table, in most months, the average estimated monthly SWP exports for future conditions are generally similar to or slightly lower than the estimated monthly exports for existing conditions. The most notable exceptions are in

April and May. Under both existing and future conditions, the values for those months are essentially the same, reflecting the regulations in place during that time of the year.

Figure 5-3 depicts the annual pattern of the monthly values for existing conditions as well as the maximum and minimum estimated exports for each month. The pattern and ranges of the monthly values under future conditions are very similar to those shown in Figure 5-3.

As shown in Figure 5-3 and Table 5-2, estimated SWP exports are highest on average in July, averaging 365 taf under existing conditions and 352 taf under future conditions. Exports are consistently lowest in April and May, averaging 60 taf in April and 65 taf in May for 2011, and 65 taf in April and 67 taf in May for 2031.

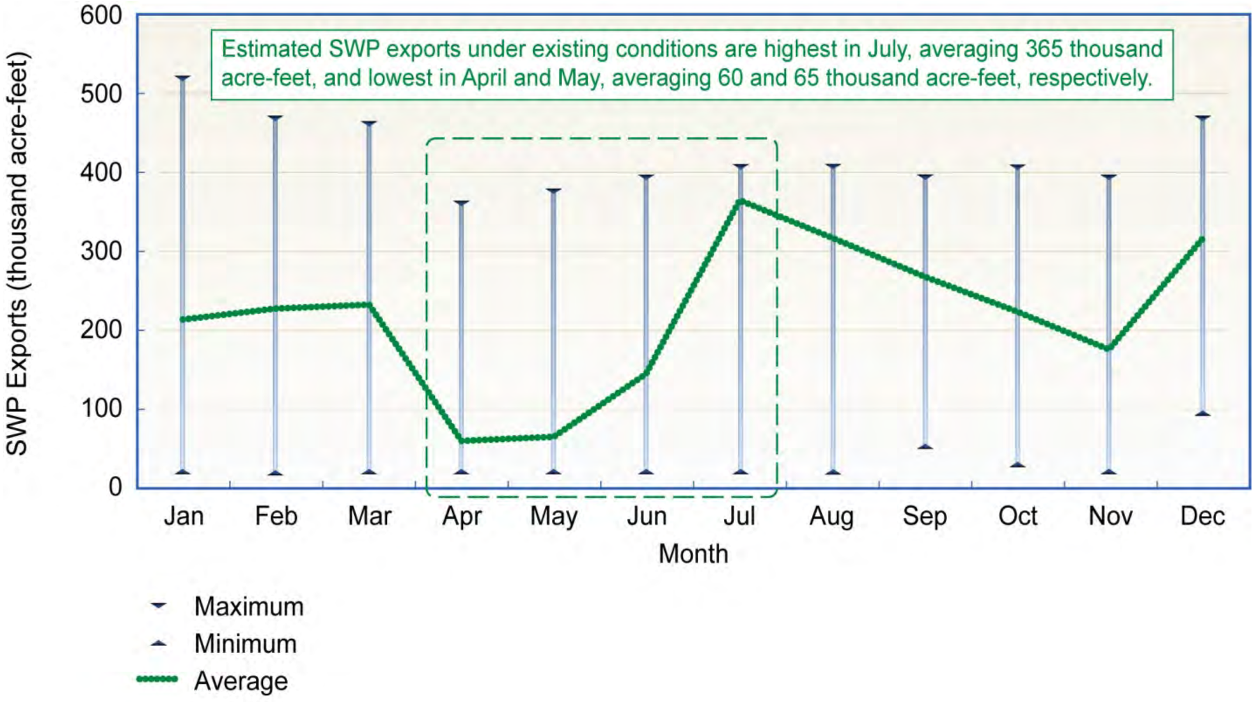


Figure 5-3. Monthly Range of Estimated SWP Exports (Existing Conditions)

Exports by Water Year Type

Tables 5-3 and 5-4 compare SWP exports by water year type under existing conditions and future conditions, as estimated for the 2009 Report and for this 2011 Report. As shown, the existing SWP exports estimated for this 2011 Report are very similar to the existing SWP exports estimated for the 2009 Report for most water year types. The same can be said of the values estimated for future conditions.

Table 5-3. Estimated SWP Exports by Water Year Type—Existing Conditions

Water Year Type	Estimated Existing SWP Exports (thousand acre-feet)	
	2009 Report	2011 Report
Wet	3,233	3,210
Above Normal	2,774	2,784
Below Normal	2,617	2,643
Dry	2,290	2,320
Critical	1,486	1,512
Average	*2,598*	*2,607*

Table 5-4. Estimated SWP Exports by Water Year Type—Future Conditions

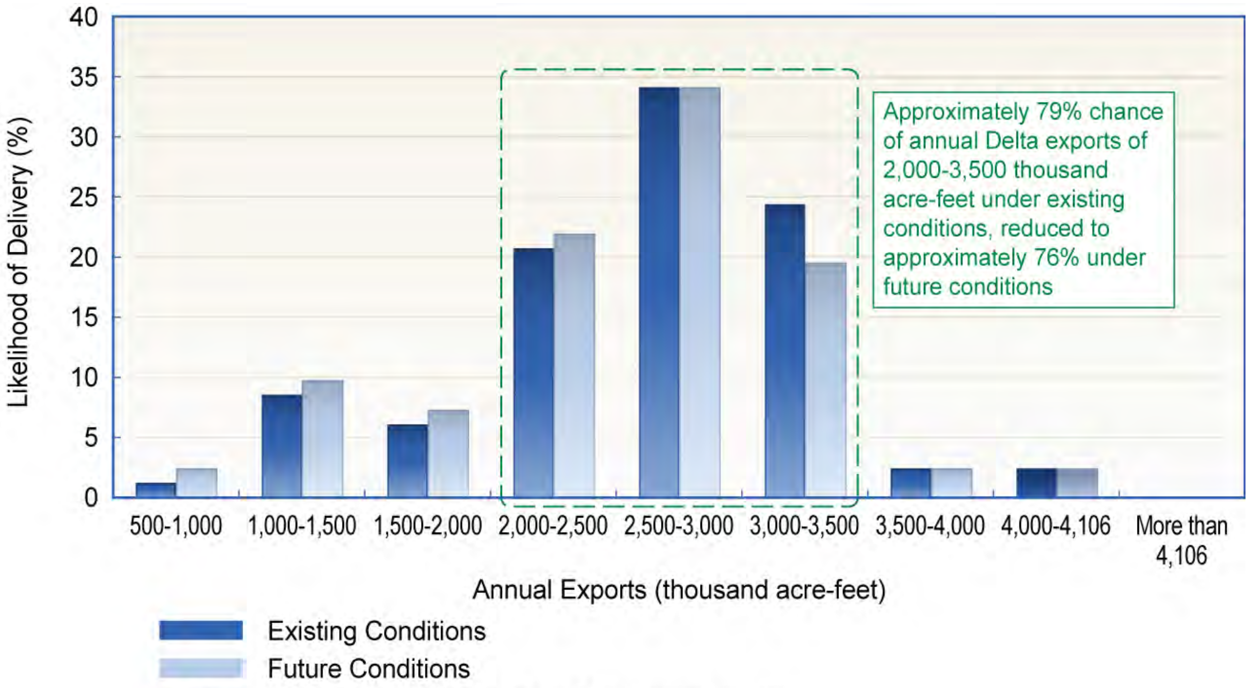
Water Year Type	Estimated Future SWP Exports (thousand acre-feet)	
	2009 Report	2011 Report
Wet	3,196	3,182
Above Normal	2,734	2,753
Below Normal	2,557	2,556
Dry	2,173	2,120
Critical	1,526	1,414
Average	*2,550*	*2,521*

Likelihood of SWP Exports—Existing and Future Conditions

The estimated likelihood of a given level of SWP exports under existing conditions and under future conditions is presented in Figure 5-4. As shown in the figure, 4,106 taf is the largest export amount that was modeled for the 2011 Report.

As shown in Figure 5-4, in 79% of simulated cases for existing conditions, estimated SWP exports are between 2,000 and 3,500 taf/year. SWP exports of other amounts are less likely, with the next most likely export amount being between 1,000 and 1,500 taf/year.

Likewise, in about 76% of simulated cases for future conditions, estimated SWP exports are between 2,000 and 3,500 taf/year (Figure 5-4). SWP exports of other amounts are less likely, with the next most likely export amount again being between 1,000 and 1,500 taf/year.



Approximately 79% chance of annual Delta exports of 2,000-3,500 thousand acre-feet under existing conditions, reduced to approximately 76% under future conditions

Note: Maximum annual SWP exports from the Delta = 4,133 thousand acre-feet.

Figure 5-4. Estimated Likelihood of SWP Exports, by Increments of 500 Acre-Feet (under Existing and Future Conditions)

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Chapter 6

Existing SWP Water Delivery Reliability (2011)

This chapter presents estimates of the SWP's existing (2011) water delivery reliability. The estimates are presented below, alongside the reliability results obtained from the *State Water Project Delivery Reliability Report 2009* (2009 Report). Like this *State Water Project Delivery Reliability Report 2011* (2011 Report), the 2009 Report incorporated into its results the requirements of biological opinions issued by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) in December 2008 and June 2009, respectively, on the effects of coordinated operations of the SWP and Central Valley Project. These BOs are discussed in detail in Chapter 2, "A Closer Look at the State Water Project," and Chapter 4, "Factors that Affect Water Delivery Reliability."

The discussions of SWP water delivery reliability in this chapter and Chapter 7 present the results of DWR's updated modeling of the SWP's water delivery reliability. A tabular summary of the modeling results is presented in the technical addendum to this report, which is available online at http://baydeltaoffice.water.ca.gov/. The technical addendum also contains curves of annual delivery probability (i.e., exceedence plots) to graphically show the estimated percentage of years in which a given annual delivery is equaled or exceeded.

Hydrologic Sequence

SWP delivery amounts are estimated in this 2011 Report for existing conditions using computer modeling that incorporates the historic range of hydrologic conditions (i.e., precipitation and runoff) that occurred from water years 1922 through 2003. The historic hydrologic conditions are adjusted to account for land-use changes (i.e., the current level of development) and upstream flow regulations that characterize 2011. By using this 82-year historical flow record, the delivery estimates modeled for existing conditions reflect a reasonable range of potential hydrologic conditions from wet years to critically dry years.

Existing Demand for Delta Water

Demand levels for the SWP water users in this report are derived from historical data and information from the SWP contractors themselves. The amount of water that SWP contractors request each year (i.e., demand) is related to:

- the magnitude and types of water demands,
- the extent of water conservation measures,
- local weather patterns, and
- water costs.

The existing level of development (i.e., the level of water use in the source areas from which the water supply originates) is based on recent land uses, and is assumed to be representative of existing conditions for the purposes of this 2011 Report.

SWP Table A Water Demands

The current combined maximum Table A amount is 4,172 thousand acre-feet per year (taf/year). See "'Table A' Water" in Chapter 3, "SWP Contractors and Water Contracts," for a full discussion of Table A, which is a table within each water supply contract. Of the combined maximum Table A amount, 4,133 taf/year is the SWP's maximum Table A water available for delivery from the Delta. The estimated demands by SWP contractors for deliveries of Table A water from the Delta under existing conditions, as determined for the 2011 Report and previously for the 2009 Report, are shown in Table 6-1. The estimated average demand for SWP Table A water is shown, along with maximum and minimum demands, because demands vary annually depending on local hydrologic patterns and other factors (e.g., demand management and the amount of water storage within the service area).

Table 6-1. Comparison of Estimated Average, Maximum, and Minimum Demands for SWP Table A Water (Existing Conditions)

	2009 Report	2011 Report
Average	3,711	3,722
Maximum	4,115	4,120
Minimum	3,007	3,043

As estimated for the 2011 Report, annual demands for SWP Table A water range between 3,043 taf and 4,120 taf under existing conditions, with an average demand of 3,722 taf. There is a 95% likelihood that more than 3,200 taf/year will be requested (i.e., demanded) for delivery under existing conditions. The estimated maximum SWP Table A water demand in the 2011 Report is very near the maximum possible Table A water delivery amount of 4,133 taf/year; however, the average annual demand of 3,722 taf is approximately 400 taf less than the possible maximum annual delivery.

Figure 6-1 shows that estimated annual demands for deliveries of SWP Table A water, as calculated for the 2009 and 2011 Reports, are essentially the same. Demands calculated for both reports range between 3,000 and 4,120 taf/year, regardless of whether a year is critical, wet, or anywhere in between.

SWP Article 21 Water Demands

Under Article 21 of the SWP's long-term water supply contracts, contractors may receive additional water deliveries only under the following specific conditions:

- such deliveries do not interfere with SWP Table A allocations and SWP operations;
- excess water is available in the Delta;
- capacity is not being used for SWP purposes or scheduled SWP deliveries; and
- contractors can use the SWP Article 21 water directly or can store it in their own system (i.e., the water cannot be stored in the SWP system).

The demand for SWP Article 21 water by SWP contractors is assumed to vary depending on the month and weather conditions (i.e., amounts of precipitation and runoff). For the purposes of this discussion of SWP Article 21 water demands, a Kern wet year is defined as a year when the annual Kern River flow is projected to be greater than 1,500 taf. Kern River inflows are significant

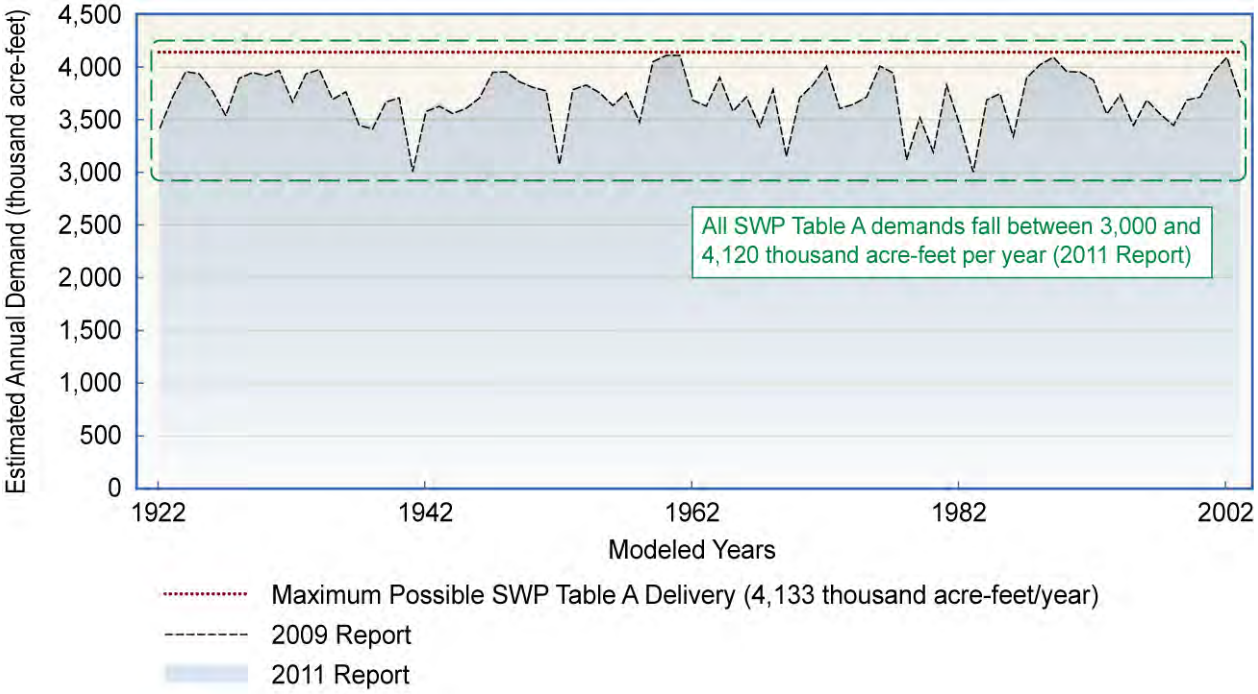


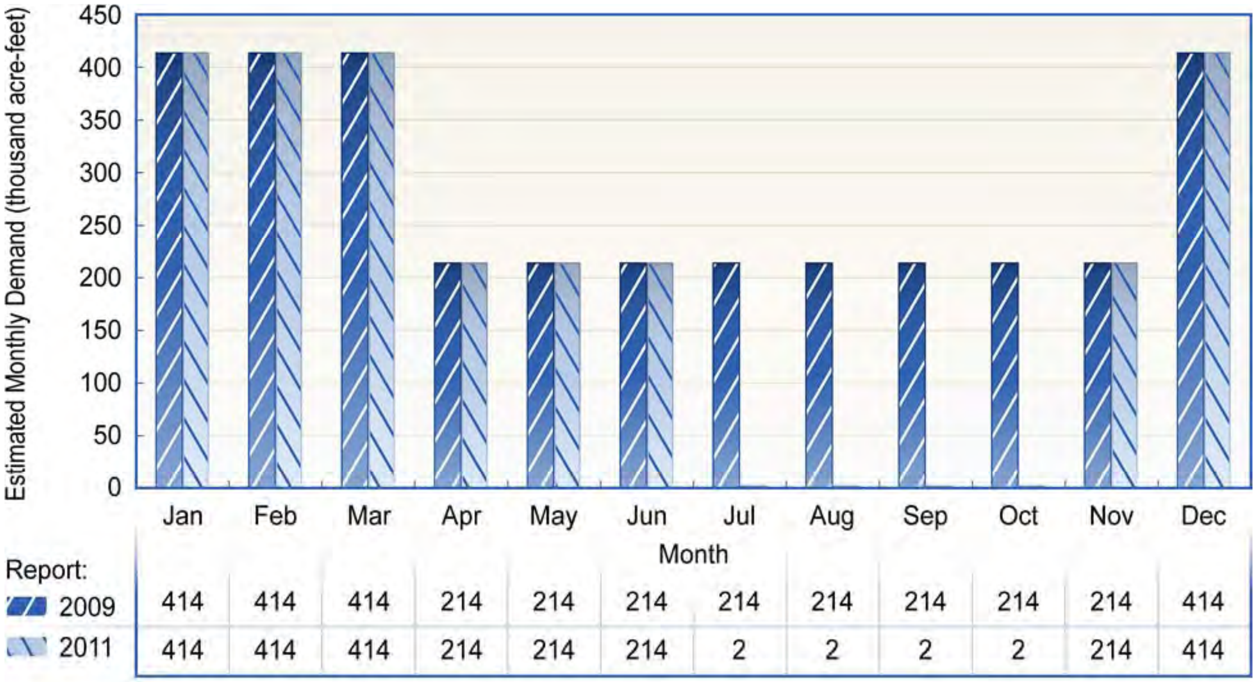
Figure 6-1. Comparison of Estimated Demands for SWP Table A Water on an Annual Basis, Using 82 Years of Hydrology (Existing Conditions)

because they are a major local water supply component for the Kern County Water Agency, which is the second largest SWP contractor and possesses significant local groundwater recharge capability. Using Kern River flows to recharge their groundwater storage significantly reduces their demand for Article 21 supply.

As shown in Figures 6-2 and 6-3, existing demands for SWP Article 21 water estimated for this 2011 Report are assumed to be high during the spring and late fall in non–Kern wet years (214 taf/month), as well as during the winter months of December through March in all weather year types (202 taf in Kern wet years and 414 taf in other years). Demands for SWP Article 21 water are assumed to be very low (2 taf/month) from April through November of Kern wet years and from July through October of other years.

Relative to levels of demand for SWP Article 21 water presented in the 2009 Report for existing conditions, the monthly existing-conditions demands for Article 21 water are 212 taf lower from July through October in normal weather years. This reduction in demand occurs because the modeling was revised for the 2011 Report to assume that only SWP contractors receiving water from the North Bay Aqueduct will have SWP Article 21 water demands during those months. A second revision to the modeling assumptions relative to the 2009 Report resulted in the addition of a year-round demand for 2 taf/month through the North Bay Aqueduct in 2011 during wet weather years.

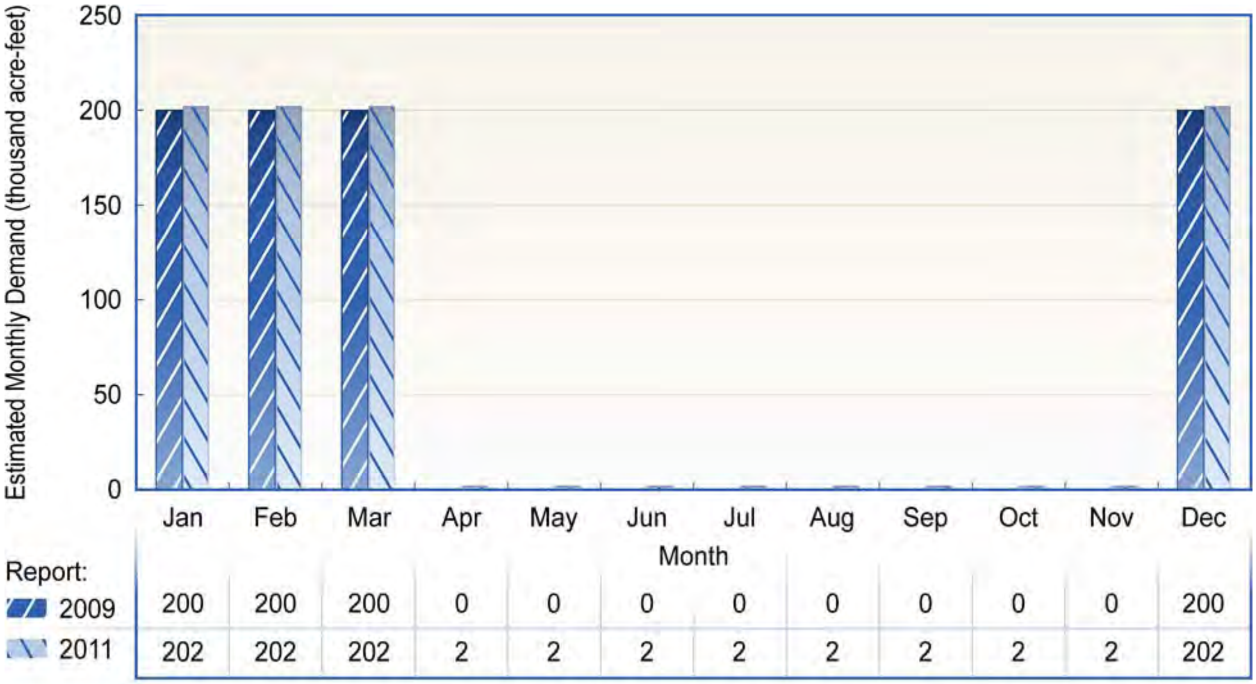
The estimated reduction in existing-conditions demand for SWP Article 21 water in this 2011 Report relative to the 2009 Report is the result of discussions with DWR's Operations and Maintenance staff and State Water Contractors staff, and it represents their best estimates of current practices. The SWP Article 21 water demands used in the 2009 Report, on the other



Report:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
▨ 2009	414	414	414	214	214	214	214	214	214	214	214	414
▧ 2011	414	414	414	214	214	214	2	2	2	2	214	414

Figure note: Values shown are the maximum amount that can be delivered monthly. However, the actual capability of SWP water contractors to take this amount of SWP Article 21 water is not the sum of these maximum monthly values.

Figure 6-2. Estimated Demands for SWP Article 21 Water in Years When Kern River Flow is Less than 1,500 Thousand Acre-Feet (Existing Conditions)



Report:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
▨ 2009	200	200	200	0	0	0	0	0	0	0	0	200
▧ 2011	202	202	202	2	2	2	2	2	2	2	2	202

Figure note: Values shown are the maximum amount that can be delivered monthly. However, the actual capability of SWP water contractors to take this amount of SWP Article 21 is not the sum of these maximum monthly values.

Figure 6-3. Estimated Demands for SWP Article 21 Water in Years When Kern River Flow is Greater than 1,500 Thousand Acre-Feet (Existing Conditions) hand, match the demands assumed in the studies conducted for the 2008 USFWS BO and 2009 NMFS BO, and those demands capture the upper boundary of the potential impact of SWP Article 21 exports on the Delta ecosystem. This assumption reflects a condition in which SWP contractors are able to use essentially any available SWP Article 21 water when capacity for moving that water exists in the SWP delivery system.

Estimates of SWP Table A Water Deliveries

Table 6-2 presents the annual average, maximum, and minimum estimates of SWP Table A deliveries from the Delta for existing conditions, as calculated for the 2009 and 2011 Reports. The Table A deliveries are similar between the 2009 and 2011 Reports. Assumptions about Table A and Article 21 water demands, along with operations for carryover water, have been updated in the model based on discussions with State Water Contractors staff and DWR's Operations and Control Office.

Table 6-2. Comparison of Estimated Average, Maximum, and Minimum Deliveries of SWP Table A Water (Existing Conditions, in Thousand Acre-Feet per Year)

	2009 Report	2011 Report
Average	2,483	2,524
Maximum	3,338	3,365
Minimum	301	380

The estimated likelihood of delivery of a given amount of SWP Table A water under the existing conditions scenario, as estimated for both the 2009 and 2011 Reports, is presented in Figure 6-4. Figure 6-4 shows that the likelihood that 2,000–3,365 taf/year of Table A water will be delivered is now 82%. There is a 48% likelihood that 2,500–3,000 taf of Table A water will be delivered, a 5% likelihood of delivery of less than 1,000 taf, and 0% likelihood of delivery of more than 3,365 taf in a given year. To compare the results estimated for this 2011 Report with results from the 2009 Report, an SWP contractor is just slightly more likely to receive a larger Table A water delivery under the current estimates.

Dry-Year Deliveries of SWP Table A Water

Table 6-3 displays estimates of SWP Table A water deliveries under existing conditions during possible drought conditions and compares them with the corresponding delivery estimates calculated for the 2009 Report. Droughts are analyzed using the historical drought-period precipitation and runoff patterns from 1922 through 2003 as a reference, although existing 2011 conditions (e.g., land use, water infrastructure) are also accounted for in the modeling. For reference, the worst multiyear drought on record was the 1929–1934 drought, although the brief drought of 1976–1977 was more intensely dry.

The results of modeling existing conditions for potential drought-year scenarios indicate that SWP Table A water deliveries during dry years can be expected to range from between 380 and 1,573 taf/year.

Wet-Year Deliveries of SWP Table A Water

Table 6-4 presents estimates of SWP Table A water deliveries under existing conditions during possible wet conditions and compares them with corresponding delivery estimates calculated for the 2009 Report. Wet periods for 2011 are analyzed using historical precipitation and runoff patterns from 1922–2003 as a reference, while accounting for existing 2011 conditions (e.g., land use, water infrastructure). For reference, the wettest single year on record was 1983.

The results of modeling existing conditions for potential wet periods indicate that estimated SWP Table A water deliveries during wet years can be expected to range between 2,833 and 2,958 taf/year.

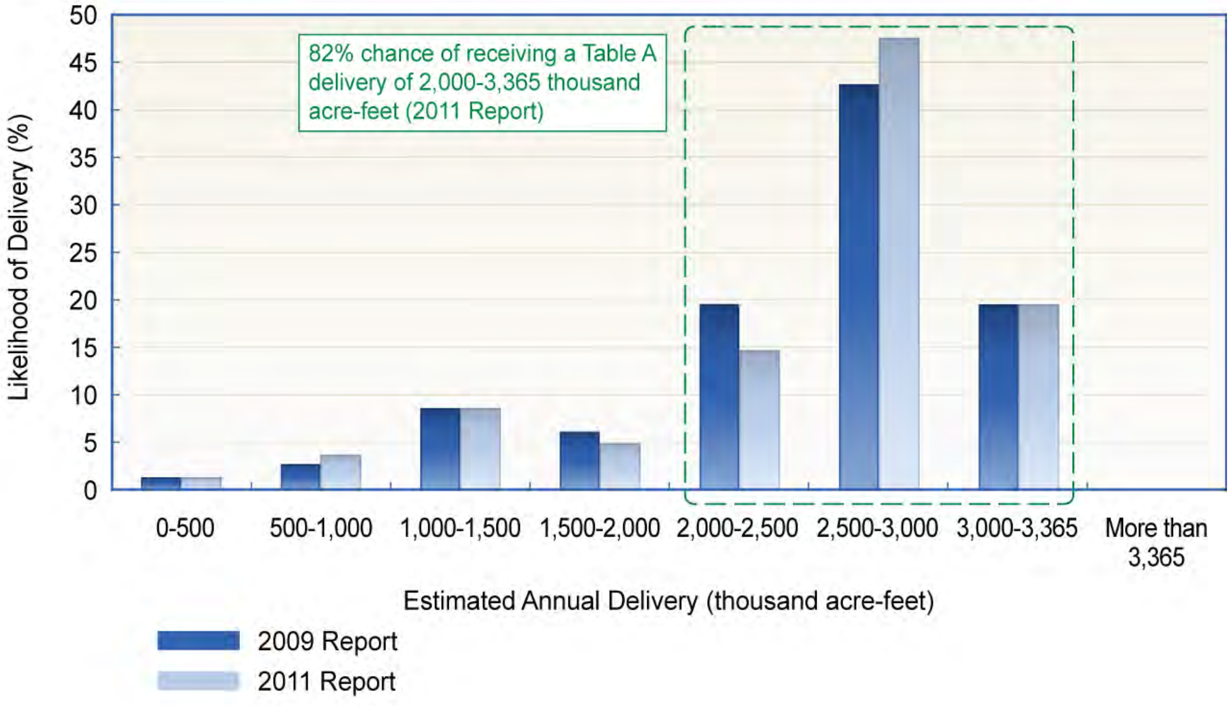


Figure 6-4. Estimated Likelihood of SWP Table A Water Deliveries (Existing Conditions)

Table 6-3. Estimated Average and Dry-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

	Long-term Average	Single Dry Year (1977)	2-Year Drought (1976–1977)	4- Year Drought (1931–1934)	6-Year Drought (1987–1992)	6-Year Drought (1929–1934)
2009 Report	2,483 (60%)	302 (7%)	1,496 (36%)	1,402 (34%)	1,444 (35%)	1,398 (34%)
2011 Report	2,524 (61%)	380 (9%)	1,573 (38%)	1,454 (35%)	1,462 (35%)	1,433 (35%)

Table 6-4. Estimated Average and Wet-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

	Long-term Average	Single Wet Year (1983)	2-Year Wet (1982–1983)	4-Year Wet (1980–1983)	6-Year Wet (1978–1983)	10-Year Wet (1978–1987)
2009 Report	2,483 (60%)	2,813 (68%)	2,935 (71%)	2,817 (68%)	2,817 (68%)	2,872 (67%)
2011 Report	2,524 (61%)	2,886 (70%)	2,958 (72%)	2,872 (69%)	2,873 (70%)	2,833 (69%)

Estimates of SWP Article 21 Water Deliveries

SWP water delivery is a combination of deliveries of Table A water and Article 21 water. Some SWP contractors store Article 21 water locally when extra water and capacity are available beyond that needed by normal SWP operations. Deliveries of SWP Article 21 water vary not only by year, but also by month. In the summer and early fall months (July through October), a maximum of 1 taf can be delivered. From November through June, maximum deliveries of SWP Article 21 water can be as high as 299 taf and as low as approximately 80 taf in a given month; however, water deliveries average in the range of 0–30 taf. The estimated range of monthly deliveries of SWP Article 21 water is displayed in Figure 6-5.

The estimated likelihood that a given amount of SWP Article 21 water will be delivered is presented in Figure 6-6. There is a 26% likelihood that more than 20 taf/year of SWP Article 21 water will be delivered under existing conditions. There is a 74% likelihood that less than 20 taf/year of SWP Article 21 water will be delivered.

Dry-Year Deliveries of SWP Article 21 Water

Although deliveries of SWP Article 21 water are smaller during dry years than during wet ones, opportunities exist to deliver SWP Article 21 water during multiyear drought periods. Deliveries in dry years are shown to often be small (less than 5 taf); however, longer drought periods can include several years that support Article 21 deliveries. Annual average Article 21 estimates for drought periods of 4 and 6 years vary significantly and can approach or exceed the average annual estimate, as shown in Table 6-5.

Wet-Year Deliveries of SWP Article 21 Water

Table 6-6 shows the estimates of deliveries of SWP Article 21 water during wet periods under existing conditions. Estimated deliveries in wet years are approximately 1.75 to seven times larger than the average delivery of SWP Article 21 water.

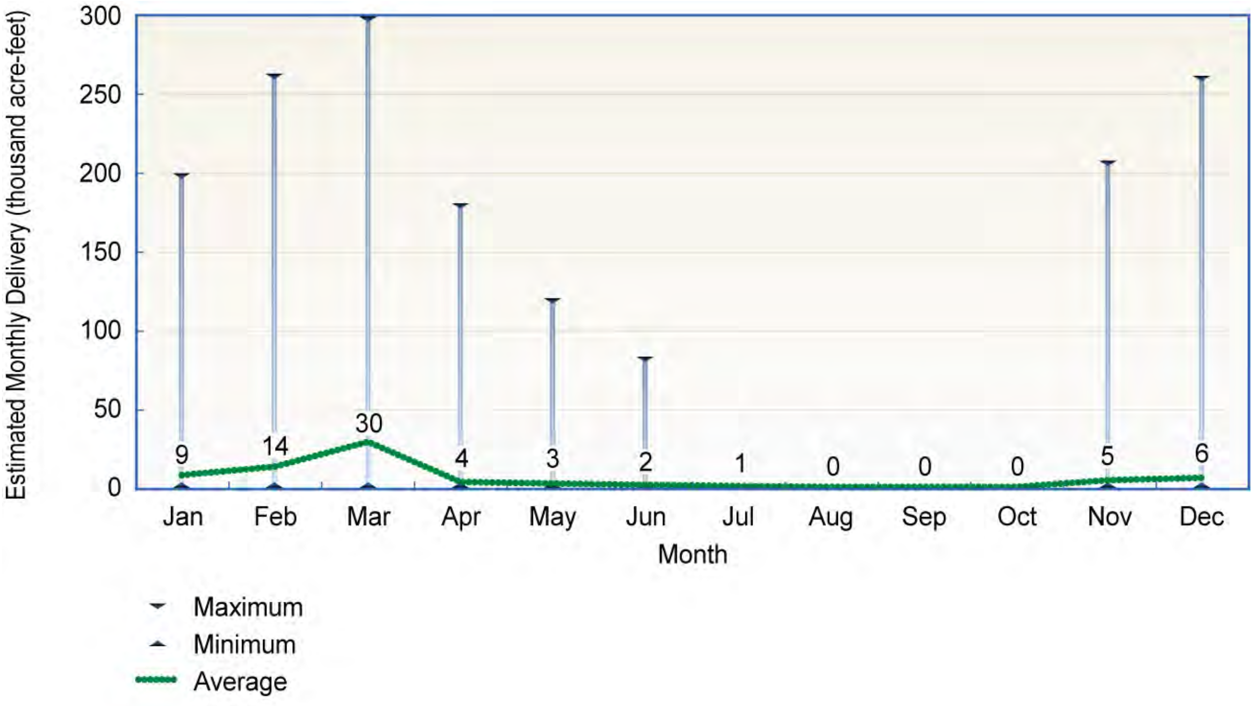


Figure 6-5. Estimated Range of Monthly Deliveries of SWP Article 21 Water (2011 Report—Existing Conditions)

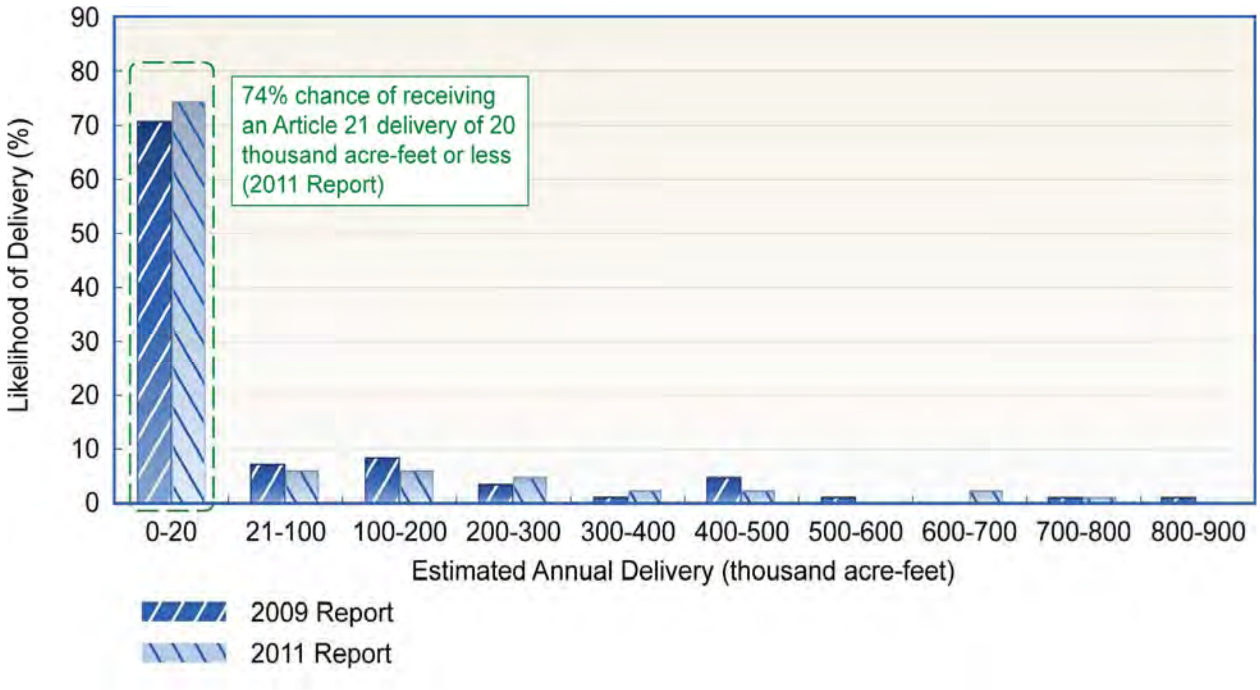


Figure 6-6. Estimated Probability of Annual Deliveries of SWP Article 21 Water (Existing Conditions)

Table 6-5. Estimated Average and Dry-Period Deliveries of SWP Article 21 Water (Existing Conditions, in Thousand Acre-Feet per Year)

	Long-term Average	Single Dry Year (1977)	2-Year Drought (1976-1977)	4- Year Drought (1931-1934)	6-Year Drought (1987-1992)	6-Year Drought (1929-1934)
2009 Report	85	2	6	142	10	98
2011 Report	76	3	5	69	9	49

Table 6-6. Estimated Average and Wet-Period Deliveries of SWP Article 21 Water (Existing Conditions, in Thousand Acre-Feet per Year)

	Long-term Average	Single Wet Year (1983)	2-Year Wet (1982-1983)	4-Year Wet (1980-1983)	6-Year Wet (1978-1983)	10-Year Wet (1978-1987)
2009 Report	85	853	659	379	273	230
2011 Report	76	608	533	307	225	207

Chapter 7

Future SWP Water Delivery Reliability (2031)

This chapter presents estimates of the SWP's delivery reliability for conditions 20 years in the future (2031). These estimates reflect hydrologic changes that could result from climate change, but they incorporate the same requirements that are assumed under existing conditions, including the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) biological opinions (BOs).

This chapter also compares these estimates of future conditions with the future-condition results presented in the *State Water Project Delivery Reliability Report 2009* (2009 Report) for the year 2029.

For consistency with previous reports, a tabular summary of the modeling results for the future conditions scenario is presented in the technical addendum to this report. The technical addendum also contains curves of annual delivery probability (i.e., exceedence plots) to graphically show the estimated percentage of years in which a given annual delivery is equaled or exceeded.

Future Demand for Delta Water

Demand levels for the SWP water users in this report are derived from historical data and information from the SWP contractors themselves. The 2031 level of development (i.e., the level of water use in the source areas from which the water supply originates) is based on the projected assumptions for land use for that year, and is assumed to be representative of future conditions for the purposes of this 2011 Report.

SWP Table A Water Demands

Future demands for SWP Table A water, as calculated for this 2011 Report, are assumed to be the maximum possible annual amount of 4,133 thousand acre-feet (taf). There is no assumed variation in demand as a result of different annual precipitation and runoff conditions; it is assumed that by 2031, the maximum amount of SWP Table A water will be requested every year. As a reminder, 4,133 taf/year is the maximum Delta SWP Table A amount.

The SWP Table A water demands under future conditions as presented in the 2009 Report are also assumed to be the maximum amount of 4,133 taf/year.

SWP Article 21 Water Demands

The assumed future demands for SWP Article 21 water are the same as those assumed for existing conditions (see Chapter 6, "Existing SWP Water Delivery Reliability [2011]").

Estimates of Future SWP Deliveries

When modeling water supply deliveries 20 years in the future, the unknowns are considerable and many assumptions must be made. As was assumed for existing conditions (see Chapter 6), modeling of SWP deliveries for 2031 take into account current Delta water quality regulations and the requirements of the USFWS and NMFS BOs. Climate change as well as changes to water uses in the upstream watersheds (i.e., source watersheds) are also taken into account when modeling water supply deliveries under future conditions. Additional discussion of how the modeling of SWP water delivery reliability is adjusted to account for climate change is provided in Chapter 4, "Factors that Affect Water Delivery Reliability."

One of the most important assumptions when modeling SWP water delivery under future conditions is that the rules and facilities related to Delta conveyance will remain at the status quo. That is, in the future-conditions scenario, no new facilities to convey water through or around the Delta are assumed to be in place because no new programs have been sufficiently developed that can be assumed with certainty.

Future Deliveries of SWP Table A Water

Table 7-1 presents the annual average, maximum, and minimum estimates of SWP Table A water deliveries from the Delta for future conditions, as calculated for the 2009 and 2011 Reports. The SWP Table A water deliveries under future conditions are similar between the 2009 and 2011 Reports. The maximum possible delivery of SWP Table A water, 4,133 taf/year, is not reached under future conditions.

Table 7-1. Comparison of Estimated Average, Maximum, and Minimum Deliveries of SWP Table A Water (Future Conditions, in Thousand Acre-Feet per Year)

	2009 Report	2011 Report
Average	2487	2,466
Maximum	3,999	4,063
Minimum	458	443

The estimated likelihood that a given amount of SWP Table A water will be delivered under future conditions is presented in Figure 7-1. Currently, there is a 70% likelihood that 2,000–3,500 taf of SWP Table A water will be delivered under the future-conditions scenario. There is a 17% likelihood of an SWP Table A water delivery of 1,000–2,000 taf, a 7% likelihood of less than 1,000 taf, and a 6% likelihood of more than 3,500 taf. In general, the estimates of the likelihood that an SWP contractor will receive a specific amount of SWP Table A water under future conditions, as presented in the 2009 and 2011 Reports, are very similar.

Dry-Year Deliveries of SWP Table A Water under Future Conditions

Table 7-2 presents estimates of future SWP Table A water deliveries during possible drought conditions and compares them with the corresponding delivery estimates calculated for the 2009 Report. Drought scenarios for future conditions in this 2011 Report are analyzed using the historical drought-period precipitation and runoff patterns from 1922–2003 as a reference, while accounting for future 2031 conditions (e.g., land use, climate change).

The results of modeling future conditions under potential drought-year scenarios indicate that estimated dry-year SWP deliveries can be expected to range between 443 and 1,457 taf/year.

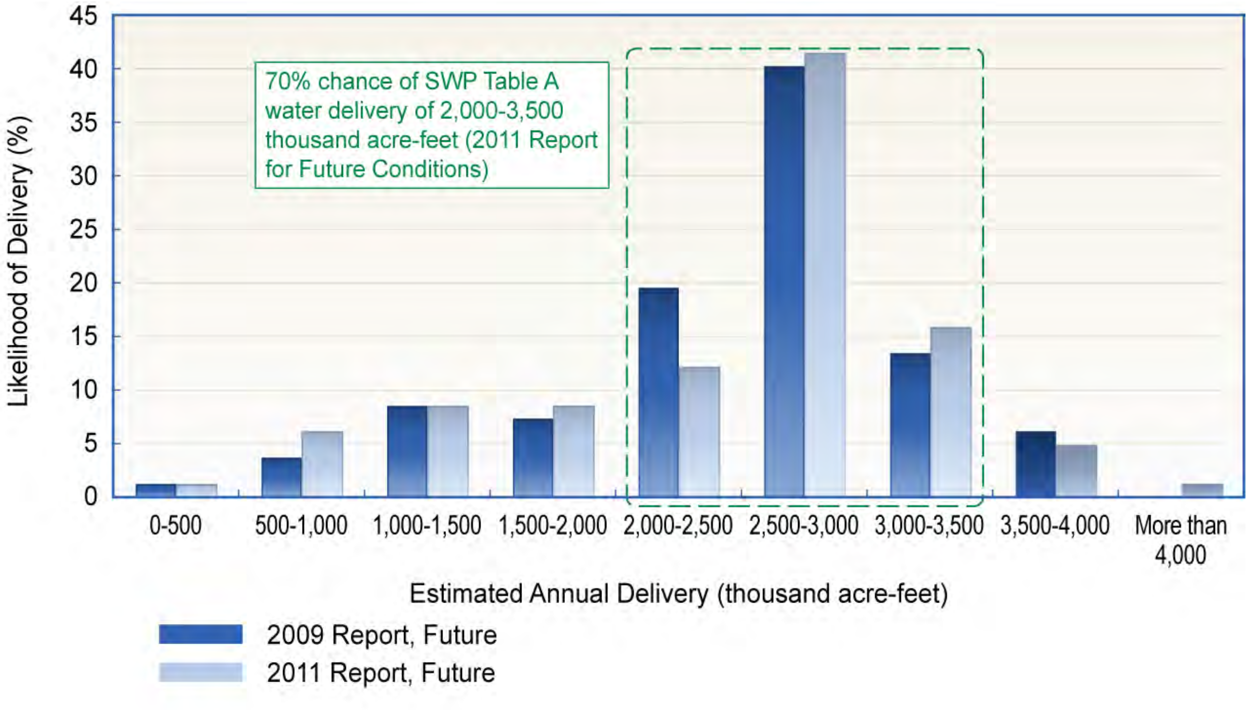


Figure 7-1. Estimated Likelihood of SWP Table A Water Deliveries, by Increments of 500 Thousand Acre-Feet (Future Conditions)

Table 7-2. Estimated Average and Dry-Period Deliveries of SWP Table A Water (Future Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

	Long-term Average	Single Dry Year (1977)	2-Year Drought (1976–1977)	4- Year Drought (1931–1934)	6-Year Drought (1987–1992)	6-Year Drought (1929–1934)
2009 Report	2,487 (60%)	458 (11%)	1,570 (38%)	1,431 (35%)	1,308 (32%)	1,480 (36%)
2011 Report	2,466 (60%)	443 (11%)	1,457 (35%)	1,401 (34%)	1,227 (30%)	1,366 (33%)

Wet-Year Deliveries of SWP Table A Water under Future Conditions

Table 7-3 presents estimates of future SWP Table A water deliveries during a wet year and compares them with the corresponding delivery estimates calculated for the 2009 Report. Wet periods were modeled for this 2011 Report using historical precipitation and runoff patterns from 1922–2003 as a reference and accounting for 2031 future conditions such as land use and climate change.

The results of modeling future conditions for potential wet periods indicate that estimated SWP Table A water deliveries during wet years can be expected to range between 2,972 and 4,063 taf/year.

SWP Article 21 Water Deliveries under Future Conditions

Estimated deliveries of SWP Article 21 water under future conditions vary not only by year, depending on the precipitation and runoff, but also by month. In the spring, summer, and early fall months (May through October), deliveries of SWP Article 21 water under future conditions are estimated to be low, with a maximum of approximately 10 taf/month and a minimum of 0 taf/month. From November through April, maximum estimated future deliveries of SWP

Table 7-3. Estimated Average and Wet-Period Deliveries of SWP Table A Water (Future Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

	Long-term Average	Single Wet Year (1983)	2-Year Wet (1982–1983)	4-Year Wet (1980–1983)	6-Year Wet (1978–1983)	10-Year Wet (1978–1987)
2009 Report	2,487 (60%)	3,990 (97%)	3,843 (93%)	3,401 (82%)	3,250 (79%)	2,975 (72%)
2011 Report	2,466 (60%)	4,063 (98%)	3,908 (95%)	3,396 (82%)	3,248 (79%)	2,972 (72%)

Article 21 water can be as high as 251 taf and as low as 50 taf in a given month; however, water deliveries average in the range of 2–22 taf. The estimated range of monthly deliveries of SWP Article 21 water is displayed in Figure 7-2.

The estimated likelihood that a given amount of SWP Article 21 water will be delivered under future conditions is presented in Figure 7-3. Currently, there is a 22% likelihood that more than 20 taf/year of SWP Article 21 water will be delivered under future conditions, and a 78% likelihood that 20 taf/year or less will be delivered.

In both the 2009 and 2011 Reports, estimated deliveries of SWP Article 21 water under future conditions are generally 20 taf/year or less (72% and 78% likelihood, respectively).

Dry-Year Deliveries of SWP Article 21 Water under Future Conditions

Table 7-4 shows the estimates of future deliveries of SWP Article 21 water during dry periods. The results of modeling future conditions for potential drought scenarios indicate that deliveries of SWP Article 21 water during dry years can be expected to range between 4 and 50 taf/year. This is a 0% to 92% decrease in Article 21 water deliveries from the average estimated future-conditions delivery calculated for this report. Although drought-period deliveries are typically less than deliveries in average years, Table 7-4 shows that opportunities to deliver SWP Article 21 water exist during multiyear drought periods.

Wet-Year Deliveries of SWP Article 21 Water under Future Conditions

Table 7-5 shows the estimates of deliveries of SWP Article 21 water during wet periods under future conditions. The results of modeling future conditions for potential wet periods indicate that wet-year SWP deliveries can be expected to range between 83 and 291 taf. This is a 66% to 483% increase in deliveries of SWP Article 21 water from the average estimated future-conditions delivery calculated for this report.

Table 7-4. Estimated Average and Dry-Period Deliveries of SWP Article 21 Water (Future Conditions, in Thousand Acre-Feet per year)

	Long-term Average	Single Dry Year (1977)	2-Year Drought (1976–1977)	4- Year Drought (1931–1934)	6-Year Drought (1987–1992)	6-Year Drought (1929–1934)
2009 Report	60	3	7	169	27	142
2011 Report	50	4	7	50	10	37

Table 7-5. Estimated Average and Wet-Period Deliveries of SWP Article 21 Water (Future Conditions, in Thousand Acre-Feet per year)

	Long-term Average	Single Wet Year (1983)	2-Year Wet (1982–1983)	4-Year Wet (1980–1983)	6-Year Wet (1978–1983)	10-Year Wet (1978–1987)
2009 Report	60	509	306	165	123	139
2011 Report	50	291	190	120	83	122

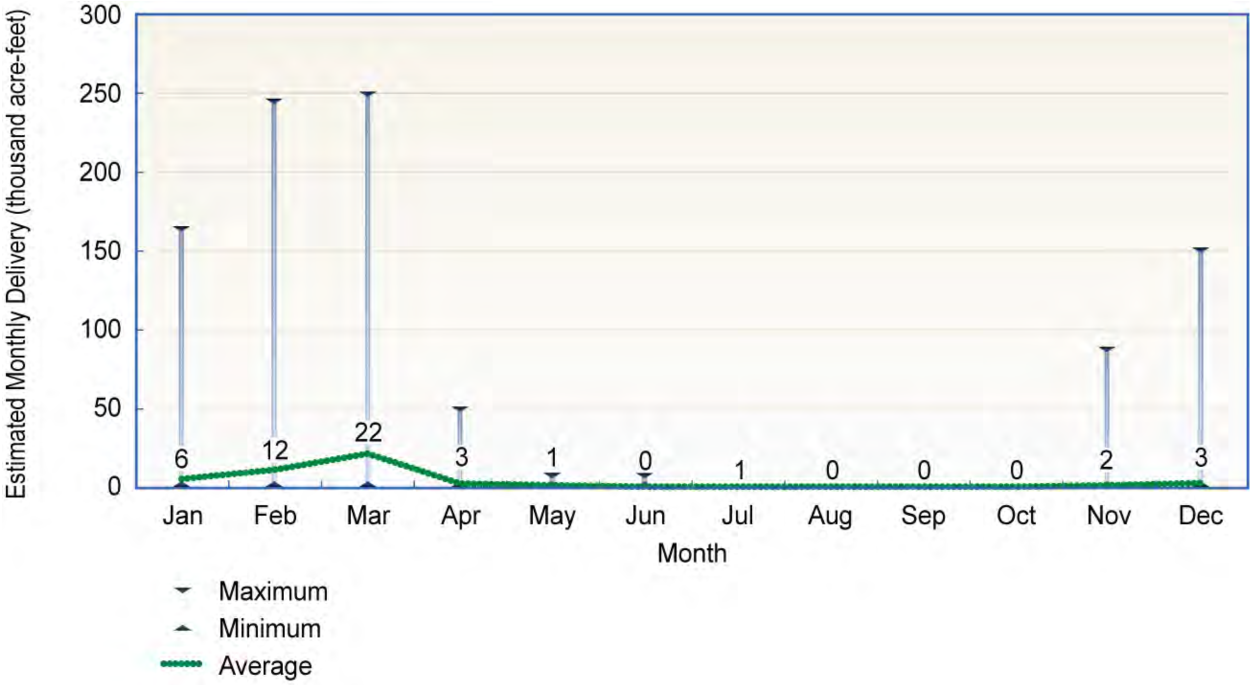


Figure 7-2. Estimated Range of Monthly Deliveries of SWP Article 21 Water (2011 Report—Future Conditions)

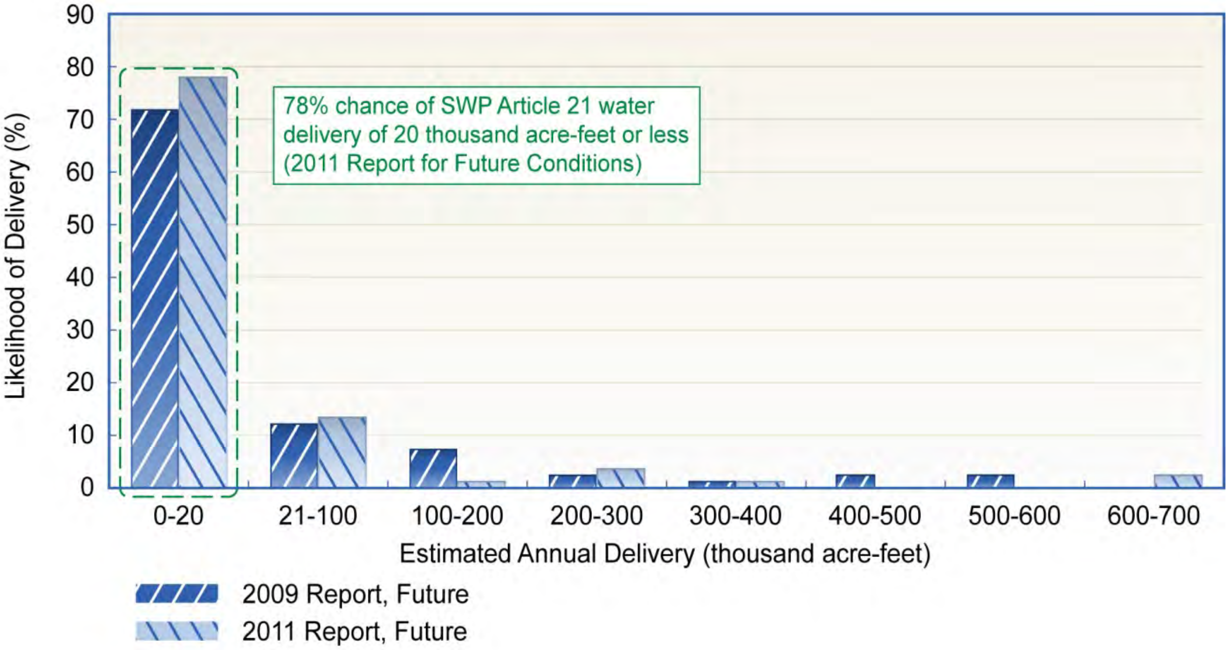


Figure 7-3. Estimated Probability of Annual Deliveries of SWP Article 21 Water (Future Conditions)

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Glossary

acre-foot The volume of water (about 325,900 gallons) that would cover an area of 1 acre to a depth of 1 foot. This is enough water to meet the annual needs of one to two households.

agricultural water supplier As defined by the California Water Code, a public or private supplier that provides water to 2,000 or more irrigated acres per year for agricultural purposes or serves 2,000 or more acres of agricultural land. This can be a water district that directly supplies water to farmers or a contractor that sells water to the water district.

annual Delta exports The total amount of water transferred ("exported") to areas south of the Delta through the Harvey O. Banks Pumping Plant (SWP) and the C. W. "Bill" Jones Pumping Plant (CVP) in 1 year.

appropriative water rights Rights allowing a user to divert surface water for beneficial use. The user must first have obtained a permit from the State Water Resources Control Board, unless the appropriative water right predates 1914.

Article 21 water Water that a contractor can receive in addition to its allocated Table A water. This water is only available if several conditions are met: (1) excess water is flowing through the Delta; (2) the contractor can use the surplus water or store it in the contractor's own system; and (3) delivering this water will not interfere with Table A allocations, other SWP deliveries, or SWP operations.

biological opinion A determination by the U.S. Fish and Wildlife Service or National Marine Fisheries Service on whether a proposed federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of designated "critical habitat." If jeopardy is determined, certain actions are required to be taken to protect the species of concern.

CALSIM II A computer model, jointly developed by DWR and the U.S. Bureau of Reclamation, that simulates existing and future operations of the SWP and CVP. The hydrology used by this model was developed by adjusting the historical flow record (1922–2003) to account for the influence of changes in land uses and regulation of upstream flows.

Among the SWP's facilities are more than 700 miles of canals that distribute water to urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California.

carryover deliveries See "carryover water."

carryover water A water supply "savings account" for SWP water that is allocated to an SWP contractor in a given year, but not used by the end of the year. Carryover water is stored in the SWP's share of San Luis Reservoir, when space is available, for the contractor to use in the following year.

Central Valley Project (CVP) Operated by the U.S. Bureau of Reclamation, the CVP is a water storage and delivery system consisting of 20 dams and reservoirs (including Shasta, Folsom, and New Melones Reservoirs), 11 power plants, and 500 miles of major canals. CVP facilities reach some 400 miles from Redding to Bakersfield and deliver about 7 million acre-feet of water for agricultural, urban, and wildlife use.

cubic feet per second (cfs) A measure of the rate at which a river of stream is flowing. The flow is 1 cfs if a cubic foot (about 7.48 gallons) of water passes a specific point in 1 second. A flow of 1 cubic foot per second for a day is approximately 2 acre-feet.

Delta exports Water transferred ("exported") to areas south of the Delta through the Harvey O. Banks Pumping Plant (SWP) and the C. W. "Bill" Jones Pumping Plant (CVP). The SWP's Delta exports are the primary component of total SWP deliveries.

Delta inflow The combined total of water flowing into the Delta from the Sacramento River, San Joaquin River, and other rivers and waterways.

exceedence curve For the SWP, a chart showing SWP delivery probability (especially for Table A water)—specifically, the likelihood that SWP contractors will receive a certain volume of water under current or future conditions.

existing-conditions scenario For the SWP delivery reliability reports, the results of modeling for SWP Delta exports or deliveries for the year the report was written.

future-conditions scenario For the SWP delivery reliability reports, the results of modeling for SWP Delta exports or SWP deliveries for 20 years into the future.

incidental take permit A permit issued by the U.S. Fish and Wildlife Service, under Section 10 of the federal Endangered Species Act, to private nonfederal entities undertaking otherwise lawful projects that might result in the "take" of an endangered or threatened species. In California, take may be authorized under Section 2081 of the California Fish and Game Code through issuance of either an incidental take permit or a consistency determination. The California Department of Fish and Game is authorized to accept a federal biological opinion as the take authorization for a State-listed species when a species is listed under both the federal and California Endangered Species Acts.

riparian water rights Water rights that apply to lands traversed by or bordering on a natural watercourse. No permit is required to use this water, which must be used on riparian (adjacent) land and cannot be stored for later use.

State Water Project (SWP) Operated by DWR, a water storage and delivery system of 33 storage facilities, 701 miles of open canals and pipelines, five hydroelectric power plants, and 20 pumping plants that extends for more than 600 miles in California. Its main purpose is to store and distribute water to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. The SWP provides supplemental water to approximately 25 million Californians (two-thirds of California's population) and about 750,000 acres of irrigated farmland. Water deliveries have ranged from 1.4 million acre-feet in a dry year to more than 4.0 million acre-feet in a wet year.

SWP contractors Twenty-nine entities that receive water for agricultural or municipal and industrial uses through the SWP. Each contractor has executed a long-term water supply contract with DWR. Also sometimes referred to as "State Water Contractors."

Table A water (Table A amounts) The maximum amount of SWP water that the State agreed to make available to an SWP contractor for delivery during the year. Table A amounts determine the maximum water a contractor may request each year from DWR. The State and SWP contractors also use Table A amounts to serve as a basis for allocation of some SWP costs among the contractors.

turnback pool water Allocated water that individual SWP contractors may offer early in the year for other SWP contractors to buy later at a set price.

urban water supplier As defined by the California Water Code, a public or private supplier that provides water for municipal use directly or indirectly to more than 3,000 customers or supplies more than 3,000 acre-feet of water in a year. This can be a water district that provides the water to local residents for use at home or work, or a contractor that distributes or sells water to that water district.

Water Rights Decision 1641 (D-1641) A regulatory decision issued by the State Water Resources Control Board in 1999 (updated in 2000) to implement the 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta*. D-1641 assigned primary responsibility for meeting many of the Delta's water quality objectives to the SWP and CVP, thus placing certain limits on SWP and CVP operations.

water year In reports on surface water supply, the period extending from October 1 through September 30 of the following calendar year. The water year refers to the September year. For example, October 1, 2010, through September 30, 2011 is the 2011 water year.

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Appendix A

Historical SWP Delivery Tables for 2001–2010

The State Water Project (SWP) contracts define several types of SWP water available for delivery to contractors under specific circumstances: Table A water, Article 21 water, turnback pool water, and carryover water. (See the glossary for definitions of these terms; Chapter 3 describes each type of SWP water in greater detail.) Many SWP contractors frequently use Article 21, turnback pool, and carryover water to increase or decrease the amount of water available to them under SWP Table A.

The Sacramento River Index, previously referred to as the “4 River Index” or “4 Basin Index,” is the sum of the unimpaired runoff of four rivers: the Sacramento River above Bend Bridge near Red Bluff, Feather River inflow to Lake Oroville Reservoir, Yuba River at Smartville, and American River inflow to Folsom Lake. The five water year types used in the Sacramento River Index are as follows:

Sacramento River Index	Water Year Type
1	Wet
2	Above Normal
3	Below Normal
4	Dry
5	Critical

Tables A-1 through A-10 list annual historical deliveries by SWP water type for each contractor for 2001 through 2010. The Sacramento River Index and water year type are presented along with the delivery results for each year. Similar delivery tables are presented for years 1999–2008 in the *State Water Project Delivery Reliability Report 2009*. SWP contractors are listed in Tables A-1 through A-10 by location, as follows:

- *Feather River Area:* Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District (FCWCD)
- *North Bay Area:* Napa County FCWCD and Solano County Water Agency (WA)
- *South Bay Area:* Alameda County FCWCD, Zone 7; Alameda County Water District (WD); and Santa Clara Valley WD
- *San Joaquin Valley Area:* Dudley Ridge WD, Empire West Side Irrigation District (ID), Kern County WA, Kings County, Oak Flat WD, and Tulare Lake Basin Water Storage District (WSD)

- *Central Coastal Area:* San Luis Obispo County FCWCD and Santa Barbara County FCWCD
- *Southern California Area:* Antelope Valley–East Kern WA, Castaic Lake WA, Coachella Valley WD, Crestline–Lake Arrowhead WA, Desert Water Agency, Littlerock Creek ID, Metropolitan WD of Southern California, Mojave WA, Palmdale WD, San Bernardino Valley Municipal Water District (MWD), San Gabriel Valley MWD, San Gorgonio Pass WA, and Ventura County Watershed Protection District (WPD)

Table A-1. Historical State Water Project Deliveries, 2001
Sacramento River Index = 4, Water Year Type = Dry

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	513	–	–	–	513
	Yuba City	1,065	–	–	–	1,065
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	4,293	996	1,723	82	7,094
	Solano County WA	17,756	2,304	1,021	–	21,081
South Bay Area	Alameda County FCWCD, Zone 7	22,307	–	5,990	308	28,605
	Alameda County WD	13,695	10	4,192	107	18,004
	Santa Clara Valley WD	35,689	–	12,233	–	47,922
San Joaquin Valley Area	Dudley Ridge WD	18,467	933	6,815	347	26,562
	Empire West Side ID	–	253	1,107	–	1,360
	Kern County WA	363,204	23,233	92,052	6,502	484,991
	Kings County	1,560	–	–	–	1,560
	Oak Flat WD	2,089	–	101	22	2,212
	Tulare Lake Basin WSD	40,830	8,755	7,889	769	58,243
Central Coastal Area	San Luis Obispo County FCWCD	4,184	–	–	99	4,283
	Santa Barbara County FCWCD	14,285	396	–	296	14,977
Southern California Area	Antelope Valley–East Kern WA	45,071	–	–	899	45,970
	Castaic Lake WA (+Rch 31A, 5 & 7)	30,471	850	–	618	31,939
	Coachella Valley WD	9,009	–	–	91	9,100
	Crestline–Lake Arrowhead WA	1,057	–	–	–	1,057
	Desert WA	14,859	–	–	151	15,010
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	686,545	10,415	200,000	7,949	904,909
	Mojave WA	4,433	–	–	–	4,433
	Palmdale WD	8,170	–	2,257	–	10,427
	San Bernardino Valley MWD	26,488	–	–	–	26,488
	San Gabriel Valley MWD	6,534	–	–	–	6,534
	San Gorgonio Pass WA	–	–	–	–	–
	Ventura County WPD	1,850	–	–	–	1,850
Total SWP Deliveries		**1,374,424**	**48,145**	**335,380**	**18,240**	**1,776,189**
Total Deliveries from the Delta**		**1,372,846**	**48,145**	**335,380**	**18,240**	**1,774,611**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-2. Historical State Water Project Deliveries, 2002
Sacramento River Index = 4, Water Year Type = Dry

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	419	–	–	–	419
	Yuba City	1,181	–	–	–	1,181
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	2,022	827	3,743	283	6,875
	Solano County WA	28,223	2,242	–	–	30,465
South Bay Area	Alameda County FCWCD, Zone 7	40,707	1,484	8,113	556	50,860
	Alameda County WD	24,250	83	2,331	862	27,526
	Santa Clara Valley WD	55,896	202	3,311	2,053	61,462
San Joaquin Valley Area	Dudley Ridge WD	38,688	1,861	1,994	1,177	43,720
	Empire West Side ID	1,278	26	101	–	1,405
	Kern County WA	670,884	21,951	15,680	20,543	729,058
	Kings County	2,800	–	–	54	2,854
	Oak Flat WD	3,841	50	134	76	4,101
	Tulare Lake Basin WSD	73,785	3,749	5,385	2,289	85,208
Central Coastal Area	San Luis Obispo County FCWCD	4,355	–	–	–	4,355
	Santa Barbara County FCWCD	24,166	436	3,455	324	28,381
Southern California Area	Antelope Valley–East Kern WA	53,907	–	3,256	1,008	58,171
	Castaic Lake WA (+Rch 31A, 5 & 7)	61,880	280	6,657	–	68,817
	Coachella Valley WD	16,170	111	–	474	16,755
	Crestline–Lake Arrowhead WA	2,189	–	–	–	2,189
	Desert WA	26,670	189	–	781	27,640
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	1,273,205	9,624	97,940	14,335	1,395,104
	Mojave WA	4,346	–	–	–	4,346
	Palmdale WD	8,359	–	–	437	8,796
	San Bernardino Valley MWD	68,268	–	3,801	–	72,069
	San Gabriel Valley MWD	18,353	–	4,698		23,051
	San Gorgonio Pass WA	–	–	–	–	–
	Ventura County WPD	4,998	–	–	–	4,998
Total SWP Deliveries		**2,510,840**	**43,115**	**160,599**	**45,252**	**2,759,806**
Total Deliveries from the Delta**		**2,509,240**	**43,115**	**160,599**	**45,252**	**2,758,206**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-3. Historical State Water Project Deliveries, 2003
Sacramento River Index = 2, Water Year Type = Above Normal

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	551	–	–	–	551
	Yuba City	1,324	–	–	–	1,324
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	6,026	376	1,055	180	7,637
	Solano County WA	25,135	2,280	1,918	–	29,333
South Bay Area	Alameda County FCWCD, Zone 7	30,695	–	13,099	656	44,450
	Alameda County WD	31,086	–	5,150	354	36,590
	Santa Clara Valley WD	90,620	936	14,104	841	106,501
San Joaquin Valley Area	Dudley Ridge WD	49,723	1,928	1,452	482	53,585
	Empire West Side ID	1,074	175	187	–	1,436
	Kern County WA	841,697	27,891	22,380	8,419	900,387
	Kings County	3,600	58	–	34	3,692
	Oak Flat WD	4,059	19	140	48	4,266
	Tulare Lake Basin WSD	94,376	6,243	4,284	938	105,841
Central Coastal Area	San Luis Obispo County FCWCD	4,417	36	–	–	4,453
	Santa Barbara County FCWCD	24,312	339	2,274	43	26,968
Southern California Area	Antelope Valley–East Kern WA	52,730	–	7,049	250	60,029
	Castaic Lake WA (+Rch 31A, 5 & 7)	49,895	991	4,760	90	55,736
	Coachella Valley WD	14,045	204	–	194	14,443
	Crestline–Lake Arrowhead WA	1,563	–	–	–	1,563
	Desert WA	23,168	330	–	321	23,819
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	1,550,356	17,622	134,845	16,920	1,719,743
	Mojave WA	10,907	–	3,528	–	14,435
	Palmdale WD	9,701	–	1,846	–	11,547
	San Bernardino Valley MWD	25,371	200	1,844	–	27,415
	San Gabriel Valley MWD	13,034	200	–	–	13,234
	San Gorgonio Pass WA	116	–	–	–	116
	Ventura County WPD	5,000	–	–	–	5,000
Total SWP Deliveries		**2,964,581**	**59,828**	**219,915**	**29,770**	**3,274,094**
Total Deliveries from the Delta**		**2,962,706**	**59,828**	**219,915**	**29,770**	**3,272,219**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-4. Historical State Water Project Deliveries, 2004
Sacramento River Index = 3, Water Year Type = Below Normal

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	1,440	–	–	–	1,440
	Yuba City	1,434	–	–	–	1,434
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	5,030	1,450	1,602	52	8,134
	Solano County WA	17,991	7,787	47	–	25,825
South Bay Area	Alameda County FCWCD, Zone 7	39,898	–	11,466	–	51,364
	Alameda County WD	20,956	–	6,714	214	27,884
	Santa Clara Valley WD	52,867	2,983	–	508	56,358
San Joaquin Valley Area	Dudley Ridge WD	36,377	7,393	2,185	291	46,246
	Empire West Side ID	1,310	626	1,626	–	3,562
	Kern County WA	640,190	86,513	40,120	5,075	771,898
	Kings County	5,850	3,157	–	46	9,053
	Oak Flat WD	4,324	–	276	29	4,629
	Tulare Lake Basin WSD	58,575	15,299	5,638	489	80,001
Central Coastal Area	San Luis Obispo County FCWCD	4,096	69	–	–	4,165
	Santa Barbara County FCWCD	29,566	–	–	122	29,688
Southern California Area	Antelope Valley–East Kern WA	50,532	–	9,199	–	59,731
	Castaic Lake WA (+Rch 31A, 5 & 7)	46,358	1,618	35,785	–	83,761
	Coachella Valley WD	8,631	–	6,745	89	15,465
	Crestline–Lake Arrowhead WA	2,006	–	–	–	2,006
	Desert WA	9,966	–	11,122	102	21,190
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	1,195,807	91,601	215,000	10,223	1,512,631
	Mojave WA	11,176	–	–	–	11,176
	Palmdale WD	10,549	–	1,613	–	12,162
	San Bernardino Valley MWD	35,522	–	20,631	–	56,153
	San Gabriel Valley MWD	15,600	–	–	–	15,600
	San Gorgonio Pass WA	841	–	–	–	841
	Ventura County WPD	5,250	–	–	–	5,250
	Total SWP Deliveries	**2,312,142**	**218,496**	**369,769**	**17,240**	**2,917,647**
	Total Deliveries from the Delta**	**2,309,268**	**218,496**	**369,769**	**17,240**	**2,914,773**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-5. Historical State Water Project Deliveries, 2005
Sacramento River Index = 2, Water Year Type = Above Normal

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	527	–	–	–	527
	Yuba City	1,894	–	–	–	1,894
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	5,322	606	1,741	–	7,669
	Solano County WA	24,515	10,421	83	–	35,019
South Bay Area	Alameda County FCWCD, Zone 7	38,388	–	7,849	275	46,512
	Alameda County WD	36,469	846	6,341	943	44,599
	Santa Clara Valley WD	89,476	6,298	11,899	342	108,015
San Joaquin Valley Area	Dudley Ridge WD	51,609	28,197	821	1,286	81,913
	Empire West Side ID	1,448	1,799	587	–	3,834
	Kern County WA	893,439	453,078	9,851	22,397	1,378,765
	Kings County	8,100	11,504	–	202	19,806
	Oak Flat WD	4,067	–	–	127	4,194
	Tulare Lake Basin WSD	86,604	47,267	3,973	2,158	140,002
Central Coastal Area	San Luis Obispo County FCWCD	4,006	245	–	–	4,251
	Santa Barbara County FCWCD	22,981	–	–	155	23,136
Southern California Area	Antelope Valley–East Kern WA	57,205	–	2,626	–	59,831
	Castaic Lake WA (+Rch 31A, 5 & 7)	54,303	2,451	2,702	–	59,456
	Coachella Valley WD	26,984	–	12,819	2,716	42,519
	Crestline–Lake Arrowhead WA	807	–	–	–	807
	Desert WA	33,168	–	14,799	1,122	49,089
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California**	1,269,291	168,300	106,032	6,530	1,550,153
	Mojave WA	10,360	–	1,201	–	11,561
	Palmdale WD	10,174	–	1,538	–	11,712
	San Bernardino Valley MWD	31,211	56	283	–	31,550
	San Gabriel Valley MWD	10,500	–	–	–	10,500
	San Gorgonio Pass WA	655	15	–	22	692
	Ventura County WPD	1,665	–	–	–	1,665
Total SWP Deliveries		**2,775,168**	**731,083**	**185,145**	**38,275**	**3,729,671**
Total Deliveries from the Delta* **		**2,772,747**	**731,083**	**185,145**	**38,275**	**3,727,250**

* Table A = State Water Project Analysis Office current-year deliveries + Next year's Article 14B carryover water

** Metropolitan Water District of Southern California 2005 Table A deliveries have been updated to reflect the addition of Article 14B carryover water that was previously omitted.

*** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-6. Historical State Water Project Deliveries, 2006

Sacramento River Index = 1, Water Year Type = Wet

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	468	–	–	–	468
	Yuba City	4,148	1,194	–	–	5,342
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	7,312	300	172	–	7,784
	Solano County WA	12,070	18,195	390	–	30,655
South Bay Area	Alameda County FCWCD, Zone 7	50,785	–	2,252	491	53,528
	Alameda County WD	–	2,375	1,331	39,373	43,079
	Santa Clara Valley WD	47,344	26,769	524	–	74,637
San Joaquin Valley Area	Dudley Ridge WD	55,343	18,515	–	1,068	74,926
	Empire West Side ID	1,500	1,124	658	–	3,282
	Kern County WA	961,882	256,634	5,418	18,610	1,242,544
	Kings County	8,991	366	–	173	9,530
	Oak Flat WD	4,118	–	17	107	4,242
	Tulare Lake Basin WSD	48,361	59,424	–	1,787	109,572
Central Coastal Area	San Luis Obispo County FCWCD	3,382	827	–	–	4,209
	Santa Barbara County FCWCD	19,255	4,020	–	–	23,275
Southern California Area	Antelope Valley–East Kern WA	76,623	–	3,761	–	80,384
	Castaic Lake WA (+Rch 31A, 5 & 7)	56,758	2,089	3,905	–	62,752
	Coachella Valley WD	121,100	–	–	–	121,100
	Crestline–Lake Arrowhead WA	257	–	–	–	257
	Desert WA	50,000	–	–	–	50,000
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	1,103,538	238,478	136,424	11,638	1,490,078
	Mojave WA	32,496	–	1,518	–	34,014
	Palmdale WD	10,374	1,653	335	130	12,492
	San Bernardino Valley MWD	31,902	–	3,427	–	35,329
	San Gabriel Valley MWD	13,524	–	–	–	13,524
	San Gorgonio Pass WA	4,262	–	–	–	4,262
	Ventura County WPD	1,850	–	–	–	1,850
Total SWP Deliveries		**2,727,643**	**631,963**	**160,132**	**73,377**	**3,593,115**
Total Deliveries from the Delta**		**2,723,027**	**630,769**	**160,132**	**73,377**	**3,587,305**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-7. Historical State Water Project Deliveries, 2007
Sacramento River Index = 4, Water Year Type = Dry

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	956	–	–	–	956
	Yuba City	2,327	–	–	–	2,327
	Plumas County FCWCD	–	–	–	–	–
North Bay Area	Napa County FCWCD	6,362	3,597	998	–	10,957
	Solano County WA	14,892	8,217	1,822	–	24,931
South Bay Area	Alameda County FCWCD, Zone 7	32,972	912	2,895	378	37,157
	Alameda County WD	16,541	550	2,103	197	19,391
	Santa Clara Valley WD	38,812	4,840	8,161	469	52,282
San Joaquin Valley Area	Dudley Ridge WD	28,457	8,953	2,000	269	39,679
	Empire West Side ID	397	1,172	515	–	2,084
	Kern County WA	592,423	99,861	19,645	4,683	716,612
	Kings County	4,924	474	–	43	5,441
	Oak Flat WD	3,430	41	69	27	3,567
	Tulare Lake Basin WSD	57,272	12,902	16,459	450	87,083
Central Coastal Area	San Luis Obispo County FCWCD	3,752	24	–	–	3,776
	Santa Barbara County FCWCD	24,760	1,070	1,390	–	27,220
Southern California Area	Antelope Valley–East Kern WA	74,459	–	4,364	–	78,823
	Castaic Lake WA (+Rch 31A, 5 & 7)	44,974	–	4,216	–	49,190
	Coachella Valley WD	72,660	–	–	568	73,228
	Crestline–Lake Arrowhead WA	1,768	–	–	–	1,768
	Desert WA	30,000	–	–	234	30,234
	Littlerock Creek ID	1,380	–	–	–	1,380
	Metropolitan WD of Southern California	1,146,900	166,517	28,098	8,962	1,350,477
	Mojave WA	45,372	–	737	–	46,109
	Palmdale WD	12,780	843	985	100	14,708
	San Bernardino Valley MWD	57,116	–	–	–	57,116
	San Gabriel Valley MWD	10,000	–	–	–	10,000
	San Gorgonio Pass WA	4,009	–	–	–	4,009
	Ventura County WPD	3,000	–	–	–	3,000
	Total SWP Deliveries	**2,332,695**	**309,973**	**94,457**	**16,380**	**2,753,505**
	Total Deliveries from the Delta**	**2,329,412**	**309,973**	**94,457**	**16,380**	**2,750,222**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-8. Historical State Water Project Deliveries, 2008
Sacramento River Index = 5, Water Year Type = Critical

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	9,436	–	–	–	9,436
	Yuba City	1,923	–	–	–	1,923
	Plumas County FCWCD	243	–	–	–	243
North Bay Area	Napa County FCWCD	3,636	1,219	7,363	21	12,239
	Solano County WA	10,436	1,510	12,389	–	24,335
South Bay Area	Alameda County FCWCD, Zone 7	13,633	–	15,400	–	29,033
	Alameda County WD	4,206	–	8,659	37	12,902
	Santa Clara Valley WD	11,133	–	21,188	88	32,409
San Joaquin Valley Area	Dudley Ridge WD	12,260	–	5,949	51	18,260
	Empire West Side ID		–	915	–	915
	Kern County WA	271,636	–	6,815	883	279,334
	Kings County	3,187	–	–	8	3,195
	Oak Flat WD	1,929	–	–	5	1,934
	Tulare Lake Basin WSD	32,302	–	281	85	32,668
Central Coastal Area	San Luis Obispo County FCWCD	8,512	–	–	–	8,512
	Santa Barbara County FCWCD	11,311	–	2,532	40	13,883
Southern California Area	Antelope Valley–East Kern WA	31,082	–	10,381	125	41,588
	Castaic Lake WA (+Rch 31A, 5 & 7)	18,710	–	12,146	–	30,856
	Coachella Valley WD	42,385	–	–	107	42,492
	Crestline–Lake Arrowhead WA	1,159	–	689	–	1,848
	Desert WA	17,500	–	–	44	17,544
	Littlerock Creek ID	805	–	–	–	805
	Metropolitan WD of Southern California	654,304	–	–	1,689	655,993
	Mojave WA	26,288	–	108	–	26,396
	Palmdale WD	4,226	–	–	19	4,245
	San Bernardino Valley MWD	30,562	–	4,444	–	35,006
	San Gabriel Valley MWD	10,080	–	–	–	10,080
	San Gorgonio Pass WA	5,419	–	300	–	5,719
	Ventura County WPD	3,798	–	–	–	3,798
	Total SWP Deliveries	**1,242,101**	**2,729**	**109,559**	**3,202**	**1,357,591**
	Total Deliveries from the Delta**	**1,230,499**	**2,729**	**109,559**	**3,202**	**1,345,989**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-9. Historical State Water Project Deliveries, 2009
Sacramento River Index = 4, Water Year Type = Dry

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	581	–	–	–	581
	Yuba City	2,114	–	–	–	2,114
	Plumas County FCWCD	200	–	–	–	200
North Bay Area	Napa County FCWCD	2,723	1,588	4,475	13	8,799
	Solano County WA	8,618	4,444	3,123	–	16,185
South Bay Area	Alameda County FCWCD, Zone 7	12,093	–	14,584	–	26,677
	Alameda County WD	5,911	–	10,494	8	16,413
	Santa Clara Valley WD	9,188	–	23,867	54	33,109
San Joaquin Valley Area	Dudley Ridge WD	13,185	–	7,810	32	21,027
	Empire West Side ID	1,034	–	–	–	1,034
	Kern County WA	226,631	–	56,367	544	283,542
	Kings County	3,153	–	70	5	3,228
	Oak Flat WD	1,825	–	66	1	1,892
	Tulare Lake Basin WSD	35,160	–	1,271	52	36,483
Central Coastal Area	San Luis Obispo County FCWCD	3,799	–	–	–	3,799
	Santa Barbara County FCWCD	12,746	–	4,523	25	17,294
Southern California Area	Antelope Valley–East Kern WA	14,419	–	18,408	77	32,904
	Castaic Lake WA (+Rch 31A, 5 & 7)	14,858	–	9,529	52	24,439
	Coachella Valley WD	40,845	–	–	66	40,911
	Crestline–Lake Arrowhead WA	–	–	893	–	893
	Desert WA	16,865	–	–	27	16,892
	Littlerock Creek ID	–	–	–	–	–
	Metropolitan WD of Southern California	544,304	–	10,721	1,042	556,067
	Mojave WA	21,312	–	242	–	21,554
	Palmdale WD	12,095	–	3,229	–	15,324
	San Bernardino Valley MWD	26,785	–	9,348	–	36,133
	San Gabriel Valley MWD	11,516	–	–	–	11,516
	San Gorgonio Pass WA	5,612	–	480	–	6,092
	Ventura County WPD	3,890	–	–	–	3,890
Total SWP Deliveries		**1,051,462**	**6,032**	**179,500**	**1,998**	**1,238,992**
Total Deliveries from the Delta**		**1,048,567**	**6,032**	**179,500**	**1,998**	**1,236,097**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

Table A-10. Historical State Water Project Deliveries, 2010
Sacramento River Index = 3, Water Year Type = Below Normal

Contractor Location	SWP Contractor	SWP Water Type Delivered (acre-feet)				Total SWP Deliveries (acre-feet)
		Table A*	Article 21	Carryover	Turnback	
Feather River Area	Butte County	807	–	–	–	807
	Yuba City	2,331	–	–	–	2,331
	Plumas County FCWCD	243	–	–	–	243
North Bay Area	Napa County FCWCD	7,275	2,207	2,845	90	12,417
	Solano County WA	16,793	5,298	3,661	–	25,752
South Bay Area	Alameda County FCWCD, Zone 7	28,694	–	12,756	249	41,699
	Alameda County WD	11,668	–	10,889	14	22,571
	Santa Clara Valley WD	6,068	–	10,741	34	16,843
San Joaquin Valley Area	Dudley Ridge WD	15,833	–	9,752	156	25,741
	Empire West Side ID	380	–	–	–	380
	Kern County WA	375,426	–	55,419	3,044	433,889
	Kings County	4,094	–	522	29	4,645
	Oak Flat WD	2,412	–	455	18	2,885
	Tulare Lake Basin WSD	35,985	–	3,199	275	39,459
Central Coastal Area	San Luis Obispo County FCWCD	3,480	–	277	–	3,757
	Santa Barbara County FCWCD	8,640	–	7,134	140	15,914
Southern California Area	Antelope Valley–East Kern WA	36,462	–	20,813	438	57,713
	Castaic Lake WA (+Rch 31A, 5 & 7)	37,054	–	14,501	295	51,850
	Coachella Valley WD	69,175	–	7,595	429	77,199
	Crestline–Lake Arrowhead WA	357	–	–	–	357
	Desert WA	27,875	–	3,135	173	31,183
	Littlerock Creek ID		–	–	–	–
	Metropolitan WD of Southern California	817,765	–	67,783	5,922	891,470
	Mojave WA	35,241	–	20	–	35,261
	Palmdale WD	5,585	–	5,325	59	10,969
	San Bernardino Valley MWD	37,733	–	11,273	–	49,006
	San Gabriel Valley MWD	19,180	–	–	–	19,180
	San Gorgonio Pass WA	6,626	–	–	6	6,632
	Ventura County WPD	4,075	–	–	–	4,075
Total SWP Deliveries		**1,617,257**	**7,505**	**248,095**	**11,371**	**1,884,228**
Total Deliveries from the Delta**		**1,613,876**	**7,505**	**248,095**	**11,371**	**1,880,847**

* Table A = State Water Project Analysis Office current-year deliveries + next year's Article 14B carryover water

** Total deliveries from the Delta = Total SWP deliveries – Feather River Service Area deliveries (Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District)

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Appendix B

Comment Letters on the Draft Report and the Department's Responses

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THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Office of the General Manager

March 12, 2012

Ms. Cynthia Pierson
California Department of Water Resources
SWP Delivery Reliability Report – Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

Dear Ms. Pierson:

State Water Project Delivery Reliability Report 2011 – January 2012 Draft

The Metropolitan Water District of Southern California (Metropolitan) has reviewed the Department of Water Resources (Department) January 2012 draft of the State Water Project (SWP) Delivery Reliability Report 2011 (DRR) and offers the following comments and observations.

Metropolitan understands the Department's desire to produce a public outreach document with the intent to educate Californians about the SWP and its operations. However, we do not agree that this should be the purpose of the DRR. The preparation of this report should be to satisfy the obligation set forth in the 2003 Monterey Settlement (Settlement) between DWR, the State Water Contractors (SWC) and the Monterey Amendment Plaintiffs. The Settlement requires a report on the delivery capability of the SWP facilities to be distributed biannually to all SWP contractors, city and county planning departments, and regional and metropolitan planning departments in the SWP's service area. Metropolitan suggests that the Department refocus the report to provide a summary of the technical analysis including the assumptions used in the analysis and a description of the results. Similar to previous versions of the DRR, the report should focus on the technical needs of the SWC and regional planning agencies for information on the reliability of the SWP. This report should not be used as a larger public outreach document.

Metropolitan believes that an education can be provided to readers of the DRR while remaining true to its original intent. To that end, we encourage the Department to reconsider the use of the term "Delta exports", which may mislead the reader. This term is used throughout the report in a fashion that promotes the notion that we are exporting a native supply out of the Delta. Rather, these supplies were developed through SWP Conservation Facilities and SWP water rights and represent a small percentage of the total flows passing through the Delta. We would like to see the report be clear on the fact that the water diverted is a SWP developed supply.

Metropolitan acknowledges the difficulties in preparing a report of this magnitude particularly with the variability in hydrology, regulatory restrictions and climate change uncertainties. Metropolitan continues to offer its assistance with the development of this report. We encourage the Department to engage not only Metropolitan but other SWP contractors early in the preparation of the document. We believe a more collaborative process will facilitate feedback from the end users resulting in an improved document.

Very truly yours,

Deven N. Upadhyay
Manager, Water Resource Management

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Mr. Mark Cowin
Director, California Department of Water Resources
P.O. Box 942836, Room 1115-1
Sacramento, CA 94236-0001

Ms. Katherine Kelly
Chief, Bay-Delta Office
California Department of Water Resources
1416, 9th Street, Room 215-37
Sacramento, CA 95814

Mr. Terry Erlewine
General Manager
State Water Contractors
1121 L Street, Suite 1050
Sacramento, CA 95814

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **EDMUND G. BROWN JR.**, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

June 25, 2012

Mr. Deven N. Upadhyay
Manager, Water Resources Management
The Metropolitan Water District of Southern California
PO Box 54153
Los Angeles, California 90054-0153

Dear Mr. Upadhyay:

This letter responds to your letter dated March 12, 2012 commenting on the draft State Water Project Delivery Reliability Report (2011). We appreciate your review and subsequent comments to the draft report.

Your first comment is regarding the format of the report. Metropolitan would like the Department of Water Resources to focus on the technical needs of the State Water Contractors and regional planning agencies for information on the reliability of the State Water Project (SWP) and not plan to use the report as a larger public outreach document.

The reformatting of the Delivery Reliability Report is intended to make the information more understandable to the public. The Monterey Settlement (2003) requires a report covering this subject to be published every two years and that the information contained in the report be readily understandable by the public. The previous versions of the report focus on estimated amounts for Table A deliveries and other categories of deliveries defined in the SWP water delivery contracts. We agree that this is valuable information for our contractors and planning entities within the SWP service area however, it is not readily understandable to the public. Our intent in reformatting the report is to meet the needs of both audiences. The main report is intended for the public audience and the accompanying technical addendum intended for State Water Contractors and regional planning agencies. The technical addendum includes descriptions of the analyses, the results, and the breakdown of the information for each contractor.

Your second comment is regarding the use of the term "Delta exports" for the water pumped from the Delta by the SWP. Your observation is that the term is used in a manner that may mislead the reader by promoting the notion that the SWP exports a "native supply" from the Delta rather than one developed through the SWP conservation facilities and water rights. The term "Delta exports" is one that is commonly used in Department reports. It refers to the water that is released from Oroville Reservoir and transferred across the Delta as well as other flows that enter the Delta and are available to the SWP while meeting the relevant water rights' requirements and other export regulations. Chapters 2 through 4 are intended to inform the reader about the history, facilities and requirements for operation of the SWP. It is our hope that this information will help to avoid any potential misinterpretation by the reader regarding what is meant by the term "Delta exports".

The final 2011 State Water Project Delivery Reliability Report is nearing completion and is expected to be available next month. If you would like to discuss your concerns further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Katherine Kelly

Katherine F. Kelly, Chief
Bay-Delta Office

Mojave
Water
Agency

13846 Conference Center Drive ◆ Apple Valley, California 92307
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VIA ELECTRONIC MAIL

March 12, 2012

California Department of Water Resources
SWP Delivery Reliability Report- Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

RE: Comments on the State Water Project Draft Delivery Reliability Report 2011

Dear Ms. Pierson:

The Mojave Water Agency has reviewed the SWP Draft Delivery Reliability Report 2011 ("2011 DRR") and offers these comments. In general, we appreciated the format and information included in the 2009 DRR and would like to see the same level of detail and information presented in the 2011 DRR. Please consider the following comments:

1. Individual Contractor Modeling Results: We appreciate the inclusion of individual contractor modeling outputs in the Technical Addendum.
2. Reliability Numbers: In addition to the charts in the 2011 DRR (figures 6-5 thru 6-9), the body of the report should include SWP reliability percentages, either in the text or in tables, as was done in the 2009 DRR. This should be done for current and future conditions for the long-term average, drought cycles, and wet cycles (example: Tables 6.1 thru 6.4 in the 2009 DRR). Average-year and dry-year numbers are critical information for urban water suppliers to include in their Urban Water Management Plans, which are used to demonstrate water supply sufficiency for their service areas.
3. Effects of Climate Change: We appreciate the inclusion of modeling results comparing future SWP deliveries with and without the effects of climate change; this will be of great help to agencies preparing climate change evaluations for water supply planning purposes.
4. Factors Affecting Reliability: Chapter 4 describes a number of factors that have reduced or have the potential to reduce future water supply reliability. The chapter should also "disclose" that some future actions may actually increase future reliability:
   a. The recent court decisions overturning Federal Biological Opinions (BO's) were mentioned; but it should be mentioned that implementation of future BO's may result in less restriction on delta exports.
   b. The Bay Delta Conservation Plan (BDCP) was described briefly, but it should also indicate that the conveyance piece of the BDCP will likely result in increased reliability.

Thank you for your consideration of our comments.

Sincerely,

Kirby Brill
General Manager

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **EDMUND G. BROWN JR.**, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

May 23, 2012

Kirby Brill
General Manager
Mojave Water Agency
13846 Conference Center Drive
Apple Valley, California 92307

Dear Mr. Brill,

This letter is in response to your letter dated March 12, 2012 providing the comments of the Mojave Water Agency for the Draft 2011 SWP Delivery Reliability Report. Our responses to your four comments are attached.

I appreciate you and your staff's comments. If you or your staff wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov. For specific questions regarding the analyses used for the report, please contact Francis Chung at (916) 653-5924.

Sincerely,

Katherine Kelly

Katherine F. Kelly, Chief
Bay-Delta Office

Attachment:

Attachment

The following responses are to the comments provided in the March 12, 2012 letter from the Mojave Water Agency. The comments are shown in italics.

1. *<u>Individual Contractor Modeling Results</u>: We appreciate the inclusion of individual contractor modeling outputs in the Technical Addendum.*

   Thank you. We strive to make the Delivery Reliability Report as informative and useful as possible.

2. *<u>Reliability Numbers</u>: In addition to the charts in the 2011 DRR (figures 6-5 thru 6-9), the body of the report should include SWP reliability percentages, either in the text or in tables, as was done in the 2009 DRR. This should be done for current and future conditions for the long-term average, drought cycles, and wet cycles (example: Tables 6.1 thru 6.4 in the 2009 DRR). Average-year and dry-year numbers are critical information for urban water suppliers to include in their Urban Water Management Plans, which are used to demonstrate water supply sufficiency for their service areas.*

   Tables 6-3, 6-4, 7-2, and 7-3 have been added to the report to include this information.

3. *Effects of Climate Change: We appreciate the inclusion of modeling results comparing future SWP deliveries with and without the effects of climate change; this will be of great help to agencies preparing climate change evaluations for water supply planning purposes.*

   Thank you. We are glad you found this information beneficial.

4. *Factors Affecting Reliability: Chapter 4 describes a number of factors that have reduced or have the potential to reduce future water supply reliability. The chapter should also "disclose" that some future actions may actually increase future reliability:*
   1. *The recent court decision overturning Federal Biological Opinions (BO's) were mentioned; but it should be mentioned that implementation of future BO's may result in less restriction on Delta exports.*
   2. *The Bay Delta Conservation Plan (BDCP) was described briefly, but it should also indicate that the conveyance piece of the BDCP will likely result in increased reliability.*

   We appreciate your suggestion. However, we feel it is premature to discuss the effects of potential future BOs or BDCP alternatives. This is something that we can keep in mind and discuss further as we begin to develop the 2013 SWP Delivery Reliability Report.

STATE WATER CONTRACTORS
SWC
Served by the State Water Project
FOUNDED IN 1982

March 12, 2012

California Department of Water Resources
SWP Delivery Reliability Report-Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

Comments on 2011 SWP Draft Delivery Reliability Report

Dear Ms. Pierson:

The State Water Contractors (SWC) has reviewed the 2011 SWP Draft Delivery Reliability Report and offers these comments. The SWC are generally concerned about the level of detail in the presentation. Additionally, the SWC has also identified numerous specific editorial changes for your consideration.

The SWC are interested in discussing our concerns with DWR, primarily in relation to the forthcoming 2013 SWP Reliability Report. If you have any questions about our concerns or specific comments, please contact me at (916) 447-7357.

Sincerely,

Terry L. Erlewine
General Manager

Attachment

1121 L Street, Suite 1050 • Sacramento, California 95814-3944 • 916.447.7357 • FAX 916.447-2734 • www.swc.org

Attachment

State Water Contractors
Specific Comments on DWR's 2011 State Water Project Delivery Reliability Report

Figure 2-2. This figure shows only inflows and outflows to the Delta, and does not provide information on the magnitude of total flows in the watershed or total outflow. A graph similar to that prepared for the Delta Vision that places the total disposition of water supply into context would be helpful.

Page 13. Discussion of how operations are coordinated with the CVP should reference the Coordinated Operations Agreement, which is the basis for that coordination.

Page 23. There is discussion of how individual SWP contractors manage their water supplies annually on the basis of available water supply. That kind of annual information is not the data that is contained in the Delivery Reliability Report and is provided separately by DWR's Operations Control Office. The discussion here reads as though the Delivery Reliability Report provides that information.

Page 27. The discussion of the status of the 2008 and 2009 Biological Opinions is not very informative. This discussion should expand briefly on Judge Wanger's opinion that the current BOs are BOs are "arbitrary, capricious and unlawful" and are currently being redone. The discussion should also note that a preliminary injunction was issued enjoining implementation of the Fall X2 action of the 2008 Delta Smelt Biological Opinion. Additionally, DWR and other plaintiffs in the case have the option to file actions challenging provisions of the Biological Opinions on a continuing basis until new BOs are developed.

Chapter 5. The SWC question that there is any need for this chapter in this report as this goes beyond the issue of delivery reliability. If DWR wants to report on the topic of exports separately, it should do so in a separate report to meet whatever purpose is identified. If DWR insists of having a chapter on exports, it should be moved to later in the report, after Chapters 6 and 7, which identify the basis for the studies reported on in the export chapter.

Page 37. The statement is made that Delta exports are the only SWP water supply source for 24 of the 29 SWP contractors. In fact, local runoff occasionally provides significant quantities of water supply in some wet years.

Page 38. The reference to "Upper Feather River Area contractors" should drop the term "Upper" and refer simply to the "Feather River contractors." The City of Yuba City is located on the lower Feather River.

Page 38. The discussion of water types is incomplete and confusing. It should either be expanded or dropped. Additionally, the word "surplus" should not be used in relation to Article 21 Water. Surplus water has a distinct meaning under the SWP Water Supply Contracts that is different than Article 21 Water

Figure 5-2. This graph would be better presented as a line graph than as a bar graph.

Page 41. The discussion presents results on existing and future conditions, without describing those conditions. This discussion would be enhanced if the entire Chapter 5 was included after Chapters 6 & 7, which are where the existing and future conditions are described.

Page 44. There is discussion of differences between the 2009 and 2011 Delivery Reliability Report that are not really meaningful and are totally within the margin of error for the modeling analysis. Rather than show repeated figures portraying these meaningless differences between the two reports, it would be preferable to abbreviate the text and figures and include a high level statement that the two reports are essentially identical.

Page 48. The discussion of the basis for local demands changing highlights water conservation as the only specific example of those changes. A much more important factor would be local management (i.e., local storage) within the service area.

Page 48. There is a reference to Kern Wet Year as the basis for variations in Article 21 Water demands, but no explanation of why that would be a factor. It would be useful to state that Kern River inflows are a major local water supply variable in Kern County Water Agency, which is the second largest SWP contractor and possesses significant local groundwater recharge potential.

Pages 51-53. As pointed out earlier, there is extensive discussion and numerous figures are presented to show the differences between the 2009 and 2011 Delivery Reliability Reports, which are essentially not meaningful and within the margin of error of the studies. Rather than included repetitive slides showing the same information, this section should be substantially reduced. In fact, the summary of results presented on Page 57 would suffice for all the presentation starting on page 51 and continuing to Page 57.

Page 57. In discussing the Dry year deliveries of Article 21 Water, there is no indication of the location of those deliveries. Given regulatory restrictions in place, it is likely that all the Article 21 Water Deliveries are made to the SWP contractors located north of the Delta. If so, that should be stated. Otherwise, the reader is left with the impression that Article 21 Water might be available for South of the Delta contractors.

Page 61. There is a reference to 4,133 taf/year as the "maximum Delta SWP Table A." The term Delta should be dropped and the reference should be only to "maximum SWP Table A."

Pages 62-68. Same comment as for Chapter 6. The discussion of differences between essentially identical modeling results is too long and should be truncated. The summary of results starting at page 68 could suffice for this entire discussion.

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **EDMUND G. BROWN JR.,** *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

May 25, 2012

Terry L. Erlewine
General Manager
State Water Contractors
1121 L Street, Suite 1050
Sacramento, California 95814-3944

Dear Mr. Erlewine,

This letter is in response to your letter dated March 12, 2012 providing the comments of the State Water Contractors. I appreciate you and your members taking the time to review the Draft 2011 SWP Delivery Reliability Report and providing feedback. Our responses to your comments are attached.

If you or your staff wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov. For specific questions regarding the analyses used for the report, please contact Francis Chung at (916) 653-5924.

Sincerely,

Katherine Kelly

Katherine F. Kelly, Chief
Bay-Delta Office

Attachment:

Attachment

The following responses are to the comments provided in the March 12, 2012 letter from the State Water Contractors. The comments are shown in italics.

Figure 2-2. This figure shows only inflows and outflows to the Delta, and does not provide information on the magnitude of total flows in the watershed or total outflow. A graph similar to that prepared for the Delta Vision that places the total disposition of water supply into context would be helpful.

> We have updated this figure to include a more thorough mass balance of the Delta.

Page 13. Discussion of how operations are coordinated with the CVP should reference the Coordinated Operation Agreement, which is the basis for that coordination.

> We have updated the text on page 13 to mention the Coordinated Operation Agreement with language similar to that used in the sidebar on page 14 of the report.

Page 23. There is discussion of how individual SWP contractors manage their water supplies annually on the basis of available water supply. That kind of annual information is *<u>not</u>* *the data that is contained in the Delivery Reliability Report and is provided separately by DWR's Operations Control Office. The discussion here reads as though the Delivery Reliability Report provides that information.*

> We have updated the language on page 23 to clarify the type of information that can be found in the SWP Delivery Reliability Report.

Page 27. The discussion of the status of the 2008 and 2009 Biological Opinions is not very informative. This discussion should expand briefly on Judge Wanger's opinion that the current BOs are "arbitrary, capricious and unlawful" and are currently being redone. The discussion should also note that a preliminary injunction was issued enjoining implementation of Fall X2 action of the 2008 Delta Smelt Biological Opinion. Additionally, DWR and other plaintiffs in the case have option to file actions challenging provisions of the Biological Opinions on a continuing basis until new BOs are developed.

> Staff from the Bay-Delta Office coordinated with DWR's Office of the Chief Counsel on this section and they felt that this section should be a factual summary of the assumptions and criteria used to operate the projects. As a result, discussion of the related litigation is kept to a minimum.

Chapter 5. The SWC question that there is any need for this chapter in this report as this goes beyond the issue of delivery reliability. If DWR wants to report on the topic of exports separately, it should do so in a separate report to meet whatever purpose is identified. If DWR insists of having a chapter on exports, it should be moved to later in the report, after Chapters 6 and 7, which identify the basis for the studies reported on in the export chapter.

> We have placed the "Exports" chapter before the "Deliveries" chapters simply because the exports precede deliveries in operations. Reordering chapters would cause significant rewriting to maintain document flow. We prefer to leave the content intact for the current report but we also want to consider the points you have brought up regarding exports as we start to formulate ideas for content to be included in the 2013 SWP Delivery Reliability Report.

Page 37. The statement is made that Delta exports are the only SWP water supply source for 24 of the 29 SWP contractors. In fact, local runoff occasionally provides significant quantities of water supply in some wet years.

> The language on page 37 has been modified to clarify that Delta exports are not the only source of SWP water for the contractors.

Page 38. The reference to "Upper Feather River Area contractors" should drop the term "Upper" and refer simply to the "Feather River contractors." The City of Yuba City is located on the lower Feather River.

> We agree completely and have removed the term "upper" from the Feather River description throughout the report and technical addendum.

Page 38. The discussion of water types is incomplete and confusing. It should either be expanded or dropped. Additionally, the word "surplus" should not be used in relation to Article 21 Water. Surplus water has a distinct meaning under the SWP Water Supply Contracts that is different than Article 21 Water.

> We have made some modifications to the discussion of water types so it will, hopefully, be more clear now. We have also taken out the word "surplus" when describing Article 21 deliveries, per your suggestion.

Figure 5-2. This graph would be better presented as a line graph than as a bar graph.

> We feel that the current graph format is aesthetically more consistent with the report layout.

Page 41. The discussion presents results on existing and future conditions, without describing those conditions. This discussion would be enhanced if the entire Chapter 5 was included after Chapters 6 & 7, which are where the existing and future conditions are described.

> We have added text to this section to direct the reader to chapters 6 and 7 for more information regarding the assumptions for modeling existing and future conditions.

Page 44. There is discussion of differences between the 2009 and 2011 Delivery Reliability Report that are not really meaningful and are totally within the margin of error for the modeling analysis. Rather than show repeated figures portraying these meaningless differences between the two reports, it would be preferable to abbreviate the text and figures and include a high level statement that the two reports are essentially identical.

> We have condensed the discussion of differences between the 2009 and 2011 report and removed some figures. Here is a list of changes for Chapter 5:
>
> - The discussion in *Average, Maximum, and Minimum Annual Delta Exports* on page 41 of the Draft has been reduced
> - Figure 5-3 has been replaced with the new Table 5-1
> - Percent changes in Table 5-3 (formerly Table 5-2) have been removed and the discussion of existing exports by water year type has been reduced
> - Percent changes in Table 5-4 (formerly Table 5-3) have been removed and the discussion of future exports by water year type has been reduced
> - Figures 5-5, 5-6 and 5-7 have been removed
> - The discussion in *Likelihood of SWP Exports—Existing and Future Conditions* section has been reduced

Page 48. The discussion of the basis for local demands changing highlights water conservation as the only specific example of those changes. A much more important factor would be local management (i.e., local storage) within the service area.

> We have updated this section per your suggestion.

Page 48. There is a reference to Kern Wet Year as the basis for variation in Article 21 Water demands, but no explanation of why that would be a factor. It would be useful to state that Kern River inflows are a major local water supply variable in Kern County Water Agency, which is the second largest SWP contractor and possesses significant local groundwater recharge potential.

> We have updated this section per your suggestion.

Page 51-53. As pointed out earlier, there is extensive discussion and numerous figures are presented to show the differences between the 2009 and 2011 Delivery Reliability Reports, which are essentially not meaningful and within the margin of error of the studies. Rather than included repetitive slides showing the same information, this section should be substantially reduced. In fact, the summary of results presented on Page 57 would suffice for all the presentation starting on page 51 and continuing to Page 57.

We have condensed the discussion of differences between the 2009 and 2011 report and removed some figures. Here is a list of changes for Chapter 6:

- Figure 6-1 has been replaced with new Table 6-1
- Figure 6-5 has been replaced with new Table 6-2 and the discussion in the *SWP Table A Water Deliveries* section has been reduced.
- Figure 6-7 has been removed
- Figures 6-8 and 6-9 have been replaced with new Tables 6-3 and 6-4 and the discussion of Dry-Year and Wet-Year Table A deliveries has been reduced on Draft page 53
- The discussion of *SWP Article 21 Water Deliveries* on Draft page 55 has been reduced
- The discussion of Dry-Year and Wet-Year Article 21 deliveries has been reduced on Draft page 57 and Figures 6-12 and 6-13 have been replaced with new Tables 6-5 and 6-6
- The Summary of Results for existing conditions have been worked into the main chapter text

Page 57. In discussion the Dry year deliveries of Article 21 Water, there is no indication of the location of those deliveries. Given regulatory restrictions in place, it is likely that all the Article 21 Water Deliveries are made to the SWP contractors located north of the Delta. If so, that should be stated. Otherwise, the reader is left with the impression that Article 21 Water might be available for South of Delta contractors.

Most of the Article 21 deliveries shown in the report for Dry years are for contractors south of the Delta. It happens during a few months under these conditions:

1. There is a low allocation
2. San Luis is full
3. Banks has capacity for pumping
4. Delta is in surplus conditions

Page 61. There is a reference to 4,133 taf/year as the "maximum Delta SWP Table A." The term Delta should be dropped and the reference should be only to "maximum SWP Table A."

This is meant to clarify that the results being presented are specific to those contractors that rely on delivery of water from the Delta. If we used "maximum SWP Table A" the value would be 4,172 taf/year.

Page 62-68. Same comment as for Chapter 6. The discussion of differences between essentially identical modeling results is too long and should be truncated. The summary of results starting at page 68 could suffice for this entire discussion.

We have condensed the discussion of differences between the 2009 and 2011 report and removed some figures. Here is a list of changes for Chapter 7:

- Figure 7-1 has been replaced with new Table 7-1
- The discussion in *Future Deliveries of SWP Table A Water* on Draft page 62 has been reduced
- Figure 7-3 has been removed
- Figures 7-4 and 7-9 have been replaced with new Tables 7-2 and 7-3 and the discussion of Dry-Year and Wet-Year Table A deliveries has been reduced on Draft page 64
- The discussion of *SWP Article 21 Water Deliveries* starting on Draft page 64 has been reduced
- The discussion of Dry-Year and Wet-Year Article 21 deliveries starting on Draft page 66 has been reduced and Figures 7-8 and 7-9 have been replaced with new Tables 7-4 and 7-5

A Look at…

Fifth Grade

in California Public Schools

and the
Common Core State Standards

CURRICULUM FRAMEWORKS AND INSTRUCTIONAL RESOURCES DIVISION
INSTRUCTION AND LEARNING SUPPORT BRANCH
CALIFORNIA DEPARTMENT OF EDUCATION
October 2011 Edition

Contents

Fifth-Grade Curriculum

What will my child learn in fifth grade?

I've been teaching second grade, and this year I've been reassigned to fifth grade. What does the fifth-grade curriculum look like?

I'm the principal of a small, private elementary school, and I want to be sure my students are meeting the state's standards. How can I find out what students are expected to learn at each grade?

In August 2010, the state adopted the Common Core State Standards for English language arts and mathematics. How will the new standards enhance fifth-grade curriculum?

This chapter is organized by sections for each subject, describing what students should know and be able to do by the end of fifth grade. Each section includes a brief overview of what the student should have learned before entering fifth grade, followed by a description of the fifth-grade standards. Each subject concludes with a list of the fifth-grade standards for that content area. The English language arts and mathematics sections include the new Common Core State Standards (CCSS), with California additions.

For a more in-depth discussion of each subject, please review the state-adopted curriculum frameworks for kindergarten through grade twelve. The frameworks are posted on the CDE Curriculum and Instruction Web page at http://www.cde.ca.gov/ci/cr/cf/allfwks.asp.

English Language Arts

Overview

Students in grade five are at the beginning of an academic stage traditionally described as reading to learn—or, more broadly, as reading and learning for life. During the first years of this stage, they begin to acquire and apply a full and complex range of lifelong language and literacy skills, skills that enable them to read to learn throughout their education and future careers. Deeper analysis of literature and informational text is a focus of fifth-grade instruction, though reading fluently and accurately remains a goal for all students. Students' understanding of the precise meanings of words, English language conventions, structural features of informational text and materials, and fundamental elements of literature all support greater comprehension of what they read, view, and hear.

Deeper analysis of literature and informational text is a focus of fifth-grade instruction…

Standards-based instruction is critical to developing students' literacy and proficiency in English language arts. The standards describe what students are expected to know and be able to do by the end of the school year. In 2010, California adopted new standards in English language arts: the CCSS, with California additions. The CCSS integrate the strands of English language arts: Reading, Writing, Speaking and Listening, and Language. The new standards will be implemented gradually over the next several years as curriculum frameworks, instructional materials, and assessments based on the CCSS are adopted.

There are many similarities between the CCSS and the 1997 California English language arts standards, but there are also some notable differences. For instance, in the CCSS, the standards in kindergarten through grade six are divided into strands: Reading, Writing, Speaking and Listening, and Language. The 1997 California English language arts standards are organized around domains: Reading, Writing, Written and Oral English Language Conventions, and Listening and Speaking. The CCSS often extend or enhance the content of the 1997 California English language arts standards. For example, the CCSS focus more on informational text, text-analysis skills for reading comprehension, opinion pieces, informational/explanatory compositions, and collaborative discussions about grade-level texts and topics.

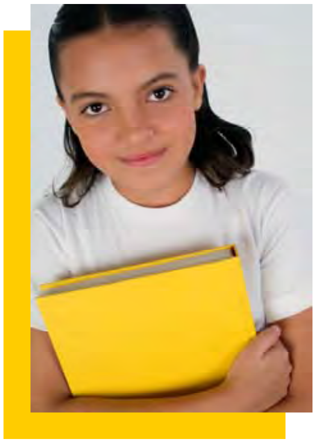
This section provides an overview of the new CCSS for fifth-grade English language arts. It includes a review of the important English language arts skills and concepts from fourth grade (prerequisite skills) and guidance to ensure success for struggling readers, including English learners. A complete list of the grade-five CCSS for English language arts can be found at the end of this section. A complete list of the fifth-grade 1997 California English language arts standards is located on the CDE Content Standards page at http://www.cde.ca.gov/be/st/ss/documents/elacontentstnds.pdf.

What Fifth-Grade Students Should Know

In fourth grade, students read a wide range of literature in different genres and from different cultures and times. They studied the structural elements of poems, prose, and dramas and learned to summarize text in a concise manner. They analyzed informational text by considering its overall structure and organization, the differences between first- and secondhand accounts, and the author's use of evidence to support points in the text. Students acquired grade-level academic language and domain-specific vocabulary to support their reading and listening comprehension, writing, and speaking. They practiced a range of strategies for acquiring vocabulary independently.

Fourth-grade students also wrote detailed informational/explanatory texts with headings, illustrations, definitions, and quotations, as well as narratives in which they developed real or imagined experiences or events. They used technology to find information, interact and collaborate with others, and produce and publish writing. Students participated in collaborative discussions on fourth-grade topics and texts, paraphrased information presented in diverse media and formats, and delivered formal narrative presentations. They learned the conventions of standard English grammar and usage, capitalization, punctuation, and spelling to support their writing and speaking (e.g., using punctuation for effect, choosing words and phrases to convey ideas precisely).

What Students Learn in Fifth Grade



Fifth-grade students read a wide range materials, including literature from different times and cultures and informational text on grade-level topics in all subject areas. They practice the foundational reading skills learned in previous grades to read accurately and fluently, but the emphasis in fifth grade is on students' comprehension of complex narrative and informational texts. Students read two or more texts on a topic and use a variety of comprehension strategies to compare, contrast, and integrate information from the texts. They analyze how structure, point of view, visual elements, and figurative language contribute to the meaning or tone of texts. As their text-analysis skills deepen, students are able to determine the main themes or points of text, understand how the author's evidence and reasons support the theme or argument of the text, and draw inferences or conclusions supported by details from the text. They learn academic language and domain-specific vocabulary through their reading and use it in their writing and speaking.

In their writing, students learn to group related information logically; use words, phrases, and clauses to link opinions to reasons and to connect ideas to related ideas; and use narrative techniques, such as dialogue, description, and pacing, to develop the story line or characters. They revise, edit, and rewrite their compositions and learn to try new approaches to improve their writing. Students conduct research projects that provide them with practice in gathering information, using print and digital sources, and summarizing information in notes.

Students engage effectively in collaborative discussions on fifth-grade topics and texts, identify and analyze logical fallacies in speakers' presentations or from media sources, and learn to deliver speeches in which they state an opinion and support it with a logical sequence of evidence. They also learn to use gestures and expressions to convey meaning when they recite a section of a speech or poem or read from a historical or scientific document. To support their writing and speaking, they learn the conventions of standard English grammar and usage, capitalization, spelling, and punctuation, such as commas and quotations to set off dialogue and correctly indicating titles of different kinds of documents and sources. Students learn to use print and digital reference materials to determine the correct pronunciation and meaning of words and to identify alternate word choices in all fifth-grade content areas.

Reading

The following section is organized according to three major areas: reading standards for literature, for informational text, and in foundational skills.

Reading Standards for Literature

Students in fifth grade read and analyze a variety of historically and culturally significant works of literature, including stories, drama, and poetry. In both the 1997 California English language arts standards and the CCSS, students analyze the structures and elements of literary works in order to comprehend the texts. They learn to recognize the theme of stories, dramas, and poetry, even when it is implied instead of directly stated. Students summarize texts, compare and contrast the actions and motives of two or more characters, and draw inferences from texts. They understand figurative language in context, including metaphors and similes, and its function as a literary device.

The 1997 California English language arts standards include a focus on literary criticism. Students read literature from different eras and cultures and evaluate the meaning of archetypal patterns and symbols found in myths and traditional literature. In addition, students evaluate techniques (e.g., appeal of characters, logic and credibility of plots and settings, use of figurative language) that an author uses to influence readers' perspectives.

There are similar standards in the CCSS. For example, students describe how a narrator's or speaker's point of view influences how events in the narrative are described. They also compare and contrast approaches to similar themes and topics in stories of the same genre. Unique to the CCSS is a standard that focuses attention on visual and multimedia elements of literature in different media, including technology-based presentations. Students analyze how visual and multimedia elements contribute to the meaning, tone, or beauty of texts, including graphic novels and multimedia presentations of fiction, folktales, myths, and poems.

Reading Standards for Informational Text

At this stage of reading to learn, students read more informational text in English language arts and other grade-level subject areas than in earlier grades. As students face increased reading demands in all fifth-grade subject areas, improved comprehension becomes critical to their academic success. The 1997 California English language arts standards focus more on informational text at this grade level than in previous grade levels and are therefore more similar to the CCSS.

In both the 1997 California English language arts standards and the CCSS, students use their knowledge of text structure, organization, and purpose to comprehend the essential ideas, arguments, and perspectives of informational text. They learn to discern the main ideas and concepts of a text and to identify and explain the reasons and evidence presented to support the main idea or argument. Students learn to gather information from multiple sources, including maps, charts, and illustrations, and understand how text features (e.g., formatting, sequence) make information more accessible. They use text features to find information quickly or answer questions about a topic. They are able to draw inferences and conclusions from text and to support them with explicit evidence from the text.

Students learn to gather information from multiple sources, including maps, charts, and illustrations, and understand how text features (e.g., formatting, sequence) make information more accessible.

The CCSS emphasize additional analysis skills that call for students to think critically and ask students to explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text. As they analyze the points of view presented in multiple accounts of the same event or topic, they learn to recognize important similarities and differences. Students learn to integrate information from several texts on the same subject in order to write or speak about the subject knowledgeably. To support their comprehension of texts on fifth-grade topics in all subject areas, students learn the meaning of general academic and domain-specific words and phrases.

Reading Standards in Foundational Skills

In fifth grade, students continue to build on the foundational skills that enable them read and comprehend complex narrative and expository text. Both the 1997 California English language arts standards and the CCSS call for students to decode words fluently and accurately. Students in fifth grade decode words by using their knowledge of all letter-sound correspondences, syllabication patterns, affixes, and root words.

Fluency expectations increase as students read grade-level narratives, prose, poetry, and informational text with accuracy, appropriate pacing, and expression. The CCSS expand on these expectations by also calling for students to read with purpose and understanding and to use context to confirm or self-correct word recognition and understanding.

After fifth grade, the CCSS no longer include standards in the foundational skills of reading. As students advance through the grades, they will apply the foundational reading skills they mastered in preceding grades, allowing them to read with fluency and accuracy to fully comprehend grade-level literature and informational text.

Writing

Students in grade five write with an awareness of their audience and purpose. Their writing demonstrates a command of the conventions of the English language, an understanding of the structures and organization of text, and experience with the stages of the writing process (e.g., prewriting, drafting, revising, editing). They use resources to gather information to support their main idea and use technology to create documents. Students learn to use transitional words or phrases to link paragraphs and ideas, making clear their line of thought.

Both the 1997 California English language arts standards and the CCSS call for students in fifth grade to write multiparagraph texts with a central idea or theme, relevant supporting details, and a conclusion. The types of writing that students produce vary under each set of standards. Students write responses to literature, persuasive letters or compositions, research reports, and narratives under the 1997 California English language arts standards. The persuasive compositions are similar to the opinion pieces students write under the CCSS, and the research reports are similar to the informative/explanatory text. Students write narratives under both sets of standards.

The two sets of standards have different expectations for the quality of students' writing, with the CCSS setting more detailed and challenging criteria for students' writing. Under the CCSS, students write routinely in both extended and short time frames for a range of discipline-specific tasks, purposes, and audiences. They learn to organize their opinion pieces so that ideas are logically grouped to support their opinion; link opinions to reasons with words (e.g., *consequently, specifically*), phrases, and clauses; and provide a concluding statement or section related to the opinion stated. The CCSS call for students to include formatting (e.g., headings), illustrations, and multimedia in their informative/explanatory texts to aid comprehension and to use precise language and domain-specific vocabulary to inform the reader about the topic. In their narrative writing, students learn how to orient the reader by establishing the situation and introducing a narrator or characters. They also learn how to organize an event sequence that unfolds naturally. Additionally, they use dialogue, description, and pacing to develop experiences and events or show the responses of characters to situations.

Technology, including the Internet, plays a larger role in the CCSS with students using it to produce and publish writing and to interact and collaborate with others. In grade five, students demonstrate a sufficient command of keyboarding skills to type at least two pages in a single sitting. Students also learn to how to obtain information from digital and print sources, summarize or paraphrase information in notes and their finished texts, and provide a list of their sources.

Speaking and Listening

Students in fifth grade listen critically to speakers and media presentations, summarize what they have heard, deliver presentations, and ask questions to gain additional information. In their oral presentations, they use the structures found in the literature and informational text they read and in their own writing (e.g., a central idea or theme supported by facts, descriptive details, or observations). Students apply the same conventions of standard English when speaking that they use in their writing.

Both the 1997 California English language arts standards and the CCSS focus on students' listening and comprehension skills and their formal oral-presentation skills. Students identify and analyze logical fallacies in a speaker's presentation or from a media source. They deliver informative reports in which they sequence ideas logically, use appropriate facts and relevant details to support the main idea, and speak clearly. Students also deliver opinion speeches in which they provide evidence and examples to support their point of view. They learn to use expression and gestures to engage the audience and for effect when they recite a poem or a portion of a speech.

There are notable differences between the 1997 California English language arts standards and the CCSS. The 1997 California English language arts standards focus on analyzing oral presentations and media communications. For example, the 1997 California English language arts standards ask students to interpret a speaker's verbal and nonverbal messages, purposes, and perspectives and make inferences based on the speaker's presentation. They also identify, analyze, and critique persuasive techniques (e.g., promises, dares, flattery, generalizations). Students analyze media sources and their influence on information, entertainment, persuasion, and as a means of transmitting culture.

The CCSS emphasize collaborative discussions during which students discuss fifth-grade topics and texts with diverse partners and in different groupings (one-on-one, in groups, or teacher-led). In these discussions, students build on others' ideas, clearly express their own ideas, follow agreed-upon rules, and carry out their assigned roles. To engage effectively in collaborative discussions, students are expected to prepare by reading or studying material that will be discussed or is related to the topic. They make comments that contribute to the discussion and elaborate on the remarks of others, review the key ideas expressed during the discussion, and draw conclusions based on what they have learned.

The CCSS emphasize collaborative discussions during which students discuss fifth-grade topics and texts with diverse partners and in different groupings (one-on-one, in groups, or teacher-led).

Multimedia components, as sources of information and complements to oral presentations, are another focus of the CCSS. Students in fifth grade learn to summarize information presented in diverse media and formats, including visual, quantitative, and oral. They also summarize the points made by a speaker or media source and explain how the claims are supported by reasons and evidence. When media enhance the development of their main ideas or themes, they incorporate multimedia components (e.g., graphics, sound) and visual displays (e.g., maps, charts) in their oral presentations. Students learn to adapt their speech to a variety of contexts and tasks and are able to use formal English when it is appropriate to do so.

Language

In fifth grade, students learn new rules for grammar and usage, capitalization, punctuation, and spelling. The specific rules or conventions they learn vary between the 1997 California English language arts standards and the CCSS. Students use their knowledge of language and its conventions when writing, speaking, listening, and reading.

There are more standards for English language conventions in the CCSS than in the 1997 California English language arts standards, and they cover a broader range of conventions in grammar and usage, capitalization, punctuation, and spelling. For example, under the 1997 California English language arts standards for fifth grade, students use conjunctions to connect ideas. Under the fifth-grade CCSS, they explain the function of conjunctions, as well as prepositions and interjections, in general and in particular sentences. The 1997 California English language arts standards call for students to identify and correctly use verbs that are often misused (e.g., *lie/lay, rise/raise*), while the CCSS call for students to use verb tense to convey the various times, sequences, states, and conditions.

The fifth-grade CCSS emphasize verb tenses. Students learn to use perfect-tense verbs (e.g*., I had walked; I have walked*) and to recognize and correct inappropriate shifts in verb tenses. Comma use is another focus of the CCSS in fifth grade. Students learn to punctuate items in a series and use a comma to separate an introductory element from the rest of the sentence. They also learn to use a comma to set off the words “yes” and “no” (e.g., *Yes, thank you*); to set off a tag question from the rest of the sentence (e.g., *It’s true, isn’t it?*); and to indicate direct address (e.g., *Is that you, Linda?*).

In the 1997 California English language arts standards, vocabulary development standards are found in the Reading strand. In the CCSS, standards for vocabulary acquisition and use are found in the Language strand. Both the 1997 California English language arts standards and the CCSS cover a range of strategies for vocabulary acquisition, though independent reading is the primary means by which students increase their vocabulary. Under both sets of standards, students use their knowledge of the relationships between synonyms, antonyms, and homonyms to understand each of the related words. These strategies are taught more explicitly under the CCSS, which have a greater focus on relationships between words than the 1997 California English language arts standards. Students understand and can explain figurative language, including similes and metaphors, in context. They use Greek and Latin affixes and roots to understand the meaning of complex words (e.g., *controversial, photosynthesis*).

In addition, the CCSS emphasize students’ use of both print and digital reference materials (e.g., dictionaries, glossaries, thesauruses) to pronounce words, clarify the precise meaning of key words, and to identify alternate word choices in all fifth-grade subject areas. In a related standard, the CCSS call for students to acquire and use grade-appropriate academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships (e.g., *although, similarly, in addition*). Students also learn and can explain the meaning of common idioms, adages, and proverbs.

Extra Support for Struggling Readers

By the end of fifth grade, students are expected to be fluent, independent readers, reading with accuracy that supports their comprehension of literature and informational text. Students who are not proficient in word-analysis skills are likely to experience academic difficulties. Early screening and intervention address specific weaknesses in a timely manner. Struggling readers—any students experiencing difficulty learning to read, which may include those who use nonstandard English, English learners, and students with disabilities—need additional support to participate in daily lessons with their peers and to ensure they become proficient in fifth-grade reading skills. Instructional support for students should include:

- flexible groupings for differentiated instruction;

- opportunities to preteach key skills, strategies, and concepts;
- intensive explicit instruction in decoding and word-recognition skills, which may include materials at the reading level of students;
- preteaching and reteaching of Greek and Latin affixes and roots;
- scaffolded instruction in the fundamental elements of plot, including conflict and resolution;
- ample opportunities to practice delivery of oral presentations;
- direct, explicit instruction in language development to address grammatical structures of oral and written standard English;
- vocabulary instruction embedded in context, including academic language;
- building of background knowledge;
- reinforcement and extension of the regular classroom program.

For those students whose reading achievement is two or more years below grade level, placement in an Intensive Intervention Program in Reading/Language Arts should be considered. These intensive, stand-alone, accelerated programs are specifically designed to address the instructional needs of students in grades four through eight whose reading achievement is two or more years below grade level. (For additional information on state-adopted intensive intervention programs, see Chapter 9 of the *Reading/Language Arts Framework for California Public Schools* [California Department of Education 2007b] and the list of adopted instructional materials on the CDE Reading/Language Arts Web page at http://www.cde.ca.gov/ci/rl/im/rlaadoptedlist.asp.)

Support for English Learners

English-language development (ELD) is a critical component of the language arts program for English learners and comes with direct, explicit, and systematic instruction in reading and writing. Instructional programs for English learners should be planned according to the students' assessed level of literacy (reading and writing) in English and their primary language as well as their proficiency in English (listening, speaking, reading, and writing). Students with strong literacy skills in their primary language have an advantage: They can concentrate on learning English rather than on receiving initial instruction in reading and writing.

English learners benefit from instructional strategies such as preteaching of concepts, vocabulary, and the grammatical features of key vocabulary…

Students in fifth grade continue to transition from learning to read to reading to learn subject-matter content, which calls for students to use and understand more sophisticated content-specific vocabulary and language structures. English learners should receive intensive instruction in vocabulary development and academic language to succeed in language arts and other subjects at their grade level. English learners benefit from instructional strategies such as preteaching of concepts, vocabulary, and the grammatical features of key vocabulary and by having multiple opportunities to use newly acquired vocabulary in their reading, speaking, and writing assignments. They also benefit from explicit writing instruction on how to write narrative compositions focusing on the use of plot elements. Students practice and learn how to switch from past and present tenses while developing narrative essays. Because English learners are still developing proficiency in English, they benefit from teacher feedback on their writing and on their grammar, usage, and so forth. English learners may need additional time and practice in writing such compositions to further their writing abilities.

English learners develop oral and written language through formal linguistic instruction. They learn common phrases, idiomatic expressions, and language patterns, as well as phonological, morphological, syntactical, and semantic structures of English. As students learn the rules of English grammar and functions of verb tenses, prepositions, conjunctions, and interjections, they practice them both in speaking and writing and receive corrective teacher feedback. (For a more extensive list of the conventions of grammar, refer to the "Transition to the Common Core State Standards with California Additions: Planning ELD Instruction" chart that follows.)

For those students whose academic achievement is two or more years below grade level, placement in an Intensive Intervention Program for English Learners should be considered. These intensive, stand-alone, accelerated programs are specifically designed for English learners in grades four through eight whose academic achievement is two or more years below grade level. (For additional information on state-adopted intensive intervention programs for English Learners, see Chapter 9 of the *Reading/Language Arts Framework for California Public Schools* [California Department of Education 2007b] and the list of adopted instructional materials on the CDE Reading/Language Arts Web page at http://www.cde.ca.gov/ci/rl/im/rlaadoptedlist.asp.)

Specially designed academic instruction in English (SDAIE) is one instructional strategy to meet the needs of English learners. For additional resources to support the teaching of English learners, please visit the CDE English Learners Web page at http://www.cde.ca.gov/sp/el/. The CDE has published an excellent resource, *Improving Education for English Learners: Research-Based Approaches* (2010b), that provides the most comprehensive and up-to-date strategies to serve English learners. Guidelines for using ELD and SDAIE strategies are provided, as well as recommended instructional practices. Information on the publication is available through the CDE Press Web page at http://www.cde.ca.gov/re/pn/rc/.

English learners need additional time for appropriate instructional support. The CCSS set rigorous expectations for student learning, and ELD instruction must accommodate these enhanced expectations. The following chart illustrates the enhancements in the CCSS for English language arts that may affect ELD instruction. This chart provides teachers with initial guidance in planning effective ELD instruction.

Transition to the Common Core State Standards
with California Additions
Planning ELD Instruction: Grade Five

Reading Standards for Literature	2. Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text. 4. Determine the meaning of words and phrases as they are used in a text, including figurative language such as metaphors and similes. **(<u>See grade 5 Language standards 4–6 for additional expectations.</u>)** 6. Describe how a narrator's or speaker's point of view influences how events are described.

	7. Analyze how visual and multimedia elements contribute to the meaning, tone, or beauty of a text (e.g., graphic novel, multimedia presentation of fiction, folktale, myth, poem). 9. Compare and contrast stories in the same genre (e.g., mysteries and adventure stories) on their approaches to similar themes and topics. 10. By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4–5 text complexity band independently and proficiently.
Reading Standards for Informational Text	3. Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text. 5. Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts. 6. Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent. 7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. 8. Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). 9. Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. 10. By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4–5 text complexity band independently and proficiently.
Reading Standards: Foundational Skills	4. Read with sufficient accuracy and fluency to support comprehension. a. Read on-level text with purpose and understanding. b. Read on-level prose and poetry orally and with accuracy, appropriate rate, and expression on successive readings. c. Use context to confirm or self-correct word recognition and understanding, rereading as necessary.

Writing Standards

1. Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
    a. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically groped to support the writer's purpose.
    b. Provide logically ordered reasons that are supported by facts and details.
    c. Link opinion and reasons using words, phrases, and clauses (e.g., consequently, specifically).
    d. Provide a concluding statement or section related to the opinion presented.
2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
    a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.
    b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
    c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially).
    d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
    e. Provide a concluding statement or section related to the information or explanation presented.
3. Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
    b. Use narrative techniques, such as dialogue, description, and pacing, to develop experiences and events or show the responses of characters to situations.
    c. Use a variety of transitional words, phrases, and clauses to manage the sequence of events.
    d. Use concrete words and phrases and sensory details to convey experiences and events precisely.
    e. Provide a conclusion that follows from the narrated experiences and events.

	5. With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grade 5.) 6. With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of two pages in a single sitting. 7. Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. 8. Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. 9. Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply grade 5 Reading standards to literature (e.g., “Compare and contrast two or more characters, settings, or events in a story or a drama, drawing on specific details in the text [e.g., how characters interact]”). b. Apply grade 5 Reading standards to informational texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point[s]”). 10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Speaking and Listening Standards	1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 5 topics and texts*, building on others’ ideas and expressing their own clearly. a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others. d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

	2. Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. 3. Summarize the points a speaker **or media source** makes and explain how each claim is supported by reasons and evidence, **and identify and analyze any logical fallacies**. 4. Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. **a. Plan and deliver an opinion speech that: states an opinion, logically sequences evidence to support the speaker's position, uses transition words to effectively link opinions and evidence (e.g., consequently and therefore), and provides a concluding statement related to the speaker's position.** **b. Memorize and recite a poem or section of a speech or historical document using rate, expression, and gestures appropriate to the selection.** 5. Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
Language Standards	1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Explain the function of conjunctions, prepositions, and interjections in general and their function in particular sentences. b. Form and use the perfect (e.g., *I had walked; I have walked; I will have walked*) verb tenses. c. Use verb tense to convey various times, sequences, states, and conditions. d. Recognize and correct inappropriate shifts in verb tense. e. Use correlative conjunctions (e.g., *either/or, neither/nor*). 2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Use punctuation to separate items in a series. b. Use a comma to separate an introductory element from the rest of the sentence.

c. Use a comma to set off the words yes and no (e.g., *Yes, thank you*), to set off a tag question from the rest of the sentence (e.g., *It's true, isn't it?*), and to indicate direct address (e.g., *Is that you, Steve?*).

d. Use underlining, quotation marks, or italics to indicate titles of works.

e. Spell grade-appropriate words correctly, consulting references as needed.

3. Use knowledge of language and its conventions when writing, speaking, reading, or listening.

    a. Expand, combine, and reduce sentences for meaning, reader/listener interest, and style.

    b. Compare and contrast the varieties of English (e.g., dialects, registers) used in stories, dramas, or poems.

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grade 5 reading and content,* choosing flexibly from a range of strategies.

    a. Use context (e.g., cause/effect relationships and comparisons in text) as a clue to the meaning of a word or phrase.

    c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases **and to identify alternate word choices *in all content areas***.

5. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

    a. Interpret figurative language, including similes and metaphors, in context.

    b. Recognize and explain the meaning of common idioms, adages, and proverbs.

    c. Use the relationship between particular words (e.g., synonyms, antonyms, homographs) to better understand each of the words.

6. Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships (e.g., *however, although, nevertheless, similarly, moreover, in addition*).

Note: California additions are in bold typeface and underlined.

The Standards

The CCSS, with California additions, that follow are the prepublication version of the standards prepared by the Sacramento County Office of Education (SCOE), updated on October 15, 2010. Content that is unique to California and was added by California to the multistate common core standards is in **bold typeface and underlined**. The SCOE document is available online at http://www.scoe.net/castandards/agenda/2010/ela_ccs_recommendations.pdf (Outside Source). These grade-five CCSS for English language arts were adopted by the California State Board of Education on August 2, 2010. The CCSS College and Career Readiness (CCR) Anchor Standards (Appendix A) define the literacy expectations for students entering college and careers and provide the foundation for the K–12 English language arts standards. Although the CCR Anchor Standards were not part of the State Board action in August, they are essential to understanding the structure and cohesive nature of the CCSS.

A complete list of the grade-five 1997 California English language arts content standards is located on the CDE Content Standards Web page at http://www.cde.ca.gov/be/st/ss/documents/elacontentstnds.pdf.

Common Core State Standards with California Additions English Language Arts: Grade Five

Reading Standards for Literature

Key Ideas and Details	
1.	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
2.	Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text.
3.	Compare and contrast two or more characters, settings, or events in a story or drama, drawing on specific details in the text (e.g., how characters interact).
Craft and Structure	
4.	Determine the meaning of words and phrases as they are used in a text, including figurative language such as metaphors and similes. **(See grade 5 Language standards 4–6 for additional expectations.)**
5.	Explain how a series of chapters, scenes, or stanzas fits together to provide the overall structure of a particular story, drama, or poem.
6.	Describe how a narrator's or speaker's point of view influences how events are described.
Integration of Knowledge and Ideas	
7.	Analyze how visual and multimedia elements contribute to the meaning, tone, or beauty of a text

	(e.g., graphic novel, multimedia presentation of fiction, folktale, myth, poem).
8.	(Not applicable to literature)
9.	Compare and contrast stories in the same genre (e.g., mysteries and adventure stories) on their approaches to similar themes and topics.
Range of Reading and Level of Text Complexity	
10.	By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4–5 text complexity band independently and proficiently.
Reading Standards for Informational Text	
Key Ideas and Details	
1.	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
2.	Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
3.	Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
Craft and Structure	
4.	Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area. **(See grade 5 Language standards 4–6 for additional expectations.)**
5.	Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.
6.	Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent.
Integration of Knowledge and Ideas	
7.	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
8.	Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).
9.	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Range of Reading and Level of Text Complexity

10. By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4–5 text complexity band independently and proficiently.

Reading Standards: Foundational Skills

Phonics and Word Recognition

3. Know and apply grade-level phonics and word analysis skills in decoding words.
    a. Use combined knowledge of all letter-sound correspondences, syllabication patterns, and morphology (e.g., roots and affixes) to read accurately unfamiliar multisyllabic words in context and out of context.

Fluency

4. Read with sufficient accuracy and fluency to support comprehension.

    a. Read on-level text with purpose and understanding.

    b. Read on-level prose and poetry orally with accuracy, appropriate rate, and expression on successive readings.

    c. Use context to confirm or self-correct word recognition and understanding, rereading as necessary.

Writing Standards

Text Types and Purposes

1. Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

    a. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically grouped to support the writer's purpose.

    b. Provide logically ordered reasons that are supported by facts and details.

    c. Link opinion and reasons using words, phrases, and clauses (e.g., consequently, specifically).

    d. Provide a concluding statement or section related to the opinion presented.

2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
    a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

	b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially). d. Use precise language and domain-specific vocabulary to inform about or explain the topic. e. Provide a concluding statement or section related to the information or explanation presented.
3.	Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences. a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally. b. Use narrative techniques, such as dialogue, description, and pacing, to develop experiences and events or show the responses of characters to situations. c. Use a variety of transitional words, phrases, and clauses to manage the sequence of events. d. Use concrete words and phrases and sensory details to convey experiences and events precisely. e. Provide a conclusion that follows from the narrated experiences or events.
Production and Distribution of Writing	
4.	Produce clear and coherent writing **(including multiple-paragraph texts)** in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
5.	With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grade 5.)
6.	With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of two pages in a single sitting.
Research to Build and Present Knowledge	
7.	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

8.	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
9.	Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply grade 5 Reading standards to literature (e.g., “Compare and contrast two or more characters, settings, or events in a story or a drama, drawing on specific details in the text [e.g., how characters interact]”). b. Apply grade 5 Reading standards to informational texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point[s]”).
Range of Writing	
10.	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Speaking and Listening Standards	
Comprehension and Collaboration	
1.	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others’ ideas and expressing their own clearly. a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others. d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.
2.	Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
3.	Summarize the points a speaker **or media source** makes and explain how each claim is supported by reasons and evidence, **and identify and analyze any logical fallacies.**
Presentation of Knowledge and Ideas	

4.	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. **a. Plan and deliver an opinion speech that: states an opinion, logically sequences evidence to support the speaker's position, uses transition words to effectively link opinions and evidence (e.g., consequently and therefore), and provides a concluding statement related to the speaker's position.** **b. Memorize and recite a poem or section of a speech or historical document using rate, expression, and gestures appropriate to the selection.**
5.	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
6.	Adapt speech to a variety of contexts and tasks, using formal English when appropriate to task and situation. (See grade 5 Language standards 1 and 3 for specific expectations.)
Language Standards	
Conventions of Standard English	
1.	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Explain the function of conjunctions, prepositions, and interjections in general and their function in particular sentences. b. Form and use the perfect (e.g., *I had walked; I have walked; I will have walked*) verb tenses. c. Use verb tense to convey various times, sequences, states, and conditions. d. Recognize and correct inappropriate shifts in verb tense.[*] e. Use correlative conjunctions (e.g., *either/or*, *neither/nor*).
2.	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Use punctuation to separate items in a series.[*] b. Use a comma to separate an introductory element from the rest of the sentence.

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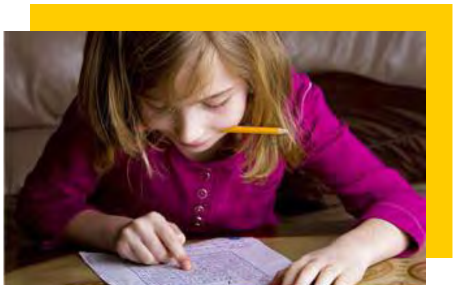
[*] The following skills are particularly likely to require continued attention in higher grades as they are applied to increasingly sophisticated writing and speaking. See the chart "Language Progressive Skills, by Grade" on page 47 in the CCSS.

	c. Use a comma to set off the words yes and no (e.g., *Yes, thank you*), to set off a tag question from the rest of the sentence (e.g., *It’s true, isn’t it?*), and to indicate direct address (e.g., *Is that you, Steve?*). d. Use underlining, quotation marks, or italics to indicate titles of works. e. Spell grade-appropriate words correctly, consulting references as needed.
Knowledge of Language	
3.	Use knowledge of language and its conventions when writing, speaking, reading, or listening. a. Expand, combine, and reduce sentences for meaning, reader/listener interest, and style. b. Compare and contrast the varieties of English (e.g., dialects, registers) used in stories, dramas, or poems.
Vocabulary Acquisition and Use	
4.	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grade 5 reading and content*, choosing flexibly from a range of strategies. a. Use context (e.g., cause/effect relationships and comparisons in text) as a clue to the meaning of a word or phrase. b. Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word (e.g., *photograph, photosynthesis*). c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases **and to identify alternate word choices *in all content areas.***
5.	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings. a. Interpret figurative language, including similes and metaphors, in context. b. Recognize and explain the meaning of common idioms, adages, and proverbs. c. Use the relationship between particular words (e.g., synonyms, antonyms, homographs) to better understand each of the words.
6.	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships (e.g., *however, although, nevertheless, similarly, moreover, in addition*).

Mathematics

Overview



Effective mathematics education provides students with a balanced instructional program. In such a program, students become proficient in basic computational skills and procedures, develop conceptual understandings, and become adept at problem solving. Standards-based mathematics instruction starts with basic material and increases in scope and content as the years progress. It is like an inverted pyramid, with the entire weight of the developing subject, including readiness for algebra, resting on the foundations built in the early grades.

In Augusts 2010, California adopted new standards in mathematics: the Common Core State Standards (CCSS), with California additions. The CCSS comprise standards developed by the state-led CCSS Initiative and material taken from the 1997 California mathematics standards. The new standards will be implemented gradually over the next several years as curriculum frameworks, instructional materials, and assessments based on the CCSS are adopted.

There are many similarities between the CCSS and the 1997 California mathematics standards, but there are also a few noteworthy differences. For instance, the CCSS are organized by "domains" that add grade-level focus and vary slightly by grade. The domains for fifth grade are Operations and Algebraic Thinking, Number and Operations in Base Ten, Number and Operations—Fractions, Measurement and Data, and Geometry. Also, the CCSS do not include "key standards" as in the 1997 California mathematics standards. Instead, the CCSS are designed to have a greater focus at each grade and to develop mathematics topics in depth. In the early grades, the CCSS continue to emphasize concepts necessary for the study of more advanced mathematics in later years. To ensure that students have adequate time to achieve mastery, some of the 1997 California mathematics standards familiar to California's fifth-grade teachers will be taught in different grades after the CCSS are fully implemented.

This section provides an overview of the new CCSS for fifth-grade mathematics, including some highlights of how the fifth-grade curriculum, based on the 1997 California mathematics standards, changes with the implementation of the new CCSS. It includes a review of the important mathematical concepts and skills from fourth grade (prerequisite skills) and guidance on areas of mathematics that may be challenging for some English learners. A complete list of the fifth-grade CCSS for mathematics can be found at the end of this section. A complete list of the fifth-grade 1997 California mathematics standards is located on the CDE Content Standards Web page at http://www.cde.ca.gov/be/st/ss/documents/mathstandards.pdf.

What Fifth-Grade Students Should Know

Students entering fifth grade who have met the fourth-grade CCSS for mathematics are able to apply the four operations (addition, subtraction, multiplication, and division) with whole numbers to solve multistep word problems, including problems in which remainders must be interpreted. They have learned to fluently add and subtract multi-digit numbers and can also round multi-digit numbers. Students can multiply multi-digit numbers by two-digit numbers and divide four-digit dividends and one-digit divisors to find whole-number quotients and remainders.

While in fourth grade, students developed an understanding of equivalence and ordering of fractions. They compared two fractions with different numerators and different denominators by creating common denominators or numerators or by comparing to benchmark fractions such as 1/2. Students decomposed a fraction into a sum of fractions with the same denominator. They solved word problems involving addition and subtraction of fractions with like denominators and multiplication of a fraction by a whole number. Students used decimal notation for fractions with denominators of 10 or 100 (e.g., rewrite 0.62 as 62/100). They also compared two decimals to hundredths by reasoning about their size and recorded the results of the comparisons with the symbols >, =, or <.

Students entering fifth grade can use the four operations to solve word problems involving measurement and conversion of measurements from a larger unit to a smaller unit within one system (e.g., metric or English units). They understand area and perimeter of rectangles and apply the formulas in real-world problems. Students have developed an understanding of the concept of lines and angles. They can measure angles in whole-number degrees and solve addition and subtraction problems to find unknown angles on a diagram. They can draw and identify points, lines (including parallel and perpendicular lines), and angles in two-dimensional figures. In addition, students can classify two-dimensional figures, including special triangles and quadrilaterals, based on the presence or absence of parallel or perpendicular lines or of angles of a specified size. Students understand the concept of symmetry for two-dimensional figures.

What Students Learn in Fifth Grade

Students in fifth grade apply their understanding of fractions and fraction models to represent the addition and subtraction of fractions with unlike denominators. They develop an understanding of the multiplication of fractions and, in limited cases, the division of fractions. Students develop fluency in multiplying and dividing decimals to hundredths and finalize fluency using the four operations with whole numbers. They find the volume of right rectangular prisms and classify two-dimensional figures into categories based on their properties. Students graph points on a coordinate plane to solve real-world problems and interpret the coordinate value of points in the context of the situation.

Operations and Algebraic Thinking

In fifth grade, students write and interpret numerical expression. The CCSS call for students to write and evaluate simple numerical expressions, including those that contain parentheses, brackets, or braces. The 1997 California mathematics standards introduce at fourth grade the use of parentheses to indicate the order of operations. Both the 1997 California mathematics standards and the CCSS develop the concept of prime factorization as students express a whole number in the range 2–50 as a product of its prime factors. Students also form ordered pairs from numerical patterns generated from given rules, and they graph the ordered pairs on a coordinate plane.

The CCSS call for students to write and evaluate simple numerical expressions, including those that contain parentheses, brackets, or braces.

With full implementation of the CCSS, the evaluation of numerical expressions involving whole-number exponents or those in which letters stand for numbers will be introduced in sixth grade; both are fifth-grade topics in the 1997 California mathematics standards. The use of the distributive property in expressions with variables—a fifth-grade topic in the 1997 California mathematics standards—will be introduced in sixth grade.

Number and Operations in Base Ten

In fifth grade, students achieve fluency with multi-digit addition, subtraction, multiplication, and division of positive whole numbers. Students find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Students develop an understanding of operations with decimals as they add, subtract, multiply, and divide decimals to hundredths. In both the 1997 California mathematics standards and the CCSS, students use their understanding of place value to read, write, and compare decimals to thousandths and round decimals to any place. Fifth-grade students expand their understanding of place value as they explain the effect of multiplying or dividing by powers of 10 on decimal position and the number of zeros in a product. They also use whole-number exponents to denote powers of 10.

With full implementation of the CCSS, operations with negative integers—a fifth-grade topic in the 1997 California mathematics standards—will be introduced in sixth grade.

Number and Operations—Fractions

Both the 1997 California mathematics standards and the CCSS further the development of critical skills required for understanding and working with fractions. Students extend previous understanding of equivalent fractions to add and subtract fractions with unlike denominators, including mixed numbers. They solve word problems involving addition and subtraction of fractions with unlike denominators by using visual fraction models or equations to represent the problem. They also mentally estimate and assess the reasonableness of their answers. (For example, recognize an incorrect result $2/5 + 1/2 = 3/7$, by observing that $3/7 < 1/2$.)

In fifth grade, students apply and extend previous understandings of multiplication and division to multiply and divide fractions. Students multiply a fraction or whole number by a fraction. They find the area of a rectangle with fractional side lengths by tiling it with unit squares and multiplying the side lengths to demonstrate procedural equivalence. Fifth-graders interpret multiplication as scaling (resizing) by explaining the results of multiplying given numbers by fractions greater than 1 (a product greater than the given number) and less than 1 (a product smaller than the given number). They solve real-world problems involving multiplication of fractions and mixed numbers.

Students interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$), a fourth-grade topic in the 1997 California mathematics standards. They use visual fraction models or equations to solve word problems involving division of whole numbers leading to answers in the form of fractions, mixed numbers, or decimal fractions. Students divide unit fractions by nonzero whole numbers and whole numbers by unit fractions. They use the relationship between multiplication and division to explain that $(1/3) \div 4 = 1/12$ because $(1/12) \times 4 = 1/3$ and $4 \div (1/5) = 20$ because $20 \times (1/5) = 4$. Division of a fraction by a fraction, a fifth-grade topic in the 1997 California mathematics standards, is a sixth-grade topic in the CCSS.

With full implementation of the CCSS, problems involving percent and negative numbers on a number line are addressed in sixth grade; both are fifth-grade topics in the 1997 California mathematics standards.

Measurement and Data

In both the 1997 California mathematics standards and the CCSS, students convert among different-sized standard measurement units within a given measurement system and use these conversions to solve problems.

They represent data in graphs and interpret the meaning of the data to solve problems involving information presented in the graph.

Fifth-grade students understand the concept of volume and relate volume to multiplication and addition to solve real-world and mathematical problems. They find the volume of right rectangular prisms using unit cubes and relate the method to multiplying the height by the area of the base to show procedural equivalence. Students use the understanding of volume to apply the formulas $V = l \text{ x } w \text{ x } h$ and $V = b \text{ x } h$ for rectangular prisms with whole-number edge lengths.

With full implementation of the CCSS, the concepts of mean and median to summarize data sets are introduced in sixth grade.

Geometry

Students extend their understanding of two-dimensional figures as they classify them in a hierarchy based on properties. They distinguish among rectangles, parallelograms, and trapezoids and derive and use the formula for the area of a triangle and of a parallelogram by comparing it with the formula for the area of a rectangle (i.e., two of the same triangles make a parallelogram with twice the area; a parallelogram is compared with a rectangle of the same area by cutting and pasting a right triangle on the parallelogram). Students know that the sum of the angles of any triangle is 180° and the sum of the angles of any quadrilateral is 360° and use this information to solve problems.

Students know that the sum of the angles of any triangle is 180° and the sum of the angles of any quadrilateral is 360° and use this information to solve problems.

Fifth-grade students graph points in the first quadrant of the coordinate plan to solve problems. With full implementation of the CCSS, the concept of graphing points on a coordinate plane is introduced at fifth grade; this was a fourth-grade topic in the 1997 California mathematics standards. In addition, although both the 1997 California mathematics standards and the CCSS address graphing points in the first quadrant of the coordinate plane to represent real-world problems in fifth grade, writing equations representing real-world problems and graphing in all four quadrants are introduced at sixth grade in the CCSS. The construction of three-dimensional figures from two-dimensional patterns to compute the surface area of figures is also addressed in sixth grade in the CCSS.

Support for English Learners

Students need to develop knowledge of mathematics as a language. However, the academic language of mathematics instruction and the specialized vocabulary of mathematics may pose particular challenges for English learners.

The language of mathematics is precise compared with the English used in common discourse. English learners need opportunities to develop their knowledge of the features of language that are used to teach mathematics, such as *semantics* (how to translate the words of a problem into a symbolic representation), *syntax* (the order of words and phrases), and *mathematical discourse* (writing or talking about mathematical terms, concepts, and so on). The specialized vocabulary of mathematics should be explicitly taught and reinforced throughout the year.

The following points address areas that may pose special challenges for English learners in the early grades:

- At an early stage, students may have difficulty with English words such as *first, second, last, before, every, each, more,* and *equal*. Students may be unfamiliar with *sum, difference, solve, length,* and *value.*

- The different meanings of multiple-meaning words should be explicitly taught. These words may have a meaning in common discourse that is different from the meaning in mathematics–such as *table* or *face* (as in the *face* of a clock).

- The place value of some numbers between 10 and 20 is not obvious from their names (e.g., the number 16 is called *sixteen* in English, but "ten plus six" in other languages).

- The narrative descriptions of a word problem may require language skills that students have not yet mastered, particularly when the language of a word problem is ambiguous or includes idioms (e.g., *a dime a dozen*), comparatives (*greater than*, *less than, most often, least often*), or position words (*behind, below, in front of, to the right* or *left of*).

- Students may have learned different symbols and procedures that may result in the same answer. In some countries, students are expected to do most steps mentally instead of writing out each step.

Instruction in mathematics, along with critical-thinking skills, should be promoted despite low literacy or limited proficiency in the English language. Specially designed academic instruction in English (SDAIE) is one instructional strategy to meet the needs of English learners. For additional resources to support the teaching of English learners, please visit the CDE English Learners Web page at http://www.cde.ca.gov/sp/el/.

Use of Calculators

Although not discussed in the CCSS, the use of calculators plays a special role in mathematics teaching and learning. Initially, it is important that students in the early grades develop a facility with basic arithmetic skills without reliance on calculators. At later grades, once students are ready to use calculators to their advantage, calculators can provide a very useful tool not only for solving problems in various contexts but also for broadening students' mathematical horizons.

The Standards

The CCSS, with California additions, that follow are the prepublication version of the standards prepared by the Sacramento County Office of Education (SCOE), updated on October 18, 2010. Content that is unique to California and was added to the multistate common core standards is in **bold typeface and underlined**. The SCOE document is available online at http://www.scoe.net/castandards/agenda/2010/math_ccs_recommendations.pdf (Outside Source). These grade-five CCSS for mathematics were adopted by the California State Board of Education on August 2, 2010.

A complete list of the grade-five 1997 California mathematics standards is located on the CDE Content Standards Web page at http://www.cde.ca.gov/be/st/ss/documents/mathstandards.pdf.

Common Core State Standards
with California Additions
Mathematics: Grade Five

Operations and Algebraic Thinking (5.OA)

Write and interpret numerical expressions.

1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as* $2 \times (8 + 7)$. *Recognize that* $3 \times (18{,}932 + 921)$ *is three times as large as* $18{,}932 + 921$, *without having to calculate the indicated sum or product.*

2.1 **Express a whole number in the range 2-50 as a product of its prime factors. For example, find the prime factors of 24 and express 24 as 2x2x2x3.**

Analyze patterns and relationships.

3. Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*

Number and Operations in Base Ten (5.NBT)

Understand the place value system.

1. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

2. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

3. Read, write, and compare decimals to thousandths.

   a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$.

   b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.	Use place value understanding to round decimals to any place.
Perform operations with multi-digit whole numbers and with decimals to hundredths.	
5.	Fluently multiply multi-digit whole numbers using the standard algorithm.
6.	Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.
7.	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Number and Operations—Fractions (5.NF)	
Use equivalent fractions as a strategy to add and subtract fractions.	
1.	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example,* $2/3 + 5/4 = 8/12 + 15/12 = 23/12$. *(In general,* $a/b + c/d = (ad + bc)/bd$*.)*
2.	Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result* $2/5 + 1/2 = 3/7$, *by observing that* $3/7 < 1/2$.
Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	
3.	Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions, mixed numbers, **or decimal fractions**, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?*
4.	Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show* $(2/3) \times 4 = 8/3$, *and create a story context for this equation. Do the same with* $(2/3) \times (4/5) = 8/15$. *(In general,* $(a/b) \times (c/d) = ac/bd$*.)*

	b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.
5.	Interpret multiplication as scaling (resizing), by: a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.
6.	Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.
7.	Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.[1] a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3. b. Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4. c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?
Measurement and Data (5.MD)	
Convert like measurement units within a given measurement system.	
1.	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world

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[1] Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade.

problems.

Represent and interpret data.

2. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*

Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
    a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.
    b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
    a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.
    b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.
    c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

Geometry (5.G)

Graph points on the coordinate plane to solve real-world and mathematical problems.

1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the

	names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).
2.	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
Classify two-dimensional figures into categories based on their properties.	
3.	Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.*
<u>**3.1**</u>	<u>**Distinguish among rectangles, parallelograms, and trapezoids.**</u>
4.	Classify two-dimensional figures in a hierarchy based on properties.
<u>**5**</u>**.**	<u>**Know that the sum of the angles of any triangle is 180° and the sum of the angles of any quadrilateral is 360° and use this information to solve problems. (CA-Standard MG 2.2)**</u>
<u>**6**</u>**.**	<u>**Derive and use the formula for the area of a triangle and of a parallelogram by comparing it with the formula for the area of a rectangle (i.e. two of the same triangles make a parallelogram with twice the area; a parallelogram is compared with a rectangle of the same area by cutting and pasting a right triangle on the parallelogram). (CA-Standard MG 1.1)**</u>
	Standards for Mathematical Practice 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. The CCSS for Mathematical Practice describe ways in which students of mathematics ought to engage with the subject matter as they grow in mathematical maturity and expertise. For a complete description of the eight Standards for Mathematical Practice, see Appendix B.

CCSS Domains

The CCSS are organized by domains. The table lists all of the domains that apply to kindergarten through grade eight, and it identifies which domains are addressed in kindergarten through grade six. The shaded row indicates a domain to be covered at later grades.

Domains	Kindergarten	Grade One	Grade Two	Grade Three	Grade Four	Grade Five	Grade Six
Counting and Cardinality (CC)	X						
Operations and Algebraic Thinking (OA)	X	X	X	X	X	X	
Number and Operations in Base Ten (NBT)	X	X	X	X	X	X	
Measurement and Data (MD)	X	X	X	X	X	X	
Geometry (G)	X	X	X	X	X	X	X
Number and Operations – Fractions (NF)				X	X	X	
Ratios and Proportional Relationships (RP)							X
The Number System (NS)							X
Expressions and Equations (EE)							X
Statistics and Probability (SP)							X
Functions (F)							

History–Social Science

Overview

The course for grade five presents the story of the development of the United States, emphasizing the period up to 1850. This course focuses on one of the most remarkable stories in history: the creation of a new nation peopled by immigrants from all parts of the globe and governed by institutions influenced by a number of religions, the ideals of the Enlightenment, and English traditions of self-government. This experiment was inspired by the innovative dream of building a new society that would realize the promises of the Declaration of Independence.

Wherever possible, events should be viewed through the eyes of historical groups such as explorers, American Indians, colonists, free blacks and slaves, women, children, and pioneers. The narrative for the year reflects the experiences of different races, religions, ethnicities, and both genders. Students also continue to develop the civic and economic skills they will need as citizens. Students examine the human and physical geography of the United States by studying present-day maps of the United States and identifying connections with thematic maps of the ethnic, linguistic, and religious settlements that developed in the new nation.

Teachers are also encouraged to build understanding of history–social science concepts while furthering beginning literacy skills as outlined in the Common Core State Standards (CCSS). For example, shared readings of narrative and expository text related to the history–social science standards can reinforce academic content vocabulary and comprehension skills.

The Historical and Social Sciences Analysis Skills for kindergarten through grade five are an integral part of the content standards for elementary school. As students learn the content outlined in the standards, they should also be practicing the skills described under the headings “Chronological and Spatial Thinking,” “Research, Evidence, and Point of View,” and “Historical Interpretation.” All of the standards for fifth-grade history–social science, including the analysis skills, are provided in full at the end of this section.

What Fifth-Grade Students Should Know

Students leave the fourth grade having studied the history of California in depth. They have learned about the pre-Columbian societies, the impact of Spanish and American settlement, and the changes that followed California’s absorption into the United States. They have continued to extend their geographic and environmental awareness, including understanding the various ways that the physical environment affects human activity, and vice versa. By the time they complete their fourth-grade studies, students should have a sound foundation in the historical and social sciences analysis skills needed for the broader narratives of early American history that are the focus of the fifth grade. In the fourth grade, students also examined the responsibilities of local, state, and federal government, which will provide a basis for their study of the origins of the United States Constitution.

The Land and People before Columbus

In this unit, students examine major pre-Columbian settlements. The North American Indians were diverse in their language, culture, social and political organization, and religious traditions. They adjusted to their natural environment. Pre-Columbian people subsisted through farming, gathering, fishing, and hunting, on diets of grain crops, local vegetation (roots, plants, seeds), fish and other seafood, and small and large game. They also built distinct housing structures that suited their stationary or nomadic lifestyles and accommodated the distinct geography and climate of their environments.

The inhabitants of North America organized varied economies and systems of government. Groups such as the Iroquois, Huron, Cherokee, Navajo, Creek, Hopi, Algonquin, and Lakota (Sioux) established pueblo/city states, tribelets, native bands, confederacies, and nations. Communal councils led by chiefs or elders formed the basis of local governance in many villages or settlements; some included women advisers. Traditional commerce involved exchanging and bartering commodities of regional significance and abundance, including salt, shells, beads, timber, agricultural products, abalone, fish, flint, and fur. Students can consider the importance of trading networks as a means of disseminating goods, and the value of information such as technology, agricultural practices, and religious beliefs (for example, animism).

Students learn how American Indians expressed their culture in art, music, and dance. By examining the role and influence of women in American Indian communities, they also gain a fuller understanding of how gender roles and family life varied among tribes. Students are introduced to the rich legends and literature of American Indian cultures and their spiritual traditions about people’s relationship to the earth.

Age of Exploration

In this unit, students concentrate on the expeditions of the early explorers and learn about the explorers’ European origins, motives, and journeys and the enduring historical significance of their voyages to the Americas. Several important factors contributed to the age of exploration: religious and political conflict in Western Europe, advances in nautical technology and weaponry, and European competition over access to and control of economic resources overseas. The global spread of plants, animals, people, and diseases (Columbian Exchange) in the fifteenth century had a devastating impact on indigenous populations in the Western Hemisphere and affected the world’s ecosystem. Over the long term, these exchanges led to overall global population growth caused by the spread of new food crops and initiated the period of European global expansion.

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European explorers sought trade routes, economic gain, adventure, national recognition, strategic advantages, and people to convert to Christianity. The early explorers traveled the globe through the innovative use of technological developments acquired from other civilizations: the compass, the astrolabe, and seaworthy ships. Explorers and crews embarked on precarious ventures with unknown outcomes.

In the study of the early explorers, students trace and learn the routes of the major land explorers of the United States, the distances traveled, and the Atlantic trade routes that linked Africa, the West Indies, the British colonies, and Europe. In addition, through mapping exercises, students record and analyze the land claims made by European explorers from Spain, France, England, Portugal, the Netherlands, Sweden, and Russia in North and South America on behalf of their monarchs or sponsors.

Cooperation and Conflict in North America

The arrival of Europeans in North America in the late fifteenth century set into motion cross-cultural interactions defined by cooperation and conflict among the American Indians and between the Indian nations and the new settlers. In what the Europeans termed "The New World," they competed with one another and the Indian nations for territorial, economic, and political control. By the seventeenth century, Nova Scotia and Quebec had been established by the French, Jamestown and the Massachusetts Bay Colony by the English, New Spain by the Spanish, and New Amsterdam by the Dutch.

The Indian nations had mixed responses to the European newcomers. Some American Indians declared war on the Europeans in defense of their sovereignty. Others remained neutral. Whether in conjunction with each other or through independent compacts and treaties, many of the American Indians negotiated terms for coexistence. The competing nations cooperated with one another in the areas of agriculture, fur trading, military alliances, and cultural interchanges. The Europeans introduced new food crops and domestic livestock that diversified the diets of the American Indians. This exchange dramatically altered the natural environment and introduced diseases that decimated many American Indian tribes.

Over time it became virtually impossible for Indian nations to practice neutrality when the presence of European colonists threatened the sustainability of traditional Indian life. Broken treaties, skirmishes, and massacres increasingly came to characterize the relationship between the national groups. American Indian resistance included armed conflict; rejection of European culture and political authority; reappraisal of native spiritual traditions; and the creation of military, political, and economic alliances among American Indian nations and tribes. Of particular concern to American Indians in the seventeenth and eighteenth centuries were permanent European settlements and the expansion of commercial farming on native land. The American Indians resisted encroachments to their territories for more than two centuries.

The presence of the Europeans exacerbated historical tensions among nations. Lucrative trade with Europeans trumped and superseded traditional inter-Indian trading networks. This changed trade patterns that existed prior to the arrival of the Europeans. Additionally, land disputes among American Indians such as the Iroquois, Huron, and Sioux led to armed warfare (made more violent with the introduction of gunpowder and horses), involved new military alliances with European settlers, and redefined boundaries of political and economic influence. However, certain military alliances proved critical. Britain and France had a history of warfare both inside and outside North America in the eighteenth century. The Iroquois played a decisive role in the outcome of the French and Indian War (1754–1763), also known as the Seven Years' War, in siding with the British and Dutch and by providing invaluable military support and strategy on native terrain.

Settling the Colonies

A brief overview of French and Spanish colonization in the New World introduces students to the different groups of people who met on the North American continent.

A brief overview of French and Spanish colonization in the New World introduces students to the different groups of people who met on the North American continent. The Spanish and French colonial systems differed from the British in that they did not have entrenched colonial populations consisting of families living in permanent settlements. Major emphasis in this unit is placed on the English colonies, where the settlers and colonists shaped the economic and political values and institutions of the new nation. Students chronicle and evaluate how the British colonial period created the basis for the development of political self-government and a free-market economic system.

The original 13 colonies differed regionally in economic, political, religious, and social development. As students compare and contrast the colonies, teachers guide students in considering how geography and climate affected their establishment and organization. For example, why did seaport cities become more prominent in New England and the Middle Colonies, and what effect did this have on commerce in the regions? Why did plantations dominate in the South while family farms flourished in New England? Students study how geography affected economic development and subsequently influenced the political organization of the colonies. Finally, religious orientation also contributed to the variation in the colonies' social and political structure.

Southern Colonies

Southern colonies developed an economy based on agriculture. The settlement of Jamestown in the Chesapeake Bay region was a risky venture, in light of the failure of its predecessors. Virginia's first immigrants included a small number of lesser gentry and laborers, including indentured servants, who made up the largest segment of the population. Captain John Smith directed the digging of wells, the planting of crops, and the construction of shelter. He also introduced a system of incentives, proclaiming that people who would not work would not get to eat. John Rolfe's suggestion of growing and selling tobacco ensured Jamestown's economic livelihood and led to the formation of the plantation economy.

The first Africans arrived in Jamestown in 1619. In seventeenth-century colonial Virginia, some Africans came as indentured servants, while others had been sold or traded as enslaved labor. A few gained their freedom. Changing economic and labor conditions, as well as presumptions of racial inequity, contributed to the tobacco planters' increasing reliance on slavery as a major source of labor.

Starting with Maryland in 1641 (technically a middle colony), laws spread to southern colonies that codified slavery throughout the Atlantic Seaboard. By the 1680s, the institution of slavery was firmly established as part of colonial economies. Students can study maps, ships' logs, and other primary sources to clarify the eighteenth-century transatlantic slave trade that linked Africa, the West Indies, the British colonies, and Europe.

In their study of Virginia, students understand the importance of the House of Burgesses as the first representative assembly in the European colonies. How did Virginia's status as a royal charter and government affect the political rights of the settlers? Who was allowed to vote? Who was excluded? They also learn the meaning of the *established church* as Anglicans in Virginia understood it.

Beyond Virginia, the founding of southern colonies ranged in purpose and organization. Teachers assist students in determining how geography and climate affected the southern colonies' agricultural production. For example, tobacco cultivation dominated in Maryland; in Georgia and North and South Carolina, humid, swampy fields were conducive to rice farming.

Life in New England

New England provided a dramatic contrast with the southern colonies. Two groups of Christians sought to live there with an emphasis on their religious beliefs: the separatist Pilgrims, who broke with the Church of England, and the Puritans, who sought to reform and purify the church from within.

The story of the Pilgrims begins with their flight from England and religious dissent within the Church of England, their temporary haven in the Netherlands, and their voyage to the New World aboard the *Mayflower*. After an arduous trip, 41 male "saints" organized and joined in signing the Mayflower Compact to "covenant and combine our selves together into a civil body politick." Led by William Bradford, the Pilgrims finally settled Plymouth in 1620. In keeping with the times, they did not ask women to sign.

Life in the new land was hard, and at first the American Indians aided the settlers. However, relations between the colonists and American Indians eventually grew violent because of land rights and trade alliances. Increasingly outnumbered, outgunned, and ravaged by diseases, the native population declined. As students examine the era, teachers help them to envision the simple homes and the rigors of each day. They might also analyze the work of men, women, and children to get a sense of each member's function in the colonial home.

The Puritans also had an enduring influence on American literature, education, and attitudes toward life and work. Inspired by religious zeal, Puritans sought to establish "a city upon a hill" where they might live out their religious ideals. Led by John Winthrop, they founded Boston and within 10 years had opened Harvard College and the first common school in Massachusetts. They valued hard work, social obligation, simple living, and self-governing congregations. Their religious views shaped their way of life, clothing, laws, forms of punishment, education practices, gender expectations, and institutions of self-government. Although they came to Massachusetts to escape religious persecution, the Puritans established a society intolerant of religious dissent and diversity. An examination of the experiences of Roger Williams and Anne Hutchinson reveals the Puritans' intolerance of religious dissent and their insistence that women firmly conform to gender-specific expectations. At the same time, the stories of Anne Hutchinson and Roger Williams are milestones in the development of religious freedom in Connecticut and Rhode Island.

The colonies of Maryland, New Amsterdam, New Jersey, Pennsylvania, and Delaware provided havens for a wide variety of ethnic, linguistic, and religious groups, including English, Dutch, Swedish, German, Irish, Scottish, Catholic, and Jewish settlers. Mapping activities can reveal to students the diversity of these colonies. In identifying the religious and political origins of the colonies, students discover that Catholics established Maryland as a political and religious refuge but became outnumbered by Protestants in search of free land. In Pennsylvania, William Penn founded a Quaker colony that practiced religious tolerance and representative government. Industrious farmers, fur traders, skilled craftspersons, indentured servants, slaves, merchants, bankers, shipbuilders, and overseas traders made the colony prosperous. Fertile soil and mild climate enabled the middle colonies to thrive and led to the development of New York and Philadelphia as busy seaports.

The Road to War

British efforts to exert more power over the colonies resulted in a strong reaction and a growing spirit of resistance. For example, Parliament's efforts to assert imperial sovereignty over the colonies and impose taxes, because of the debts incurred during the French and Indian War, fueled a growing dissatisfaction with Parliament among colonists, particularly among those who firmly believed that only the colonial assemblies were empowered to raise taxes. Students should become familiar with the Stamp Act of 1765 and the colonists' outrage against it; the Townshend Acts that again stirred protest and led to the Boston Massacre; the tax on tea that provoked the Boston Tea Party; and the Coercive Acts, designed in part to punish colonists for their destruction of tea. Amidst these struggles, the colonists still perceived themselves as fully British. In general, the feeling of the King and Parliament was that the French and Indian War had been fought to protect the colonists and it consequently drained the British Treasury. Parliament's efforts to repress resistance led to the first Continental Congress of 1774 and the Committees of Correspondence that established communication between the colonies and forged a new national identity based on opposition to British policies.

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In discussing the conflict, students can read excerpts from speeches in the Parliament by William Pitt and Edmund Burke, whose pleas for moderation were ignored. Students learn that a third of the colonists remained loyal to King George III, and many others were undecided. For example, John Dickinson of Pennsylvania argued against independence and promoted reconciliation. He maintained that independence would lead to chaos. Philadelphia merchant Thomas Clifford complained, "Independence would assuredly prove unprofitable." He feared that France and Spain would prey on the colonies without British protection.

Students consider Thomas Paine's *Common Sense,* published in January 1776. Paine galvanized support for independence by persuasively arguing that America needed to break free from a government that violated the natural rights of its citizens. "We have it in our power, to begin the world over again . . . the birthday of a new world is at hand," Paine promised. Over 120,000 copies of *Common Sense* sold within its first few months of publication.

Paine's arguments became the foundation of the Declaration of Independence, drafted by Thomas Jefferson. Influenced by leading Enlightenment thinkers as well as other revolutionaries, the Declaration of Independence listed grievances against King George, outlined a social contract between the government and the governed, and declared independence from Great Britain. Teachers should help students read and understand the Declaration, given its importance to American history and its relevance today. Although written in the eighteenth century, its discussion of natural rights and the relationship between the governed and the government became pillars of American democracy.

The American Revolution

As the war began with the clashes at Lexington and Concord, the second Continental Congress met in 1775 to begin administering and coordinating the war effort, as well to establish revolutionary governments within the colonies. A veteran of the Seven Years' War, George Washington commanded the Continental Army and fought key battles at Boston, New York, Philadelphia, Valley Forge, and Yorktown. His task was unique in that he was charged with removing the British while fighting a defensive war. Students can immerse themselves in the major events in the Revolution, including the battles of Bunker Hill and Saratoga and Patrick Henry's appeal to his fellow legislators to support the fight. Studying the events at Valley Forge, the alliance with France, and the final battle at Yorktown provides students with a dramatic narrative of the Revolutionary War.

In addition to the conventional style of warfare conducted by the Continental Army, much of the fighting in the colonies was done by local militias that spontaneously took up their own arms and engaged in battles with the British Regulars, known as Red Coats. In this context, each side courted alliances with American Indians who knew the terrain. Most American Indians ultimately sided with the British; during the Revolution, approximately 1,500 Iroquois fought alongside the British soldiers. The American Indians had the potential for losing vast amounts of land if the colonists won. This fear proved to be prophetic with the passage of the Northwest Ordinance of 1787 and, nearly a half century later, with the "Trail of Tears," the forceful removal and relocation of American Indians from their homelands.

Students also examine the issues at stake for free blacks and slaves, as well as that group's contributions to the war. Thousands of black men fought on both sides of the war. In Virginia, the royal governor Lord Dunmore promised freedom to slaves who fought for the British cause, and in the closing days of the war he upheld his promise. For many black people, in and out of bondage, the Revolutionary War allowed a vision of liberty that was not fully attained. Over several years following the war, the northern states abolished slavery, and the Northwest Ordinance of 1787 banned slavery from the new territories north of the Ohio River. The antislavery movement did not, however, abolish slavery in the South, where nine out of ten American slaves lived.

In the spring of 1776, Abigail Adams asked John Adams to "remember the Ladies," as he and other statesmen contemplated establishing a new nation and delineating the rights of citizens. To appreciate the role women played in the Revolutionary War, students should examine the Daughters of Liberty, the experiences of women who directly supported the war effort, the unique challenges and opportunities slave women faced, and the changing role of women. The contributions of women traveling with troops included nursing, cooking, laundering, and cleaning. Teachers guide students in debating the effects of the revolutionary struggle on women by comparing women's pre- and post-war status.

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The Development and Significance of the U. S. Constitution

The Articles of Confederation were the first attempt to create a federal government for the 13 autonomous states that had freed themselves from British rule. The Articles provided a governing structure for the United States during the Revolutionary War, but they quickly proved to be inadequate for the needs of the new nation. By the spring of 1787, plans were under way to revise the Articles of Confederation. James Madison played an influential role in planning the Constitutional Convention and setting its agenda. Between May and September of 1787, 55 delegates met in Philadelphia to draft the U. S. Constitution. Students learn about the delegates to better understand the conflicts and compromises in drafting the new Constitution. For example, although these delegates were geographically dispersed and held different ideas about government, they shared personal traits and common characteristics that set them apart from the other white men with the franchise. The majority, mainly born in the colonies, fought in the war; 41 served in the Continental Congress. Although some, such as Benjamin Franklin, were self-taught, most were relatively well educated.

With an understanding of the framers in mind, students can participate in mock Constitutional conventions to consider the document's major compromises. In the Great Compromise, the framers divided the federal government's legislative power between two houses, one which represented all states equally and another in which state population accounted for state representatives. The framers also agreed with the 3/5 compromise, that three-fifths of the slave population would be counted in determining states' representation in the national legislature and for imposing property taxes. Lastly, the Northwest Ordinance codified the process for admitting new states.

The U.S. Constitution vested the federal government with power divided among three branches, while it also preserved states' and individual rights. Teachers can use the metaphor of a three-legged stool to describe the stability of a government with power distributed among three branches. Students also study how state constitutions written after the Revolution influenced the writing of the U.S. Constitution. Learning songs that express American ideals, such as "America the Beautiful" and "The Star-Spangled Banner," can guide students to understand the meaning of the American creed and the spirit of the era.

Life in the Young Republic

In this unit, students examine the daily lives of those who built the young republic under the new Constitution. Between 1789 and 1850, new waves of immigrants arrived from Europe, especially English, Scots–Irish, Irish, and Germans. The Great Irish Famine helped to push immigrants to come to the United States during this period. Traveling by overland wagons, canals, flatboats, and steamboats, these newcomers advanced into the fertile Ohio and Mississippi valleys and through the Cumberland Gap to the south. Students learn about the Louisiana Purchase and the expeditions of Lewis and Clark, guided by Sacagawea, and of John C. Fremont.

Interest in promoting civic virtue among citizens increased with the establishment of a republic. Mothers had the important role of raising their sons to become virtuous and active citizens. To ensure that women could fulfill this new role, a movement began to open the doors of education more widely to women. For example, the Young Ladies' Academy of Philadelphia (later called the Philadelphia Academy) was founded by Benjamin Rush and supported by many of the signers of the Constitution.

The New Nation’s Westward Expansion

The American West should be presented as a borderland region inhabited by diverse and competing populations. In this unit, students examine the advance of pioneer settlements beyond the Mississippi. The westward migration began with fur traders and mountain men who made the first forays into the west. Many fur traders and mountain men married Native American women who served as liaisons between the two cultures. Westward migration continued with settlers heading for Texas, Mormon families relocating to the new Zion in Utah, Midwestern farmers moving to western Oregon’s fertile valleys, and forty-niners traveling to the Mother Lode region of California. These migrants were joined by whalers, New England sailors engaged in the hide and tallow trade in California, and traders of sea otter and seal furs, who sailed their clipper ships around Cape Horn and westward to the Pacific. Migrants from the United States arrived in areas already inhabited and claimed by diverse populations of American Indians, Mexicans, British, and small numbers of Russians and Chileans. They also encountered immigrants from Asia, including China, Japan, Korea, the Philippines, and India, in search of labor in gold mines and farming.

Students may compare overland trail routes, especially the purpose of the journey; where the trail ran; the influence of geographic terrain, rivers, vegetation, and climate; and life in the territories at the end of these trails. Meanwhile, Mexican settlers also migrated into New Mexico, Texas, and California. While learning about life on the trail, students can discuss the reactions of American Indians to the increasing migration and the reasons for the Indians’ growing concern.

Pioneer women played varied roles in coping with the rigors of daily life on the frontier. Biographies, journals, and diaries disclose the strength and resourcefulness of pioneer women who helped to farm the land and worked as missionaries, teachers, and entrepreneurs. The autobiographical works of Laura Ingalls Wilder provide a unique perspective on these topics. Some slave women gained their freedom in the West. Once established by Anglo–American settlers, many western communities and territories proved to be less beholden to eastern traditions, as evidenced by the territory of Wyoming granting women in 1869 the right to vote, followed by Utah, Colorado, and Idaho.

Studying maps and geographic landmarks explains how and when California, Texas, and other western lands became part of the United States.

Studying maps and geographic landmarks explains how and when California, Texas, and other western lands became part of the United States. Battles for independence followed Anglo–American settlement in modern-day Texas. The war with Mexico led to annexation of this territory by the United States. These events provide important opportunities to focus on the Hispanic people of California and the Southwest, on the effects of these events on their lives, and on their distinctive contributions to American culture. Students can also learn how the Oregon Territory boundary conflict was settled by negotiation with England and how that territory became a state.

The Education and the Environment Initiative

The following fifth-grade units from the Education and the Environment Initiative (EEI) Curriculum can be used to provide instruction in the history–social science standards listed below.

Fifth Grade		
Standard Number	**Standard Text**	**EEI Curriculum Unit Name**

5.4.1.	Understand the influence of location and physical setting on the founding of the original 13 colonies, and identify on a map the locations of the colonies and of the American Indian nations already inhabiting these areas.	*Human Settlement and the Natural Regions of the Eastern Seaboard*
5.8.4.	Discuss the experiences of settlers on the overland trails to the West (e.g., location of the routes; purpose of the journeys; the influence of the terrain, rivers, vegetation, and climate; life in the territories at the end of these trails).	*Nature and Newcomers*

For more information about EEI instructional units at the California Environmental Protection Agency, visit its Web page at http://www.calepa.ca.gov/Education/EEI (Outside Source).

Support for English Learners

History–social science is particularly challenging for English learners. They must simultaneously develop fluency in a second language and also gain content and analysis skills in a complex subject area with high literacy demands. To learn English and achieve mastery of the history–social science content standards, students must participate in instructional programs that combine critical content knowledge and skill development in both English-language proficiency and the content standards and analysis skills contained in the *History–Social Science Framework for California Public Schools* (California Department of Education 2005).

All students should have an opportunity to actively engage with the history–social science content standards regardless of their proficiency in the English language. Effective instructional practices foster English-language development (ELD) and at the same time teach history–social science content. Early instruction in English literacy and content knowledge across all disciplines must be incorporated into ELD programs. In a structured English immersion program, history–social science for English learners continues to be taught while students are mastering English. In fact, most studies promote instruction in the content areas despite low literacy or limited proficiency in the English language, along with the critical-thinking and analysis skills and the particular reading strategies of the disciplines.

Teachers should align history–social science instruction with the grade-level expectations in the four domains (reading, writing, speaking and listening, and language) described in the CCSS for English language arts. Before classroom instruction, teachers need to determine what they want the students to learn, their students' English-language proficiency, and the language demands of each lesson's instructional materials.

Specially designed academic instruction in English (SDAIE) is one instructional strategy to meet the needs of English learners. For additional resources to support the teaching of English learners, please visit the CDE English Learners Web page at http://www.cde.ca.gov/sp/el/.

The Standards

The following fifth-grade history–social science content standards were adopted by the California State Board of Education on October 9, 1998. In addition, the recently adopted CCSS include standards for literacy in history/social studies. These standards do not replace the history–social science content standards but supplement them by setting specific requirements for reading and writing informational texts, including history–social science documents. The new standards will be implemented gradually over the next several years as curriculum frameworks, instructional materials, and assessments based on the CCSS are adopted. See the English language arts section for more information about the CCSS for grade five.

History–Social Science Content Standards
Grade Five
United States History and Geography: Making a New Nation

5.1 Students describe the major pre-Columbian settlements, including the cliff dwellers and pueblo people of the desert Southwest, the American Indians of the Pacific Northwest, the nomadic nations of the Great Plains, and the woodland peoples east of the Mississippi River.

1. Describe how geography and climate influenced the way various nations lived and adjusted to the natural environment, including locations of villages, the distinct structures that they built, and how they obtained food, clothing, tools, and utensils.

2. Describe their varied customs and folklore traditions.

3. Explain their varied economies and systems of government.

5.2 Students trace the routes of early explorers and describe the early explorations of the Americas.

1. Describe the entrepreneurial characteristics of early explorers (e.g., Christopher Columbus, Francisco Vásquez de Coronado) and the technological developments that made sea exploration by latitude and longitude possible (e.g., compass, sextant, astrolabe, seaworthy ships, chronometers, gunpowder).

2. Explain the aims, obstacles, and accomplishments of the explorers, sponsors, and leaders of key European expeditions and the reasons Europeans chose to explore and colonize the world (e.g., the Spanish Reconquista, the Protestant Reformation, the Counter Reformation).

3. Trace the routes of the major land explorers of the United States, the distances traveled by explorers, and the Atlantic trade routes that linked Africa, the West Indies, the British colonies, and Europe.

4. Locate on maps of North and South America land claimed by Spain, France, England, Portugal, the Netherlands, Sweden, and Russia.

5.3 Students describe the cooperation and conflict that existed among the American Indians and between the Indian nations and the new settlers.

1. Describe the competition among the English, French, Spanish, Dutch, and Indian nations for control of North America.

2. Describe the cooperation that existed between the colonists and Indians during the 1600s and 1700s (e.g., in agriculture, the fur trade, military alliances, treaties, cultural interchanges).

3. Examine the conflicts before the Revolutionary War (e.g., the Pequot and King Philip's Wars in

New England, the Powhatan Wars in Virginia, the French and Indian War).

4. Discuss the role of broken treaties and massacres and the factors that led to the Indians defeat, including the resistance of Indian nations to encroachments and assimilation (e.g., the story of the Trail of Tears).
5. Describe the internecine Indian conflicts, including the competing claims for control of lands (e.g., actions of the Iroquois, Huron, Lakota [Sioux]).
6. Explain the influence and achievements of significant leaders of the time (e.g., John Marshall, Andrew Jackson, Chief Tecumseh, Chief Logan, Chief John Ross, Sequoyah).

5.4 Students understand the political, religious, social, and economic institutions that evolved in the colonial era.

1. Understand the influence of location and physical setting on the founding of the original 13 colonies, and identify on a map the locations of the colonies and of the American Indian nations already inhabiting these areas.
2. Identify the major individuals and groups responsible for the founding of the various colonies and the reasons for their founding (e.g., John Smith, Virginia; Roger Williams, Rhode Island; William Penn, Pennsylvania; Lord Baltimore, Maryland; William Bradford, Plymouth; John Winthrop, Massachusetts).
3. Describe the religious aspects of the earliest colonies (e.g., Puritanism in Massachusetts, Anglicanism in Virginia, Catholicism in Maryland, Quakerism in Pennsylvania).
4. Identify the significance and leaders of the First Great Awakening, which marked a shift in religious ideas, practices, and allegiances in the colonial period, the growth of religious toleration, and free exercise of religion.
5. Understand how the British colonial period created the basis for the development of political self-government and a free-market economic system and the differences between the British, Spanish, and French colonial systems.
6. Describe the introduction of slavery into America, the responses of slave families to their condition, the ongoing struggle between proponents and opponents of slavery, and the gradual institutionalization of slavery in the South.
7. Explain the early democratic ideas and practices that emerged during the colonial period, including the significance of representative assemblies and town meetings.

5.5 Students explain the causes of the American Revolution.

1. Understand how political, religious, and economic ideas and interests brought about the Revolution (e.g., resistance to imperial policy, the Stamp Act, the Townshend Acts, taxes on tea, Coercive Acts).

2. Know the significance of the first and second Continental Congresses and of the Committees of Correspondence.

3. Understand the people and events associated with the drafting and signing of the Declaration of Independence and the document's significance, including the key political concepts it embodies, the origins of those concepts, and its role in severing ties with Great Britain.

4. Describe the views, lives, and impact of key individuals during this period (e.g., King George III, Patrick Henry, Thomas Jefferson, George Washington, Benjamin Franklin, John Adams).

5.6 Students understand the course and consequences of the American Revolution.

1. Identify and map the major military battles, campaigns, and turning points of the Revolutionary War, the roles of the American and British leaders, and the Indian leaders' alliances on both sides.

2. Describe the contributions of France and other nations and of individuals to the outcome of the Revolution (e.g., Benjamin Franklin's negotiations with the French, the French navy, the Treaty of Paris, The Netherlands, Russia, the Marquis Marie Joseph de Lafayette, Tadeusz Ko´sciuszko, Baron Friedrich Wilhelm von Steuben).

3. Identify the different roles women played during the Revolution (e.g., Abigail Adams, Martha Washington, Molly Pitcher, Phillis Wheatley, Mercy Otis Warren).

4. Understand the personal impact and economic hardship of the war on families, problems of financing the war, wartime inflation, and laws against hoarding goods and materials and profiteering.

5. Explain how state constitutions that were established after 1776 embodied the ideals of the American Revolution and helped serve as models for the U.S. Constitution.

6. Demonstrate knowledge of the significance of land policies developed under the Continental Congress (e.g., sale of western lands, the Northwest Ordinance of 1787) and those policies' impact on American Indians' land.

7. Understand how the ideals set forth in the Declaration of Independence changed the way people viewed slavery.

5.7 Students describe the people and events associated with the development of the U.S. Constitution and analyze the Constitution's significance as the foundation of the American republic.

1. List the shortcomings of the Articles of Confederation as set forth by their critics.

2. Explain the significance of the new Constitution of 1787, including the struggles over its ratification and the reasons for the addition of the Bill of Rights.

3. Understand the fundamental principles of American constitutional democracy, including how the government derives its power from the people and the primacy of individual liberty.

4. Understand how the Constitution is designed to secure our liberty by both empowering and limiting central government and compare the powers granted to citizens, Congress, the president, and the Supreme Court with those reserved to the states.

5. Discuss the meaning of the American creed that calls on citizens to safeguard the liberty of individual Americans within a unified nation, to respect the rule of law, and to preserve the Constitution.

6. Know the songs that express American ideals (e.g., "America the Beautiful," "The Star Spangled Banner").

5.8 Students trace the colonization, immigration, and settlement patterns of the American people from 1789 to the mid-1800s, with emphasis on the role of economic incentives, effects of the physical and political geography, and transportation systems.

1. Discuss the waves of immigrants from Europe between 1789 and 1850 and their modes of transportation into the Ohio and Mississippi Valleys and through the Cumberland Gap (e.g., overland wagons, canals, flatboats, steamboats).

2. Name the states and territories that existed in 1850 and identify their locations and major geographical features (e.g., mountain ranges, principal rivers, dominant plant regions).

3. Demonstrate knowledge of the explorations of the trans-Mississippi West following the Louisiana Purchase (e.g., Meriwether Lewis and William Clark, Zebulon Pike, John Fremont).

4. Discuss the experiences of settlers on the overland trails to the West (e.g., location of the routes; purpose of the journeys; the influence of the terrain, rivers, vegetation, and climate; life in the territories at the end of these trails).

5. Describe the continued migration of Mexican settlers into Mexican territories of the West and Southwest.

6. Relate how and when California, Texas, Oregon, and other western lands became part of the United States, including the significance of the Texas War for Independence and the Mexican-American War.

5.9 Students know the location of the current 50 states and the names of their capitals.

Historical and Social Sciences Analysis Skills
Kindergarten Through Grade Five

The intellectual skills noted below are to be learned through, and applied to, the content standards for kindergarten through grade five. They are to be assessed *only in conjunction with* the content standards in kindergarten through grade five.
In addition to the standards for kindergarten through grade five, students demonstrate the following intellectual, reasoning, reflection, and research skills:

Chronological and Spatial Thinking

1. Students place key events and people of the historical era they are studying in a chronological sequence and within a spatial context; they interpret time lines.

2. Students correctly apply terms related to time, including *past, present, future, decade, century,* and *generation.*

3. Students explain how the present is connected to the past, identifying both similarities and differences between the two, and how some things change over time and some things stay the same.

4. Students use map and globe skills to determine the absolute locations of places and interpret information available through a map's or globe's legend, scale, and symbolic representations.

5. Students judge the significance of the relative location of a place (e.g., proximity to a harbor, on trade routes) and analyze how relative advantages or disadvantages can change over time.

Research, Evidence, and Point of View

1. Students differentiate between primary and secondary sources.

2. Students pose relevant questions about events they encounter in historical documents, eyewitness accounts, oral histories, letters, diaries, artifacts, photographs, maps, artworks, and architecture.

3. Students distinguish fact from fiction by comparing documentary sources on historical figures and events with fictionalized characters and events.

Historical Interpretation

1. Students summarize the key events of the era they are studying and explain the historical contexts of those events.

2. Students identify the human and physical characteristics of the places they are studying and explain how those features form the unique character of those places.

3. Students identify and interpret the multiple causes and effects of historical events.

4. Students conduct cost-benefit analyses of historical and current events.

Science

Overview

Grade-five students are expected to learn both the content and process of science. Effective science programs reflect a balanced, comprehensive approach that includes the teaching of investigation and experimentation skills along with direct instruction. Key elements of a balanced science program include explicit teaching of science content and concepts, identifying students' prior knowledge, and addressing student misconceptions. Investigation skills should also be highlighted, with students encouraged to find answers or reach conclusions using their own experiences or observations. High-quality science instruction should also develop students' command of the academic language of science and use standards-based connections with other core subjects to reinforce science learning.

Key elements of a balanced science program include explicit teaching of science content and concepts, identifying students' prior knowledge, and addressing student misconceptions.

Safety should always be the foremost consideration in teacher modeling, the design of demonstrations, investigation and experiments, and science projects. Safety must be taught. Knowing and following safe practices in science are a part of understanding the nature of science and scientific enterprise. Everyone involved in science education should become familiar with the *Science Safety Handbook for California Public Schools*, which is posted on the CDE Web page at (http://www.cde.ca.gov/pd/ca/sc/documents/scisafebk.pdf). The publication contains specific and useful information relevant to teachers, administrators, parents/guardians, and students.

What Fifth-Grade Students Should Know

Students who have mastered the science standards for kindergarten through grade four already possess foundational knowledge regarding the science topics they will encounter in grade five. In the physical sciences, they were introduced to the concept of atoms and elements in grade three. In life sciences, they studied the relationship between the structure and function of the external characteristics of living things in grades one, three, and four and have learned to recognize this relationship as an adaptation.

Similarly, students have had introductory experiences with the grade-five earth science topics. In first grade, students studied weather and the water cycle. They learned about the solar system in grade three and know that Earth orbits the Sun and that the Moon orbits Earth. They have also had numerous experiences with investigation and experimentation and have practiced observation, measurement, and recordkeeping skills, including creating graphs and making drawings to record, organize, interpret, and display data. They have also practiced differentiating between evidence and opinion. By the time students enter grade five, they understand that asking meaningful questions and conducting careful investigations are central to making progress in science.

What Students Learn in Fifth Grade

During fifth grade, students learn to develop testable questions and plan their own investigations, selecting appropriate tools to make quantitative observations.

In the physical sciences, students develop the ability to distinguish between molecules and atoms and chemical compounds and mixtures and learn about the organization of atoms on the periodic table of the elements. They learn about chemical reactions and discover the special properties of metallic elements and salts. In the life sciences, they learn the basics of physiology, building on what they have learned in previous grades about the external adaptations of plants and animals to learn about the internal structures and processes of living things.

Students in grade five also deepen their understanding of the hydrologic cycle, the process by which water moves between the land and the oceans. They learn how the hydrologic cycle influences the distribution of weather-related precipitation. They study the causes and effects of weather. They also study the solar system and learn that it contains asteroids, comets, the Sun, planets, and moons. They learn the composition of the Sun and the relationship between gravity and planetary orbits.

Grade-five science topics are organized into six standard sets: Physical Sciences, Life Sciences, Earth Sciences (Earth's Water), Earth Sciences (Weather), Earth Sciences (The Solar System), and Investigation and Experimentation. As students learn the content defined by the standards in the Life, Earth, and Physical Sciences strands, they are also practicing investigation and experimentation skills. That is, the investigation and experimentation standards should be infused throughout science instruction.

Physical Sciences

In grade five, students learn that elements and their combinations account for all of the types of matter in the world and that living organisms and most materials are composed of just a few elements. They learn that all matter is composed of atoms that may combine to form molecules and that during chemical reactions the atoms in the reactants rearrange to form products with different properties. The introduction to chemical reactions and the concept that atoms combine to form molecules requires students to clearly distinguish between molecules and atoms and chemical compounds and mixtures.

Students are introduced to the idea that the organization of atoms on the periodic table of the elements is related to similarities and trends in the chemical properties of the elements. They learn that scientists have developed instruments that create images of atoms and molecules revealing well-ordered arrays of atoms and molecules. They learn that metals have properties in common; some metals are pure elements, while others are composed of a combination of elemental metals. Students also learn the common properties of salts.

Life Sciences

Students in grade five learn about the internal structures of plants and animals, building on their understanding of adaptation as it applies to the external features of organisms. They learn that plants and animals have specialized structures for the vital functions of respiration, digestion, waste disposal, and transport of materials. They study blood circulation and respiration in humans and learn about the structures responsible for the digestion of food and collection and excretion of wastes in animals. Students learn more about the process of photosynthesis, the movement of water and minerals from the roots of plants to the leaves, and the transport of sugar from the leaves to the other parts of vascular plants. They also learn that, through cellular respiration, both plants and animals break down sugar to obtain energy and that carbon dioxide and water are by-products of this process.

Earth Sciences (Earth’s Water)

The hydrologic cycle (water cycle) is the process by which water moves between the land and the oceans. Students in grade five learn that cooling in the atmosphere returns water vapor to a liquid or a solid state as rain, hail, sleet, or snow. They are also introduced to factors that control clouds, precipitation, and other weather phenomena.

Students also learn that most of Earth’s water is present as salt water in the oceans, that oceans cover most of Earth’s surface, and that the amount of fresh water on Earth is limited.

Students also learn that most of Earth’s water is present as salt water in the oceans, that oceans cover most of Earth’s surface, and that the amount of fresh water on Earth is limited. They study their local watershed to learn about the origins of the water used by their local communities and learn that the availability of fresh water can be extended by recycling and conservation practices.

Earth Sciences (Weather)

Students in grade five learn about the causes of large-scale and small-scale movements in the atmosphere. They learn that uneven heating of Earth by the Sun results in local and global temperature differences that create convection currents in the oceans and the atmosphere. They learn that warm air rises and cold air falls toward Earth’s surface, setting up convection currents in the air that are called winds. Students apply their knowledge of the hydrologic cycle to understanding weather and weather patterns and understand that the oceans influence weather. In addition, students study the causes and effects of different types of severe weather, learn how to use weather maps and data to predict local weather, and understand that many variables may affect the reliability of a weather forecast. They learn about atmospheric pressure and understand that although air is invisible, it has mass and is pulled by gravity toward Earth’s center.

Earth Sciences (The Solar System)

Students in grade five learn the composition of the Sun and that the solar system includes small bodies, such as asteroids and comets, as well as the Sun, eight planets,[*] and their moons. They learn the basic relationship between gravity and the planetary orbits and understand that gravity causes a pull between the mass of each of the planets and the mass of the Sun.

Investigation and Experimentation

In the context of activities that support mastery of the Physical, Earth, and Life Sciences standards, grade-five students learn to develop testable questions, conduct simple investigations, and write basic scientific reports. After developing a testable question based on factual information and observation, students identify dependent and controlled variables in an investigation. They learn to identify a single, independent variable in a scientific investigation and explain how this variable can be used to collect information and answer a question about the results of an experiment. They select appropriate tools, make quantitative observations, record data, make inferences based on the data, and draw conclusions based on evidence. When appropriate, students indicate whether further information is needed to support a specific conclusion.

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[*] Under resolutions passed by the International Astronomical Union on August 24, 2006, there are eight planets. Pluto no longer meets the definition of a “planet” but is now classified under a new, distinct class of objects called “dwarf planets.”

The Education and the Environment Initiative

Fifth-grade science instruction continues to build environmental literacy as students better understand how they influence the environment and how it influences them. The following fifth-grade units from the Education and the Environment Initiative (EEI) Curriculum can be used to provide instruction in the science standards listed below.

Fifth Grade		
Standard Number	**Standard Text**	**EEI Curriculum Unit Name**
5.3a.	Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.	*Earth's Water*
5.3.b.	Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.	*Changing States: Water, Natural Systems and Human Communities*
5.3.c.	Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.	*Precipitation, People, and the Natural World*
5.3.d.	Students know that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.	*Our Water: Sources and Uses*

For more information about EEI instructional units, visit the California Environmental Protection Agency Web page at www.calepa.ca.gov/Education/EEI (Outside Source).

Science Across the Content Areas

The fifth-grade science standards are readily integrated with other academic content standards. For example, the science standards and the English language arts standards are complementary so that the writing strategies will lay a foundation for good writing on science reports and informative oral science presentations. The mathematics and science standards also complement each other as students analyze, strategize, and solve problems, finding solutions to apply to new circumstances.

In addition, the recently adopted Common Core State Standards (CCSS) include standards for literacy in science. These standards do not replace the science content standards but supplement them by setting specific requirements for reading and writing informational texts, including science documents. The new standards will be implemented over the next several years as curriculum frameworks, instructional materials, and assessments based on the CCSS are adopted. Refer to the English language arts section for more information about the CCSS for fifth grade.

Support for English Learners

All students, regardless of English language proficiency, should have access to high quality science instruction. With its focus on domain-specific vocabulary acquisition and utilization of hands-on, collaborative activities, a balanced fifth-grade science program provides many opportunities for English-language development (ELD). However, science instruction may still present challenges for some English learners. Specific challenges include learning science-related terms and academic vocabulary. Directions may be complex and contain multiple steps. Visual information may not be easily comprehensible.

Some strategies that may help students understand new science concepts and processes include connecting to students' background knowledge, experiences, and familiar terminology; focusing on key science terms before, during, and after a lesson; and utilizing different formats (e.g., charts, graphs, pictures).

Students benefit from clear and consistent classroom routines, group or peer interaction to share information, processes, and activities that are relevant and meaningful. ELD is especially enhanced by (1) opportunities for informal conversations about content and concepts, (2) modeling of the appropriate use of equipment, and (3) an adequate amount of wait time for student response.

The Standards

The following grade-five science content standards were adopted by the California State Board of Education on October 9, 1998.

Science Content Standards **Grade Five**	
Physical Sciences	
1.	**Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:**
1.a.	Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
1.b.	Students know all matter is made of atoms, which may combine to form molecules.
1.c.	Students know metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), and gold (Au), are pure elements; others, such as steel and brass, are composed of a combination of elemental metals.
1.d.	Students know that each element is made of one kind of atom and that the elements are organized in the periodic table by their chemical properties.
1.e.	Students know scientists have developed instruments that can create discrete images of atoms and molecules that show that the atoms and molecules often occur in well-ordered arrays.

1.f.	Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
1.g.	Students know properties of solid, liquid, and gaseous substances, such as sugar ($C_6H_{12}O_6$), water (H_2O), helium (He), oxygen (O_2), nitrogen (N_2), and carbon dioxide (CO_2).
1.h.	Students know living organisms and most materials are composed of just a few elements.
1.i.	Students know the common properties of salts, such as sodium chloride (NaCl).
Life Sciences	
2.	**Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept:**
2.a.	Students know many multicellular organisms have specialized structures to support the transport of materials.
2.b.	Students know how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO_2) and oxygen (O_2) are exchanged in the lungs and tissues.
2.c.	Students know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.
2.d.	Students know the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder.
2.e.	Students know how sugar, water, and minerals are transported in a vascular plant.
2.f.	Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.
2.g.	Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).
Earth Sciences (Earth's Water)	
3.	**Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:**
3.a.	Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
3.b.	Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.
3.c.	Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.

3.d.	Students know that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.
3.e.	Students know the origin of the water used by their local communities.
Earth Sciences (Weather)	
4.	**Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:**
4.a.	Students know uneven heating of Earth causes air movements (convection currents).
4.b.	Students know the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
4.c.	Students know the causes and effects of different types of severe weather.
4.d.	Students know how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.
4.e.	Students know that the Earth's atmosphere exerts a pressure that decreases with distance above Earth's surface and that at any point it exerts this pressure equally in all directions.
Earth Sciences (The Solar System)	
5.	**The solar system consists of planets and other bodies that orbit the Sun in predictable paths. As a basis for understanding this concept:**
5.a.	Students know the Sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium.
5.b.	Students know the solar system includes the planet Earth, the Moon, the Sun, eight other planets and their satellites, and smaller objects, such as asteroids and comets.
5.c.	Students know the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.
Investigation and Experimentation	
6.	**Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:**
6.a.	Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
6.b.	Develop a testable question.

6.c.	Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
6.d.	Identify the dependent and controlled variables in an investigation.
6.e.	Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.
6.f.	Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
6.g.	Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
6.h.	Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.
6.i.	Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

Visual and Performing Arts

Overview

Fifth-grade students bring to the classroom a strong sense of what they like and dislike and can tell why they hold their opinions. At this age they are growing in ability to talk about, describe, and evaluate the arts, using specific criteria, and understand and work with complex concepts in the arts. Inventing new possibilities for dance sequences, composing music, developing plots in theatre, and using perspective in the visual arts are all within their grasp.

With this new level of sophistication, students can explore the rich history of the arts in this country, working to gain a deep understanding of the vast array of artists and works of art this nation has to offer. Having dance, music, theatre, and the visual arts in the classroom can provide students with a broad background in the arts and with experiences to support learning throughout the curriculum. Using their increased knowledge and skills, students can now improvise, create, and perform in all the arts.

Having dance, music, theatre, and the visual arts in the classroom can provide students with a broad background in the arts and with experiences to support learning throughout the curriculum.

What Fifth-Grade Students Should Know

In the fourth grade, students studied California history and learned about the rich cultural heritage of their state as expressed in art. They were exposed to artistic traditions from a number of different cultures and can now evaluate art both in its historical and cultural context and for its own inherent aesthetic value. Students have continued to develop their own ability to communicate through the arts and are now able to use music notation, knowledge of structure and style, and advanced technical skill to create works of art.

What Students Learn in Fifth Grade

Dance

Students use variety, contrast, and unity as they create, learn, and perform dances, applying their knowledge of dance and performance skills to analyze possible solutions and strategies for specific problems with movement. In their study of United States history, they learn to perform traditional, social, and theatrical dances from the eighteenth and nineteenth centuries. They also develop and apply specific criteria for critiquing dance performances that show more in-depth analysis and assessment of technical skill, musicality, dynamics, and mood.

Music

Students analyze how different elements are used in music of various styles and from many cultures as they increase their musical skills by singing and playing instruments. They also learn to create simple melodies and read and write those melodies on the treble clef. And because of their increased knowledge of musical elements and vocabulary, they develop and apply appropriate criteria to support their opinions about specific musical selections.

Theatre

Students describe theatrical experiences with an increased vocabulary, using such terms as *protagonist* and *antagonist*. They identify more complex structural elements of plot in a script, discover universal themes in the theatrical literature they are studying, and recognize more fully how theatre, television, and films play a part in their daily lives. Using appropriate criteria for critiquing theatrical performances, they can judge what they see and hear.

Visual Arts

Principles of design, such as composition, emphasis, unity, and the depiction of space, become part of the visual arts vocabulary and are applied as students create original works of art with traditional and new media. Students refine their artistic skills, such as perspective, and use those skills in drawings, sculpture, mixed media, and digital media (e.g., computer-generated art, digital photography, and videography). Using a defined set of criteria to describe how they would change or improve their work, they become more proficient in assessing their artwork.

The Standards

The visual and performing arts content standards provide expectations for students in four disciplines: dance, music, theatre, and visual arts. At each grade level, the standards are grouped under five strands:

1. **Artistic perception** refers to processing, analyzing, and responding to sensory information through the use of the language and skills unique to dance, music, theatre, and the visual arts.

2. **Creative expression** involves creating a work, performing, and participating in the arts disciplines.

3. **Historical and cultural context** concerns the work students do toward understanding the historical contributions and cultural dimensions of an arts discipline.

4. **Aesthetic valuing** includes analyzing and critiquing works of dance, music, theatre, and the visual arts.

5. **Connections, relationships, and applications** involve connecting and applying what is learned in one arts discipline and comparing it to learning in the other arts, other subject areas, and careers.

When reading the standards at a particular grade level, one must know which standards were accomplished in all the previous grade levels to understand how expectations are based on prior learning. In addition, an examination of the standards for any of the art forms at a given grade level reveals overlaps and points of connection across the strands because the strands and the content standards for the four disciplines are intrinsically related.

Key Content Standards

Each arts discipline and artistic process has many entry points throughout the grades. Because particular ideas, concepts, and experiences are critical to student achievement at certain times in their artistic and cognitive development, the standards provide students with a picture of what is essential to know and be able to do, from kindergarten through grade eight, in each of the four arts disciplines. The key content standards provide a beginning point for standards-based instruction in each grade of elementary and middle school and focus on fundamental content that students need in order to move to the next level of understanding and expression. Like the complete standards, the key standards build up content in each successive grade level and spiral throughout the curriculum for kindergarten through grade eight. They are essential in preparing students for beginning-level high school arts courses in which they engage in more focused and independent work. Key standards are indicated in the list below with an asterisk (*).

The following fifth-grade visual and performing arts standards were adopted by the California State Board of Education on January 10, 2001.

Visual and Performing Arts Content Standards
Fifth Grade

Component Strand: 1.0 Artistic Perception

Dance Processing, Analyzing, and Responding to Sensory Information Through the Language and Skills Unique to Dance	**Music** Processing, Analyzing, and Responding to Sensory Information Through the Language and Skills Unique to Music	**Theatre** Processing, Analyzing, and Responding to Sensory Information Through the Language and Skills Unique to Theatre	**Visual Arts** Processing, Analyzing, and Responding to Sensory Information Through the Language and Skills Unique to the Visual Arts
Students perceive and respond, using the elements of dance. They demonstrate movement skills, process sensory information, and describe movement, using the vocabulary of dance. **Development of Motor Skills and Technical Expertise** 1.1 Demonstrate focus, physical control (e.g., proper alignment, balance), and coordination in performing locomotor and axial movement. 1.2 Name and use a wide variety of movements (e.g., isolations/whole body). **Comprehension and Analysis of Dance Elements** 1.3 Demonstrate a greater dynamic range in movement utilizing space, time, and force/energy concepts. 1.4* Incorporate the principles of variety, contrast, and unity with dance studies. **Development of Dance Vocabulary** 1.5 Use appropriate dance vocabulary to describe dances.	Students read, notate, listen to, analyze, and describe music and other aural information, using the terminology of music. **Read and Notate Music** 1.1* Read, write, and perform simple melodic notation in treble clef in major and minor keys. 1.2 Read, write, and perform major and minor scales. 1.3 Read, write, and perform rhythmic notation, including quarter-note triplets and tied syncopation. **Listen to, Analyze, and Describe Music** 1.4* Analyze the use of music elements in aural examples from various genres and cultures. 1.5 Identify vocal and instrumental ensembles from a variety of genres and cultures. 1.6 Identify and describe music forms, including theme and variations and twelve-bar blues.	Students observe their environment and respond, using the elements of theatre. They also observe formal and informal works of theatre, film/video, and electronic media and respond, using the vocabulary of theatre. **Development of the Vocabulary of Theatre** 1.1* Use the vocabulary of theatre, such as *sense memory, script, cue, monologue, dialogue, protagonist,* and *antagonist*, to describe theatrical experiences. **Comprehension and Analysis of the Elements of Theatre** 1.2 Identify the structural elements of plot (exposition, complication, crisis, climax, and resolution) in a script or theatrical experience.	Students perceive and respond to works of art, objects in nature, events, and the environment. They also use the vocabulary of the visual arts to express their observations. **Develop Visual Arts Vocabulary** 1.1* Identify and describe the principles of design in visual compositions, emphasizing unity and harmony. 1.2 Identify and describe characteristics of representational, abstract, and nonrepresentational works of art. **Analyze Art Elements and Principles of Design** 1.3 Use their knowledge of all the elements of art to describe similarities and differences in works of art and in the environment.

*Indicates a key standard.

Component Strand: 2.0 Creative Expression			
Dance Creating, Performing, and Participating in Dance	**Music** Creating, Performing, and Participating in Music	**Theatre** Creating, Performing, and Participating in Theatre	**Visual Arts** Creating, Performing, and Participating in the Visual Arts
Students apply choreographic principles, processes, and skills to create and communicate meaning through improvisation, composition, and performance of dance. **Creation/Invention of Dance Movements** 2.1 Create, memorize, and perform complex sequences of movement with greater focus, force/energy, and intent. 2.2* Invent multiple possibilities to solve a given movement problem and analyze problem-solving strategies and solutions. **Application of Choreographic Principles and Processes to Creating Dance** 2.3 Describe and incorporate simple dance forms in dance studies (e.g., AB form, canon). 2.4 Demonstrate principles of opposing weight and force/energy, balance and counterbalance, or cantilever. **Communication of Meaning in Dance** 2.5 Convey a wide range of feeling and expression through gestures, posture, and movement. **Development of Partner and Group Skills** 2.6 Demonstrate cooperation, collaboration, and empathy in working with partners and in groups (e.g., leading/ following, mirroring, calling/responding, echoing, opposing).	Students apply vocal and instrumental musical skills in performing a varied repertoire of music. They compose and arrange music and improvise melodies, variations, and accompaniments, using digital/electronic technology when appropriate. **Apply Vocal and Instrumental Skills** 2.1 Sing a varied repertoire of music, including rounds, descants, and songs with ostinatos and songs in two-part harmony, by oneself and with others. 2.2 Use classroom instruments to play melodies and accompaniments from a varied repertoire of music from diverse cultures, including rounds, descants, and ostinatos and two-part harmony, by oneself and with others. **Compose, Arrange, and Improvise** 2.3* Compose, improvise, and perform basic rhythmic, melodic, and chordal patterns independently on classroom instruments.	Students apply processes and skills in acting, directing, designing, and scriptwriting to create formal and informal theatre, film/videos, and electronic media productions and to perform in them. **Development of Theatrical Skills** 2.1* Participate in improvisational activities to explore complex ideas and universal themes in literature and life. 2.2 Demonstrate the use of blocking (stage areas, levels, and actor's position, such as full front, quarter, profile, and full back) in dramatizations. **Creation/Invention in Theatre** 2.3 Collaborate as an actor, director, scriptwriter, or technical artist in creating formal or informal theatrical performances.	Students apply artistic processes and skills, using a variety of media to communicate meaning and intent in original works of art. **Skills, Processes, Materials, and Tools** 2.1 Use one-point perspective to create the illusion of space. 2.2 Create gesture and contour observational drawings. 2.3* Demonstrate beginning skill in the manipulation of digital imagery (e.g., computer-generated art, digital photography, or videography). **Communication and Expression Through Original Works of Art** 2.4 Create an expressive abstract composition based on real objects. 2.5 Assemble a found object sculpture (as assemblage) or a mixed media two-dimensional composition that reflects unity and harmony and communicates a theme. 2.6* Use perspective in an original work of art to create a real or imaginary scene. 2.7 Communicate values, opinions, or personal insights through an original work of art.

*Indicates a key standard.

Component Strand: 3.0 Historical and Cultural Context			
Dance Understanding the Historical Contributions and Cultural Dimensions of Dance	**Music** Understanding the Historical Contributions and Cultural Dimensions of Music	**Theatre** Understanding the Historical Contributions and Cultural Dimensions of Theatre	**Visual Arts** Understanding the Historical Contributions and Cultural Dimensions of the Visual Arts
Students analyze the function and development of dance in past and present cultures throughout the world, noting human diversity as it relates to dance and dancers. **Development of Dance** 3.1 Describe how and why a traditional dance may be changed when performed on stage for an audience. **History and Function of Dance** 3.2* Identify and perform folk/traditional, social, and theatrical dances done by Americans in the eighteenth and nineteenth centuries. **Diversity of Dance** 3.3 Select traditional dances that men, women, or children perform and explain the purpose(s) of the dances.	Students analyze the role of music in past and present cultures throughout the world, noting cultural diversity as it relates to music, musicians, and composers. **Role of Music** 3.1 Describe the social functions of a variety of musical forms from various cultures and time periods (e.g., folk songs, dances). **Diversity of Music** 3.2 Identify different or similar uses of musical elements in music from diverse cultures. 3.3 Sing and play music from diverse cultures and time periods. 3.4 Describe the influence of various cultures and historical events on musical forms and styles. 3.5 Describe the influences of various cultures on the music of the United States.	Students analyze the role and development of theatre, film/video, and electronic media in past and present cultures throughout the world, noting diversity as it relates to theatre. **Role and Cultural Significance of Theatre** 3.1 Select or create appropriate props, sets, and costumes for a cultural celebration or pageant. 3.2 Interpret how theatre and storytelling forms (past and present) of various cultural groups may reflect their beliefs and traditions. **History of Theatre** 3.3* Analyze ways in which theatre, television, and film play a part in our daily lives. 3.4 Identify types of early American theatre, such as melodrama and musical theatre.	Students analyze the role and development of the visual arts in past and present cultures throughout the world, noting human diversity as it relates to the visual arts and artists. **Role and Development of the Visual Arts** 3.1 Describe how local and national art galleries and museums contribute to the conservation of art. 3.2 Identify and describe various fine, traditional, and folk arts from historical periods worldwide. **Diversity of the Visual Arts** 3.3* Identify and compare works of art from various regions of the United States. 3.4 View selected works of art from a major culture and observe changes in materials and styles over a period of time.

*Indicates a key standard.

Component Strand: 4.0 Aesthetic Valuing			
Dance Responding to, Analyzing, and Making Judgments About Works of Dance	**Music** Responding to, Analyzing, and Making Judgments About Works of Music	**Theatre** Responding to, Analyzing, and Critiquing Theatrical Experiences	**Visual Arts** Responding to, Analyzing, and Making Judgments About Works in the Visual Arts
Students critically assess and derive meaning from works of dance, performance of dancers, and original works based on the elements of dance and aesthetic qualities. **Description, Analysis, and Criticism of Dance** 4.1 Use dance vocabulary to identify and support personal preferences for dances observed or performed. 4.2* Apply specific criteria to analyze and assess the quality of a dance performance by well-known dancers or dance companies (e.g., technical skill, musicality, dynamics, mood). **Meaning and Impact of Dance** 4.3 Identify the special and challenging characteristics of the experience of dancing for an audience. 4.4 Explain how outstanding dancers affect audience members emotionally or intellectually.	Students critically assess and derive meaning from works of music and the performance of musicians according to the elements of music, aesthetic qualities, and human responses. **Analyze and Critically Assess** 4.1 Identify and analyze differences in tempo and dynamics in contrasting music selections. **Derive Meaning** 4.2* Develop and apply appropriate criteria to support personal preferences for specific musical works.	Students critique and derive meaning from works of theatre, film/video, electronic media, and theatrical artists on the basis of aesthetic qualities. **Critical Assessment of Theatre** 4.1* Develop and apply appropriate criteria for critiquing the work of actors, directors, writers, and technical artists in theatre, film, and video. **Derivation of Meaning from Works of Theatre** 4.2 Describe devices actors use to convey meaning or intent in commercials on television.	Students analyze, assess, and derive meaning from works of art, including their own, according to the elements of art, the principles of design, and aesthetic qualities. **Derive Meaning** 4.1 Identify how selected principles of design are used in a work of art and how they affect personal responses to and evaluation of the work of art. 4.2 Compare the different purposes of a specific culture for creating art. **Make Informed Judgments** 4.3 Develop and use specific criteria as individuals and in groups to assess works of art. 4.4* Assess their own works of art, using specific criteria, and describe what changes they would make for improvement.

*Indicates a key standard.

Component Strand: 5.0 Connections, Relationships, Applications			
Dance Connecting and Applying What Is Learned in Dance to Learning in Other Art Forms and Subject Areas and to Careers	**Music** Connecting and Applying What Is Learned in Music to Learning in Other Art Forms and Subject Areas and to Careers	**Theatre** Connecting and Applying What Is Learned in Theatre, Film/Video, and Electronic Media to Other Art Forms and Subject Areas and to Careers	**Visual Arts** Connecting and Applying What Is Learned in the Visual Arts to Other Art Forms and Subject Areas and to Careers
Students apply what they learn in dance to learning across subject areas. They develop competencies and creative skills in problem solving, communication, and management of time and resources that contribute to lifelong learning and career skills. They also learn about careers in and related to dance. **Connections and Applications Across Disciplines** 5.1* Describe how historical events relate to dance forms (e.g., the rebellion of the 1960s was represented in popular social dances with a move from partners to individual expression). 5.2 Describe how dancing requires good health-related habits (e.g., individual and group goals for flexibility, strength, endurance, stress management, nutrition). 5.3 Cite examples of the use of technology in the performing arts. **Development of Life Skills and Career Competencies** 5.4 Demonstrate social skills that enable students to become leaders/teachers and followers/learners.	Students apply what they learn in music across subject areas. They develop competencies and creative skills in problem solving, communication, and management of time and resources that contribute to lifelong learning and career skills. They also learn about careers in and related to music. **Connections and Applications** 5.1 Explain the role of music in community events. **Careers and Career-Related Skills** 5.2 Identify ways in which the music professions are similar to or different from one another.	Students apply what they learn in theatre, film/video, and electronic media across subject areas. They develop competencies and creative skills in problem solving, communication, and time management that contribute to lifelong learning and career skills. They also learn about careers in and related to theatre. **Connections and Applications** 5.1 Use theatrical skills to dramatize events and concepts from other curriculum areas, such as reenacting the signing of the Declaration of Independence in history–social science. **Careers and Career-Related Skills** 5.2 Identify the roles and responsibilities of performing and technical artists in theatre, film, television, and electronic media.	Students apply what they learn in the visual arts across subject areas. They develop competencies and creative skills in problem solving, communication, and management of time and resources that contribute to lifelong learning and career skills. They also learn about careers in and related to the visual arts. **Connections and Applications** 5.1 Use linear perspective to depict geometric objects in space. **Visual Literacy** 5.2 Identify and design icons, logos, and other graphic devices as symbols for ideas and information. **Careers and Career-Related Skills** 5.3 Research and report on what various types of artists (e.g., architects, designers, graphic artists, animators) produce and how their works play a role in our everyday environment.

*Indicates a key standard.

Health

Overview

Through health education, students learn skills that enable them to make healthy choices and avoid high-risk behaviors. They also learn health concepts and acquire related knowledge. Students develop communication skills, decision-making and goal-setting skills, refusal techniques, and the ability to access health information and assess its accuracy. They learn health skills and content simultaneously.

Health literacy is a primary goal of health education. *Health literacy* is defined as the capacity of an individual to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health. The knowledge and skills that comprise health literacy are woven throughout the health education content standards.

The health education content standards provide a vision of what students need to know and be able to do so they can adopt and maintain healthy behaviors. The eight overarching content standards are taught within the context of six content areas. For grades one through six, only three content areas are addressed each year to allow for sufficient time for effective instruction. For fifth grade, the three content areas are Nutrition and Physical Activity; Growth, Development, and Sexual Health; and Personal and Community Health.

The grade-five emphases on growth and development and on nutrition and physical activity are particularly suitable for ten- and eleven-year-olds. Students in grade five are entering early adolescence; some students are already experiencing its many changes, which can begin as early as grade three. As their physical appearance changes at different rates, students may become more concerned about body image and looking like their peers. The fifth-grade standards help students to understand the differences in growth and development rates and to adopt a healthy body image.

The fifth-grade standards help students to understand the difference in growth and development rates and to adopt a healthy body image.

In the standards for growth, development, and sexual health, there is an emphasis on the physical, social, and emotional changes that occur during puberty as well as on personal hygiene and safety. The physical changes of adolescence generally include growth spurts that result in additional nutritional demands on student's bodies and make healthy food choices and regular physical activity particularly important for adolescents. Personal hygiene and safety are also covered in the standards for personal and community health that students learn and practice. In addition, the personal and community health standards draw students' attention to the links between their own health and the health of their community and the environment.

What Fifth-Grade Students Should Know

In grade four, students learned about nutrition and physical activity, two important factors in their healthy growth and development. They learned about healthy food choices, nutrients, and the many influences on their eating. They monitored their physical activity and increased the amount of time they are physically active. Students learned how to prevent many types of injuries by using appropriate safety equipment and avoiding or reducing risks. They planned responses to emergencies and natural disasters, identified trusted adults, and practiced conflict resolution techniques. They learned skills for avoiding and reporting bullying and harassment and for resisting involvement in gang activities. Students also learned about the harmful effects of alcohol, tobacco, and other drugs and ways to cope with situations (e.g., by using refusal skills) involving those substances.

What Students Learn in Fifth Grade

In grade five, students learn to read and understand food nutrition labels and to use the information to select healthy food. They also research age-appropriate guidelines for healthy eating and physical activity to determine if changes in their eating habits and level of physical activity would improve their health and fitness. Students learn about the human reproductive cycle, the changes that occur during puberty, and how to prevent the transmission of bloodborne communicable diseases. They analyze the influence of media, peers, and culture on their food choices, physical activity level, perceptions about gender roles and body image, and personal health practices. They recognize reliable sources of information and learn and practice effective communication skills to obtain information from others. Grade-five students learn about and adopt health practices and behaviors that promote their own health. They monitor their health behaviors and their progress toward personal health goals.

Nutrition and Physical Activity

In grade five, students learn how to use the information on food nutrition labels to distinguish between more-nutritous and less-nutritious foods and beverages. As they gain an understanding of what constitutes a balanced diet, they set personal nutritional goals based on age-appropriate nutrition guidelines and use a decision-making process to select nutritious food. They practice effective communication skills to counter the influences of peers and media, which frequently promote less-nutritous foods. To help achieve their personal nutrition goal, students learn to prepare healthy foods following sanitary food preparation guidelines. They also monitor their progress toward the nutritional goal they have set.

In grade five, students can explain how good health is influenced by both healthy eating and physical activity. They understand how physical activity, rest, and sleep are related, and they can identify the benefits of regular physical activity. Students are able to balance their food intake and physical activity. After learning about age-appropriate guidelines for physical activity, they compare their own level of physical activity with the guidelines and, if necessary, determine how to increase their physical activity. They use their skills in goal setting to set realistic goals to increase their physical fitness and monitor their progress toward the goal. Students in grade five also learn how to support opportunities for healthy eating and increased physical activity in their school and community. For example, students help select fund-raising activities that are consistent with efforts to promote health, such as choosing a jog-a-thon rather than a candy sale or promoting intramural games during lunch recess.

Growth, Development, and Sexual Health

Students in grade five learn about the structure, function, and major parts of the human reproductive system in the context of the human life cycle of reproduction, birth, growth, aging, and death. They also learn about the physical, social, and emotional changes that occur during puberty. They learn that physical development can vary considerably between individuals and still be normal, heredity affects their growth and development, and puberty influences their thoughts, emotions, and behaviors. Students obtain accurate information about puberty by practicing health skills such as differentiating between reliable and unreliable sources of information, recognizing parents/guardians and other trusted adults as resources, and using effective communication skills to discuss the changes that occur during puberty with their parents/guardians or other trusted adults.

Students learn that everyone has the right to establish personal boundaries. They understand the importance of setting personal boundaries and develop refusal skills to protect their personal boundaries. They recognize that there are different ways to express friendship, attraction, and affection and use their communication skills to express them in a healthy and respectful manner. They also analyze how culture, media, and other factors influence their perceptions about body image, gender roles, and attractiveness. Students use their goal-setting skills to identify steps to achieve and maintain a healthy and accurate body image.

In grade five, students learn the definition of sexually transmitted diseases, in particular human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS), and how HIV is and is not transmitted. This knowledge helps students understand why it is safe to be a friend to someone who is living with HIV or AIDS and explain to others how to protect themselves against serious bloodborne communicable diseases such as HIV.

Personal and Community Health

In grade five, students learn about effective health strategies to reduce their risk of illness and injury, when and whom to ask for medical assistance, what constitutes a life-threatening situation (e.g., heart attack, asthma attack), and how viruses and bacteria affect the immune system. They also learn about personal hygiene needs associated with the onset of puberty (e.g., skin care to control acne). As students learn about the relationship between their personal health and environmental conditions (e.g., asthma attacks are exacerbated by poor air quality), they understand their responsibility for protecting the environment, set and monitor goals to help protect the environment, and encourage others to minimize pollution in the environment.

Students analyze the internal and external influences on their personal health practices (e.g., getting enough sleep, using sunscreen, protecting their hearing), make decisions that promote their health, demonstrate personal responsibility for their health habits, and set and monitor goals to improve their personal health. They can identify valid sources of information about personal health products and services, a skill that helps students be more informed consumers and less influenced by advertisements or negative peer pressure.

They can identify valid sources of information about personal health products and services, a skill that helps students be more informed consumers and less influenced by advertisements or negative peer pressure.

Support for English Learners

Teachers may need to modify instruction to meet the instructional needs of English learners. Strategies to support learning may include using graphic organizers, pictures and other visual cues; summarizing or paraphrasing text; and additional time and providing opportunities for practice and interactions with classmates and the teacher. As in other subject areas, the academic language of health must be directly taught to all students, but English learners may need additional opportunities to use new words. For example, with students who speak Spanish, instruction that identifies cognates (e.g., *protein/proteina, vitamin/vitamina*) supports their understanding of content-specific vocabulary. The interpersonal-communication, decision-making, and health-promotion skills of health education provide opportunities for students to use the academic language necessary to gain access to health content. Comparing alternatives and justifying choices require the use of academic language and provide meaningful situations for students to practice using new vocabulary and content knowledge.

The Standards

The following fifth-grade health education content standards were adopted by the California State Board of Education on March 12, 2008.

Health Education Content Standards
Grade Five

Overarching Standards

Standard 1: Essential Health Concepts
All students will comprehend essential concepts related to enhancing health.

Standard 2: Analyzing Health Influences
All students will demonstrate the ability to analyze internal and external influences that affect health.

Standard 3: Accessing Valid Health Information
All students will demonstrate the ability to access and analyze health information, products, and services.

Standard 4: Interpersonal Communication
All students will demonstrate the ability to use interpersonal communication skills to enhance health.

Standard 5: Decision Making
All students will demonstrate the ability to use decision-making skills to enhance health.

Standard 6: Goal Setting
All students will demonstrate the ability to use goal-setting skills to enhance health.

Standard 7: Practicing Health-Enhancing Behaviors
All students will demonstrate the ability to practice behaviors that reduce risk and promote health.

Standard 8: Health Promotion
All students will demonstrate the ability to promote and support personal, family, and community health.

Nutrition and Physical Activity

Standard 1: Essential Concepts

1.1.N	Describe the food groups, including recommended portions to eat from each food group.
1.2.N	Identify key components of the “Nutrition Facts” labels.
1.3.N	Explain the relationship between the intake of nutrients and metabolism.
1.4.N	Explain why some food groups have a greater number of recommended portions than other food groups.

1.5.N	Describe safe food handling and preparation practices.
1.6.N	Differentiate between more-nutritious and less-nutritious beverages and snacks.
1.7.N	Explain the concept of eating in moderation.
1.8.N	Describe the benefits of eating a nutritionally balanced diet consistent with current research-based dietary guidelines.
1.9.N	Explain how good health is influenced by healthy eating and being physically active.
1.10.N	Describe how physical activity, rest, and sleep are related.
1.11.N	Identify physical, academic, mental, and social benefits of regular physical activity.
Standard 2: Analyzing Influences	
2.1.N	Describe internal and external influences that affect food choices and physical activity.
2.2.N	Recognize that family and cultural influences affect food choices.
2.3.N	Describe the influence of advertising and marketing techniques on food and beverage choices.
Standard 3: Accessing Valid Information	
3.1.N	Locate age-appropriate guidelines for eating and physical activity.
3.2.N	Interpret information provided on food labels.
Standard 4: Interpersonal Communication	
4.1.N	Use communication skills to deal effectively with influences from peers and media regarding food choices and physical activity.
Standard 5: Decision Making	
5.1.N	Use a decision-making process to identify healthy foods for meals and snacks.
5.2.N	Use a decision-making process to determine activities that increase physical fitness.
5.3.N	Compare personal eating and physical activity patterns with current age-appropriate guidelines.
Standard 6: Goal Setting	
6.1.N	Monitor personal progress toward a nutritional goal.
6.2.N	Monitor personal progress toward a physical activity goal.
Standard 7: Practicing Health-Enhancing Behaviors	

7.1.N	Identify ways to choose healthy snacks based on current research-based guidelines.
7.2.N	Demonstrate how to prepare a healthy meal or snack using sanitary food preparation and storage practices.
7.3.N	Demonstrate the ability to balance food intake and physical activity.
7.4.N	Demonstrate the ability to assess personal physical activity levels.
Standard 8: Health Promotion	
8.1.N	Encourage and promote healthy eating and increased physical activity opportunities at school and in the community.
Growth, Development, and Sexual Health[1]	
Standard 1: Essential Concepts	
1.1.G	Describe the human cycle of reproduction, birth, growth, aging, and death.
1.2.G	Explain the structure, function, and major parts of the human reproductive system.
1.3.G	Identify the physical, social, and emotional changes that occur during puberty.
1.4.G	Define sexually transmitted diseases (STDs), including human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS).
1.5.G	Describe how HIV is and is not transmitted.
1.6.G	Recognize that there are individual differences in growth and development, physical appearance, and gender roles.
1.7.G	Recognize that everyone has the right to establish personal boundaries.
1.8.G	Recognize that friendship, attraction, and affection can be expressed in different ways.
1.9.G	Explain that puberty and physical development can vary considerably and still be normal.
1.10.G	Identify personal hygiene practices and health and safety issues related to puberty (e.g., showering, use of sanitary products, deodorant, and athletic supporters).
Standard 2: Analyzing Influences	
2.1.G	Explain how culture, media, and other factors influence perceptions about body image, gender roles, and attractiveness.
2.2.G	Describe how heredity influences growth and development.

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[1] *Education Code* (*EC*) Section 51933(a)(b)(c)

2.3.G	Discuss how changes during puberty affect thoughts, emotions, and behaviors.
Standard 3: Accessing Valid Information	
3.1.G	Recognize parents, guardians, and other trusted adults as resources for information about puberty.
3.2.G	Differentiate between reliable and unreliable sources of information about puberty.
Standard 4: Interpersonal Communication	
4.1.G	Use effective communication skills to discuss with parents, guardians, and other trusted adults the changes that occur during puberty.
4.2.G	Use healthy and respectful ways to express friendship, attraction, and affection.
4.3.G	Demonstrate refusal skills to protect personal boundaries.
Standard 5: Decision Making	
5.1.G	Describe the importance of identifying personal boundaries.
5.2.G	Analyze why it is safe to be a friend to someone who is living with HIV or AIDS.
Standard 6: Goal Setting	
6.1.G	Identify steps to achieve and maintain a healthy and accurate body image.
6.2.G	Develop plans to maintain personal hygiene during puberty.
Standard 7: Practicing Health-Enhancing Behaviors	
7.1.G	Engage in behaviors that promote healthy growth and development during puberty.
7.2.G	Describe ways people can protect themselves against serious blood borne communicable diseases.
Standard 8: Health Promotion	
Skills for this content area are not identified until grades seven and eight.	
Personal and Community Health	
Standard 1: Essential Concepts	
1.1.P	Identify effective personal health strategies that reduce illness and injury (e.g., adequate sleep, ergonomics, sun safety, hand washing, hearing protection, and tooth brushing and tooth flossing).

1.2.P	Explain how viruses and bacteria affect the immune system and impact health.
1.3.P	Describe how environmental conditions affect personal health.
1.4.P	Describe the personal hygiene needs associated with the onset of puberty.
1.5.P	Define life-threatening situations (e.g., heart attacks, asthma attacks, poisonings).
1.6.P	Explain that all individuals have a responsibility to protect and preserve the environment.
Standard 2: Analyzing Influences	
2.1.P	Identify internal and external influences that affect personal health practices.
Standard 3: Accessing Valid Information	
3.1.P	Identify sources of valid information about personal health products and services.
3.2.P	Identify individuals who can assist with health-related issues and potentially life-threatening health conditions (e.g., asthma episodes or seizures).
Standard 4: Interpersonal Communication	
4.1.P	Practice effective communication skills to seek help for health-related problems or emergencies.
Standard 5: Decision Making	
5.1.P	Use a decision-making process to determine personal choices that promote personal, environmental, and community health.
5.2.P	Use a decision-making process to determine when medical assistance is needed.
Standard 6: Goal Setting	
6.1.P	Monitor progress toward a goal to help protect the environment.
6.2.P	Monitor progress toward a personal health goal.
Standard 7: Practicing Health-Enhancing Behaviors	
7.1.P	Practice good personal and dental hygiene.
7.2.P	Demonstrate personal responsibility for health habits.
7.3.P	Practice strategies to protect against the harmful effects of the sun.
Standard 8: Health Promotion	
8.1.P	Encourage others to minimize pollution in the environment.

Physical Education

Overview

Elementary physical education programs emphasize the importance of physical activity and personal fitness. Fitness is developed through the activities in the daily lessons, which emphasize physical activity, continuous movement, and challenges that involve overloading the major muscle groups. Students have opportunities to understand the fitness components, fitness assessment, and the need for a lifetime of physical activity. Participation in physical activity also can be an important venue for the social, psychological, and emotional development of children.

Elementary physical education programs emphasize the importance of physical activity and personal fitness.

The elementary school physical education program emphasizes the development of fundamental locomotor, nonlocomotor, and manipulative skills. The movement framework, basic biomechanical and motor learning principles (see Appendixes C, D, and E in the *Physical Education Framework for California Public Schools*), and fundamental game tactics are also part of the content for elementary school students.

State law requires that schools provide students in grade five with at least 200 minutes of physical education each 10 school days. Recess and lunch time do not count toward the required instructional minutes.

The grade-five physical education model content standards are organized by five overarching content standards. Under each of the overarching standards are grade-level model content standards that provide a vision of what students in grade five should know and be able to do. Together, the content standards represent the essential skills and knowledge that all students need to be physically active and enjoy a healthy lifestyle.

Students in grade five are entering early adolescence, and many are beginning to experience physical changes. Flexibility continues to decrease, especially in boys, presenting the need for more stretching exercises during physical education. Because of differences in growth rates, it is not uncommon for girls to be taller than boys. Fifth-grade students have sufficient eye–hand and eye–foot coordination to allow them to concentrate on improving accuracy when manipulating objects.

What Fifth-Grade Students Should Know

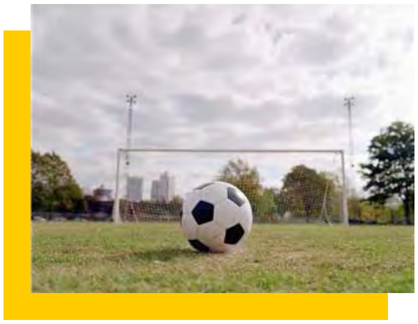
In grade four, students focused on learning and practicing manipulation skills (e.g., kicking, throwing, striking). They learned to use rackets and paddles to strike objects. They also learned about the correct technique for manipulative skills, such as body orientation when serving a ball, and to distinguish between similar skills (e.g., kicking and punting). They learned individual defensive and offensive moves. Students increased the level and frequency of their physical activity, set goals for health-related physical fitness, and monitored their improving skills and fitness. Fourth-grade students were also introduced to the concept of perceived exertion. Instruction highlighted the value of muscular endurance/strength, aerobic and flexibility exercises, and the importance of water and healthy foods to improve physical performance. Students learned to include others in physical activity and to respect differences in skill levels, as well as to accept responsibility for their own performance of physical activities and to both win and lose with dignity and respect.

What Students Learn in Fifth Grade

In grade five, students learn manipulative skills with an emphasis on improving accuracy and distance while efficiently manipulating objects by using body parts or implements. For example, they stop a kicked ball by trapping it with a foot and strike a dropped ball with a racket or paddle. They learn and practice offensive and defensive skills. Students create and then perform dances with intentional changes in speed and direction and rhythmic routines that involve manipulating an object. They learn fitness concepts, such as the principles of training, and how to increase their aerobic capacity. They demonstrate how to set and monitor achievable short-term and long-term goals for improved physical fitness. Students assess their health-related physical fitness and increase the amount of time and the intensity of their physical activity. They learn to work cooperatively with and respect others with differing abilities.

Overarching Standard 1: Students demonstrate the motor skills and movement patterns needed to perform a variety of physical activities.

For fifth-grade students, jumping is the focus of locomotor skill practice, including jumping for height, jumping for distance, and jumping a rope turned by others. They also apply locomotor skills to creative dances that combine locomotor patterns with changes in speed and direction. Building on rhythmic skills learned in earlier grades, students add the manipulation of an object to rhythmic routines set to music.



Throughout grade five, students concentrate on learning and practicing manipulative skills with an emphasis on improving accuracy. They focus on accuracy when practicing throwing, fielding, punting, striking, serving, dribbling, passing, and volleying. For example, they punt a ball at a target and volley a tossed ball to an intended location. Students also refine their trapping and catching skills. They learn how to perform manipulative skills in an open environment (one that has variables such as a defender). Students practice defensive skills such as dribbling and kicking a ball toward a goal while being guarded and avoiding an opponent as they throw an object. Becoming proficient at performing manipulative skills in an open environment prepares students for the lead-up games performed in grade six.

Overarching Standard 2: Students demonstrate knowledge of movement concepts, principles, and strategies that apply to the learning and performance of physical activities.

Standard 2 represents the cognitive knowledge that supports the locomotor, nonlocomotor, and manipulative skills described in standard 1. For example, standard 2.5 calls for students to design a routine to music, changing speed and direction while manipulating an object, and standard 1.19 calls for students to perform a routine to music that involves manipulation of an object. Students learn about the principles for designing a routine to music and then design and perform a rhythmic routine while applying those principles.

Students learn about the concept of open space, which is the basis for offensive and defensive strategies, and its importance in playing sport-related games. They learn about the phases of striking a ball (preparation, application of force, follow-through, and recovery) and how to adjust their body position to catch a ball thrown off center. They also learn about the differences in technique between applying force on liftoff and receiving force on landing when jumping for height and distance.

Overarching Standard 3: Students assess and maintain a level of physical fitness to improve health and performance.

In grade five, students perform moderate to vigorous physical activities three to four days each week for increasing periods of time and with the related goals of increasing their aerobic capacity and the amount of time they sustain continuous movement. They learn how to warm up their muscles and joints before jumping, kicking, throwing, and striking. They also learn about and perform exercises that stretch specific muscle areas in preparation for a particular physical activity. Thus, their warm-up and cool-down exercises are targeted to the planned activity or skills practice and the parts of the body that are involved in the activity. One way students develop their muscular strength/endurance is to perform an increasing number of oblique curl-ups on each side of the body and triceps push-ups. In addition, students apply what they have learned about nutrition to plan a day of healthy, balanced meals and snacks designed to enhance their performance of physical activities.

Grade-five students periodically assess their health-related physical fitness, which includes aerobic capacity, muscle strength and endurance, flexibility, and body composition, using scientifically based assessments. Grade five is also the first grade level at which students must take the statewide, comprehensive health-related physical fitness test (PFT). The primary goal of the PFT is to assist students in establishing lifetime habits of regular physical activity. (See the CDE Testing Web page at http://www.cde.ca.gov/ta/tg/pf/ for additional information about the PFT.)

Grade five is also the first grade level at which students must take the statewide, comprehensive health-related physical fitness test (PFT).

Overarching Standard 4: Students demonstrate knowledge of physical fitness concepts, principles, and strategies to improve health and performance.

Similar to the relationship between standards 1 and 2, standard 4 provides the cognitive information to support the fitness activities described in standard 3. Students in grade five are interested in learning about the human body and how to improve their performance in physical education. The content students learn in grade five reflects this interest and emphasizes fitness concepts, aerobic capacity, and body composition.

Students are given the results of their most recent health-related physical fitness assessment and instructed to identify one or more ways to improve performance in those areas where minimum standards were not met. Based on the assessment results, and with guidance from their teacher, students develop short-term and long-term fitness goals. They also analyze their food intake and make a plan to replace foods with healthier choices and adjust quantities to improve their performance in physical activity. They learn about the effects of dehydration on their physical and mental performance and learn to record their water intake to ensure they drink sufficient amounts.

Students learn about target heart-rate range, how to measure their heart rate, and to determine the intensity of their physical activity using the concept of perceived exertion. They measure and compare their heart rates with their perceived-exertion levels so they learn what being in their target heart-rate zones feels like. They also learn about and practice using technology (e.g., heart monitors, pedometers) that can help them achieve physical fitness.

In grade five, students learn why body weight is maintained when calorie intake is equal to the calories expended. They also learn about the short-term and long-term benefits of maintaining a healthy body composition.

Overarching Standard 5: Students demonstrate and utilize knowledge of psychological and sociological concepts, principles, and strategies that apply to the learning and performance of physical activity.

Students in grade five set and work toward a long-term physical activity goal with guidance from their teacher. The teacher ensures that the students' goals are clear, measurable, and achievable. Students record their progress, and the teacher reviews it and suggests adjustments if the student is not making progress toward the goal. Students also set two additional goals—a health-related physical fitness goal and a motor skills goal—both of which they strive to attain outside of school hours.

Students learn to distinguish between acts of physical courage and physically reckless acts and the key characteristics of each. They also learn to demonstrate how to act in a safe and healthy manner when confronted by negative peer pressure and the temptation to act recklessly during physical activity. Students learn and demonstrate social skills by adapting physical activities to accommodate individual differences and by showing appreciation for games and activities reflecting diverse heritages. They learn how to acknowledge others' contributions while also contributing their own ideas during cooperative problem-solving activities.

Support for English Learners

The goal of physical education programs in California is to ensure universal access to high-quality curriculum and instruction so that every student can meet or exceed the state's physical education model content standards. To reach that goal, teachers design instruction to meet the instructional needs of each student. Different instructional approaches may be needed for English learners to gain access to physical education content. Specially designed academic instruction in English (SDAIE), also known as sheltered instruction, provides students with a variety of interactive and multimodal means to obtain information. With sheltered instruction techniques, teachers modify the language demands of the lesson. Cooperative learning with high levels of interaction may also be an effective strategy. (See the *Physical Education Framework for California Public Schools*, Chapter 7, "Universal Access," for more information.)

Students learn new vocabulary through physical activity instruction that is modeled by other students (e.g., volley a tossed ball, serve a lightweight ball over a low net)…

Physical education instruction provides opportunities for students to develop their English-language skills. Students learn new vocabulary through physical activity instruction that is modeled by other students (e.g., *volleying* a tossed ball, *serving* a lightweight ball over a low net) and demonstrations of manipulative skills that include labeling the steps of the skill (e.g., "Bend the knees halfway"; "Shift weight from heels to balls of feet"). Instruction that draws attention to cognates (e.g., *flexibility/flexibidad*, *intensity/intensidad*) can help students understand domain-specific and academic vocabulary. Participating in small-group activities and modified team games, coaching other students, discussing rules, and speaking and listening about physical education concepts and principles also provide opportunities for English learners to acquire academic vocabulary and practice both informal and formal English.

Support for Students with Special Needs

Successful participation in physical activities by students with special needs depends on the teacher's skill and training in providing instruction and support to all students. When systematically planned differentiation strategies are used, students with special needs can benefit from appropriately challenging curriculum and instruction. The strategies for differentiating instruction include pacing, complexity, depth, and novelty. Despite the modifications made, however, the focus is to always help students meet the physical education model content standards to the best of their ability.

In helping students achieve at their grade level, teachers use instructional resources aligned with the standards and provide additional learning and practice opportunities. Some students with 504 Plans or individualized education programs (IEPs) are eligible for special education services in physical education. A student's 504 Plan or IEP often includes suggestions for techniques to ensure that the student has full access to a program designed to provide him or her with appropriate learning opportunities and that uses instructional materials and strategies to best meet his or her needs. The 504 Plan or IEP also determines which services or combination of services best met the student's need. See the *Physical Education Framework for California Public Schools*, Chapter 7, "Universal Access," for more information. The framework is posted at http://www.cde.ca.gov/ci/pe/cf/index.asp.

The Standards

The following fifth-grade physical education model content standards were adopted by the California State Board of Education on January 12, 2005.

Physical Education Model Content Standards Grade Five	
STANDARD 1: Students demonstrate the motor skills and movement patterns needed to perform a variety of physical activities.	
Body Management	
1.1	Perform simple small-group balance stunts by distributing weight and base of support.
Locomotor Movement	
1.2	Jump for height, using proper takeoff and landing form.
1.3	Jump for distance, using proper takeoff and landing form.
Manipulative Skills	
1.4	Enter, jump, and leave a long rope turned by others.
1.5	Throw a flying disc accurately at a target and to a partner, using the backhand movement pattern.
1.6	Throw and catch an object underhand and overhand while avoiding an opponent.
1.7	Field a thrown ground ball.
1.8	Punt a ball, dropped from the hands, at a target.

1.9	Stop a kicked ball by trapping it with the foot while moving.
1.10	Strike a dropped ball, with a racket or paddle, toward a target by using the forehand movement pattern.
1.11	Hit a softly tossed ball backhanded with a paddle or racket.
1.12	Strike a tossed ball, with different implements, from a side orientation.
1.13	Serve a lightweight ball over a low net, using the underhand movement pattern.
1.14	Dribble a ball (by hand or foot) while preventing another person from stealing the ball.
1.15	Dribble a ball and kick it toward a goal while being guarded.
1.16	Pass a ball back and forth with a partner, using a chest pass and bounce pass.
1.17	Volley a tossed ball to an intended location.
Rhythmic Skills	
1.18	Design and perform a creative dance, combining locomotor patterns with intentional changes in speed and direction.
1.19	Design and perform a routine to music that involves manipulation of an object.
STANDARD 2: Students demonstrate knowledge of movement concepts, principles, and strategies that apply to the learning and performance of physical activities.	
Movement Concepts	
2.1	Explain the importance of open space in playing sport-related games.
2.2	Explain the differences in applying and receiving force when jumping for height and distance.
Body Management	
2.3	Explain how to adjust body position to catch a ball thrown off-center.
Manipulative Skills	
2.4	Identify the following phases for striking a ball: preparation, application of force, follow-through, and recovery.
Rhythmic Skills	
2.5	Design a routine to music, changing speed and direction while manipulating an object.

STANDARD 3: Students assess and maintain a level of physical fitness to improve health and performance.	
Fitness Concepts	
3.1	Demonstrate how to warm up muscles and joints before running, jumping, kicking, throwing, and striking.
3.2	Plan a day of healthful balanced meals and snacks designed to enhance the performance of physical activities.
Aerobic Capacity	
3.3	Participate three to four days each week, for increasing periods of time, in continuous moderate to vigorous physical activities at the appropriate intensity for increasing aerobic capacity.
Muscular Strength/Endurance	
3.4	Perform an increasing number of oblique curl-ups on each side.
3.5	Perform increasing numbers of triceps push-ups.
Flexibility	
3.6	Perform flexibility exercises that will stretch particular muscle areas for given physical activities.
Body Composition	
3.7	Sustain continuous movement for an increasing period of time while participating in moderate to vigorous physical activities.
Assessment	
3.8	Assess health-related physical fitness by using a scientifically based health-related fitness assessment.
3.9	Meet age- and gender-specific fitness standards for aerobic capacity, muscular strength, flexibility, and body composition, using a scientifically based health-related fitness assessment.
STANDARD 4: Students demonstrate knowledge of physical fitness concepts, principles, and strategies to improve health and performance.	
Fitness Concepts	
4.1	Record and analyze food consumption for one day and make a plan to replace foods with healthier choices and adjust quantities to enhance performance in physical activity.
4.2	Explain why dehydration impairs temperature regulation and physical and mental performance.
4.3	Develop and describe three short-term and three long-term fitness goals.

4.4	Examine personal results of a scientifically based health-related physical fitness assessment and identify one or more ways to improve performance in areas that do not meet minimum standards.
4.5	Explain the elements of warm-up and cool-down activities.
4.6	Record water intake before, during, and after physical activity.
4.7	Describe the principles of training and the application to each of the components of health-related physical fitness.
Aerobic Capacity	
4.8	Identify the heart rate intensity (target heart-rate range) that is necessary to increase aerobic capacity.
4.9	Determine the intensity of personal physical activity, using the concept of perceived exertion.
4.10	Compare target heart rate and perceived exertion during physical activity.
4.11	Measure and record the heart rate before, during, and after vigorous physical activity.
4.12	Explain how technology can assist in the pursuit of physical fitness.
Muscular Strength/Endurance	
4.13	Explain the benefits of having strong arm, chest, and back muscles.
Flexibility	
4.14	Explain the benefits of stretching after warm-up activities.
Body Composition	
4.15	Explain why body weight is maintained when calorie intake is equal to the calories expended.
4.16	Describe the short- and long-term benefits of maintaining body composition within the healthy fitness zone.
STANDARD 5: Students demonstrate and utilize knowledge of psychological and sociological concepts, principles, and strategies that apply to the learning and performance of physical activity.	
Self-Responsibility	
5.1	Improve the level of performance on one component of health-related physical fitness and one identified motor skill by participating in fitness and skill development activities outside school.
5.2	Work toward a long-term physical activity goal and record data on one’s progress.
5.3	Distinguish between acts of physical courage and physically reckless acts and explain the key characteristics of each.

5.4	Act in a safe and healthy manner when confronted with negative peer pressure during physical activity.
Social Interaction	
5.5	Contribute ideas and listen to the ideas of others in cooperative problem-solving activities.
5.6	Acknowledge orally the contributions and strengths of others.
Group Dynamics	
5.6	Accommodate individual differences in others’ physical abilities in small-group activities.
5.7	Appreciate physical games and activities reflecting diverse heritages.

World Languages

Overview

To succeed in the twenty-first century, today's students need to develop linguistic and cultural literacy, including academic knowledge and proficiency in English and in world languages and cultures. California schools teach a wide variety of languages spoken throughout the world, as well as American Sign Language (ASL). Because every language is a "foreign" language to those who do not know it, the term used in this document and in the standards is "world" languages.

Students no longer simply learn about languages and cultures; rather, they are provided with opportunities to learn languages and cultures through participation in communicative interactions that prepare them for real-world language use and global citizenship. Language learning needs to be a lifelong endeavor.

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What Fifth-Grade Students Should Know

Although world language instruction is not a required subject for the elementary grades, instruction in world languages is encouraged to begin as soon as possible. Some fifth-grade students may have participated in language instruction in the earlier grades, but many will have had no formal instruction in another language. However, because of the diversity of students in California, most classrooms will include students who bring a rich variety of languages and cultures with them. Students may have learned a heritage language in their homes, be recent immigrants, or acquired the ability to understand and/or produce one or more languages through contact in their communities or abroad.

What Students Learn in Fifth Grade

The variety of languages and cultures in California classrooms provides opportunities to learn about and celebrate the contributions of many people to the local community and reinforce lessons from fifth-grade history–social science.

California schools offer a variety of language programs, some beginning in elementary school, continuing in middle school, and most typically in comprehensive high school. Elementary programs in language instruction include the following types:

- Immersion—a program in which at least 50 percent of the core curriculum instruction is in the target language.
- Foreign Language in the Elementary School (FLES)—a program that provides instruction for a minimum of 70 minutes a week. The goal is to develop proficiency in language and culture.

- Foreign Language Experience (FLEX)—a program that exposes students to the study of a language or languages and cultures to motivate them to pursue further study of a language.

These programs differ substantially in the number of hours allocated for instruction. All programs need to be age-appropriate in order to address students' cognitive, emotional, and social needs. Programs for heritage and native speakers may include immersion, specialized courses designed to meet learner needs, and accommodations for these learners within the world language classroom.

Organization of the Standards

The world language content standards, adopted by the State Board of Education in 2009, represent a strong consensus that the study of a wide variety of world languages and cultures is part of the core curriculum. The standards present the knowledge, skills, and abilities in a world language that all learners of a world language should acquire in the California public school system.

Because of the considerable number of languages spoken in California schools, the world language content standards were developed to accommodate all languages and the various stages a learner goes through to become proficient. Therefore, the world language contents standards are not language-specific. In addition, because of the various levels of student proficiency and the variety of California's language programs, the world language content standards are not designated for specific grade levels; instead, they describe levels of linguistic and cultural acquisition. The standards provide an organizing principle to ensure the continuous development of student proficiency, regardless of the multiple points of entry and exit from California's language programs. For these reasons, this section is also general and not specific to fifth grade, focusing on the organization of the world language standards and the beginning level of language proficiency.

The standards are separated into five categories and four stages or levels of proficiency. The five categories are taught together and in practice merge into seamless instruction within the various stages. The categories are Content, Communication, Cultures, Structures, and Settings.

Content

The content of the language course includes vocabulary from a wide variety of topics that are age- and stage-appropriate. This content enables students to make connections and reinforce knowledge from other areas of the curriculum and to participate in everyday social interactions in the target language. As students develop their ability to communicate in the target language and culture, they address topics that increase in complexity.

Communication

Real-world communication occurs in a variety of ways. It may be interpersonal, in which listening, reading, viewing, speaking, signing, and writing occur as a shared activity among language users. It may be interpretive, in which language users listen, view, and read using knowledge of cultural products, practices, and perspectives. Or it may be presentational, in which speaking, signing, and writing occur. Students actively use language to transmit meaning while responding to real situations.

Cultures

To understand the connection between language and culture, students learn how a culture views the world. Students understand the ideas, attitudes, and values that shape that culture. These shared, common perspectives, practices, and products incorporate not only formal aspects of a culture—such as contributions of literature, the arts, and science—but also the daily living practices, shared traditions, and common patterns of behavior acceptable to a society. Students acquire the ability to interact appropriately with individuals in the target culture, to communicate successfully, and to make connections and comparisons between languages and cultures.

Structures

Languages vary considerably in the structures that learners use to convey meaning; therefore, the curriculum will feature language-specific structures essential to accurate communication. As they acquire vocabulary in the target language, students grasp the associated concepts and understand the structures of the language to convey meaning. Students learn patterns in the language system, which consist of grammar rules and vocabulary and elements such as gestures and other forms of nonverbal communication. A language system also includes discourse, whereby speakers learn what to say to whom and when. As they progress in proficiency with language, students use linguistically and grammatically appropriate structures to comprehend and produce messages. Students identify similarities and differences among the languages they know.

As they progress in proficiency with language, students use linguistically and grammatically appropriate structures to comprehend and produce messages.

Settings

For students to communicate effectively, they use elements of language appropriate for a given situation. Language conveys meaning best when the setting, or context, in which it is used is known. This knowledge of context assists students not only in comprehending meaning but also in using language that is culturally appropriate. Context also helps define and clarify the meaning of language that is new to the learner. Understanding social linguistic norms will assist learners in communicating effectively in real-world encounters.

Stages of Proficiency

The world language content standards describe four levels of proficiency for each of the five categories. These levels of proficiency are based on the stages of the Language Learning Continuum, a framework developed by the College Board to indicate growth in linguistic and cultural proficiency. The stages provide benchmarks of progress:

- Stage I (Formulaic): Learners understand and produce signs, words, and phrases. (*Note:* It is common in the elementary school context for nonheritage learners to remain in Stage I for an extended period of time.)

- Stage II (Created): Learners understand and produce sentences and strings of sentences.

- Stage III (Planned): Learners understand and produce paragraphs and strings of paragraphs.
- Stage IV (Extended): Learners understand and produce cohesive texts composed of multiple paragraphs.

The Language Learning Continuum also includes Stage V (Tailored) proficiency, which represents performance typically achieved through university-level study. Stage V is not included in the standards.

The Standards

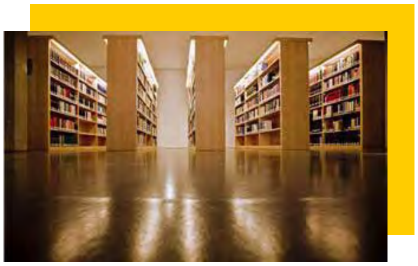
The world language content standards, adopted by the California State Board of Education on January 7, 2009, are organized by stage, not by grade level. Most fifth-grade students would be at Stage I, so only those standards are listed below. For a complete list of the standards for all four stages, view the world language content standards posted on the CDE Content Standards Web page http://www.cde.ca.gov/be/st/ss/.

World Language Content Standards Stage I	
	Content
1.0	Students acquire information, recognize distinctive viewpoints, and further their knowledge of other disciplines.
1.1	Students address discrete elements of daily life, including: a. Greetings and introductions b. Family and friends c. Pets d. Home and neighborhood e. Celebrations, holidays, and rites of passage f. Calendar, seasons, and weather g. Leisure, hobbies and activities, songs, toys and games, sports h. Vacations and travel, maps, destinations, and geography i. School, classroom, schedules, subjects, numbers, time, directions j. Important dates in the target culture k. Jobs l. Food, meals, restaurants m. Shopping, clothes, colors, and sizes n. Parts of the body, illness o. Technology
	Communication
1.0	Students use **formulaic language** (learned words, signs [ASL], and phrases).
1.1	Engage in oral, written, or signed (ASL) conversations.

1.2	Interpret written, spoken, or signed (ASL) language.
1.3	Present to an audience of listeners, readers, or ASL viewers.
Functions	
1.4	List, name, identify, enumerate.
1.5	Identify learned words, signs (ASL), and phrases in authentic texts.
1.6	Reproduce and present a written, oral, or signed (ASL) product in a culturally authentic way.
Cultures	
1.0	Students use appropriate responses to rehearsed cultural situations.
1.1	Associate products, practices, and perspectives with the target culture.
1.2	Recognize similarities and differences within the target cultures and among students' own cultures.
1.3	Identify cultural borrowings.
Structures	
1.0	Students use orthography, phonology, or ASL parameters to understand words, signs (ASL), and phrases in context.
1.1	Use orthography, phonology, or ASL parameters to produce words or signs (ASL) and phrases in context.
1.2	Identify similarities and differences in the orthography, phonology, or ASL parameters of the languages the students know.
Settings	
1.0	Students use language in highly predictable common daily settings
1.1	Recognize age-appropriate cultural or language-use opportunities outside the classroom.

School Library

Overview



School libraries have evolved from having a focus on print materials to providing a rich selection of resources, both print and digital; from students learning how to search a card catalog to learning strategies for searching a variety of digital resources and using Web browsers; from basic literacy to information literacy (the ability to access, evaluate, and use information effectively). However, the skills learned from print transcend their use in books alone. “Students who understand systems of text organization are better equipped to use the Internet as it is today. Most notably, they expect worthy resources to have order. This may drive them to probe complex web sites, which, for all their bells and whistles, are fundamentally arranged like reference books, with A-Z lists and topical divisions” (Preston 2009, 80).

California *Education Code* Section 18100 reinforces the essential role of school libraries:

> The governing board of each school district shall provide school library services for the pupils and teachers of the district by establishing and maintaining school libraries or by contractual arrangements with another public agency.

The following describes what fifth-grade students should know and be able to do as a result of having an effective school library program at their school.

What Fifth-Grade Students Should Know

Fourth-grade students used standard reference tools in print and online. They understand and can explain the organization of nonfiction books in the school library (e.g., the Dewey decimal system).

Students became more knowledgeable about online searching, use of electronic menus and icons, and URL Internet extensions (e.g., *.com*, *.org*, *.edu*, *.gov*) while using approved or personal passwords appropriately. Students are now aware that the Internet has an environment of anonymity and not everyone on the Internet is truthful or reliable.

Students in fourth grade extracted information from resources, recording the main ideas and significant details from their research. In fourth grade, students identified the factors that make a source comprehensive, current, credible, accurate, and authoritative. Students communicated with others outside the school environment through the use of technology to share information.

Students read increasingly complex works, including a wide representation of grade-level-appropriate text such as classic and contemporary literature, magazines, newspapers, online information, and informational text. They know the purpose of age-appropriate book awards such as the Caldecott, Newbery, and California Young Reader awards.

What Students Learn in Fifth Grade

Fifth-grade students continue to read a wide variety of grade-level-appropriate text, both in print and online. In fifth grade, students understand how features of both print and digital text make information accessible and use these specialized text features to locate relevant information. They use appropriate reference materials, including the thesaurus, to obtain needed information. Students are able to define the topic of a research investigation and create and use complex key-word searches to locate specific information online. Fifth-grade students are comfortable locating materials in the library, including biographies, using the library catalog and the library classification system.

Scanning and skimming skills are used to locate relevant information within resources. Students evaluate the source and the information for accuracy, credibility and relevance. They determine whether the information confirms or changes their original questions and whether more information is needed. When necessary, students use more than one resource to verify and determine accuracy. They also record bibliographic information in an acceptable format.

Media literacy continues as students describe how media resources can serve as sources for information, entertainment, persuasion, interpretation of events, and transmission of culture.

Media literacy continues as students describe how media resources can serve as sources for information, entertainment, persuasion, interpretation of events, and transmission of culture.

Fifth-grade students use basic safety procedures when online. They demonstrate legal and ethical behavior in information use while understanding and respecting personal intellectual property. Students recognize suspicious online offers and invitations such as spam and phishing.

An added benefit for students is when the classroom teacher and school librarian collaborate to plan and implement a lesson that addresses different content areas. An example of a possible lesson that includes science, English language arts, and school library standards is provided below.

Sample Collaborative Lesson

Standards:

Science 4.c	Students know the causes and effects of different types of severe weather.
ELA RI.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
SLS 1.3.e	Use appropriate reference materials, both print and online, to obtain needed information.
SLS 3.1.a	Record bibliographic information in an acceptable format.

In their science class, students learn basic information about the causes of different types of weather. The teacher provides a list of specific instances of severe weather that took place in various parts of the world. Students choose one weather event to study further. In the library, students are introduced to several reference materials, both in print and online, and to other resources, such as online newspaper and magazine databases. Students are taught the appropriate format for recording bibliographic information before beginning their searches. After locating relevant information, students take notes and record the bibliographic information for each source. Students write a report, including pictures, data, and a bibliography, on the causes and effects of the incident of severe weather.

The Standards

The model school library standards incorporate information literacy (the ability to access, evaluate, and use information effectively) and digital literacy (the ability to use digital technology, communications tools, or networks to access, manage, integrate, evaluate, create, and communicate) to enable students to function in a knowledge-based economy and society. They describe what students should know and be able to do by the end of fifth grade.

The standards are organized around four overarching concepts. Detailed standards explain what each student is expected to have successfully achieved. In addition, students are expected to have mastered the standards for previous grades and continue to use those skills and knowledge as they advance in school.

School library standards are aligned with many content standards in the subject areas included in the course of study and are best learned through the content. The following fifth-grade model school library content standards were adopted by the California State Board of Education on September 10, 2010.

Model School Library Content Standards **Grade Five**	
1. Students access information. The student will access information by applying knowledge of the organization of libraries, print materials, digital media, and other sources.	
1.1 Recognize the need for information:	
1.1.a	Define the topic of a research investigation.
1.2 Formulate appropriate questions:	
1.2.a	Formulate and refine questions that cover the necessary scope and direction of the investigation.
1.2.b	Use key words, phrases, and notes to create an outline.
1.3 Identify and locate a variety of resources online and in other formats by using effective search strategies:	
1.3.a	Use a thesaurus to identify word choices and meanings to facilitate research.
1.3.b	Interpret information from the automated library catalog.
1.3.c	Use call numbers, spine labels, and the library classification system to locate information in the library.
1.3.d	Identify a variety of online information sources.
1.3.e	Use appropriate reference materials, both print and online, to obtain needed information.

1.3.f	Understand how text features make information accessible and usable (e.g., chapter headings, subheadings, captions, indexes).
1.3.g	Use features of electronic text for locating information (e.g., indexes, key words, *see* and *see also* cross references).
1.3.h	Use the library catalog to locate biographies available in the library.
1.3.i	Create and use complex key word searches to find specific information online.
1.4 Retrieve information in a timely, safe, and responsible manner:	
1.4.a	Compare and contrast information obtained from library catalogs, subscription databases, and open-ended search engines on the Internet.
1.4.b	Use scanning and skimming skills to locate relevant information.
1.4.c	Locate relevant information by using specialized features of print (e.g., citations, endnotes, preface, appendix, bibliographic references) and digital text (e.g., key word, controlled vocabulary.
2. Students evaluate information. The student will evaluate and analyze information to determine what is appropriate to address the scope of inquiry.	
2.1 Determine relevance of information:	
2.1.a	Assess how new information confirms and/or changes the original questions (e.g., what I know, what I want to know, and what I learned [KWL] chart).
2.2 Assess comprehensiveness, currency, credibility, authority, and accuracy of resources:	
2.2.a	Describe how media resources serve as sources for information, entertainment, persuasion, interpretation of events, and transmission of culture.
2.2.b	Identify and assess evidence that supports the main ideas and concepts presented in texts.
2.2.c	Evaluate Internet resources for accuracy, credibility, and relevance.
2.3 Consider the need for additional information:	
2.3.a	Evaluate information located to determine whether more information is needed and, if so, identify additional resources to search.
2.3.b	Ask questions that seek information not already located.
3. Students use information. The student will organize, synthesize, create, and communicate information.	

3.1 Demonstrate ethical, legal, and safe use of information in print, media, and digital resources:	
3.1.a	Record bibliographic information in an acceptable format.
3.1.b	Demonstrate an understanding of and show respect for personal intellectual property.
3.1.c	Demonstrate legal and ethical behavior in information use.
3.1.d	Use basic safety procedures when online (e.g., e-mailing, texting, chatting).
3.1.e	Recognize suspicious online offers and invitations (e.g., spam, phishing, polls, contests).
3.2 Draw conclusions and make informed decisions:	
3.2.a	Use more than one resource, when needed, to verify and determine accuracy.
3.3 Use information and technology creatively to answer a question, solve a problem, or enrich understanding:	
3.3.a	Use a thesaurus to edit and revise manuscripts to improve the meaning and focus of writing.
4. Students integrate information literacy skills into all areas of learning. The student will independently pursue information to become a lifelong learner.	
4.1 Read widely and use various media for information, personal interest, and lifelong learning:	
4.1.a	Read a good representation of grade-level-appropriate text, making progress toward the goal of reading one million words annually by grade eight (e.g., classic and contemporary literature, magazines, newspapers, online information).
4.2 Seek, produce, and share information:	
4.2.a	Demonstrate maturity in consideration of others, both in person and during communications and interactions using technology.
4.2.b	Understand the basic components of information literacy, (e.g., identify, access, evaluate, and use information effectively).
4.3 Appreciate and respond to creative expressions of information:	
4.3a	Understand that *genre* is a term that describes types of literary works that are similar (e.g., drama, fable, fairy tale, fantasy, folklore, essay, speeches).

California
Urban Water
Conservation
Council

School Education
BMP Implementation Guidebook

CONTENTS

Introduction

In December 2008, the California Urban Water Conservation Council (CUWCC) updated the Best Management Practices (BMPs) required under the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU)[1], incorporating a broader approach to achieving water savings, improving water use efficiency, and measuring progress.

As a Foundational Best Management Practice (BMP), School Education is an essential water conservation activity for all water utilities and is adopted for implementation by all signatories to the Memorandum of Understanding as an ongoing practice.

Sustainable water use is crucial for social and economic stability as well as for a healthy environment. This challenge is even more important as climate change and population growth affect the amount of water available to competing interests.

Education is a fundamental element for promoting wise water use among customers. School education programs can provide young people with a deeper understanding of complex environmental issues and equip them to contribute to solutions.

Water conservation education can encourage a lifelong understanding and commitment to responsible use of water. When school-aged children are provided with knowledge, they can become the champions and leaders in water conservation.

The three main benefits of school education programs are:

- children develop good water use habits at an early age;
- children are likely to take the information learned home to influence their families to conserve water; and
- children leave a lasting impression on society and improve water use behavior in the next generation.

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[1] The Memorandum of Understanding and Best Management Practices, as amended December 10, 2008, are available in the Resource Center at www.cuwcc.org.

Coverage Requirements

First Requirement: Tie into Content Standards

All school districts must ensure that their curriculum meets California Content Standards (http://www.cde.ca.gov/be/st/ss). **Educators will be much more likely to teach water conservation if the materials help them cover required content.** The standards often suggest a sequence for presenting content, moving from simple concepts with younger children to more complex presentations of the same ideas with older children. Content also may follow a set sequence within grade levels. School districts can use a variety of materials to meet the content standards, and many teachers supplement with other materials. As long as the standards are taught at some point in the year, teachers usually have some flexibility.

How to confirm materials meet the state education framework requirements and are grade-level appropriate

- The content standard should be stated in the materials. Look for lesson plans developed by credentialed teachers who are familiar with the content standards. When presentations are contracted out, presenters should be experts in teaching water conservation and water science. They should understand and teach to the content standards. In addition, ensure that the material developed is not too dated. Content standards can change, and it's important to have up-to-date curriculum. Review curriculum content regularly, at least every two to three years.

How to find curriculum that meets the standards

- Many agencies, both large and small, use an "education in a box" approach with materials developed by experts such as Project WET (http://www.projectwet.org/) and Water Education Foundation (http://www.watereducation.org/doc.asp?id=873). For those with a small education budget, this approach may make the most financial sense. There are many other resources for curriculum, including:
    - Department of Water Resources (DWR) Education Committee: This is an ad hoc group of people involved in water education that meets to share ideas and resources. Getting involved is one of the best ways to find out what other water agencies are doing to meet their School Education BMP and find resources that can be adapted locally. Contact Michelle Robinson at DWR's Water Education unit.
    - Education and Environment Initiative (EEI) (Curriculum http://www.calepa.ca.gov/Education/EEI/default.htm/): The EEI Curriculum is a State Board of Education approved curriculum that teaches select Science and History/Social Science academic content standards in grades K-12 to mastery using the environment as a context for learning. Many of the curriculum units address water issues. The lessons are available online, free of charge. CalEPA is

working with local school districts and a wide range of partners to implement the EEI Curriculum statewide.

- California Environmental Education Community Network (www.creec.org): The California Department of Education operates this program, which is coordinated locally through County Offices of Education. CREEC maintains a database of environmental education resources, including lesson plans on water conservation. Contact a local CREEC coordinator or the Science Resource Coordinator at the local County Office of Education.
- Metropolitan Water District (http://www.mwdh2o.com/): Some wholesalers, such as Metropolitan Water District, conduct periodic meetings on water education and can provide lesson plans and other guidance. Any agency can participate in the MWD education meetings. Many other water suppliers offer educational resources. See the Resources section for more ideas.
- California Department of Education's Environmental Education Resources (http://www.cde.ca.gov/pd/ca/sc/oeeintrod.asp): This website lists curriculum resources and grant programs.

When an agency should develop its own curriculum

With all of the resources available today, it seldom is necessary to develop custom curriculum. However, it is very important to tailor existing materials to the needs of local teachers. Build close relationships with local schools to find out what teachers need and will use (see Establishing Partnerships below).

Pegging non-classroom activities to content standards: Many agencies, teachers, and facilities work together to customize tours, gardens, and projects to meet current lessons and the associated standards. For examples, see these case studies and links:

American River Water Education Center (ARWEC), Otay Water District Demonstration Garden (See case-study-Otay_garden) and Discovery Science Center (http://www.discoverycube.org/education.aspx?q=107).

Second Requirement: Distribute materials to K-6 students and, when possible, also to grades 7-12

Although many water agencies hire teachers or send other employees into classrooms, there are other effective ways to distribute age-appropriate classroom materials on water conservation. Project Wet training can be offered to teachers (See "project_wet_SWEP" document) and/or support teachers' efforts with lesson plans, equipment loans, and supplies See "casestudy_classroom_demos_HVLCSD.pdf"). Third-party providers offer turnkey assembly and classroom programs for a fixed cost per student ("casestudy_runningtoilet_ACWD" document). Poster and calendar contests offer opportunities to reach out to students and their families:

- "case_study_lakearrowhead_calendar"
- "SanJuan-PosterContest"
- "case_study_san_juan_calendar"

How to discover what programs teachers will use

It's best to assess needs and requirements before designing a program. Call the superintendant's office and ask if one must follow a specific process to have a program approved. Then, with the district's permission, ask local educators what they already teach about water conservation and what enrichment programs they would welcome. Contact science and lead teachers, principals, and district-level staff who manage curriculum. Regional coordinators for the California Regional Environmental Education Community (CREEC Network) and the CalServe Service Learning Initiative, usually based in the County Office of Education, may know local educators who are active in environmental education. Also ask neighboring water agencies which of their programs have been popular with teachers.

When to "push" programs out to schools or rely on teachers to request support

Proactive contact is essential to promote new programs. Once established, programs often grow to capacity through returning participants, word of mouth, and annual publicity. Nurture relationships with every teacher, district policy maker, and school administrator that show interest. They will become champions and allies for the programs.

Getting started: Explain the program to a school's principal through a letter or phone call before contacting teachers. This is a good idea even if the district doesn't require it. Pilot new programs with a small group of educators. Seek their feedback and tweak programs annually to incorporate suggestions. If a program isn't growing, evaluate why and either change it or discontinue it. Once a program is successful with a core group of teachers, expand to more schools or grade levels.

Publicity

School office staff usually will distribute flyers, letters, and newsletters to teacher mailboxes. Follow their procedures, listen to their advice, and show appreciation for their help. Here are some examples of brochures and water use efficiency follow-up information:

- "VallejoWaterBrochure"
- "Water in Your Classroom 09-10"
- "Water in Your Classroom order form 09-10"

- Many teachers prefer to be contacted by e-mail because they can respond at a time that's convenient for them. Check school web sites for teacher e-mail addresses.
- Contact new participants during the fall to schedule presentations for the upcoming academic year (avoid the first two weeks when teachers are especially busy). Contact past

participants in the spring to schedule presentations for the next school year, then reconfirm several weeks before the scheduled visit.

- Take advantage of newsletters and websites that teachers read, such as those published by the CREEC Network and your County Office of Education.

Tracking success

Determine objective criteria for measuring results as part of an education plan. East Bay Municipal Utility District (EBMUD) has a great example: EBMUD-SchoolPlan". Then design simple ways to obtain and document the required data, such as the following:.

- Use pre- and post-assessments to document the level of knowledge gained through the program.
- Provide a feedback form (and stamped return envelope if necessary) for each classroom presentation to evaluate presenter effectiveness and tally the number of students reached. Or use an online survey tool such as Survey Monkey and e-mail each teacher a link to the evaluation.
- Look for assembly programs that ask students to answer questionnaires throughout the presentation and turn in at the end or as part of follow-up enrichment activities.

- For home conservation audits, have families report participation and results. Agencies have used business reply postcards ("ACWD_Leak_detect_postcard_02") or worksheets and stamped envelopes. They may ask families to report results on the agency's web site. Consider providing a reward to boost participation (see for example, the Orange County Water Hero campaign http://www.ocwaterhero.com/). The LivingWise and WaterWise programs offered by Resource Action Programs include follow-up reports for the agency (below).

- Any time teachers are asked to return evaluation and reporting forms, make it quick and simple. And a small thank-you gift (a $5 coffee gift card, for example) would be greatly appreciated! The Alameda County Water District provides $50 to classrooms participating: "Post-assembly lesson plan:!

How to Start a School Education Program

This section suggests a step-by-step roadmap for agencies that are starting a School Education Program. Again, EBMUD has a great example: "EBMUD-SchoolPlan".

1. Identify the K-12 schools in your service area. Locate public school districts and private schools in the Yellow Pages or online and then visit their websites.
2. Identify the number of children in each grade level. Phone the school and ask for grade populations (this will give you an idea as to how many items, booklets, brochures that you may need).
3. Research the school district's process for reviewing and approving supplemental curriculum and assess teachers' needs (?:).
4. Determine your budget; it will dictate the number of students and/or grade levels you will be able to reach.
5. Call your wholesaler, neighboring water agencies, and other utlities, looking for partnerships, curriculum, training, and grants.
6. Explore grant funding through government and private sources.
7. Choose your best options based on budget and time available. Write an Education Plan ("EBMUD-SchoolPlan") that includes goals, key messages, measurable objectives, tactics, budget, and ways to measure results.
8. Execute your plan. For BMP reporting and future budgets, document the number of presentations or other activities, dates, students reached, grade levels reached, schools and teachers reached, and all expenses.
9. Evaluate and plan for next year.

Establishing Partnerships

Partnerships can be a valuable asset and can help offset costs associated with a school education program. Through partnerships, agencies can share expertise, planning, staffing, printing and designing of materials, writing and editing text content, and the cost of getting the word out. For example, West Basin and Central Basin Municipal Water Districts developed "Conservation Connections," a curriculum for analyzing water and energy use in the home (find the workbook here: "StudentBook", and find the teachers' guide here: "TeacherGuide").

When considering a partnership, it is imperative to identify the goals that agencies have in common, as well as the benefits each agency will receive from partnering, and how that will work toward accomplishing their individual goals. Another benefit of partnerships, especially regionally, is economies of scale. Regionally, a group of agencies or partners can order or print more materials at a lower rate per item, reducing the total expense for materials.

Partnering with a wholesaler also can simplify reporting for retailers. BMP 2.2 specifies that, when mutually agreeable and beneficial, the wholesale agency or another lead regional agency can operate all or part of the education program. If the wholesale agency operates all or part of the retail agency's school education program, then it may, by mutual consent with the retail agency, assume responsibility for CUWCC reporting of this BMP. Under this arrangement, a wholesale agency may aggregate all or portions of the reporting and coverage requirements of the retail agencies joining into the mutual consent.

Other water agencies, wholesalers, and regional organizations are common potential partners, but also look to other organizations and businesses. Energy utilities have a growing interest in water education due to the links between water and energy conservation. California American Water partnered with Southern California Edison and Southern California Gas to significantly reduce the cost of offering the turnkey program LivingWise ("casestudy_LivingWise_CalAm"). Entities that teach how to reduce source point pollution in stormwater also are likely partners for water conservation education, linking irrigation run-off as a potential pollutant in waterways. Local businesses, community groups, and environmental organizations are all potential partners.

1. Wholesale/retail partnerships

a) The Metropolitan Water District of Southern California also has a wholesale-assistance program for public education and outreach: http://www.mwdh2o.com/mwdh2o/pages/education/h2o/h2o.html

b) San Diego County Water Authority offers a similar program to its retail agencies: http://www.sdcwa.org/teachers

2. Regional partnerships

a. Sacramento Regional Water Authority (RWA) is a joint powers authority that serves and represents the interests of 21 water providers in the greater Sacramento, Placer, El Dorado and Yolo County region. The Authority's primary mission is to help its members protect and enhance the reliability, availability, affordability and quality of water resources. They leverage economies of scale to support school education programs throughout the four counties. RWA also participates in a theater assembly program and the Radio Disney Kidcaster program in the Sacramento region. "Smart Rebates Program Update".

b. A group of water agencies in Southern California formed the Water Education Water Awareness Committee (WEWAC) to promote the efficient use of water and to increase public awareness of the importance of water. They can be contacted at: http://www.usewaterwisely.com/index.cfm.

3. Investor-owned utilities

Investor-owned water utilities (private water suppliers) may plan school education programs and other water conservation efforts at a corporate level. Water conservation coordinators in branch offices should first determine what corporate programs and materials are available ("casestudy_LivingWise_CalAm"). It still is important to understand the needs of local educators to customize programs when possible. It also can be beneficial to collaborate with other local water agencies to take advantage of economies of scale and to simplify coordination with school districts. When more than one utility serves a school district, district officials will appreciate a unified approach to water education.

Planning the Budget

What are typical budgets for small, medium, and large agencies?

CUWCC members reported a wide range of annual budgets for school education programs for 2007 and 2008. The average (mean) varied considerably by who sponsored the programs:

- Wholesalers: $54,743
- Mixed retail and wholesale sponsorship: $16,291
- Retailers: $20,781

The charts below summarize data reported by CUWCC agencies for 2007 and 2008, including the average (mean) numbers of students served in school education programs, costs, and the percentages of agencies using two popular methods—teacher workshops and class presentations. Data for wholesale-sponsored programs includes all sizes of wholesalers, since their population data was not reported. For programs with mixed (retail and wholesale) sponsorship and retail-only sponsorship, averages are shown by agency size: small (less than 20,000 customers), medium (20,000 – 200,000 customers), and large (more than 200,000 customers).

Analysis of BMP 8 data reported for 2007 and 2008

Wholesale Sponsored Programs			Percent Using This Method	
Average # Students Reached	Average Budget	Average Cost per Student	Teacher Workshops	Class Presentations
23,316	$137,799	$40	66.7%	91.7%

Wholesale and Retail Sponsored Programs (mixed)*			Percent Using This Method*	
Average # Students Reached	Average Budget	Average Cost per Student	Teacher Workshops	Class Presentations
23,226	$69,230	$5	100.0%	100.0%
3,811	$11,154	$9	38.5%	92.3%
222	$153	$1	0.0%	100.0%

Retail Sponsored Programs*			Percent Using This Method*	
Average # Students Reached	Average Budget	Average Cost per Student	Teacher Workshops	Class Presentations
11,242	$94,046	$19	55.6%	88.9%
1,233	$14,426	$23	20.0%	66.7%
330	$2,492	$16	5.3%	47.4%

Reporting Unit Sizes

Wholesale customer base	Population not reported
Large*	More than 200,000 customers
Medium*	20,000 – 200,000 customers
Small *	Less than 20,000 customers

*Includes only agencies that reported population

"Model" programs that are most cost-effective for small, medium, and large agencies

School Education Program data reported for 2007-2008 is not detailed enough to identify statistically representative "models" for agencies of various sizes. However, the data presented above do provide evidence that partnerships between wholesale and retail agencies have the widest reach for the amount invested per student.

- Wholesale sponsored education programs have more budgets to work with and reach more students. They typically cost more per student.
- Wholesale/retail sponsored (mixed) programs reach more students than retail-only sponsored programs. However, mixed programs cost much less per student on average than retail-only programs.
- As would be expected, smaller reporting units typically have the smallest budgets, reach the fewest number of students, and spend the least per student. However, the data suggests that small agencies spend 16 times more working when working independently.

Determining how many students or schools should be approached:

BMP 2.2 does not require agencies to serve a specific percentage of students. Agencies interviewed for this guidebook set goals for their programs in different ways. Some strive to reach all students in specific grade levels. For example, they select grade levels where the content standards fit well with key water conservation messages. Other agencies set goals based on the historical growth of their programs, seeking to reach more students each year as budgets permit. Others contact all of their schools each year and serve as many as students as they can on a first-come, first-served basis. Budget is always a factor.

How to justify funding a school education program to a board of directors:

Agencies interviewed for the guidebook said their boards make school education programs a priority for all of these reasons:

- Children are water consumers and the next generation of rate-payers. Educating them about the scarcity of water as a resource and the role of essential infrastructure helps agencies meet state mandates to reduce per capita water consumption and build a valuable positive identity in the community.
- Teachers are opinion leaders and educational programs create tremendous goodwill in local communities.
- Data from studies such as the 2009 ACWA survey (*Californians and Water Conservation: Key Findings from Focus Groups and a Statewide Survey,* March 2009) show that kids make the best teachers. Parents listen to their children and are influenced by them.

Resources

Classroom presentations:

Managing a classroom presentation programs can be a challenging task for any water agency of any size. Dublin San Ramon Water Services District has had that experience recently, and wrote a case study on their "lessons learned": "DSRD-classroom-admin"

- Small agencies can conduct classroom education programs, too! See this case study from the Hidden Valley Lake Community Services District: "casestudy_classroom_demos_HVLCSD.pdf".
- The US Bureau of Reclamation offers lesson plans for a variety of classroom levels: www.usbr.gov/mp/watershare/resources/lessonplans.html.
- Conservation Connection: A curriculum developed by West Basin and Central Basin Municipal Water Districts: find the workbook here: "StudentBook", and find the teachers' guide here: "TeacherGuide".
- Discovery Science Center (http://www.discoverycube.org/education.aspx?q=4&c=103) is the largest provider of water education programs in Southern California. Each year, approximately 110,000 students participate in their school-based water programs. Depending on location, schools may be eligible to sign up at no cost. Each program includes a Discovery Science Center instructor, free materials for students and aligns with California Science Content Standards. This program is used by Irvine Ranch Water District.
- The US Environmental Protection Agency also offers lesson plans for all age levels (http://www.epa.gov/safewater/kids/index.html) and teacher resources to compliment the materials (http://www.epa.gov/students/teachers.html#epawater).
- Getwise.org is a website sponsored by Resource Actions Programs, a family of community conservation programs designed to increase residential resource efficiency and community awareness: http://www.getwise.org and http://www.resourceactionprograms.org/.

Large group assemblies

- ZunZun (http://zunzuntunes.com/intro.php) is a service that organizes classroom and larger school assemblies on the theme of water conservation and resource use. The Alameda County Water District makes use of this organization: "casestudy_runningtoilet_ACWD".
- Discovery Science Center, mentioned above, also does large assemblies: http://www.discoverycube.org/education/atschool/assemblies/.

- EarthCapades describes their events as "environmental vaudeville." More information is available on their website: http://www.earthcapades.com/. This service is used by Eastern Municipal Water District.
- Shows that Teach (http://www.showsthatteach.com/)
- Rock Steady Juggling (http://www.rocksteadyjuggling.com)

Children's water festivals or other events:

For more information on the considerations necessary in holding a successful event, please see the Public Information Guidebook.

- The Folsom office of the US Bureau of Reclamation holds an event every year called the "Get W.E.T. Event." "casestudy event get-wet" This event is targeted at young children and brings together many of the water agencies, environmental groups, and other commercial entities in the region to put on what has become an annual occasion.

The CA Department of Water Resources joins in the fun at the 2010 Get W.E.T. Event.

Water is magic at the Get W.E.T event!

- The Orange County Water District has held the Children's Water Education Festival for several years, now. It is a huge event that takes many months and many participants to plan: "case-study-OCWD-Water-Ed-Festival".

Cooperative efforts with existing science/water education programs:

- For those students interested in water-related science projects, Eastern Municipal Water District provides a Science Fair Handbook for grades K-12. The handbook guides the student from the initial choosing of a water-related topic, to providing a general timeline for productivity, to portraying a finished science fair display. More information is available here: http://www.emwd.org/index.aspx?page=208.

Other methods of disseminating information:

- Online: When budget cuts suspended its classroom education program, Dublin San Ramon Services District posted its lesson plans online and encouraged teachers to borrow equipment and supplies: http://www.dsrsd.com/Education/lessonplans.html.
- Order forms distributed to schools:
- "Water in Your Classroom 09-10"
- "Water in Your Classroom order form 09-10"

Water conservation contests such as poster and photo:

Outreach doesn't have to consist of big, expensive events. Contests, by their very nature, often grab students' attention and will do part of the job of marketing. While an agency may want to reproduce the "winners" of contests, this effort is likely to be substantially less expensive than many other types of outreach.

Poster and essay contest examples:

- San Juan Water District: "SanJuan-PosterContest"
- Alameda County Water District: "School pocket folder 09-10"
- Helix Water District holds an annual photo contest: "case_study_helix_photo_contest". The forms necessary for holding this photo contest are also available:
  - Letter to educators: "Letter to educators 2010-2011"
  - Flyer: "Flyer - Photo Contest 2010-2011" http://dnn.cuwcc.org/Portals/0/BMPResources/SchoolEducation/Flyer-PhotoContest2010-2011.doc
  - Release form: "Image Release Form 2010-2011"
    - Eastern Municipal Water District
      - Poster contest: http://www.emwd.org/index.aspx?page=204
      - Write-off contest: http://www.emwd.org/index.aspx?page=205
    - San Diego County Water Authority essay contest: http://www.sdcwa.org/be-watersmart-essay-contest

Calendar contest examples:

- San Juan Water District: "case_study_san_juan_calendar"
- Lake Arrowhead Water District: LINK to "case_study_lakearrowhead_calendar" document

Teacher training workshops:

- Solano County Education Program: "project_wet_SWEP"
- Eastern Municipal Water District in-service training: http://www.emwd.org/index.aspx?page=217

Fund and/or staff student field trips:

- American River Water Education Center "ARWEC"
- Otay Water District Garden Tour: "case-study-Otay_garden"
- Water-wise gardening workshop for teachers, San Diego County Water Authority: http://www.sdcwa.org/workshops

Careers:

- Elsinore Valley Municipal Water District:
  http://www.evmwd.com/depts/admin/public_affairs/education/default.asp#CAREER
- Dublin San Ramon Services District:
  http://www.dsrsd.com/employment/careertraining.html

Federal, State, and private grant funding:

- Environmental Protection Agency grants for environmental education in California: http://www.epa.gov/region09/enviroed/index.html. All federal grants are summarized on a searchable database www.grants.gov.
- California Department of Education searchable database of grants: http://www.cde.ca.gov/fg.
- California Department of Water Resources grants page: http://www.grantsloans.water.ca.gov/
- California Coastal Commission WHALE TAIL® Grants Program: http://www.coastal.ca.gov/publiced/plate/plgrant.html]
- California State Parks Land and Water Conservation Fund: http://www.parks.ca.gov/?page_id=21360
- Grant summary websites such as Conservationgrants.com: http://www.conservationgrants.com/water.htm
- Private sector programs such as Raley's Reach http://www.raleys.com/cfapps/reach/reach.cfm. Check with companies based in your region.
- Non-profit organizations such as the National Gardening Association: http://www.kidsgardening.com/

Agency-sponsored Grant programs:

- Elsinore Valley Municipal Water District
  http://www.evmwd.com/depts/admin/public_affairs/education/default.asp#GRANTS
- Western Municipal Water District: Educator grants:
  http://www.wmwd.com/index.aspx?nid=149
- Inland Empire Utilities Agency: Garden in Every School grant program: http://www.ieua.org/education/gies.html
- Metropolitan Water District: Community Partnering Program http://www.mwdh2o.com/mwdh2o/pages/yourwater/cpp/cpp.html provides sponsorships for water-related projects, events and activities. CPP's primary focus is currently on water conservation programs and activities.

California
Urban Water
Conservation
Council

Public Information
BMP Implementation Guidebook

Contents

Introduction

In December 2008, the California Urban Water Conservation Council (CUWCC) updated the Best Management Practices (BMPs) required under the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU)[1], incorporating a broader approach to achieving water savings, improving water use efficiency, and measuring progress.

As a Foundational Best Management Practice (BMP), Public Information is an essential water conservation activity for all water utilities and is adopted for implementation by all signatories to the Memorandum of Understanding as an ongoing practice.

Public information programs *inform* customers and other stakeholders about water resources so they understand why it is important to use water wisely. Effective programs also *engage* listeners in water-efficient behaviors so they make life-long changes in how they use water. The principal purpose of the guidebook is to showcase "what works" to achieve these goals. 1.1 Recent studies demonstrate effectiveness of public information programs

According to a 2010 statewide public opinion survey[2] conducted by the Association of California Water Agencies (ACWA), public information programs play a critical role in educating Californians about how they use and conserve our water resources. Likewise, a Water Research Foundation (WRF) survey[3] identified water supply managers as the most credible source of information on issues such as water conservation. These and other findings in the surveys support the role of strategic public information programs in securing future water resources.

The ACWA survey found that a vast majority of Californians have heard water conservation messages as a result of public information programs conducted by state and local public agencies. Turning messages into behavioral change is the challenge for every public information program. But as noted in the ACWA survey, those who had heard water conservation messages were two times more likely to reduce their household water use than those that had not heard such messages.

The WRF survey found that the public prefer bill inserts and television ads for learning about water issues. Regardless of delivery method, however, public information programs can convey important facts about water use that may trigger changes in behavior. For example, the ACWA survey found that 71 percent of Californians believe that they use more water indoors than outdoors—though most Californians in fact use more water outdoors. Correcting such

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[1] The Memorandum of Understanding and Best Management Practices, as amended December 10, 2008, are available in the Resource Center at www.cuwcc.org.

[2] Association of California Water Agencies – Statewide Water Conservation Survey – May 2010 http://www.acwa.com/sites/default/files/news/water-supply/2010/06/320-444-summary-survey-findings-final.pdf

[3] Water Research Foundation – Water Conservation: Customer Behavior and Effective Communications – August 2010

http://www.waterrf.org/ExecutiveSummaryLibrary/4012_Executive_Summary.pdf misconceptions is one way public information programs help create water-conscious Californians.

There is a growing body of work that documents the effectiveness of using social norms to cause long term behavior change. A social marketing campaign should focus on showing the public desired (or undesirable) behaviors, and encourage adoption (or avoidance) through the public's psychological desire to conform to the community's social norms. An October 2010 Wall Street Journal article summarizes several studies that explain why this approach works.

Excellent examples of social marketing campaigns and general resources in the field are listed below. For a discussion of social marketing being used by CUWCC members, turn to the Social marketing programs on page 30.

- Peter Mitchell is a one of the nation's foremost experts on social marketing. His firm, Salter Mitchell, has conducted innovative social marketing campaigns throughout the nation. They have also written a nice overview that explains social marketing, called the Little Book of Social Marketing. This book, and examples of social marketing campaigns, can be found on their website, www.saltermitchell.com.
- Dr. Wesley Schulz of California State University San Marcos developed a presentation to explain the concepts of community-based social marketing and present an example of a campaign to motivate consumers to recycle used auto oil.
- The blog, Social Marketing Panorama, has lots of good information on social marketing campaigns. Note the Blog Roll for other commentaries on social marketing.
- This blog article discusses the community-based social marketing efforts of Doug McKenzie-Mohr, noted Canadian psychologist and social marketing expert. At last count, McKenzie-Mohr's web site, www.cbsm.com, provided links to 72 articles and 11 case studies about water-related social marketing.

Changes in water use attitudes and behaviors—as well as state and federally imposed manufacturing standards—can permanently transform the market for products that use water (e.g., toilets and clothes washers). Water conservation programs that effect permanent market changes continue to yield water savings long after the program has ended. Public information campaigns are essential to the success of such programs. There is more information on programs that spur market transformation in the Residential Guidebook.

Agencies interviewed for this guidebook cited a wide variety of "most effective strategies."

- Information on mandatory conservation regulations:
    - Long Beach Water Department: "Our most effective program started in the fall of 2007, when our Board of Water Commissioners established citywide mandatory water prohibitions for all water customers. This was followed by an aggressive outreach campaign that utilized a variety of public advertising and promotional methods to ensure that all Long Beach Water customers were aware of the new, permanent prohibitions and how wasteful water habits in our

city would no longer be tolerated." Matt Veeh, Director, Government & Public Affairs.

  - El Dorado Irrigation District: "[Our most effective strategy was an] awareness campaign for the new water waste regulation the first summer it was adopted. We grew the awareness organically from the ground up, culminating in public workshops." Sharon Fraser; Water Conservation Coordinator.

- Home water surveys/audits
  - Contra Costa Water District: "The most effective program [is providing] in-home water surveys. This allows for one-on-one communication with customers." Chris Dundon, Water Conservation Supervisor (Read more about this in the Residential Guidebook, and about landscape audits in the Landscape Guidebook.
- Turf replacement programs
  - City of Roseville: "The city's most effective program for publicity, education and customer support is its Cash for Grass Program. In a city that is all turf, changing the perception that removing turf is a bad thing is extremely successful. The city council sees the positive [change] helping with future development, and we received about $1 million dollars in free advertising from all major networks and interest around the nation." Lisa Brown; Water Conservation Administrator. (Read more about this in the Residential Guidebook and in the Landscape Guidebook.
- Events
  - Hidden Valley Lake Community Services District: "Public events seem to be most effective because you can reach out to a larger crowd. Being there with water conservation information generates conversation and questions." Tami Ipsen, Administrative Assistant
- Irrigation efficiency retrofits
  - San Juan Water District: Our Irrigation Efficiency Improvement Reimbursement Program has backlog of requests for landscape audits and rebates. We market it through bimonthly bills, direct mailers, our website, in partnership with regional agencies, news releases, and direct customer contact with our certified conservation technicians and customer service staff." Vicki Sacksteder; Water Resource Analyst. (Read more about this in the Residential Guidebook and in the Landscape Guidebook.)
- Landscaping guides
  - Mojave Water Agency: "Our landscaping guides support the Alliance for Water Awareness and Conservation's (AWAC) draft landscape ordinance that was adopted by five of the six incorporated municipalities within the Mojave Water Agency service area long before the California water efficient landscape

ordinance was adopted in 2009." Tamara Alaniz, Water Conservation Program Manager. (Read more about this in the Residential Guidebook Flex Track Education and Public Outreach sections)

- Online advertising
  - Santa Clara Valley Water District: "With more and more people turning to the Internet for news and entertainment, we knew that the district's conservation campaign needed to expand its online presence beyond the occasional Google AdWords and newspaper and TV websites. For the 2009-10 campaign, a series of animated ads were developed in multiple sizes and appeared on a wide variety of news and information sites. These web sites were chosen for their geographically focused audience and positioning as centers for local news and current events. In early August 2009, we expanded the online campaign to include display ads on specific sites and via ad networks. In addition, the campaign utilized behavioral remarketing and retargeting to focus on interested "hand-raisers," refined keywords, and increased delivery during 7-10 a.m. and 3-6 p.m. when usage is highest. The result was a tremendous jump in visits to the save20gallons website." Jerry DeLaPiedra, Senior Water Conservation Specialist.
- Tours
  - Orange County Water District: "Our most effective program is now tours of our new water replenishment system. It continues to grow, reaches a broad audience, and is very cost-effective." Eleanor Torres, Public Affairs.
  - City of Roseville: "The city's Utility Exploration Center teaches visitors about water use efficiency, as well as energy conservation, recycling and the use of recycled water in a fun and interactive way. The center had 34,000 people walk through the exhibits in 2009." Lisa Brown, Water Conservation Administrator.
- Websites
  - Santa Barbara County Water Agency: "Our website, www.sbwater.org is our most effective strategy because through it people access many great programs and information. It is useful to residents and businesses. It is a collective effort of all of the local water districts. People can use the landscape calculator to determine a good watering schedule or access the watering index weekly (calculated on CIMIS numbers) to do minor adjustments to their schedule related to current weather patterns. They can watch the CAPIO Award-winning series of *Garden Wise Guys* episodes and view the High School Video contest videos (which we use broadly as our Summer Media Campaign). They can find information about rebates. The Waterwise Gardening CD is entirely online and linked, they can access videos and written tips on how to conserve, and there is a *Programs in My Community Page* that drives them to the programs in their area." Cinnamon McIntosh, Public Works Program Specialist.

Coverage Requirements

BMP 2.1 requires agencies to maintain an active public information program to promote and educate customers about water conservation. At a minimum, the agency must contact the public and the media at least four times a year; have a web site that is updated regularly; and track its annual spending for public outreach. When reporting how it has complied, the agency will describe the materials it used to meet these requirements as well as its other outreach activities.

This section discusses recommended ways to meet the minimum coverage requirements. The two sections that follow, Public Information Programs and Social Marketing Programs, provide additional examples and resources.

Contacts with the Public

A public information program is essential to the success of any comprehensive water conservation effort. If the public is being asked to conserve water, citizens need to understand the water supply situation in the community, why they need to save water, and how to do so.

BMP compliance requires *contacts* with the public a minimum of four times per year, or at least quarterly. Ideally, agencies should have mechanisms for making regular contact with the public and the media.

Each time a public information "mechanism" is utilized, it counts as a *contact*. For the public, this might be a quarterly newsletter (four contacts), a mailed postcard (one contact), or a public event (one contact). For the media it might be a news release, telephone calls to several reporters on a topic, or a letter to editor (each tactic is one contact). "Contact" does not mean the number of people reached, although when you report BMP compliance data, you may need to state how many newsletters or postcards were sent, how many people visited your booth at the event, etc.

Efforts made by a wholesaler on behalf of a retail water agency count as "contacts" for the retailer. A retail water agency may want to participate in offering these wholesaler-based programs, such as running advertisements within its region or contributing funding for regional marketing. The goal is to increase the number of the retail agency's customers who take advantage of a wholesaler program.

More information on wholesale/retail collaboration is available in the Utility Operations Guidebook.

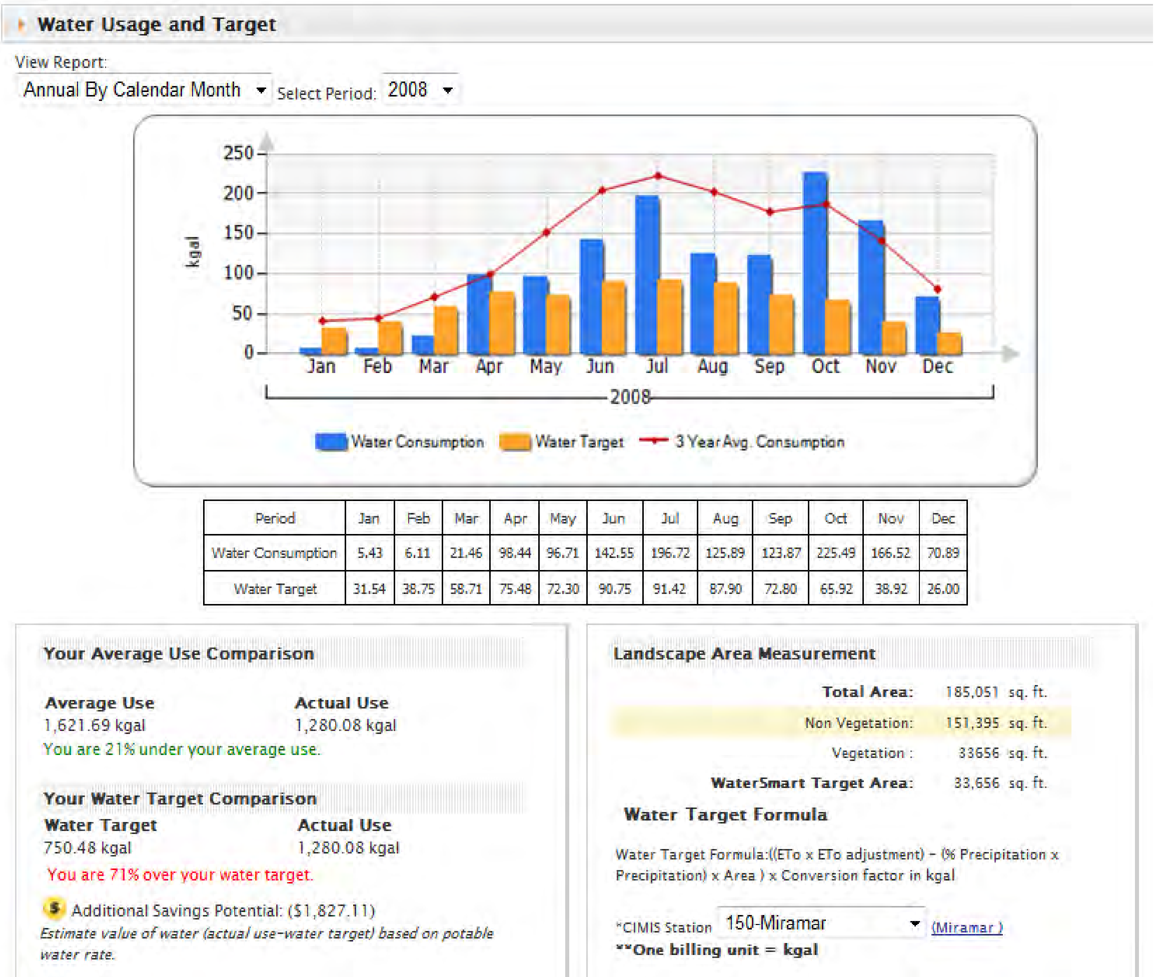
Basic programs for contacting the public

Information on bills and inserts

Following are some general tips for using customer bills for conservation outreach. For a technical discussion of various approaches, see the Residential Guidebook's Flex Track section. Also see an overview of important considerations in the Utility Operations Guidebook.

Capitalize on the customer's undivided attention. Utility branding expert John Ruetten says your water bill is the most important communication vehicle because the customer is paying attention and, in many cases, is motivated to find ways to pay less. (See Ruetten's Utility Branding Network).

Show year-to-year consumption comparisons. This will help customers understand how their water use has changed over time, and may inspire them to achieve previous low consumption levels. A graph showing historical consumption data can also alert a customer to a major leak or other source of water waste.



Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Consumption	5.43	6.11	21.46	98.44	96.71	142.55	196.72	125.89	123.87	225.49	166.52	70.89
Water Target	31.54	38.75	58.71	75.48	72.30	90.75	91.42	87.90	72.80	65.92	38.92	26.00

Your Average Use Comparison

Average Use	**Actual Use**
1,621.69 kgal	1,280.08 kgal

You are 21% under your average use.

Your Water Target Comparison

Water Target	**Actual Use**
750.48 kgal	1,280.08 kgal

You are 71% over your water target.

Additional Savings Potential: ($1,827.11)

Estimate value of water (actual use-water target) based on potable water rate.

Landscape Area Measurement

Total Area:	185,051	sq. ft.
Non Vegetation:	151,395	sq. ft.
Vegetation :	33656	sq. ft.
WaterSmart Target Area:	33,656	sq. ft.

Water Target Formula

Water Target Formula:((ETo x ETo adjustment) – (% Precipitation x Precipitation) x Area) x Conversion factor in kgal

*CIMIS Station 150-Miramar (Miramar)

****One billing unit = kgal**

Use editable and static message spaces on the bill to point to conservation pages on your web site.

Keep inserts small and lightweight to prevent an increase in postage costs. Inserts should also be printed on Even newsletters can be brochure sized; example: Dublin San Ramon Services District's *Newsline*.

Good topics for inserts include seasonal reminders on irrigation adjustments; workshops, public events, and meetings; rebates and other incentive programs; and conservation measures that are in force.

Wholesalers may offer bill insert templates or the opportunity to print jointly with other retailers in the area. This cuts design and printing costs and disseminates a consistent message on conservation throughout the region. For example, San Diego Water Authority offered this conservation bill insert to its retailers:

SDWABillStuffer1_09.pdf

We face unprecedented water supply challenges.

Severe drought and court-ordered pumping restrictions have caused our water supply to drop to historic low levels. The photos of Lake Oroville, above, show a 35 percent drop in its water level since 2005. Metropolitan Water District of Southern California, the largest supplier of San Diego County's water, could deplete its non-emergency storage reserves by the end of 2009. Water deliveries to many farmers have been cut by 30 percent. Water rationing for homes and businesses could be imposed.

You can help. The San Diego County Water Authority and your local water agency urge you to reduce water use now, especially outdoors. Significant savings can be achieved by:

- Watering no more than three days a week, and even less during cool weather.
- Shortening your watering cycle times by 1-3 minutes.
- Fixing leaks and broken sprinkler heads.
- Adjusting sprinklers to avoid spraying paved areas.

A list of rebates for your home is on the reverse side. More tips, as well as business and multi-family property rebates are at **20gallonchallenge.com**.

Water: Save it or Lose it

San Diego County Water Authority

A message brought to you by the San Diego County Water Authority and its member retail water agencies.

Carlsbad Municipal Water District
City of Del Mar
City of Escondido
Fallbrook Public Utility District
Helix Water District
Lakeside Water District
City of Oceanside
Olivenhain Municipal Water District
Otay Water District
Padre Dam Municipal Water District
Camp Pendleton Marine Corps Base
City of Poway
Rainbow Municipal Water District
Ramona Municipal Water District
Rincon del Diablo Municipal Water District
City of San Diego
San Dieguito Water District
Santa Fe Irrigation District
Sweetwater Authority
Vallecitos Water District
Valley Center Municipal Water District
Vista Irrigation District
Yuima Municipal Water District

The Municipal Water District of Orange County designs and prints bill inserts on behalf of its 28 retail water agencies and cities.

Include links that enable electronic bill-payers to view the inserts, varying the message and links in the cover e-mail to capture customer's attention at each billing cycle.

Public service advertising

Public service advertising (PSA) is an option in some communities, but television and radio stations are no longer required to provide "free" air time to non-profits or for public service messages. If local media produce and/or air PSAs, it is generally as part of a partnership or sponsorship. Most of the air time that is dedicated to public service announcements is now dedicated to a branded corporate effort by the respective station.

Some water agencies have built successful partnerships with private businesses and media outlets that have sustainability initiatives to air water conservation messages at no cost to the agency. The Municipal Water District of Orange County partnered with a private business, Hurley (a sportswear and accessories manufacturer), to develop a public service announcement focusing on water conservation. The PSA – paid for in full by Hurley – featured world champion surfer, Rob Machado, promoting the water district's "Water: Do More with Less" campaign. The case study is available here: case-study_Water-Do-More-with-Less

Other times, PSAs are produced for free online distribution and used in combination with paid advertising. For example, the Sacramento Regional Water Authority's Blue Thumb campaign (case-study-RWA-Blue-Thumb-Campaign) featured local residents and dignitaries in PSAs distributed to television and radio stations. The campaign, conducted in partnership with 19 water agencies in the region, also utilized paid advertising, a website (www.bewatersmart.info), and promotional tie-ins with a professional baseball team and local retailers. Partnering agencies could tailor programs to their own customers while promoting a consistent message across the region. San Juan Water District, for example, used the PSA on its web site and Facebook page.

Community bulletin boards that run on public access and government channels are another low- or no-cost alternative. Contact the cable provider or the city to determine how to provide information for this venue.

If you have a 30-minute video production, it might be suitable for airing on the government, public access or education channel. Contact your city or the cable provider to determine how to get it on the air. In some cities, the cable provider may operate these channels; in others, these channels are operated and controlled by the city or the county.

Film and production costs can be quite expensive. To reduce these costs, try working with the film department at a local college. Often, students are looking for projects that will give them experience filming and editing. Their quality of work can be quite good and their costs are considerably lower than using a professional film company. Work through a professor initially so that he or she can recommend specific students to you.

Paid advertising

Paid advertising can be expensive, but often it makes economic sense when an organization is truly serious about widely promoting its conservation message or if the agency has a very large service area with many customers. Advertising options include local newspapers and magazines, radio spots, movie theaters, billboards, bus shelters, cable TV spots, and online sites.

Because of the cost, water utilities must be vigilant in designing the structure of a campaign, developing effective messages, and tracking results. Often it can be cost effective to hire a public relations/advertising firm to aid in developing an advertising campaign. This is especially true if an agency is under-staffed requires specific expert knowledge about advertising techniques and practices that can't be sourced from internal staff. Additionally, if the campaign requires buying media from a large variety of outlets, an ad agency may be able to bundle media buys to reduce cost. For media that reach large geographic areas, consider working with regional partners to spread out media costs and cut the percentage of the budget devoted to producing the ads.

Consistency and frequency are crucial in water conservation advertising campaigns. Use frequent, consistent messages to achieve long-term results.

Examples of paid advertising:

- TV and radio campaigns – Broadcast advertising was an important component of the regional Blue Thumb Campaign (case-study-RWA-Blue-Thumb-Campaign), conducted by the Regional Water Authority and 19 participating water providers in the Sacramento area.
- Outdoor ads - Denver (Colorado) Water used an award-winning advertising campaign, Use Only What You Need, to help reduce water consumption 18-21% over four years.
- Local newspapers - Lake Arrowhead Community Service District is a small agency that uses a consistent presence in the community's local newspaper to remind residents of conservation policies and tips. Each year the agency runs a half-page ad 22 times and a full-page ad twice. Wholesaler Three Valleys Municipal Water District works with its retailers on ads in smaller local newspapers, which have proven effective and educational.
- Online – Santa Clara Valley Water District pays to have its website pop up in Google local search results. The ads are tied to specific keywords used to search for water conservation topics.
- Van wrap – Santa Clara Valley Water District thermal-wrapped a district van with conservation messages. Used anytime employees go out into the community, the van has been a successful mobile billboard for promoting conservation messages.

- Vehicle magnets – The Municipal Water District of Orange County (MWDOC) developed vehicle magnets to raise water awareness and promote specific water conservation behaviors. The magnets are displayed on the utility vehicles of MWDOC's member agencies as they drive throughout Orange County. The figures below represent other agencies' takes on the vehicle magnet.

Speakers

Chambers of Commerce, Rotary clubs and other community organizations frequently invite speakers to their meetings, providing many opportunities to talk about water-related topics. Having a speaker ready to go when the group has a time slot to fill enhances water utility's reach into the community. In addition, water agencies should include speakers as a part of any major outreach campaign. Identify groups that represent segments of the audience you need to reach and proactively seek opportunities to address them. A primary goal of both types of speaking engagements is to reach active and influential community leaders who will pass on information to others, lending their own credibility to the message in the process.

Using staff speakers is the easiest way to have presentations ready, edited by the water utility, and consistent. If the presentation is written by a subject matter expert, it is prudent to ask the public relations or outreach department and other management to review the material. This will promote consistent messages across agency staff and ensure that information is up-to-date. Your public relations staff may also be able to offer training to subject matter experts and inexperienced speakers to improve their technique and bolster their confidence.

Volunteers can sometimes be used in place of staff. The Indian Wells Valley Water District XERIC© Ambassador Program is a good example (case-study-IWDWV-xeriscape-workshop). For more than a decade, the Long Beach Water Department has sent volunteer Water Ambassadors to community events throughout the year. They set up tables, offering water-efficient devices and useful water conservation information. Working with five to 10 volunteers at a time, Long Beach can maintain on-going community outreach while staff focuses on other pressing issues.

In some cases, staff, together with board members, can team effectively to present issues to the public, especially high profile issues. For example, the San Diego Water County Water Authority launched an active speaker's bureau that paired board directors with staff to explain water supply issues and coming allocations. Directors were scheduled to speak in their communities, since they were familiar with the issues and sensitivities. Staff addressed the technical issues in the presentation, and the board directors presented information that dealt with asking community members to conserve and to take action.

Events

Community and regional events can reach a large audience at a limited cost.

Community events, such as Earth Day celebrations, farmers' markets, Water Awareness Month events, home and garden shows, and green expos occur on an ongoing basis. They offer water utilities a varied audience – ready to walk by booths and take information – at a very low cost. Municipal Water District of Orange County incorporated many such events into its Water: Do More with Less campaign (case-study Water-Do-More-with-Less). Often, event organizers are even willing to offer a water utility free booth space or will offer a non-profit discounted rate. Smaller community events are excellent places to offer water conservation giveaway items, home water use surveys, and kids' activity books. Furthermore, these events can provide an excellent platform for engaging customers in one-on-one discussion regarding their water use and how they can conserve. Small community events can be a bit hard to find at first, but once your agency has participated, the event organizers will likely contact you to participate again in the future.

Regional events, such as county fairs, trade and industry expos, conferences, and regional symposiums happen less frequently, but they can provide excellent opportunities to reach a large, cross-sectional audience. To take part, the agency will often have to pay relatively high fees in exchange for space at the event. Regional events are best suited for a medium to large water utility that serves a large area within the region. These events can be very demanding on staff time and resources, so smaller water utilities who wish to participate may consider partnering with other local utilities to share event space. Contact the local commerce bureau for the city or county for a schedule of such events and how to reserve a booth.

Tours and open houses are a relatively inexpensive way to get customers excited and informed about water agency operations and can generate positive media coverage (like the El Toro Water District: http://www.ocregister.com/news/water-271839-county-district.html). Most customers have never seen the inside of a water treatment plant or considered the power necessary to pump water to different elevations within the district.

A tour enables water agency staff to give accurate and interesting information directly to the customer. Getting several staff members involved in the tour is a good way to break up the time. Having regional stakeholders present information can also be an informative way of enforcing a water utility's message. For example, the local chapter of a wilderness society could speak about the importance of treated effluent releases into a local stream, or an early childhood development advocate could describe how the water utility's school education program impacts the community. Hearing the information (especially from a third party) and seeing the location and infrastructure reinforces a water utility's message in its customers' minds.

Hosting your own event can develop community goodwill and influence market transformation. While events can be costly, they provide an exclusive setting to promote water conservation and water utility messages. The Children's Water Education Festival (case-study-OCWD-Water-Ed-Festival), which targets fourth, fifth, and sixth graders throughout Orange County, is an excellent example of an event that has steadily grown in attendance over time and won the support of educators and local businesses.

Tours Provide Customer Education!

El Dorado Irrigation District, in the upper foothills of the Sierra Nevada, has collaborated with the local Resource Conservation District on a series of summer watershed tours that educate the public on the complexities of providing water in and from a shared watershed.

The District's watershed coordinator works with other watershed stakeholders to schedule the Saturday tours:

- two in June in the lower watershed discuss urban drainage, endangered species protection, recycled water, and water conservation;
- two in July in the middle watershed discuss issues central to that area, including agriculture, flow requirements, diversion points, and power production; and

- two tours in August in the upper watershed discuss recreation issues and water quality, climate change, forest management, and collaborative decision-making.

The tours enable the District to showcase its regional cooperation and partnerships, including environmental stewardship and cost-savings measures. Participants may ride in a 15-passenger van provided by the Irrigation District or may follow along in their cars. The tour usually visits three to five locations, ranging from recycled water treatment plants to overlooks exhibiting good forest management practices. There are guest speakers at each location, including power providers, public and private foresters, recreational interest group representatives, business people, agriculturalists, and public advocates.

For more information, contact *El Dorado County Resource Conservation District*: *http://www.eldoradorcd.org/index.php*.

It's important to refine an event's theme and activities to target a particular customer base, be it homeowners, CII customers, or other locally significant groups. For example, Get W.E.T. ("casestudy_event_get-wet"), an annual event sponsored by the US Bureau of Reclamation at the American River Water Education Center, specifically targets families with young children. If a utility's entire customer base is to be targeted, a cohesive and inclusive marketing strategy is needed to create an event that is relevant to everyone.

Making the event attractive to the target audience is very important. Having several booths – perhaps for each department within the water utility – is a great way to get customers acquainted with a utility's operations, as well as provide several distinct locations for customers to get their specific questions answered. Food can be offered to customers as well if an agency has the budget for it, and this can bring in a larger number of customers, especially families.

Location, time of year, and time of day also are important considerations. For example, having an outdoor event in a warm area from 1:00-3:00pm in August will discourage public attendance. Remember that May is Water Awareness Month: a great time to highlight water education, but be aware of overlapping event days, times, and locations.

Finally, it's important to market the event sufficiently to attract an adequate percentage of the customer base. The marketing strategy will vary by target audience. For general audiences, newspapers are usually a good bet, as well as advertisements in other local publications, like regional magazines or homeowner association newsletters. Announcing the event through the utility's newsletter or directly on a bill usually is cost effective and will reach a water utility's entire customer base. To reach a target audience, such as families with young children, schools and day care centers may be appropriate channels.

Contacts with the Media

Contacts and BMP Compliance – The BMP requires a minimum of four contacts per year with the news media, which include newspapers, television and radio stations, trade and regional publications, filmmakers, and writers of blogs, and other social media. When you provide the same information to several media outlets, count it as one contact. When you contact several reporters with a variety of story ideas, count each contact individually.

Phone calls, e-mails, face-to-face meetings, and fliers are all methods to make contact with the media, but press releases and media advisories are the most effective, time-honored methods. A press release is a news story that you write. It's the starting place for a reporter, who usually changes it significantly. A media advisory makes reporters aware of an event that they may want to attend or cover. Often it is in bulleted style.

Drafting a press release in Associated Press style:

Press releases are the primary way to disseminate information to the media whether the issue is urgent, such as mandatory conservation restrictions, or less significant, such as an award your agency received.

Press releases inundate media outlets by the hour, so making your press release stand out is a must. For a crash course on writing a press release, look at past examples from your agency. However, if nothing is available or if the examples do not follow Associated Press (AP) style, then follow this formula: **Lead + Nutgraph + the rest of the story in an Inverted Pyramid.** When you have an effective lead and nutgraph, you've won the battle! A reporter will call for more details instead of reading the rest of the press release.

i. ***Lead*** *– Sometimes spelled "lede," this is the opening paragraph of the press release where you find* ***who, what, when, how and where****. It is probably the only paragraph the reporter will read in order to decide whether to read further. Experts suggest different styles and lengths. Given the constraints on reporters' time, shorter is probably best. Strive for 35 words or less if possible.*

ii. ***Nut graph*** *– If the lead answers who, what, when, where and how, then the nut graph answers* ***why*** *this information is newsworthy"in a nutshell." This journalistic term is a contraction of the expression "nutshell paragraph." Its length and location all depend on the situation. If you have a short lead and* ***why*** *can be answered in one sentence, move it into the lead paragraph. If the nutgraph is more drawn out, give it its own paragraph immediately under the lead.*

iii. ***Inverted Pyramid*** *– Fancy term for "upside down triangle" that immediately follows the lead and nutgraph. The inverted pyramid is the road to the end of the press release or news article. With this format, you basically tell the rest of the story or provide background, with the most important information first.*

iv. ***Headline -*** *Don't forget a headline that restates the key points of the lead. Make sure it appears in the subject line of your e-mail distribution, instead of static info such as For Immediate Release or contact names.*

v. ***Contact Info -*** *Always list a contact name, an e-mail address, and a phone number that will be answered or checked frequently.*

Example press releases:

- *Water district ends mandatory water conservation; calls for 10% voluntary conservation*
- *Rain barrel installation starts first phase of garden makeover*

Maintaining Relationships with Reporters

Particularly with journalists, the purpose of a contact is to establish a relationship in order to disseminate information to the public. The better the relationships, the easier it will be to inform your target audience of pertinent events and key messages. Journalists appreciate effective “sources” that make their job easier. Be accessible and provide a steady stream of accurate, newsworthy information.

- Learn the names and contact information for reporters who cover water, environmental/green issues, and/or government in your market. Create your own database and keep it up to date.
- Track local coverage for each media outlet to become familiar with reporters’ interests, coverage, and reporter names. Suggest seasonal or local tie-ins to regional or national stories.
- Introduce yourself to reporters who attend board and committee meetings. Make sure they have a copy of the agenda packet as soon as it is available.
- Also introduce yourself to reporters by e-mail and, when appropriate, thank them for coverage and include information for a follow-up story.
- Increase your visibility with letters to the editor, guest columns, and presentations to local groups that will be covered by the paper.

Working with Editorial Boards:

Newspaper editorial boards have a mixed reputation among public affairs professionals. Some consider editorials irrelevant due to low readership or a perception of perceived bias. Others consider a positive editorial to be powerful tool in creating favorable public perception of agency objectives.

It is important to understand the structure and responsibility of an editorial board prior to meeting with its members. Size varies by newspapers, from a one-person staff at small papers to 18 at large, popular dailies such as the *New York Times*. Larger papers post the process for presenting an issue to the board on their websites. With smaller papers, contact the editor directly. Although the board as a whole chooses the topics to consider and concurs on the opinion, one person will write the final piece that appears in the paper.

There is only one board and many possible topics they could recommend. Be persistent to get their attention on an issue that's central to your agency. For more tips, see this case study in *PRSA Journal* and this article from *Public Relations Tactics*.

Actively Maintained Website

More flexible and timely than printed materials, a comprehensive website should be the foundation of your public outreach program. Always include your online address in bill inserts, newsletters, social media posts, flyers, newspaper articles, and any other communication tool you produce. Then these other tools can work like headlines, capturing attention and leading interested readers to your website for the rest of the story.

- Be timely – **The BMP requires that you update your website at least four times a year. Consider that the bare minimum!** You can give your site a fresh look 12 times a year simply by posting a conservation tip of the month on the home page. Or alternate tips with clickable headlines that are linked to conservation program pages. Fresh content keeps getting read, while static elements, such as photos or a mission statement, fade into the background. Fresh content also helps search engines find your site and list it higher in search results. Finally, fresh content "builds a stronger connection between you and your community and provides the strongest reason for your audiences to return—frequently—to your website" (*Secrets of Successful Government Websites*, Vision Internet).
- Be customer-centric – Design your website to deliver the water conservation content that is most important to your customers. Ask your customer service team and conservation coordinators what questions they answer most often. Also talk to board members and employees who interact with other community agencies. Look for ideas on the websites of other water agencies, especially your wholesaler. If your agency is considering a major website overhaul, suggest conducting surveys or focus groups to discover what content and functions customers want on the site. It can save money in the long run. Being customer-centric also means being accessible. Make it easy for customers to find phone numbers and instructions for taking advantage of your conservation programs.
- Be prominent – The home page is the most visited page on any website. Suggest making it a billboard that always gives customers fresh information related to water conservation and other key messages in your agency's strategic plan. On inside pages, try to keep the most important information "above the fold" (the area that's visible on a normal-sized screen without scrolling). It may be better to have several short pages on related topics rather than one long one. Group conservation pages under logical topics rather than headings that mirror your agency's organizational chart. Use common terms in the navigation headings such as rebates, understanding water budgets, native plant guide, and so on.
- Be accurate – Accuracy is key to building trust with reporters, customers and the public. Cite sources for any statistics that you list and verify that the information is still current. Check statistics about your agency at least annually for accuracy. Test all phone

numbers and website addresses before you post them. Take down pages created for special projects once the project is over. When you archive a page, make sure search engines aren't still finding it. Try a test search in your web site's search function and in several public search engines. If you still see old page, ask your webmaster to archive it in a place where it can't be indexed by search engines.

- Be found – Use keywords as you write conservation pages so that search engines such as Google and Bing will find and list your pages in search results. Keywords are terms that people type into search engines when looking for information. Search engine optimization is complex, but in general, the more often the keyword appears on the page, the higher the page will rank in search results. So use important keywords often in the text and make sure your web programmer also adds them as "meta tags" in the source code.
- Measure results - Also ask your webmaster to track the traffic viewing specific website pages. By comparing spikes in page views to the dates of outreach tactics (bill cycles, advertisements, a major news story, etc), you can evaluate which tactics are producing desired results.

Tools and topics to consider adding to your website:

- How-to information on rebates and incentives, including forms, rules, deadlines and lists of eligible models. If you participate in regional programs, check periodically to make sure funds are still available. To keep model lists up to date automatically, host to the list hosted on the source's site (your wholesaler or http://www.waterenergysavings.com for example) instead of posting the list on your own site.
- Conservation kit requests: East Bay Municipal Utility District has this option on their website: https://www.ebmud.com/for-customers/district-store/.
- Ordinances: explain in simple language how customers can comply with water shortage ordinances or how they can use a water budget to their advantage. When listing mandatory and voluntary conservation measures, emphasize those currently in force to avoid confusion.
- Recommended irrigation schedules and other seasonal guidelines.
- Download ACWA's free Save Our Water widget which displays rotating tips on your website.
- An online version of your newsletters, with the option of signing up for an e-mail alert when a new edition is available.
- Sources of your water. Make sure it aligns with the information required in your annual Consumer Confidence Report.
- News releases on conservation programs and success stories. Link them from your home page.

- Hydrant flushing schedule, explaining why it is necessary and doesn't waste water.
- Water waste reporting form. Determine in advance how your agency will use the information and respond to the person reporting the problem and to the suspected water waster.
- School education programs you offer, including how to request materials and presentations.
- Information geared to younger students doing research for school reports.
- Micro-sites that focus on a specific topic or program. For example, www.ocwaterhero.com was developed by the Municipal Water District of Orange County and Orange County Water District as part of the OC Water Hero Program (case study OC Water Hero), which makes it fun to use water wisely.

Annual Budget for Public Outreach Programs

Budgeting and planning for a public outreach program should follow similar principles as for other projects. The more specific you can be in determining your overall objective upfront, the better you can determine what strategies and tactics you truly need to employ to accomplish your goal. That in turn, enables you to develop an accurate plan and budget that are more likely to make sense to decision-makers in management or on your board of directors, and are less likely to seem discretionary or require future requests for additional funding to get the job done.

With either case in mind, here are guidelines and suggestions to help ensure the development of a sensible and successful outreach plan and budget:

Creating a plan: When creating your public outreach plan, make sure it is well-thought-out by taking into account all the basic components. Plan outlines will vary from agency to agency, but generally they include these sections: **Situation, Objective(s), Audience, Strategies, Tactics, Messages, Timeline, Metrics, and Costs/Budget.**

Situation: Include a short evaluation of your agency's circumstances and any internal or external factors that are relevant to the plan you're developing. These factors may range from revenue and staffing levels, to board and management interests/direction, to water supply conditions or regulatory requirements, to local politics.

Objective(s): Define what you are trying to accomplish with your community outreach plan. Are you simply trying to maintain on ongoing level of awareness of an issue or program throughout the year? Are you trying to achieve some kind of extraordinary change in audience/customer behavior over the next year? Are you trying to conduct a more limited-duration campaign, calling for a specific action at a defined period of time (for example, calling for reduced outdoor watering in the fall)? A well-defined objective is essential for developing appropriate strategies, duration, and budget.

Audience: Make sure you know who you need to reach to achieve your objective, so you don't waste valuable time and dollars trying to reach people that are not relevant to your objective. Do you need to reach your entire customer base, or just business, civic, and political leaders? Are there any specific ethnic, socioeconomic, or geographical elements that need to be considered to help limit or focus the plan?

Strategies: What are the main strategic ways or mechanisms you will use to achieve your objective? For example, do you need to be the sole source of information, or do you need to bring on partners from the business or environmental community to make you more credible or to leverage limited resources? Are you going to rely on paid media or earned (free) publicity from media or other means of outreach?

Tactics: What specific activities are you going to execute? Attend community events? One-on-one meetings with stakeholders? Advertising? Media Relations? Try to be as specific as possible so you can determine the budget and staff resources needed to support them. For example, don't simply say "Sponsor community festivals" in your plan. Try to ascertain how many events are critical to attend to reach your audience. It's much better to say "Sponsor three community festivals, including the X Street Fair, the Y 4th of July Celebration, and the Z Labor Day Parade."

Messages: What do you want to say, or what do you want people to remember? Prioritizing your most important points or information helps to ensure these messages are consistently and prominently conveyed as you execute your plan, enhancing its chance of success.

Timeline: What needs to happen when? A solid timeline helps to make sure all activities are coordinated and no opportunities fall through the cracks. It also ensures activities are scheduled appropriately to achieve your ultimate objectives.

Metrics: How will you define your success? Determine trackable and measurable goals upfront so you can measure progress and adjust or manage your plan as needed to give you the best chance to achieve those goals and document the return on your agency's investment in its outreach efforts. Your metrics could be the same as your objective (for example, "Achieve 10% reduction in water use during June, July and August" could be an objective and the metric) or simply document progress toward achieving a more general objective (for example, your objective could be "Brand the Local Conservation Garden as the top regional destination for consumers seeking outdoor conservation information," and metrics could be "increase garden class registrations by 50 percent" or "attract 5,000 visitors during July, August and September."

Costs/Budget: How much funding do you need? Evaluate all the pieces in the plan and their costs as specifically as possible, and document them in a form that's easy to understand and communicate. A few of other points to consider:

- If you are given a limited or set budget to work with upfront, carefully consider your available resources to ensure your plan is scaled to that budget. Keep the focus of our outreach effort as tight as possible and prioritize strategies and tactics that are the most efficient on dollars and staff time.
- Try to include funding for some pre-outreach research—focus group, survey, etc.—if you're trying to motivate your audience to take some sort of action and you need to test the effectiveness of your messages or determine how much people do/do not

understand the issue at the heart of your outreach plan. If your metrics include measuring awareness of an issue before and after your campaign or plan, make sure you budget for post-campaign research to compare to your baseline research.

- Build in a small but reasonable level of contingency. Things may not go as planned due to a variety of factors. Try not to spend it if at all possible, but plan to have a small cushion in case you need to reach an additional audience or execute your outreach effort a little longer to achieve success.
- Look for grants or partnerships that can execute some of your tactics with external resources. For example, instead of an ad campaign, have environmental or business groups include a message in the newsletters they send to their members.
- Take labor needs into account. Determine if your outreach plan requires overtime (events on nights and weekends, for example) or hiring temporary help to get done. Carefully consider how much additional labor you may need so you don't get caught short.
- Consider using "off the shelf" communication materials from other agencies. A number of groups and organizations sell well-developed conservation-related communications materials or license their designs for a fee. (Current examples include "Save Our Water" materials from Association of California Water Agencies (ACWA), or the national "Water Use It Wisely".) campaign.) These costs may be a lot less than the cost of developing original materials on your own, and may lessen the workload on your staff.

Working with an outside agency: Outside consultants (PR, advertising, etc.) can provide valuable help putting together or executing your outreach plan, especially if you do not have internal staff availability or expertise for certain tasks. Here are recommendations to help you get the most value from communications consultants:

- Competitively bid for services whenever possible. You may get along great with a particular firm or individual, but you're likely to get more favorable rates or fee structures if that firm or individual knows they must compete for your business.
- Set a maximum "not to exceed" amount in the contract to help ensure consultant services stay within budget.
- Carefully set up your contract so the consultant's scope of work is clear. This will help ensure they do not spend time on tasks that are not relevant or important.
- Set up the contract so the consultant agrees in writing to not execute or bill for any activities without that activity being approved in advance by the appropriate representative from your agency.
- If working with a firm that has more than a few employees, make sure their higher-billing senior staff or executives are limiting their time to the most important or strategic tasks. Lower-level staff should be assigned to more basic or routine functions.

- If paying a commission to a consultant (for example, for media buys), negotiate the lowest possible commission before agreeing to the contract to maximize dollars spent on outreach. Consultants may not always disclose commissions up front in their proposals. If you're not sure if a consultant plans to receive a commission, ask during your selection process.
- Review invoices carefully every month. Even the most well-intentioned consultant may make errors (double-billing, etc.) and catching them will save you money.

Resources for and Examples of Recommended Public Information Programs

Agencies may report on any or all of the following activities, but agencies are only expected to meet the minimum requirements in section C of the BMP Coverage Requirements.

1) Newsletter articles on conservation:
    a. Association of California Water Agencies Save Our Water campaign
    b. San Juan Water District newsletter (see figure below)

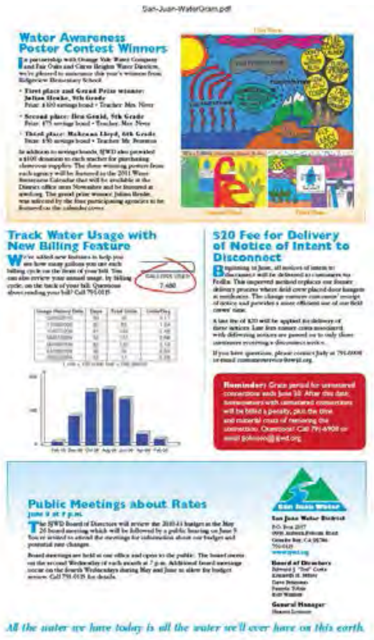
WaterGram

May is Water Awareness Month

Save Money with Rebates

Lawn Aeration Tips

Free Irrigation Workshop



Water Awareness Poster Contest Winners

Track Water Usage with New Billing Feature

$20 Fee for Delivery of Notice of Intent to Disconnect

Public Meetings about Rates

All the water we have today is all the water we'll ever have on this earth.

    c. DSRSD customer newsletter: http://www.dsrsd.com/news_and_event/Spring_2010.pdf
    d. El Dorado Irrigation District newsletter archive (see the drop-down menu "Waterfront Archives" about halfway down the page)

2) Flyers and/or brochures, bill stuffers, messages printed on bill, information packets can be an excellent and inexpensive way to get your customers' attention. Below are

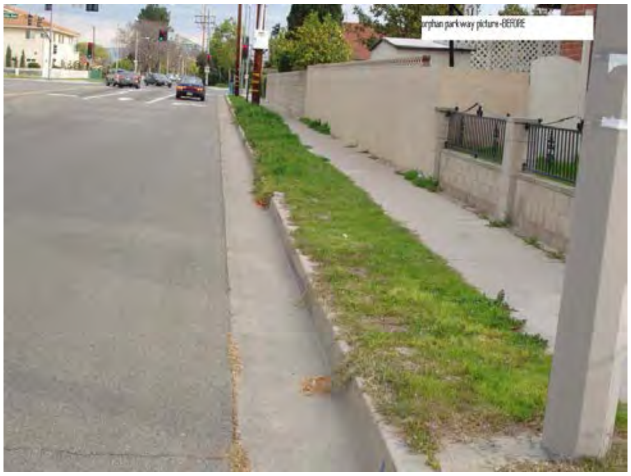
some examples, and there is also more information on this in the Residential Guidebook.

   a. San Diego Water Authority: bill insert distributed by wholesaler on behalf of retailers (SDWABillStuffer1_09.pdf).
   b. Monte Vista Water District bill insert on best practices and rebates.
   c. Case study: Helix Water District Bookmarks (case_study_Helix-bookmarks).

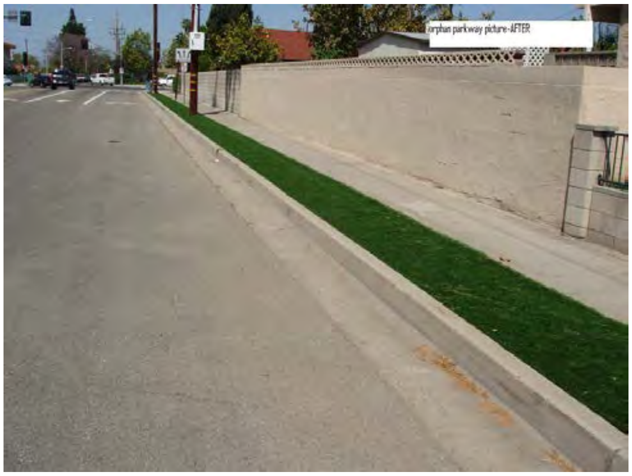
3) Landscape water conservation media campaigns:
   a. case-study-RWA-Blue-Thumb-Campaign
   b. CLWA-Residential-Landscape-Program
   c. case-study- Anaheim-orphaned-parkways

Anaheim implements an "orphaned parkway" program, as described in the case study referenced above. Here are some "before" and "after" photos:

Before:



After:



4) General water conservation information: this includes basic information on what water use efficiency is, how it applies to your region, and any programs offered by your agency. These can be distributed in any way that works for the agency: though mail, website, bill messaging, or other method.

5) Website:

  a. Request the free booklet, *Secrets of Successful Government Websites*, from Vision Internet, a company that has designed more than 300 government websites, including those of Lake Arrowhead Community Services District, Cucamonga Valley Water District, and Las Virgenes Municipal Water District.
  b. Municipal Water District of Orange County launched its refreshed website www.mwdoc.com during the summer of 2010. The website features streaming video, integration with social media, RSS feeds, and a homepage with timely water-related news and announcements.
  c. Irvine Ranch Water District's website, www.irwd.com, won a 2010 "Best in Industry" New Media Institute Award (http://www.newmediaawards.org/websiteawards/2010/irwd.html) for being customer-friendly and making it easy to connect with the district via social media tools.
  d. A micro-site developed by the Municipal Water District of Orange County and Orange County Water District, www.ocwaterhero.com, is part of a program (case study OC Water Hero) that makes it fun for children to get involved in water conservation on a daily basis.

6) E-mail messages: Contra Costa Water District allows customers to sign up for instant e-mail notification regarding when to reset their sprinkler timers:

   http://www.ccwater.com/conserve/sprinkleremail.asp.

7) Website links to qualified landscape professionals, associations and other helpful sites:
   a. Qualified landscape professionals - www.epa.gov/WaterSense, California Landscape Contractors Association, Irrigation Association
   b. Regional, statewide, national and international resources - your wholesaler's site, www.aThirstyplanet.org, DWR Water Use Efficiency, American Water Works Association
   c. Resources on plants that thrive with little water in your climate: California Native Plant Society, GardenSoft (See also developing plant lists, below)
   d. Water saving tips and consumption calculators. Use credible studies and sources such as http://www.saveourh2o.org, www.h2ouse.org, and www.wecalc.org.

8) Direct mail - seasonal postcards noting irrigation requirement changes:
   a. Zone 7 Water Agency: Seasonal postcard sent to retailer's customers (Z7 Fall Postcard.pdf).

9) Direct mail or other notification to customers about high water use:
    a. City of Santa Barbara uses door hangers: http://www.santabarbaraca.gov/NR/rdonlyres/43C147A6-FB39-47A8-A5DE-D0222D76B5B9/0/DoorHangerSaveWater_web_letter.pdf
    b. Monte Vista Water District provides an online form for reporting water wasters: http://www.mvwd.org/reportwaste.cfm
    c. Irvine Ranch Water District provides an excellent and informative letter offering an assistance visit to customers who may have a leak (IRWD_Outreach_2010).
    d. The City of Roseville has a customer contact program designed to change the behavior of customers who incur high-water-use over a series of months (Roseville High Water User Contact)
    e. Dublin San Ramon Services District's meter readers use this flyer to communicate with customers about water waste (DSRSD_overwatering_flyer.pdf).

10) Customer notification when runoff is noticed or bill is at least 20% higher than same time last year: there is more information on this technique available in the Residential Guidebook.

11) Dedicated phone line or "on hold" messaging: this could be a phone line dedicated totally to water conservation messaging (similar to healthcare "flu lines" in the winter), or it could be recordings that customers hear when they are on hold or being transferred.

12) Fairs/events:
    a. casestudy_event_get-wet
    b. case-study-OCWD-Water-Ed-Festival
    c. case-study_Water-Do-More-with-Less
    d. El Toro Water District open house celebrated its 50th anniversary: http://www.ocregister.com/news/water-271839-county-district.html.

13) Monthly water use reports: share progress in reaching conservation goals with your customers via website reports and/or a small section of their bill. This is also good information for your agency's newsletter.

14) Presentations:

   a. case-study-IWDWV-xeriscape-workshop
   b. CLWA-Residential-Landscape-Program

15) Point of purchase pieces:

   a. Dublin San Ramon Services District: Free "water on request" table tents for restaurants, mirror stickers for public building restrooms: http://www.dsrsd.com/waterconservation/conservationresources.html
   b. While East Bay Municipal Utility District (EBMUD) no longer employs this program, itformerly worked with local nurseries and landscaping supply stores to offer downloadable discount coupons on garden mulch. The agency established a relationship through a letter of agreement with the retail outlets (EBMUD mulch coupon LETTER OF AGREEMENT), and then advertised the program through its newsletter (http://ebmud.com/sites/default/files/pdfs/Pipeline_2010_MayJune_.pdf) and web site (http://ebmud.com/).

16) Media outreach

   a. case-study-RWA-Blue-Thumb-Campaign
   b. case-study_Water-Do-More-with-Less

17) Adult Education/Training Programs:

   a. case-study-Surfrider-OFG
   b. CLWA-Residential-Landscape-Program
   c. case-study-IWDWV-xeriscape-workshop
   d. case-study-RWA-Blue-Thumb-Campaign
   e. Metropolitan Water District of Southern California offers excellent online training classes that anyone can access through their website: http://www.bewaterwise.com/knowledge01.html.

18) Water Conservation Gardens: involvement in a garden that promotes and educates the public about water-efficient landscaping and conservation techniques. May include "corporate" or "business" sponsorship or membership.

a. case-study-Otay Garden

b. case-study-Surfrider-OFG

c. case-study-RWA-Blue-Thumb-Neighbors

d. case-study- Anaheim-orphaned-parkways

e. Sustainable Landscape Demonstration Garden - Olivenhain Municipal Water District collaborates with the Surfrider Foundation and Mira Costa College

19) Sponsor or co-sponsor landscape workshops/training for homeowners and/or homeowners associations: see #17, above.

20) Landscape watering calculator and watering index to assist with weekly irrigation scheduling

a. Irvine Ranch Water District Irrigation Schedule

b. Metropolitan Water District provides a Watering Index and Calculator that its member agencies can add to their websites. See www.bewaterwise.com.

c. City of Santa Barbara posts an up-to-date Watering Index on the home page of its web site. Customers can click through to get help in using the index.

21) Other programs not listed in the BMP but done by the local agency:

a. The City of Sacramento employs a "water ambassador program," making use of neighborly connections. Training is offered through the city's website: www.sparesacwater.org or:

http://www.cityofsacramento.org/utilities/water/CityofSacramentoDepartmentofUtilities-SolidWaste-h2oAmbassador.cfm.

b. Advertise:

   i. Municipal Water District of Orange County's public service announcement featuring world champion surfer Rob Machado (case-study Water-Do-More-with-Less)

   ii. Each year Santa Barbara water agencies host a video competition for Santa Barbara County High Schools. Schools from throughout the County submit 30 to 60 second commercial-style videos that promote water conservation in fun and innovative ways. The agencies use the best videos for a summer media campaign. http://www.sbwater.org/education.aspx?id=392

c. Develop lists of plants/landscape options that will thrive locally:

   i. The Alliance for Water Awareness and Conservation (AWAC), a coalition of 25 regional organizations, developed prototypical residential landscape plans, with plant palettes and irrigation plans for High Desert appropriate landscapes

   ii. Zone 7 Water Agency sponsors a gardening site featuring water-efficient plants and landscape designs. GardenSoft produces the software, which is used by many other agencies, appropriately customized for each region's local climate and soils.

d. Put conservation messages on agency vehicles, and for municipalities, extend to additional municipal fleet

   i. Monte Vista Water Agency:

   ii. Dublin San Ramon Services District

e. Reach out to local master gardeners for landscape product community education; they are experts, typically well tied into their communities, and enjoy sharing their knowledge

        i. Garden Wise Guys
        ii. case-study-IWDWV-xeriscape-workshop

    f. Train a volunteer speakers group who can represent conservation issues on behalf of your agency when requests come in
        i. The Long Beach Water Department sends volunteer Water Ambassadors to community events throughout the year. They set up a table to give away water-efficient devices and useful water conservation information. Working with five to 10 volunteers at a time, Long Beach can maintain on-going community outreach, while staff focuses on other pressing issues.
        ii. case-study-IWDWV-xeriscape-workshop

Social marketing programs

When water agencies undertake public information programs about water conservation, they are seeking to change behavior, not just inform. Recognizing this goal, the Education BMP encourages water agencies to use social marketing principles in designing public information programs.

Social marketing, says Peter Mitchell in his agency's book, the *Little Book on Social Marketing*, is "a methodology for deciding what factors might encourage a specific behavior and then employing common marketing tools, such as promotions and program changes, to influence those factors and encourage positive social change." Another expert, Doug McKenzie-Mohr, says in his book *Fostering Sustainable Behavior* that "initiatives to promote behavior change are often most effective when they are carried out at the community level and involve direct contact with people." This is because conforming to the norms of one's community is a strong motivator for changing behavior.

BMP 2.1 focuses on two areas of social marketing: developing the conservation message and partnering programs.

1) Developing the conservation message
    a. Test assumptions with research: Before developing a conservation message or planning specific marketing tactics, it is important to identify the barriers that are preventing the desired behavior change, as well as the perceived benefits that will cause individuals to take the desired action. As noted in this program design outline (ProgramDesignOutline) barriers and benefits may have nothing to do with the desired outcome. Market research can determine the most effective messages and tactics.

b. Conduct pilot programs: The outline (above) also emphasizes the importance of testing public information messages and tactics on a small scale through pilot programs. In its Blue Thumb Neighbors campaign (case-study-RWA-Blue-Thumb-Neighbors) for example, the Sacramento Regional Water Authority ran a pilot program in one neighborhood, involving 16 households, in order to test and refine a program that will eventually be available to 18 partnering agencies.

c. Target your message: Different types of customers may respond to different messages and communication strategies. Consider business sectors, age of homes/fixtures, lot sizes, influential groups (e.g., landscapers), and ethnic/language groups. For example, the City of Newport Beach has identified residential customers, hotels, and restaurants as key target audiences based on water savings potential and municipal code requirements. Based on bi-annual public opinion and awareness polling, Sonoma County Water Agency targets females between the ages of 28-65 living in single family residential properties as well as Spanish-speakers.

d. Getting public input and developing support: Stakeholder committees can play a critical role in mobilizing industries to help water agencies meet short and long term water savings goals. An advisory committee provides a forum for all involved to raise problems, identify solutions to complex problems, increase awareness, highlight success stories, and rally the community. For example, San Diego Water Authority has had a standing Conservation Action Committee (San Diego Region Conservation Action Committee) for many years. In the fall of 2006, the committee helped pull together a Water Conservation Summit that involved stakeholders from throughout the region. Feedback from the summit was instrumental in developing a strategic plan for addressing the region’s serious water issues.

   Identifying the right mix of participants is important to the success of stakeholder committees. They must include decision makers, end-users and influencers. Below is a cross-section of industry associations, public entities, and commercial and non-profit interests that are important to consider.

   - American Society of Landscape Architects (ASLA)
   - Building Industry Association (BIA)
   - California Association of Community Managers (CACM)
   - California Landscape Contractors Association (CLCA)
   - Irrigation Association

- Regional Apartment Association

Commercial, non-profit, and public sector interests include:

- Biotech
- Commercial, Industrial and Institutional (CII) firms
- Community associations
- County planning and enforcement agencies
- Environmental interests
- Landscape professionals
- Other local water agencies
- Manufacturers
- Municipalities
- Nurseries and propagators
- Product distributors
- Regional gardens and museums
- Regional utility sector
- Service providers
- Watershed collaboratives

2) Partnering Programs
    a. Reach out to community leaders (mayors, city council, leading business/chambers of commerce executives, etc.) to create partnerships and carry your message, get referrals and open the door to dialogue with customers about water issues.

    b. Train stakeholders outside the utility staff in water conservation priorities and techniques.
        i. Case study: Surfrider Foundation's Ocean Friendly Garden Program uses social marketing to shift individual's thinking about what constitutes desirable landscaping and then influence their neighbors to spark a movement. Through a series of workshops and volunteer days, property owners and landscape professionals learn to apply Surfrider's principles of CPR – Conservation, Permeability and Retention – to landscapes in order to revive watersheds and oceans.

    In a project with West Basin Water District, volunteers created an Ocean Friendly Demonstration Garden at a local library (case-study-Surfrider-OFG).

    ii. Master Gardeners: Indian Wells Valley Water District XERIC© Ambassador Program uses expert gardener volunteers to teach landscaping workshops (case-study-IWDWV-xeriscape-workshop).

c. Develop partnerships with stakeholders who carry the conservation message to their target markets: For example, coordinate themed events with local retailers, landscape distributors – anything from parking lot event/barbeque with educational information to full-scale training/conferences/expos.

    i. Case study: The Municipal Water District of Orange County partners with private corporations, non-profit organizations, and educational institutions to expand the reach of its programs and target new audiences. Through partnerships with action sports industry companies like Hurley and Volcom, the agency is able to reach a younger audience than would traditionally receive water messages. Through partnerships with non-profits and environmental organizations, the agency is able to team-up with like minded organizations with similar goals (case-study Water-Do-More-with-Less).

    ii. Case study: Sacramento Regional Water Authority's Blue Thumb Campaign (case-study-RWA-Blue-Thumb-Campaign) starred well-known community influencers, including Sacramento Mayor Kevin Johnson, Meteorologist Elissa Lynn, and Dinger, mascot of the Sacramento River Cats, plus six local residents showing off their "Blue Thumb" and demonstrating how they made a personal commitment to use water wisely.

    iii. While EBMUD no longer employs this program, it formerly worked with local nurseries and landscaping supply stores to offer downloadable discount coupons on garden mulch. The agency established a relationship through a letter of agreement with the retail outlets (EBMUD mulch coupon LETTER OF AGREEMENT), and then advertised the program through its newsletter (http://ebmud.com/sites/default/files/pdfs/Pipeline_2010_MayJune_.pdf) and web site (http://ebmud.com/).

d. Work with colleges.

   i. Case study: Municipal Water District of Orange County utilizes a team of student interns in its Water: Do More with Less program. (case-study Water-Do-More-with-Less)

   ii. Case study: Otay Water District's demonstration garden (case-study-Otay Garden) is the result of a long-term partnership with Cuyamaca College.

   iii. Sustainable Landscape Demonstration Garden - Olivenhain Municipal Water District is collaborating with the Surfrider Foundation and Mira Costa College to create a demonstration garden.

e. Water industry partnerships

   i. Wholesale-retail agency partnerships: Assistance may be provided, when mutually agreeable and beneficial, from large-scale wholesalers to regional wholesalers or from regional wholesalers to retail agencies. The assistance may include:

      - Financial investments or incentives;
      - Technical support;
      - Program management and/or support;
      - Water shortage allocation agreements;
      - Non-signatory reporting;
      - Regional partnerships, and;
      - Encouragement and/or financial assistance in joining the CUWCC.

      More information on this is available in the Utility Operations Guidebook.

   ii. Neighboring agencies: The O.C. Water Hero program (case study OC Water Hero) is a collaborative product of Orange County's imported water provider, the Municipal Water District of Orange County (MWDOC), and Orange County's groundwater management agency, Orange County Water District.

   iii. Regional organizations, such as Integrated Regional Water Management groups and Joint Powers Authorities can create partnerships, as well. One good example of this is the Smart Rebates Program managed by the Sacramento Regional Water Authority (Smart-Rebates-Program-Update).

f. Other utilities: Energy and/or wastewater utilities can make good partners for water conservation implementation. Bay Area water agencies and the City of Davis joined Pacific Gas & Electric (PG&E) to form a first of its kind partnership to promote most water and energy efficient clothes washers. The partnership offers customers a combined water and energy rebate in one check, streamlines the rebate application experience, and enhances knowledge of the issues surrounding water and energy efficiency. Also combining rebate processing activities reduced administrative costs.

g. Social media: Social marketing should not be confused with social media, a term used to describe types of media that are based on online conversations and interactions. Social media can be effective tools in a social marketing campaign because they connect people who are interested in similar issues and help the group articulate its normative values. However, adoption by water agencies is in early stages. Out of 22 agencies interviewed for the guidebook in 2010, 12 were using social media, primarily Facebook, Twitter, and YouTube.

   Several agencies use contact us links or forms on their websites to generate dialog with customers, and consider this as a social media channel. City of Anaheim’s link is called ShareWithME, and it goes directly to the general manager. Anaheim also has a presence on Anaheim Anytime, which residents access by calling 311 or via the Web to inquire/report water waste or ask questions about what the city is doing about water conservation.

   Long Beach Water Department is enthusiastic about using social media to reach out to customers that are both tech savvy and interested in conservation issues. They use Twitter, Facebook, Blogspot, Secondlife, YouTube, and at one point also had Ning and myspace accounts. They focus on generating content for Twitter and Facebook but have linked all of their social media accounts, so that when they update one site, the others update, too. “From telling people not to water after it rains or letting them know of important upcoming events or meetings, social media tools provides immediate access to our customer base and allows us to get feedback from them and respond,” said Matt Veeh, Director, Government & Public Affairs.

   At the other end of the spectrum, several wholesalers said see little need for social media because they refer customers to the appropriate retailer in most cases. Some agencies said they are testing social media. For example, San Juan Water District joined Facebook in April 2010 as part of year-long trial urged by its PR agency. At the end of the trial, they will determine if the dialog is worth the staff time they have invested. Facebook requires a new message once a week plus responses to questions. They decided not to use Twitter because it is even more labor intensive, requiring daily updates to be effective. They feel that, except in emergencies, water agency messages don't require such intensive frequency. City of Santa Rosa concurs. They used Facebook and Twitter heavily during the 2008-09 water shortage to push messages to customers.

Recruiting Participants for Your Programs

The Orange County Water District has some great strategies for recruiting participants for its Children's Water Education Festival. Maybe some of these would work for your agency!

Recruitment Strategies for Students:

- *Attend community events and distribute information.*
- *Post information at local libraries and community centers.*
- *Work with department of education to distribute event information.*
- *Compile database of all schools within the county. Update on an ongoing basis.*
- *Create and send press releases and calendar alerts to local media.*
- *Collaborate with other water agencies to enlist participation in their service areas.*
- *Implement early registration incentives, such as offering opportunity drawings.*
- *Visit local schools and distribute event information.*
- *Host a booth at events for educators.*
- *Design enticing event collateral.*
- *Offer simplified online registration.*

Recruitment Strategies for Volunteers:

- *Compile database of potential volunteers.*
- *Collaborate with other water agencies to obtain volunteer contacts.*
- *Contact local organizations that have established volunteer programs.*
- *Give presentations to local service clubs.*
- *Offer participation incentives.*
- *Offer simplified online registration.*
- *Design effective event collateral.*
- *Encourage staff participation at our agency by enlisting the support of management.*

- *Send information packets about the event, including a short, three minute DVD.*
- *Distribute press release.*
- *Post call for volunteers in newsletters.*

Recruitment Strategies for Presenters:

- *Compile database of potential presenters.*
- *Collaborate with other water agencies to obtain contacts.*
- *Design enticing collateral.*
- *Offer simplified online registration.*
- *Offer incentives to participate.*
- *Distribute press release.*
- *Cold calls to organizations whose missions align with that of the Festival.*
- *Host one-on-one meetings with potential organizations.*
- *Send information packets about the event, including a short, three minute DVD.*
- *Include confirmed presenters in all program and marketing materials.*
- *Offer participating presenters the opportunity to distribute appropriate literature and promotional items at booths.*
- *Offer participating presenters the opportunity to distribute educational materials in student bags.*
- *Post call for presenters in newsletters.*

What would you advise a small agency on a limited budget to do first?

“Seek out and take advantage of inexpensive promotional messaging opportunities. Social media, standard media releases, editorials, volunteer programs, etc. get your message out without having to spend a lot of money. You can also attend neighborhood and community events to make contact with your customers. Finally, having a good, informational website is important. There are plenty of options available in this economy for a successful, yet cheap to maintain website.” Matthew Veeh, Long Beach Water Department

“Utilize existing mailings (bills) to provide additional information for customers. Create a website that is easy to navigate and access conservation information.” Chris Dundon, Contra Costa Water District

“Add water conservation tips to bills and any existing publications. Create a Water Conservation Tip brochure and participate at public events with a booth displaying water conservation literature and handouts. Posters are great for these events and reasonable in cost. Have them laminated on poster board for longevity.” Tami Ipsen, Hidden Valley Lake Community Services District

“Develop a communications plan and get buy-in from all departments. Then develop a budget that focuses on earned media opportunities. Don't forget about social media opportunities, least of which is an external web site.” Alison Jordon, City of Santa Barbara

“Form partnerships with other agencies to pool resources for paid [advertising] spots. For public visibility, I would recommend attending community outreach events with information to hand out. Websites are a very inexpensive way to get your message out and the website address should be included on all marketing material. I would find other agencies that have marketing material that you like and ask for the file. You could easily change the contact information and make it your own without the cost of development. Most agencies would be happy to share. I found the best way to get the message out is in small community groups. Contact neighborhood leaders and community groups to let them know you are available for speaking engagements. Word spreads fast. Also keep in front of your Board or Council to keep your message live. The more they know, the better they can represent you in the community.” Lisa Brown, City of Roseville

“Tiered rates are important, that's how you can pay for conservation and public information programs.” Marc Lippert, Lake Arrowhead Community Services District

“Participate in as many public events as possible and provide literature. It’s cheap and gives you a chance to connect with your customer direct and ask them for feedback.” Jarred Ross, City of Anaheim

“Utilize the media as much as possible. Utilize your website, bill messages, and limited advertising. Customers need constant reminders." Herbert Garcia, City of Glendale

“Target the exterior residential element first. Community associations and interest groups are your best ally. Get the word out via billing messages and community workshops.” Shane Burckle, City of Newport Beach

“Billing inserts. Offer water surveys and train staff to offer them at every possible customer interaction.” Vicki Sacksteder, San Juan Water District

“You have the best chance to grab customers’ attention when they open their bills. Maximize the opportunity with well-designed and well-written inserts (don’t skimp on appearance and content), comparative usage data right on the bill, and messages and offers that drive customers to your website (which means you also need an effective, customer-oriented website).” Renee Olsen, Dublin San Ramon Services District

“Determine target audience, have a list of stakeholders, keep in touch with stakeholders via email blasts.” Eleanor Torres, Orange County Water District

“Work with your wholesaler if you have one.” Stephanie Anagnoson, Castaic Lake Water Agency

“Don’t reinvent the wheel because there are so many people in the water conservation field that have invested time and money into finding out what does and does not work in public education and outreach. Start with CUWCC, WEF, ACWA and DWR. These organizations all have outreach materials that can be used for foundational conservation activities without having to make a huge investment in research and development. Tamara Alaniz, Mojave Water Agency

“We recommend starting with direct mail campaigns. They can be targeted to customers who use the most water. We have found this to be a cost-effective tool for many years. Another effective tool to reach audiences is online ads, such as Google AdWords, which allows for geo-targeting, and the organization pays per click and not just for the ad to appear.” Jerry DeLaPiedra, Santa Clara Valley Water District

“For events, seek out corporate sponsors because they may be able to offer funding and/or in-kind assistance with marketing and oversight of the project. Secure a place and start planning a year ahead of event if possible.” Elena Layugan, Upper San Gabriel Valley Municipal Water District

“For a retail agency, I’d recommend two-hour classes that provide a “California Water 101” focus that lures an audience in with a water-saving gadget/give-away. I believe linking education to incentives is the best “bang for the buck.” Cindy DeChaine, Three Valleys Municipal Water District

“If the goal of the agency is to reach school-age water users, a water education assembly program is a good first step to reach thousands of elementary students along with teachers and administrators that would attend. A large number of students are reached in a small amount of time.” Dave Beard, Kern County Water Agency

California Climate Action Registry General Verification Protocol

Verifying Entity-Wide Greenhouse Gas Emissions

Version 3.0 | August 2008

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Abbreviations and Acronyms

CARB	California Air Resources Board
CARROT	Climate Action Registry Reporting Online Tool
CDF	California Department of Forestry and Fire Protection
CEMS	Continuous Emissions Monitoring Systems
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COI	Conflict of Interest
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
N_2O	nitrous oxide
PFC	perfluorocarbon
RFA	Request for Applications
SAR	IPCC Second Assessment Report (1996)
SF_6	sulfur hexafluoride
TA	Technical Assistance Provider
TAC	Technical Advisory Committee
TAR	IPCC Third Assessment Report (2002)

Part I Introduction

1.1 Overview

The California Climate Action Registry created this General Verification Protocol to provide California Registry-approved verifiers with clear instructions for executing a standardized approach to the independent verification of greenhouse gas (GHG) emissions baselines and annual emissions reported by California Registry participants. This standardized approach defines a verification process that promotes the relevance, completeness, consistency, accuracy and transparency of emissions data reported to the California Registry. While this Protocol is written for verifiers, California Registry participants who are interested in understanding and preparing for the verification process may also find it useful.

This Protocol is intended to be used in combination with the California Registry's General Reporting Protocol and web-based calculation and reporting tool (CARROT—Climate Action Registry Reporting Online Tool). **Approved verifiers will verify participants' GHG emissions reports to the standards of the California Registry's General Reporting Protocol, and sector-specific protocols using the process outlined in this General Verification Protocol**.

At a minimum, each emissions report must contain all of an entity's emissions of CO_2 in the state of California for a calendar year, reported in five categories: indirect emissions from purchased electricity, imports of steam, district heating/cooling, and direct emissions from mobile combustion, stationary combustion, manufacturing processes, and fugitive emissions. Where a participant is reporting their U.S. emissions, the report must contain all of their emissions nationally. Starting with the fourth year of reporting, each emissions report must contain all emissions of all six greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6).

Emissions reports may also contain other information about an organization and its emissions that does not require verification. For instance, this could include information about a company's environmental goals, programs, policies, etc. Participants may also choose to report other indirect emissions, like business travel or employee commuting. In the emissions reports, optional information will be clearly distinguished from information that is verified.

Activities for each specific verification will differ based on the length and complexity of a participant's emissions report, but the verification process will include at least the following steps:

- Case-by-case evaluation of Conflict of Interest
- Scoping and planning a participant's verification activities
- Conducting verification activities
    1. Identifying emissions sources
    2. Reviewing methodologies and management systems
    3. Verifying emission estimates
- Preparing a participant's Verification Report and Verification Opinion

- Submitting a participant-authorized electronic Verification Form and Verification Activity Log to the California Registry via CARROT

Upon completion of the above steps, the California Registry will review the emissions report before accepting a participant's verified emissions report into its emissions database. This process is repeated every year of an organization's participation in the California Registry.

To help decrease the potential for conflict of interest between a verifier and a participant, a verifier can verify the same participant for a maximum of six consecutive years. After six years, a participant must choose another verifier for at least three years. After that time, the original verifier would again be eligible to verify the participant's emissions for up to six consecutive years.

The California Registry assumes that the verifiers will use their best professional judgment when conducting verification activities.

1.2 Organization of this General Verification Protocol

This General Verification Protocol is divided into four parts which outline the necessary steps a verifier must follow to initiate and complete the verification of a participant's emissions report.

Part I, *Introduction* (this section), provides a brief overview of the purposes and requirements of the verification process, describes the principles of verification, highlights important definitions, and answers some key questions.

Part II, *Preparing for Verification*, focuses on activities that take place prior to beginning verification activities, including bidding for a contract with participants, determining conflict of interest, negotiating a contract with participants, providing required notifications, and designing appropriate verification activities for each participant.

Part III, *Core Verification Activities*, provides guidance on conducting the primary activities that the verifier will complete, including: identifying sources, reviewing management systems and methodologies, and verifying emission estimates.

Part IV, *Completing the Verification Process*, covers procedures for completing the verification process including: preparing a Verification Report and Verification Opinion, completing the Verification Form to submit a participant's verified data to the California Registry, and recording and retaining proper records.

1.3 Principles of Verification

The purpose of verification is to provide an independent review of data and information being submitted to the California Registry to ensure that they meet minimum quality criteria. To fulfill this purpose, the independent verification process maintains the criteria of completeness, consistency, accuracy, comparability and transparency as its underlying principles.

Relevance. Verification should ensure that GHG inventories submitted to the California Registry appropriately reflect the GHG emissions of the entity and include emissions information produced in accordance with the program rules on defining reporting boundaries and sources.

Completeness. Verification should ensure accounting of all material GHG emissions sources and activities within the specified scope of the participant's inventory (a minimum of 95%). Baseline and annual emissions results should include all sources for which the participant is responsible.

Consistency. An emissions report should allow for meaningful comparison of emissions performance over time and across similar organizations. Independent verification should ensure that consistent methodologies and measurements are used between the baseline results and annual emissions results. Additionally, changes to participant emission baselines are verified to ensure appropriate comparisons.

Accuracy. Entity-wide reported data should be within the materiality threshold of 5% of the verifier's estimate of total emissions. Calculations and estimates need to be as accurate as possible to prevent material errors.

Transparency. Verification should be a transparent exercise. The data used for verification and the verification activities should be clearly and thoroughly documented to allow for outside review by the California Registry or potential review by the State of California (the State) in the context of overseeing verification activities.

1.4 Verification Principles and Definitions

1.4.1 Verification Standard

Verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. If a participant is reporting process or fugitive emissions, a separate industry-specific protocol may also be used and cited, where available. Some participants may wish to use their GHG emissions report for additional purposes such as registering in another registry, participating in emissions trading schemes, crediting programs, etc., and thus may add additional standards for verification.

1.4.2 Minimum Quality Standard

A verified emissions report submitted to the California Registry must be free of material misstatements, achieving a level of at least 95% accuracy. It is possible that during the verification process, differences will arise between the emissions totals estimated by participants and those estimated by verifiers. Differences of this nature may be classified as either material (significant) or immaterial (insignificant). A discrepancy is considered to be material if the overall reported emissions differ from the overall emissions estimated by the verifier by 5% or more. A difference is immaterial if it is less than 5%.

1.4.3 Reporting Uncertainty vs. Inherent Uncertainty

When evaluating participants' emissions reports, verifiers are to determine if the reporting uncertainty (vs. the inherent uncertainty) is less than the minimum quality standard.

Reporting uncertainty entails the mistakes made in identifying emissions sources, managing data or information, and calculating GHG emissions. Inherent uncertainty refers to scientific uncertainty associated with measuring GHG emissions. The California Registry is aware that there is inherent uncertainty in emissions factors and measurement of activity data through metering and instrumentation (even after the calibration of meters and other data collection methods are verified as accurate), but determining scientific accuracy is not the focus of the California Registry or its General Reporting Protocol.

1.5 Professional Judgment

Approved verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. The California Registry asks verifiers to use their professional judgment when executing the verification activities described in this General Verification Protocol. The purpose of the verifier approval process is to find verification firms that demonstrate, through their staff's professional qualifications and relevant GHG experience, their ability to render sound professional judgments about GHG emissions reports.

Application of a verifier's professional judgment is expected in the following areas:

- Implementation of verification activities with appropriate rigor for the size and complexity of a participant's organization and with regard to the uncertainty of calculations associated with the participant's emissions sources;
- Review of the appropriateness of a participant's GHG emissions tracking, monitoring, and management systems for providing information to the California Climate Action Registry;
- Evaluation of participant compliance with the California Registry's General Reporting Protocol;
- Assessment of methods used for estimating emissions from sources for which the General Reporting Protocol does not provide specific guidance, such as process and fugitive emissions, and indirect emissions from sources other than electricity, imported steam, district heating/cooling; and
- Appraisal of assumptions, and estimation methods and emission factors that are selected as alternatives to those provided in the General Reporting Protocol.

The General Verification Protocol and training provided by the California Registry are intended to explain to the verifier the California Registry's guidelines and expectations and thus what types of professional judgments are appropriate for this program. In addition to these resources, verifiers may contact the California Registry at any time for clarification of California Registry guidelines, expectations and policies.

1.6 Conflict of Interest

In order to ensure the credibility of the emissions data reported to the California Registry and its potential utility under any future regulatory regime, it is critical that the verification process is completely independent from the influence of the participant submitting the emissions report. While conducting verification activities for California Registry participants, verifiers must work in a credible, independent, nondiscriminatory and transparent manner, complying with applicable state and federal law and the current version of the State of California's *Conflict of Interest Process and Requirements for State and California Registry-Approved Verifiers*. This document is posted on the California Registry's website**.**

Any pre-existing relationship between the verifier and participant must be acknowledged to the California Registry, which will evaluate the potential for a conflict of interest (COI) between the two organizations.

Verifiers must provide information to the California Registry about its organizational relationships and internal structures for identifying potential conflicts of interest (organizational COI). Then, on an individual basis, the California Registry will review any pre-existing relationship between a verifier and participant and will assess the potential for conflict of interest (case-by-case COI). When the California Registry determines there is a low risk of COI, the participant and verifier can finalize negotiations of their contract. Following completion of a verification, the verifier must monitor for the next year if any new business relationship may create a COI (emerging COI).

As an added protection, a verifier may provide verification services to a California Registry participant for, at most, six consecutive years. After a six-year period, the California Registry participant must engage a different verifier. The original verifier may not provide verification services to that participant for three years. This three year hiatus begins with any lapse in providing annual verification services to a California Registry participant.

In the event that a verifier violates these conditions, the California Registry, in consultation with the State and at its discretion, may disqualify an approved verifier for a period of up to five years.

This conflict of interest clause does not preclude a verifier from engaging in consulting services for other clients that participate in the California Registry for whom the verifier does not provide any verification activities.

Part II Preparing for Verification

2.1 Verification Process Overview

Before any verification activities begin, a number of procedural steps must be taken to ensure that the obligations and responsibilities of both the verifier and participant are clear.

The following summary of the major steps of verification is provided as a reference.

1. **Verifier receives California Registry approval**: Verifier meets all accreditation requirements and completes a California Registry-sponsored verification training workshop.

2. **Participant selects verifier**: Participant contacts one or more State/California Registry-approved verifiers to discuss verification activities. Participant selects an organization to verify its GHG emissions results and begins to negotiate contract terms.

3. **Verifier submits case-specific Evaluation of Conflict of Interest (COI) and State Notification Form**: After a participant chooses a verifier, the verifier must submit a Conflict of Interest Evaluation and State Notification Form to the California Registry to establish that the likelihood of a COI between parties is low or that risk of any conflict can be sufficiently mitigated by the verifier. The form must be submitted at least 10 working days prior to the first scheduled verification meeting.

4. **California Registry sends COI determination to verifier**: The California Registry reviews the Evaluation of COI Form and supporting information to determine the level of risk associated with the proposed participant/verifier relationship, and notifies the verifier of its determination.

5. **Verifier & participant finalize contract**: When the California Registry provides a favorable COI determination between a participant and verifier, verifiers may finalize their contract with a participant.

6. **Verifier conducts verification activities**: Verifier follows the guidance in the General Verification Protocol to evaluate a participant's annual GHG emissions report.

7. **Verifier prepares Verification Report and Verification Opinion for participant**: Verifier prepares a detailed summary (Verification Report) of the verification activities for the participant. Verifier also prepares a Verification Opinion for participant's review, prior to sending opinion electronically to the California Registry via CARROT.

8. **Verifier & participant discuss Verification Report and Opinion**: Verifier meets with participant to discuss Verification Report and Opinion.

9. **Verifier completes Verification Form via CARROT**: Once authorized by a participant, a verifier completes the Verification Form via CARROT. Participant then submits the original Verification Opinion to the California Registry.

10. **California Registry Conducts Final Review**: California Registry reviews the Verification Opinion and Verification Activity Log and evaluates the participant's

emissions reports. Once accepted by the California Registry, a participant's aggregated entity-level emissions become available to the public via CARROT.

Even in multi-year verification contracts, verifiers must repeat steps 3-11 for each annual verification before submission to the California Registry.

2.2 Becoming an Approved Verifier

Only those firms approved by the California Registry, the State or those involved in the American National Standards Institute (ANSI) accreditation program may provide verification services to California Registry participants. In order to become approved, a verifier must complete a two-step process: 1) Obtain accreditation as a GHG verifier from either the California Air Resources Board or from the American National Standards Institute (or other approved accreditation body as specified on the California Registry website) and 2) achieve California Registry approval by attending a verification training workshop facilitated by the California Registry.

Information on ANSI GHG Verifier Accreditation is available at www.ansi.ghg.org.

Information on CARB GHG accreditation is available at arb.ca.gov.

The second step of the approval process requires that lead verifiers one of the California Registry's verification training workshops. A lead verifier is any verifier from the firm who will sign their firm's Verification Opinion. After completing the training workshop, the verification firm becomes an "approved verifier." Following the training session, the California Registry will provide verifiers with a notification of their full approval. Upon receiving this notice, a firm may approach current or prospective California Registry participants to market their services and capabilities, and advertise that they are "approved verifiers for the California Climate Action Registry". All approved verifiers are listed on the California Registry's website.

Approvals are valid for three years from the date of the California Registry approval. At the end of this period, the California Registry will send a notification to each firm's primary contact. If for any reason the State, ANSI or the California Registry finds that a verifier has failed to meet the standards of either the General Reporting Protocol or the General Verification Protocol, it may disqualify a verifier for a period of up to five years.

2.3 Updates to the General Verification Protocol

Periodically, the California Registry may update the General Verification Protocol. The California Registry will advise all verifiers of any changes, and any new requirements that may affect them. Where any changes are significant, the California Registry may require that lead verifiers attend the next verification training workshop.

2.4 Adding or Deleting Designated Staff

During the application process, verification firms will identify all staff members who will be designated verifiers for the California Registry. An applicant who is State-approved may add or delete staff to their roster. To add or delete designated staff after being approved, the verifier should submit the Designated Staff Form (available on the California Registry's Verifiers Only webpage), with the names and contact information for any personnel changing from the roster, and note if staff are to be deleted or added to the roster. When adding staff, the firm should describe each individual's job classifications, relevant experience, education, academic degrees, professional licenses for technical staff members and their respective roles.

2.5 Bidding on a Verification Contract

The California Registry recommends that those participants with complex GHG emissions reports solicit competitive bids for verification services from at least three approved verifiers. Those participants with simpler GHG emissions reports who do not seek, or are not eligible for, batch verification may wish to secure competitive bids or may wish to sole source the verification contract in order to reduce costs and expedite the verification process.

When preparing to send out a request for bids from verifiers, participants should first review the list of approved verifiers and select some (or all) as prospective bidders. Due to the possibility of access to proprietary information, participants may want to send each prospective bidder a non-disclosure agreement. The California Registry suggests that participants distribute requests for bids to prospective verifiers only after they have received a signed non-disclosure agreement from verifiers.

The California Registry recommends that participants include the following information in their requests for bids from verifiers:

1. The expected contract duration;
2. A general description of the participant's organization;
3. The geographic boundaries of the participant's emissions report;
4. The number and locations of facilities and operations;
5. The GHGs reported in the participant's emissions report;
6. The emission source categories (and possibly emission sources) in the participant's emissions report;
7. The password to a read-only (Reviewer) version of the participant's emissions report in CARROT; and
8. A list and description, by category, of how emissions data is organized and calculated (either using CARROT or another methodology).

The California Registry suggests that participants request that commercial proposals from potential verifiers include the following components:

1. History and description of verification company;
2. Explanation of core competencies;
3. Proposed price for verification services;
4. Proposed staff;
5. Statement of verifier liability;
6. Confidentiality policy; and
7. Duration of contract.

The California Registry expects only limited variation in the technical proposals since all of the approved verifiers are trained to implement the California Registry's standardized verification process.

2.6 Conflict of Interest (COI)

2.6.1 Objective of the Conflict of Interest Process

This COI process was developed by the State of California and adopted, with modifications, by the California Registry to assess the risk of potential COI between verifiers and California Registry participants. This process gives verifiers the ability to demonstrate that their organization is capable of identifying and mitigating situations that would impair their ability to render an impartial verification opinion.

Through this process, applicants and any partners must demonstrate:

1. Clearly-defined organizational boundaries, internal structures, and relationships with other companies that have management or financial control over the applicant.
2. The presence of internal mechanisms to identify and mitigate organizational and personal COIs with any potential clients.
3. The ability to be objective in providing verification activities.

To protect the credibility and rigor of the California Registry verification process, the relationship between verifiers and California Registry participants must not create or appear to create a COI. While conducting verification activities for California Registry participants, the verifier must work in a credible, independent, nondiscriminatory and transparent manner, complying with applicable state and federal law and the current version of the California Registry's conflict of interest process

2.6.2 Process and Requirements

In the verification process, all verifiers must demonstrate they do not have significant conflicts of interest with participants:

1. **Organizational COI** – in the application process, each verifying organization shows that they have internal mechanisms in place that help maintain their objectivity in verification activities.

2. **Case-by-Case COI** – in each case where verification services are requested, before a contract is signed with a participant, each verifier demonstrates that any pre-existing relationship between the verifier and participant will not impair impartiality in verifying a GHG emissions report.

3. **Emerging COI** – for a period of one year following a verification, verifiers will monitor their relationship with the participant to ensure impartiality has been protected in the verification process.

These are each discussed in greater detail below.

2.6.2.1 Organizational COI

As part of the application process, a verifier has already documented the ability of its organization to identify and react to COI due to organizational relationships. Verifiers have also submitted the form *Conflict of Interest Declaration of Ability and Intent to Comply*, declaring the applicant and each partner's ability to subsequently perform and submit a case-by-case evaluation of COI to the California Registry. This form also conveys the applicant's intent to comply with the California Registry's COI process and requirements.

2.6.2.2 Case-by-Case COI

As an early step in the contract negotiation process between verifiers and participants, a verifier must demonstrate on a case-by-case basis that it, its partners, and the individuals performing verification activities do not have any actual or potential conflict of interest with the California Registry participants for which it has been selected to carry out verification functions.

A verifier will have a high risk of COI if the verifier and participant share any management, or if any of the California Registry participant's managers of GHG-related activities were previously employed with or by the verifier within the last three years, or vice versa. A verifier will have a high risk of COI if the verifier or its related companies (e.g., parent company, subsidiaries of a parent company, affiliates) has provided any GHG management or advocacy services (as identified on the list below) to the California Registry participant within the last three years. If a verifier has performed these services, they have a high potential COI, as they would be: 1) verifying their own work, 2) performing management functions for the client, or 3) acting as an advocate for the client. Where a high risk of COI is determined, the verifier is not approved to conduct the verification.

2.6.2.3 Incompatible Services

- Designing, developing, implementing, or maintaining a GHG emissions inventory
- Designing or developing GHG information systems
- Developing GHG emissions factors or other GHG-related engineering analysis
- Designing energy efficiency, renewable energy, or other projects which explicitly identify GHG reductions as a benefit
- Preparing or producing GHG-related manuals, handbooks, or procedures specifically for the California Registry participant
- Appraisal services of carbon or GHG liabilities or assets
- Brokering in, advising on, or assisting in carbon or GHG-related markets
- Management over health, environment and safety functions
- Legal and expert services unrelated to California Registry verification

If the verifier identifies a potential or actual COI, the verifier must also submit a plan to avoid, neutralize, or mitigate the COI situation. The California Registry will review the information submitted to determine if the verifier provided enough information to make a COI determination. If not, the California Registry may request additional information. Once the information is found to be complete, the California Registry will review and evaluate the case, and will issue a written determination within ten working days.

Once the case-by-case evaluation is complete, a verifier may provide verification services to a California Registry participant for, at most, six consecutive years. After a six-year period, the California Registry participant must engage a different verifier. The original verifier may not again provide verification services for at least three years. This three-year period is triggered following any lapse in providing annual verification services to a California Registry participant.

This cycling of verifiers will help to avoid potential COI situations due to lengthy and ongoing relationships. Also, this guarantees that another firm will review material previously reviewed by another verifier, thus providing another "check" on the consistency and appropriateness of professional judgments made.

2.6.2.4 Emerging COI

Verifiers agree to monitor their activities for one year after the verification, and seek the approval of the California Registry and the State before entering into arrangements or relationships during that time that may present COI. The verifier may not enter into any contract with a California Registry participant or related entity that the California Registry and/or the State determines would create an unacceptable level of risk of COI.

In order to obtain this determination, the verifier must submit *Form COI-AB: Notification of Verification Activities And Request for Evaluation of Potential for Conflict of Interest Between Verifier and California Registry Member* (available on the California Registry's Verifiers Only webpage) to the California Registry detailing the specifics of their situation and request a determination. The California Registry will use a similar procedure to determine the risk for COI during that period.

2.6.2.5 Confidentiality

The California Registry will enter into confidentiality agreements with verifiers and California Registry participants as necessary to evaluate potential COI. Any organization that must provide confidential information to support the evaluation should clearly indicate what information is confidential, and the California Registry will follow its standardized procedures to do its utmost to protect confidential business information.

2.7 Negotiating a Contract with the Participant

After a verifier has been selected by a California Registry participant, the two parties should negotiate and complete contract terms. This contract is exclusively between the participant and the verifier, and the particulars of any given contract are at the discretion of the two parties. However, contracts for verification services typically include the following components:

- **Scope of the Verification Process.** This component of the contract should outline the exact geographic and organizational boundaries of the participant's emissions inventory to be examined. This should, but may not necessarily, match the boundaries used in the GHG emissions report to the California Registry. This scope should indicate whether a participant's California-only emissions are included or if both California and U.S. emissions are included. It should also identify whether the participant has used the management control, equity share, or other methods based on contractual relationships to determine organizational boundaries.

- **Confirmation of Approved Verifier Status.** This is a simple statement that the verifier has been approved by the California Registry to verify emissions reports covering the scope listed above.

- **Verification Standard.** Verifiers must verify participants' GHG emissions reports against the California Registry's General Reporting Protocol using the process outlined in this General Verification Protocol. If a participant is reporting process or fugitive emissions, a separate industry-specific protocol may also be used and cited, where available. Some participants may wish to use their GHG emissions report for additional purposes such as, registering in another registry, participating in emissions trading schemes, crediting programs, etc., and thus may add additional requirements into their contract for verification.

- **Non-Disclosure Terms.** The verifier and the participant should agree in advance on methods for identifying and protecting proprietary and confidential business data that may be revealed during verification.

- **Site Access.** The verifier and the participant should agree in advance to the time, place, and conditions of a verifier's site visits, if any are required.

- **Documentation and Data Requirements.** The verifier and participant should agree on how and when the participant will provide activity and emissions data to the verifier. The range of required documentation will largely be determined by the size and complexity of participant operations, and whether the participant has used the online calculation tools available through CARROT.

- **Period of Performance.** The period of performance for verification services may be up to six years. Where a participant's operations do not significantly change from year to year, they may wish to work with a verifier on a three-year cycle. However, the participant has discretion as to whether to sign a one or multi-year contract.

- **Performance Schedule.** Participants and verifiers may wish to agree on a schedule to complete the verification process and for the verifier to deliver a Verification Report and Verification Opinion. Verification should be completed by October 31 of the same calendar year when the emissions report was submitted.

- **Payment Terms.** Typical payment terms include total value, schedule of payments, and method of payment (e.g., electronic funds transfer).

- **Re-Verification Terms.** If the verifier identifies material misstatements, the participant may choose to revise its GHG emissions report. At that time, the participant may ask the verifier to re-verify the portions of the report with material misstatements or seek verification from another provider. *A verifier may not provide guidance, technical assistance, or implementation work on the remediation of material misstatements, as this constitutes consulting services and results in a conflict of interest.* Contracts should also specify the length of time a participant will have to correct material misstatements.

- **Liability.** All verifiers are subject to minimum liability associated with completing the verification per the terms of the verification contract. The participant may require and the verifier may agree to additional liability under this contract.

- **Contacts.** Parties should identify technical leads for both the participant and verifier, as well as responsible corporate officials of each party.

- **Dispute Resolution.** Both parties must state their consent to submit irreconcilable differences for review to the California Registry-convened Dispute Resolution Committee.

- **Acknowledgement of State Site Visits.** Both parties must sign an acknowledgement that, on a random basis, the State may accompany a verifier for purposes of monitoring the verification process.

2.8 Batch Verification

In an effort to minimize the transaction costs of verification for small organizations with relatively simple emissions, the California Registry will contract with an approved verifier to undertake the verification work for interested participants with limited GHG emissions. The California Registry calls this batch verification. Emissions reports verified under batch verification must meet the same standards as non-batch reports. Eligible participants include those with:

- Less than 500 metric tons of CO_2e emissions per year;
- No significant process or fugitive emissions (significance threshold is 5% of total CO_2e emissions) ;
- Indirect emissions from purchased electricity at four or fewer sites; and/or
- Direct emissions from five or fewer passenger vehicles only; and/or
- Direct emissions from stationary combustion at one site.

Upon the recommendation of the batch verifier, the California Registry reserves the right to deem a participant's GHG emissions inventory too complex for batch verification. The California Registry also reserves the right to grant batch verification eligibility on a case-by-case basis.

2.8.1 Procedures

Each year, the California Registry will solicit competitive bids for batch verification services from all eligible approved verifiers.

Participants interested in batch verification will contact the California Registry to express their interest. After confirming the participant's eligibility, the California Registry will keep track of interested participants.

Each participant will sign a standardized contract with the verifier that has been developed by the California Registry. If participants require non-standard contract language, they cannot participate in batch verification.

Once the contracts are signed, the California Registry will work with the verifier to identify all necessary documentation, as requested by the verifier and as required in the General Reporting and General Verification Protocols. The California Registry will collect the necessary supporting documentation from the participants and forward it to the verifier. It is expected that batch verification will not require a site visit, but will consist of document review and telephone interviews.

The verifier will contact each participant to understand their operations. Then, the batch verifier will review and assess the emissions reports and documentation and prepare the Verification Report and Opinion. The verifier will then discuss the findings with each participant and upon authorization, will submit the electronic Verification Form to the California Registry via CARROT.

To minimize any potential conflict of interest, the California Registry will contract with a batch verifier on an annual basis and the designated batch verifier will perform all eligible verifications for that calendar year of emissions. The batch verifier will be ineligible to bid on batch verification for the following three years. Because of this term limit, the limited nature of emissions and operations of the participant and the elevated level of oversight by the California Registry, the potential for COI is deemed low, and the requirement to request determination of COI is waived.

2.9 Notification of Planned Verification Activities

After verifiers and participants have completed contract terms, the verifier must notify both the California Registry and the State of California 10 business days prior to the beginning of verification activities, using Form D, *Notification of Verification Activities*. This form is available on the California Registry's Verifiers Only webpage. Notification should include:

- Verifying company information;
- Participant information;
- Year and types of greenhouse gas emissions data being verified;
- Schedule of verification activities; and
- Names of approved staff members conducting the verification activities

This notification period is necessary to allow the State the opportunity to accompany verifiers on visits to participants' sites. The State will observe, evaluate, and report on the quality and consistency of verification activities. A verifier that does not provide proper notification to the California Registry and the State may be disqualified as an approved verifier.

2.10 Kick-off Meeting with the Participant

After contract terms have been completed and the California Registry and State have been notified of planned verification activities, verifiers should conduct a kick-off meeting with participants. For some verifications, this may consist of a telephone call. The agenda for that meeting should include:

1. Introduction of the verification team;
2. Review of verification activities and scope;
3. Transfer of background information and underlying activity data (See Table 2); and
4. Review and confirmation of the verification process schedule.

Based on the information provided in agenda items 2 and 3, the verifier should determine the most effective, efficient, and credible detailed verification approach tailored to the particular characteristics of the participant.

2.11 Online Reporting

All participants must report their emissions using the California Registry's online calculation tool, CARROT. Participants may also opt to use CARROT to calculate their indirect emissions and direct emissions from stationary and mobile combustion. Where participants have used CARROT to calculate their emissions, the verifier needs to verify that data have been collected properly and entered accurately. The verifier should assume CARROT's calculations are correct and do not need to re-calculate the emissions. Due to the time savings, this should result in a less expensive and expedited verification process.

It is the participant's responsibility to provide the verifier with access to CARROT. A verifier will have read-only access to the participant's Total Emissions Summary, which provides a detailed summary of all the information that the participant has reported. Because the verifier needs to be able to evaluate any operational changes, access is also provided to the previous year's total emissions summary, as well as emissions reported in the baseline year if this has been specified and if it is different than the current emissions year. For example, for a participant who has set a baseline year of 2002, has reported data from 2002 – 2006, and is contracting with a verifier for evaluation of their 2007 emissions; the verifier will be able to access their 2007 report, their 2006 report, and their 2002 report. They would have public access to emissions reported in the intervening years.

Additional assistance with navigating and using CARROT is provided in the California Registry's Verification Training Workshops and by contacting the California Registry at 213-891-1444 or **help@climateregistry.org**. Verifiers may also request temporary access to CARROT for training purposes.

Part III Core Verification Activities

3.1 Overview

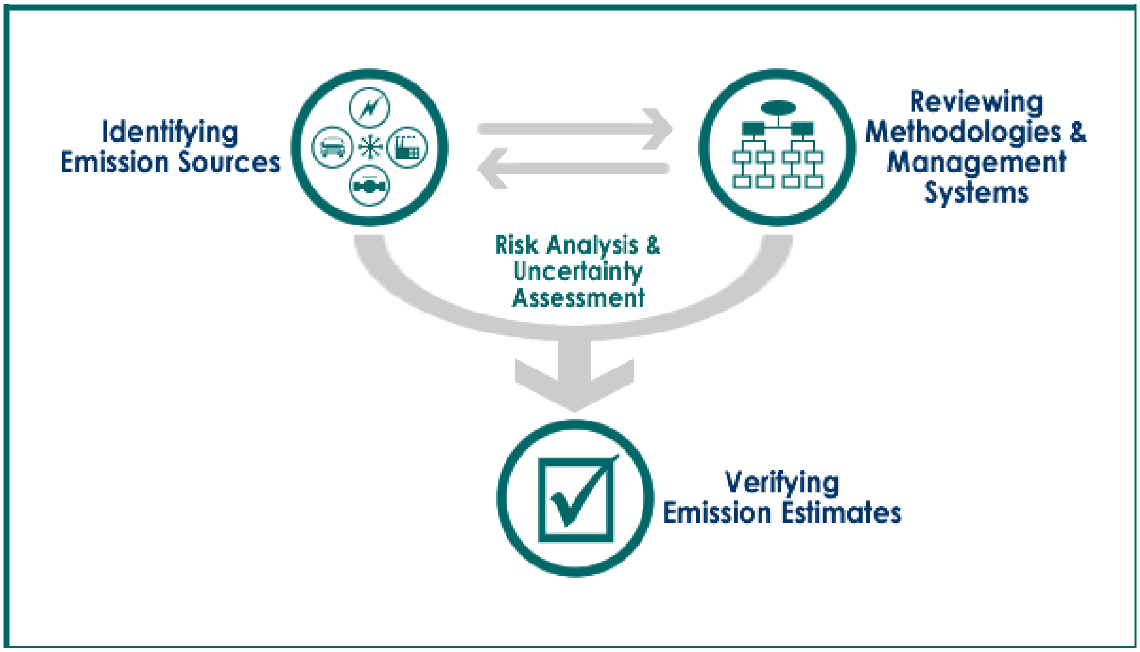
Once verifiers have completed the preparations for verification, they are ready to begin the core verification activities.

The core verification activities include three primary elements:

1. Identifying emissions sources in five emission source categories (indirect, mobile, stationary, process, and fugitive emissions);
2. Understanding management systems and estimation methods used; and
3. Verifying emission estimates.

The core verification activities are a risk assessment and data sampling effort aimed at ensuring that no material sources are excluded and that the risk of error is assessed and addressed through appropriate sampling and review. The complete core verification process is illustrated in Figure 1 below.

Figure 1. The Core Verification Process



3.2 Verification Activities Based on Participant Characteristics

Verifiers must apply the verification activities consistently for all participants. However, based on the size and complexity of participants' operations and management systems, verification activities and the duration of the process will vary. The documents that will need to be reviewed during verification will also vary depending on the nature of the emission sources contained in the participant's emissions report.

3.2.1 Determining Appropriate Verification Activities

To guide verifiers in their determination of appropriate verification activities, the California Registry divides participants into three general groups, based on the level of effort necessary to verify their emissions. The characteristics of the verification approach for each of these groups are listed below. Of course, verifiers are expected to use their professional judgment to augment or narrow these approaches based on uncertainty in emissions estimates and other items affecting material accuracy.

Group 1: Small participants with simple operations. This group includes participants who have only the following material emissions sources:

- Indirect emissions from electricity consumption, steam imports, and district heating/cooling at four or fewer buildings; and/or
- Direct emissions from stationary combustion at one site; and/or
- Direct emissions from five or fewer passenger vehicles.

In an effort to minimize verification costs, small participants who also have total emissions that are less than 500 metric tons of CO_2e per year may elect to be batch verified with similar organizations. The California Registry will assist this batch of participants in bidding and negotiating contracts with the verifier. Standard terms and conditions will apply for all contract elements. Verification for these participants will usually not require a site visit, but rather, activities will be conducted via a telephone interview.

Alternatively, small participants may choose to contract out verification services through a sole source procurement or competitive bidding process.

Group 2: Larger participants with more complex operations. These include participants with only the following material emissions sources:

- Indirect emissions from electricity consumption, steam imports, and district heating/cooling at more than four sites;
- Direct emissions from stationary combustion at more than one site;
- Direct emissions from more than five vehicles; and/or
- No material process or fugitive emissions.

For these participants, most verifications will require at least one site visit. Additional visits may be required when characteristics of the participant changes between reporting periods (e.g., new sites, changed location, began new operations). Site visits are used to ensure that all material GHG emission sources have been included and appropriately accounted for in the greenhouse gas emissions report.

Group 3: Participants with process or fugitive emissions. For participants with material process or fugitive emissions or other emissions not covered above, verification activities must be more detailed. Because these emission calculations are not currently included in the General Reporting Protocol, the verifier is required to use their professional judgment as to the appropriateness of the calculations used by the participant.

3.3 Verification Cycle

For participants whose operations do not change significantly, verification can be a three-year cycle. In Year 1, a verifier will need to form a detailed understanding of a participant's operations and resulting GHG emissions. If there have been no significant changes in a participant's boundaries, GHG emissions sources and/or management systems, a verifier may streamline and expedite the verification activities in Years 2 and 3 by focusing on verifying emissions estimates. To ensure data integrity, all of the core verification activities should be completed again in Year 4, followed by streamlined activities in Years 5 and 6.

The minimum core verification activities for each year are:

Year 1: Identify emission sources, review management systems, verify emissions estimates

Year 2: Verify emissions estimates

Year 3: Verify emissions estimates

Year 4: Same as Year 1

3.4 California Registry's Expectations for Verification Activities

Through these verification activities, verifiers are to verify that the annual emissions reports submitted to the California Registry via CARROT meet the standards of the General Reporting Protocol:

1. The participant has reported all material emissions, broken out into the following five categories:
    - Indirect emissions from purchased electricity, imported steam, district heating/ cooling;
    - Direct emissions from mobile combustion;
    - Direct emissions from stationary combustion;
    - Direct emissions from process activities; and
    - Direct fugitive emissions.
2. Total emissions reported as de minimis are less than 5% of the total emissions.
3. From the fourth year of reporting to the California Registry, all material emissions from all six greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) are reported.
4. All California emissions are identified separately from the rest of a participant's U.S. emissions, where the participant has chosen to report their U.S. emissions.
5. All emissions were emitted during the calendar year specified.

6. Reported emissions meet the minimum quality standard of 95% accuracy.

Emissions reports may also contain other information about an organization and its emissions that does not require verification. This could include, for instance, information about a company's environmental policies and goals, and emission reduction projects. Participants may also choose to report other optional indirect emissions (e.g., business travel, employee commuting). In the report generated by CARROT, optional information will be clearly distinguished from verified information.

To verify information is accurately reported, the verifier will want to review, at a minimum, the documents listed in Table 1. To facilitate this review, once the participant reports their emissions using CARROT, the participant and the verifier can generate a Verification Checklist. Based on the types and categories of emissions they have reported, CARROT will provide participants and verifiers with a list of documents they will need for verification.

Table 1. Documents to be Reviewed during Verification

Activity or Emissions Source	Documents
Identifying Emission Sources	
Emission Source Inventory	Facility Inventory
	Emission Source Inventory Stationary Source Inventory Mobile Source Inventory Fuel Inventory
Understanding Management Systems and Methodologies	
Responsibilities for Implementing GHG Management Plan	Organization Chart, Greenhouse Gas Management Plan, Documentation and Retention Plan
Training	Training Manual, Procedures Manual, Consultant Quals Statement
Methodologies	Protocols Used (if in addition to the California Registry's General Reporting Protocol)
Verifying Emission Estimates	
Indirect Emissions from Electricity Use	Monthly Electric Utility Bills, Emission Factors (if not default)
Direct Emissions from Mobile Combustion	Fuel Purchase Records, Fuel in Stock, Vehicle Miles Traveled, Inventory of Vehicles, Emission Factors (if not default)
Direct Emissions from Stationary Combustion	Monthly Utility Bills, Fuel Purchase Records, CEMs Data, Inventory of Stationary Combustion Facilities, Emission Factors (if not default)
Indirect Emissions from Cogeneration	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from Imported Steam	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Heating	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Cooling	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Direct Emissions from Process Activities	Raw Material Inputs, Production Output, Calculation Methodology, Emission Factors
Direct Fugitive Emissions	
Refrigeration Systems	Refrigerant Purchase Records, Refrigerant Sales Records, Calculation Methodology, Emission Factors
Landfills	Waste-in-Place Data, Waste Landfilled, Calculation Methodology, Emission Factors
Coal Mines	Coal Production Data Submitted to EIA, Quarterly MSHA Reports, Calculation Methodology, Emission Factors
Natural Gas Pipelines	Gas Throughput Data, Calculation Methodology, Emission Factors
Electric Transmission and Distribution	Sulfur Hexafluoride Purchase Records, Calculation Methodology, Emission Factors

Step 1: Identifying Emission Sources

Verifiers should review a participant's reported emission source inventories (facility, source, and fuel) to ensure that all sources are identified. Verifiers should then determine the GHGs that will result from the identified sources and estimate their magnitude. GHGs that are not required to be reported can be disregarded. Finally, verifiers should rank the remaining reported emissions by CO_2e (using the Global Warming Potentials [GWPs] contained in the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR) - see Table 2, below) to assess the environmental risk associated with the emissions.

Table 2. GWPs from IPCC's Second Assessment Report

Greenhouse Gas	GWP (SAR, 1996)
CO_2	1
CH_4	21
N_2O	310
HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,000
C_6F_{14}	7,400
SF_6	23,900

Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003 (April 2005).

When the emission source inventory is complete, verifiers should review participant's GHG emissions report and document answers to the following questions to assess if the GHG emissions report reflects the geographic, organizational, and operational scope of the participant:

1. Does the GHG emissions report include all processes and facilities under the management control of the participant? If not, why?

2. Does the report include all sources of GHG emissions within the geographic and organizational boundaries of the participant?

3. Does the report include all applicable types of GHGs from each emission source within the geographic and organizational boundaries of the participant?

4. Have any mergers, acquisitions, or divestitures occurred during the current reporting year? Have any activities been outsourced in the current year? If yes, has the participant specified a baseline? If so, has it been adjusted?

After these questions have been answered, verifiers will be able to determine if the GHG emissions report accurately reflects the geographic, organizational, and operational scope of the participant. Once all emission sources have been identified, verifiers may proceed to Step 2 to review the calculation methods used and the management systems employed.

Step 2: Reviewing Methodologies and Management Systems

After the scope and comprehensiveness of the participant's emission sources has been confirmed, verifiers should review the methodologies and management systems that the participant used to calculate their emissions. This is principally a risk assessment exercise, in which the verifier must weigh the relative complexity of the scope of the participant's emissions, the participant's methodologies and management systems used to prepare the GHG emissions report, and the risk of calculation error as a result of reporting uncertainty or misstatement. Through these steps, the verifier should determine the appropriateness of the management systems to provide required data to the California Registry. For example, the absence of a comprehensive GHG management system for a participant with a single retail outlet and solely indirect emissions from electricity purchases may not add significant risk of material misstatement. In contrast, a large vertically-integrated manufacturing company with facilities in 31 states would require a much more robust management system for tracking and reporting its GHG emissions.

A verifier's general review of a participant's GHG management systems should document answers to the following questions:

1. Are calculation methodologies/procedures used to manage GHG emissions at the source level? Are they appropriate given the uncertainty/risk associated with the emissions? Are these methodologies/procedures standard within this industry?

2. Are appropriate methods used to manage and implement entity-wide GHG emissions reporting programs? If the participant has more than one facility, are the emissions data correctly aggregated and monitored?

3. Is someone responsible for managing and reporting GHG emissions? Is this individual qualified to perform this function?

4. Is appropriate training provided to personnel assigned to GHG emissions reporting duties? If the participant relies on external staff to perform required activities, are the contractors qualified to undertake such work? Is there internal oversight to assure quality of the contractor's work?

5. Are appropriate documents created to support and/or substantiate activities related to GHG emissions reporting activities, and is such documentation retained appropriately? For example, is such documentation maintained through reporting plans or procedures, utility bills, etc.?

6. Are the mechanisms used to measure and review the effectiveness of GHG emissions reporting programs appropriate for this purpose? For example, are policies, procedures, and practices evaluated and updated at appropriate intervals?

Verifiers should also consider how the participant's management systems are designed to support reporting five categories of emission sources (indirect, mobile, stationary, process and fugitive). Consequently, in reviewing a participant's Total Emissions Report, verifiers should document answers to the following questions:

1. Does the management system capture the diversity of the sources that comprise each emission category? For example, are there multiple types of vehicles and other transportation devices that require different emission estimation methodologies?

2. Does the system capture all the diversity of GHGs emitted from each emission source category?

3. Has the participant used the default emission factors and standardized estimation methods in the California Registry's General Reporting Protocol to calculate emissions in each source category? Has the participant or its technical assistance provider developed estimation methods independently? If the participant uses alternative emission factors, are they documented and explained appropriately?

4. Does the participant's GHG management systems appropriately track emissions in all of the emission source categories?

Once the verifier has assessed the overall risk associated with the management systems, the risks should be assessed in conjunction with the weighted CO_2e estimates determined in Step 1 (Identifying Emission Sources). Verifiers should then identify the areas with the greatest potential for material misstatements (either based on volume of emissions, lack of management systems, or both) to determine the best risk-based strategy to identify a representative sample of emissions to recalculate.

Step 3: Verifying Emission Estimates

Based on a participant's identified emission sources, management systems, and corresponding risk profile of GHG emissions, verifiers should select a representative sample of calculations to verify and sites to visit. Sampling procedures may entail conducting site visits, but should include reviewing documents such as utility bills or emissions monitor results, and recalculating emission estimates based on underlying activity data. In Table 3, below, the California Registry specifies the minimum number of sites that should be visited based on the size of the entity. The verifier should use professional judgment to assess if additional visits are needed.

Table 3. Minimum Site Visit Sample Size

Total Sites	Minimum Sample Size
2-10	30%
11-25	20%
26-50	15%
51-100	10%
101-250	5%
251-500	3%
501-1,000	2%
Over 1,000	1-2%

3.5 Potential Site Visits by the State of California

As part of the State of California's oversight of the verification process, the State will randomly accompany verifiers on site visits. The California Registry's enabling legislation directed the State to observe the verifier during verification visits, evaluate whether the participant has a GHG accounting program consistent with California Registry-approved procedures and protocols, and evaluate the reasonableness of the emissions information being reported. The State may send an employee or a contractor to accomplish this responsibility. The purpose of any site visit is to oversee the verifier's activities, and to evaluate the reasonableness of the participant's reported data. The State will report on its findings to the California Registry.

To accomplish this, during a site visit, the State will need to access the same information and sources as that of the verifier. The State will work with the verifier and participant to obtain this access. This may involve requesting access to on-site locations that may have GHG emission sources or related activities and participant information, data, records, or copies of records; observing verifiers during any exchange of participant data or data analyses; and/or asking the verifier to provide specific information related to their on-site and off-site data analyses. The State will also make every effort to not impede the normal activities of either the participant or the verifier. All costs for the State site visit are borne by the State.

Before the end of a site visit, the State will discuss its preliminary observations and evaluations with the verifier and participant. The State will also contact and discuss with the verifier and participant any findings that identify either party before reporting this to the California Registry.

As the Participant requests, a representative from the State, and/or the Verifier that will view confidential information should sign the Standard Nondisclosure Agreement (NDA). Rules covering State confidentiality can be found in the *California Code of Regulations, Title 20, Sect. 2501 et seq*.

3.6 Targeted Review & Recalculation of GHG Emissions

The California Registry does not expect nor require verifiers to review all of the participant's documents and recheck all their calculations. To ensure that data meet a minimum quality standard on an entity-wide basis, verifiers should concentrate their activities in the areas that have the greatest uncertainty and amount of emissions. Verifiers should calculate emissions for these sources and compare those calculations to emission levels reported by the participant. If they are free of material misstatement (have a difference of <5%), the verifier should declare that the participant's report conforms to the California Registry's Protocols.

If the reported data is not free of material misstatement, the verifier should include this information in its Verification Report and should complete its sampling effort of other sources. Once verifiers have confirmed that a sample of data is free of material misstatements, they should estimate total emissions and confirm that all material GHG emissions are reported.

3.7 De Minimis Emissions

De minimis emissions are a quantity of GHG emissions from one or more sources, for one or more gases, that when summed equal less than 5% of an organization's total CO_2e emissions. The percentage applies to California emissions for the purposes of California-only emissions reporting, and applies to U.S. emissions for national reporting. Participants have some discretion in choosing which sources and/or GHGs are de minimis, but are expected to disclose all de minimis emission sources in their emissions report. Verifiers should review participant's documentation and explanation of how de minimis emissions were calculated to confirm that not more than 5% of total CO_2e emissions are considered de minimis.

3.8 Identifying Material or Immaterial Misstatements

In order for verifiers to verify a GHG emissions report, a sample of data must be free of material misstatement. It is possible that during the verification process differences will arise between the emissions estimated by the participant and those estimated by the verifier. Differences of this nature may be classified as either material or immaterial. A discrepancy is considered to be material if the overall reported emissions differ from the overall emissions estimated by the verifier by 5% or more. A difference is immaterial if this difference is less than 5%.

A verifier's verification of emissions estimates should document the answers to the following questions:

1. Are the reported electricity, steam, and district heating and cooling use consistent with utility bills?

2. Is the reported total stationary fuel use by fuel type consistent with the fuel use records?

3. Is the reported total consumption of fuels in motor vehicles consistent with available documentation and by vehicle type? If the entity calculates transportation emissions based on vehicle mileage, is the reported vehicle mileage consistent with vehicle mileage records?

4. Are the reported process and fugitive emissions consistent with activity data or maintenance records?

5. Are the emission factors used by the participant appropriate? If California Registry default factors are not used, do the alternative emission factors provide increased accuracy? Is their derivation and explanation of increased accuracy properly documented and reasonable?

6. Does a sample of the participant's calculations agree with your re-calculated direct (mobile, stationary, process and fugitive) and indirect emissions estimates? Have you documented your process for determining the appropriate sampling plan?

7. Are all material GHG emissions included? Are all emissions that are considered de minimis emissions documented and reported as such?

8. Are the current year's reported emissions significantly different from the prior year's emission levels? If so, what has changed from prior years?

9. Has the accumulated change in reported emissions, since the last baseline update, changed by more than ten (10) percent? If so, has the baseline, if any, been recalculated?

10. Are there any discrepancies between your emissions estimates and the participant's material?

Once verifiers have reviewed these activities and answered these questions, they are ready to complete the verification process.

Part IV Completing the Verification Process

4.1 Overview

Once a verifier has completed reviewing a participant's annual GHG emissions report, they must do the following to complete the verification process:

1. Complete a detailed Verification Report, and deliver it to the participant;
2. Prepare a concise Verification Opinion, and deliver it to the participant;
3. Conduct an exit meeting with the participant to discuss the Verification Report and Verification Opinion and determine if material misstatements (if any) can be corrected. If so, the verifier and participant should schedule a second set of verification activities after the participant has revised the GHG emissions report.
4. Submit an electronic Verification Form and Verification Activity Log to the California Registry via CARROT;
5. Return important records and documents to the participant for retention.

4.2 Completing a Verification Report

4.2.1 Verification Report Content

The Verification Report is a confidential document that is shared between a verifier and a participant, and is only available to the California Registry or the public at the participant's request.

The Verification Report should include the following elements:

- The scope of the verification process undertaken;
- The standard used to verify emissions (this is the California Registry's General Reporting Protocol, but may also include other protocols or methodologies for those sources for which the California Registry has yet to provide detailed guidance);
- A description of the verification activities, based on the size and complexity of the participant's operations;
- A list of emission sources identified, including de minimis sources;
- A description of the sampling techniques and risk assessment methodologies employed for each source;
- An evaluation of whether the participant's annual GHG emissions report is in compliance with the California Registry's General Reporting Protocol;
- A comparison of the participant's overall emissions estimates with the verifier's overall emissions estimates;

- A list of material misstatements, if any;
- A list of immaterial misstatements, if any; and
- A general conclusion to be reflected in the Verification Opinion.

4.2.2 Quality Assurance Check

When the Verification Report is completed, it should be forwarded to an independent senior reviewer within the verifier's firm for a quality assurance check. No Verification Report should be forwarded to a participant until it has had an independent internal review.

4.2.3 Participant Review of Verification Report

Once a participant receives a Verification Report from their verifier, they should have at least 30 days to review and comment on the Verification Report. At the end of that review, the verifier and the appropriate official at the participant's organization should hold an exit meeting to discuss the nature of any material or immaterial misstatements.

4.3 Preparing a Verification Opinion

Verifiers should prepare a Verification Opinion using the template shown in Figure 2. The Verification Opinion is a simple confirmation of the verification activities and outcomes for all stakeholders (participants, verifiers, the California Registry, and the public). The Verification Opinion must also follow the same internal review process as the Verification Report and consequently must be reviewed by an independent senior reviewer within the verifier's firm, and signed by a designated lead verifier. An electronic version of this template is available on the California Registry's Verifiers Only webpage or may be obtained from the California Registry by emailing **help@climateregistry.org**.

4.4 Verification Activity Log

In order to assess the consistency of professional judgments that verifiers have been asked to make, verifiers should also complete a Verification Activity Log (Table 4 below) and submit a completed copy to the California Registry, along with the electronic Verification Form, in CARROT.

Table 4 includes a step-by-step outline of the standardized verification activities that all verifiers must consider. Not all activities are required of all participants or during each year, depending on a participant's specific circumstances, but verifiers should review this list and note "not applicable" (or "N/A") where appropriate. The table also includes a series of yes/no questions. Any "no" response should be explained, without revealing a participant's confidential information.

The California Registry will consider both the Verification Opinion and the answers in Table 4 in its final review of emissions data, before accepting a participant's report into the California Registry. An electronic version is available for download in CARROT, on the California Registry's Verifiers Only webpage, and from the California Registry by emailing **help@climateregistry.org**.

Table 4. Verification Activity Log

Verifier Company:		
California Registry Participant:		
Preparing for Verification	**Date Achieved**	
Bid on a Verification Contract		
Request determination of COI from California Registry		
Negotiate Contract with California Registry Participant		
Notify State of California and California Registry of Planned Verification Activities		
Conduct Kick-off Meeting With Participant		
Plan Verification Activities Based on Participant Characteristics		
Core Verification Activities **Identify Emission Sources**	**Date Achieved**	
Identify and list all facilities in the entity		
Identify and list all emission sources (indirect, mobile, stationary, process and fugitive)		
Identify and list all fuel types		
Rank all sources by magnitude on a carbon dioxide equivalent basis		
Assess any changes in geographic and organizational boundaries		
	Yes	**No**
1. Does the GHG emissions report include all processes and facilities under the management control of the participant?		
2. Does the report include all sources of GHG emissions within the geographic and organizational boundaries of the participant?		
3. Does the report include all applicable types of GHGs from each emission source within the geographic and organizational boundaries of the participant?		
4. Have any mergers, acquisitions, or divestitures occurred during the current reporting year?		
5. Have any activities been outsourced in the current year?		
6. If a baseline has been specified, has it been adjusted accordingly?		
7. Does the GHG emissions report include all processes and facilities under the management control of the participant?		
Review Methodologies and Management Systems	**Date Achieved**	
Evaluate procedures and systems for preparing emissions report		
Evaluate personnel and training for preparing emissions report		
Consider the uncertainty associated with methodologies and management systems		
	Yes	**No**
8. Are appropriate calculation methodologies/procedures used to manage GHG emissions at the source level? Are they appropriate given the uncertainty/risk associated with the emissions?		
9. Are appropriate methods used to manage and implement entity-wide GHG emissions reporting programs?		
10. If the participant has more than one facility, is the emissions data correctly aggregated and monitored?		
11. Is someone responsible for managing and reporting GHG emissions?		
12. Is that person qualified to do so?		
13. Is appropriate training provided to personnel assigned to GHG emissions reporting duties? If the participant relies on external staff to perform required activities, are the contractors' qualified to undertake such work?		
14. Are appropriate documents created to support and/or substantiate activities related to GHG emissions reporting activities, and is such documentation retained appropriately?		
15. Are appropriate mechanisms used to measure and review the effectiveness of GHG emissions reporting programs? For example, are policies, procedures, and practices evaluated and updated at appropriate intervals?		

16. Does the system account for the diversity of the sources that comprise each emission category? For example, are there multiple types of vehicles and other transportation devices that require different emission estimation methodologies?		
17. Do you know the diversity of GHGs emitted from each emission source category?		
18. Has the participant used the default emission factors and standardized estimation methods in the California Registry's General Reporting Protocol to calculate emissions in each source category?		
19. Has the participant or its technical assistance provider developed estimation methods independently?		
20. If participant uses alternative emission factors, are they documented and explained appropriately?		
21. Does the participant's GHG management system appropriately track emissions in all of the emission source categories?		
Assess Risk of Material Misstatement Associated with Management Systems/Procedures	**Date Achieved**	
Develop sampling procedures for sources based on risk of material misstatement		
Verify Emission Estimates		
Confirm total fuel consumption		
Confirm vehicle miles traveled		
Confirm that appropriate emission factors are used. If not default factors, ensure the derivation and explanation of increased accuracy is properly documented		
Calculate direct (mobile, stationary, process & fugitive) & indirect emissions based on sampling procedures		
Compare estimates from sample calculations to reported emissions		
Determine if there are any discrepancies between sample calculation and reported emissions		
Confirm that all material GHG emissions are included (that all emissions not included are either de minimis or not required)		
Determine if Discrepancies are Material or Immaterial	**Yes**	**No**
22. Based on the following table, have you visited an appropriate number of sites?		

Total Sites	Minimum Sample Size
2-10	30%
11-25	20%
26-50	15%
51-100	10%
101-250	5%
251-500	3%
501-1,000	2%
Over 1,000	1-2%

Total number of sites:________
Total number visited:_________

23. Are the reported electricity, steam, and district heating and cooling use consistent with utility bills?		
24. Is the reported total stationary fuel use by fuel type consistent with the fuel use records?		
25. Is the reported total consumption of fuels in motor vehicles consistent with available documentation and by vehicle type? If the entity calculates transportation emissions based on vehicle mileage, is the reported vehicle mileage consistent with vehicle mileage records?		
26. Is the reported process and fugitive emissions consistent with activity data or maintenance records?		
27. Are the emission factors used by the participant appropriate? If California Registry default factors are not used, ensure that alternative emission factors provide increased accuracy and that the derivation and explanation of increased accuracy is properly documented and reasonable.		
28. Does a sample of the participant's calculations agree with your re-calculated direct (mobile, stationary, process & fugitive) & indirect emissions estimates? Have you documented your process for determining the appropriate sampling plan?		
29. Are all material GHG emissions included? Are all emissions that are considered de minimis emissions documented as such?		
30. Are the current year's reported emissions significantly different from the prior year?		
31. Has the accumulated change in reported emissions, since the last baseline update, changed by more than 10%? If so, has the baseline, if any, been recalculated?		
32. Are discrepancies between your emissions estimates and the participant's immaterial?		

Completing the Verification Process	Date Achieved
Prepare a detailed Verification Report and submit to participant	
Prepare a Verification Opinion and submit to participant	
Conduct exit meeting with participant to discuss Verification Report & Opinion	
Provide records to participant for retention	

4.5 Completing the Verification Contract

4.5.1 Exit Meeting

Verifiers should prepare a brief summary presentation of their verification findings for the participant’s key personnel. At the exit meeting, verifiers and participants might exchange lessons learned about the verification process and share thoughts for improving the verification process in the future. Verifiers and participants may wish to consider joint feedback to the California Registry.

The goals of this meeting should be:

- Acceptance of the Verification Report and Opinion (unless material misstatements exist and can be remediated, in which case the verification contract may need to be revised and a second verification process scheduled). If the participant does not wish to retain the verifier for the re-verification process, the verifier shall turn over the participant’s relevant documentation to the participant within 30 days.

- Authorization for the verifier to complete the Verification Form in CARROT.

If the verifier is under contract for verification activities in future years, the verifier and participant may wish to establish a schedule for the next year’s verification activities.

Figure 2. Sample Verification Opinion

[*Insert Verification Firm Logo*]

California Climate Action Registry Verification Opinion

Name of Verification Firm: _____

This is to verify that _____ [*Name of Member Organization*] has had its greenhouse gas emissions report covering the period January 1, _____ [*Insert Reporting Year*] to December 31,_____ [*Insert Reporting Year*] verified according to the California Climate Action Registry's General Verification Protocol against a standard of the California Registry's General Reporting Protocol.

Organizational Boundary of Verification

☐ Financial Management Control ☐ Operational Management Control ☐ Equity Share

GHGs Verified

☐ CO_2 ☐ CH_4 ☐ N_20 ☐ HFCs ☐ PFCs ☐ SF_6

Total Direct Emissions: _____

Total Indirect Emissions: _____

Geographic Scope of Verification

☐ California Emissions ☐ U.S. Emissions

Baseline Year (if specified)

_____ (Direct) _____ (Indirect) Year, if specified

Verification Opinion

☐ Verified without Qualification

☐ Unable to Verify

Attestation

_________________________________ _____________

[*Insert Name*], Lead Verifier Date

_________________________________ _____________

[*Insert Name*], Senior Internal Reviewer Date

Authorization

I _____ [*Name of Member Representative*] authorize the above named verifier to submit this Verification Opinion to the California Climate Action Registry for _____ [*Name of Member Organization*].

_________________________________ _____________

[Member Representative Signature] Date

4.5.2 Limits to Verifier Feedback

If a participant's emissions report is not verifiable due to material misstatements, a *verifier must not provide guidance on how to remediate the identified misstatements*. Such guidance would be considered a consulting activity and therefore, a conflict of interest. However, verifiers may provide any existing documentation that may be useful to participants in preparing remediation plans. A verifier should also enumerate any shortcomings in a participant's GHG tracking and management systems.

The California Registry will retain the participant's unverified emissions report in the California Registry database for up to two years pending verification. After two years, if the emissions report is still not verifiable, the California Registry will render the emissions report inactive.

4.6 Submitting the Verification Opinion to the California Registry

Once the Verification Opinion is complete and has been authorized by the participant, the verifier must complete the Verification Form and Verification Activity Log electronically in CARROT and the participant must email a Portable Document File (PDF) copy of the fully executed verification opinion to help@climateregistry.org. The participant may also elect to send a hard copy of the verification opinion with wet signatures to the address listed below:

Verification Opinion
California Climate Action Registry
523 W. Sixth Street, Suite 428
Los Angeles, CA 90014

Once the California Registry receives an electronic or hard copy of the Verification Opinion, the California Registry will perform a final review of the emissions report in CARROT. When successful, the participant's report will be formally accepted into the California Registry database and the annual verification process will be completed.

*Note: Participants are *not* required to submit their Verification Opinions to the California Registry for the first two years of their participation. However, it is important to note that a participant's emissions data will not be considered accepted by the California Registry unless the California Registry receives a Verification Opinion indicating a "verified without qualification" assessment.

4.7 Record Keeping and Retention

While the California Registry views the verification process essentially as a private exchange between the verifier and the participant, the verifier should remind the participant to retain sufficient records to enable an ex-post verification of the participant's emissions. The California Registry recommends that the following records be retained for a minimum of seven years as specified by contract with the participant.

Verifiers should retain hard and electronic copies, as applicable, of:

- The participant's GHG emissions report (printable from CARROT);
- The Verification Report; and
- The Verification Opinion.

The participant should maintain the following documentation for a minimum of seven years:

- Contact information for the lead verifier and a responsible corporate officer at the participant's organization;
- A general description of the participant's organization;
- The geographic boundaries;
- The number of facilities and operations assessed in the verification activities;
- The GHGs evaluated;
- The sources of emissions identified;
- Assessment of emission factors, demonstrating greater accuracy if not default emission factors;
- Copies of fuel use, mileage, or other activity data records used in sample recalculations;
- Verification methodology used based on the size and complexity of the participant;
- Sampling procedures for selecting site visits;
- Dates of site visits;
- The verifier's evaluation of the participant's management systems; and
- The verifier's estimates of the participant's emissions.

Copies of the original activity data records are necessary to perform an ex-post verification.

4.8 Timeline of Verification Process

Incorporating all of the steps and procedures involved in reporting, reviewing and verifying credible emissions data may be a lengthy process. The following table gives you an overview of the consecutive steps and necessary lapses of time between steps in the verification process.

Table 5. Verification Process Timeline

Activity	Elapsed Time
Preparing for Verification	
Contacted by participant to submit proposal for services	Where no consulting activities for 3 years prior to contract
Selected by participant	Varies
Submit request for case-by-case determination of COI to California Registry	Prior to contract negotiation
California Registry evaluates case and issues notification of low risk for COI	One month
Negotiate contract with participant	Varies
Notify State of California and California Registry of verification activities	One month
Core Verification Activities	
Begin verification activities	Maximum one year
Completing the Verification Process	
Submit Verification Report and Opinion to participant	Varies
Participant reviews Verification Report and Opinion and returns comments to verifier	One month
Verifier discusses findings with participant	Varies
Participant authorizes submission of electronic Verification Form to the California Registry	By October 31 of data year +1
Monitor emerging COI	One year
Verifier cannot provide consulting services to participant	One year
Participant chooses a new verifier	After a maximum of six years

Glossary

Applicant	A firm, or lead firm (if part of a team), responding to a State-issued RFA for Verifiers.
Baseline	Datum against which to measure greenhouse gas emissions performance over time, usually annual emissions in a selected base year.
Batch Verification	Verification process arranged by the California Registry for multiple participants with relatively simple GHG emissions (less than 500 tons of CO_2e emissions and typically only indirect emissions from electricity consumption and/or direct emissions from stationary or mobile combustion).
Verification	The process used to ensure that a given participant's greenhouse gas emissions inventory (either the baseline or annual result) has met a minimum quality standard and complied with the California Registry's procedures and protocols for calculating and reporting GHG emissions.
Verified Member	A California Registry participant that has submitted at least one verified annual emissions report to the California Registry.
Verifier	A firm or team of firms that has been State- and California Registry-approved to conduct verification activities under the California Registry program. A verifier may also refer to a single employee within a State- and California Registry-approved firm who conducts verification activities.
CO_2 equivalent*	(CO_2e) The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of harm which can be caused by different GHGs.
Conflict of Interest	A situation in which, because of other activities or relationships with other persons or organizations, a person or firm is unable or potentially unable to render an impartial Verification Opinion of a potential client's greenhouse gas (GHG) emissions, or the person or firm's objectivity in performing verification activities is or might be otherwise compromised.
Datum	A reference or starting point.
De Minimis	A quantity of greenhouse gas emissions from one or more sources, for one or more gases, which, when summed equal less than 5% of an organization's total CO_2e emissions.
Direct Emissions	Emissions from sources that are owned or controlled by the reporting organization.
Emerging COI	A potential or actual COI situation that arises, or becomes known, during verification or for a period of one year after the completion of verification activities.

Emission Factor*	A factor relating activity data and absolute GHG emissions.
Equity Share	Fractional percentage or share of an interest in an entity based either on ownership interest, or on some other contractual basis negotiated among the entity's stakeholders.
Fugitive Emissions*	Unintended or incidental emissions of GHGs from the transmission, processing or transportation of fossil fuels or other materials, such as HFCs from refrigeration leaks, SF_6 from electric power distribution equipment, methane from mined coal, CO_2 emitted incidentally with geyser steam and/or fluid used in geothermal generating facilities.
Global Warming Potential*	(GWP) The ratio of radiative forcing (degree of harm to the atmosphere) that would result from the emission of one unit of a given GHG to one unit of CO_2.
Greenhouse Gases	(GHGs) For the purposes of the California Registry, GHGs are the six gases identified in the Kyoto Protocol: carbon dioxide (CO_2), nitrous oxide (N_20), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
Indirect Emissions	Emissions that are a consequence of the actions of a reporting entity, but are produced by sources owned or controlled by another entity.
Inherent Uncertainty	The scientific uncertainty associated with measuring GHG emissions due to limitations on monitoring equipment, or measurement methodologies.
Lead Verifier	An individual who has completed a California Registry-sponsored verification training workshop and who has the authority to sign a verification firm's Verification Opinion.
Management Control	The ability of an entity to govern the operating policies of another entity or facility so as to obtain benefits from its activities.
Material misstatement	An error (for example from an oversight, omission or miscalculation) that results in the reported quantity being significantly different from the true value to an extent that will influence performance or decisions.
Member	A California Registry participant that is preparing its annual GHG emissions report, but has not yet submitted its verified report to the California Registry.
Minimum Quality Standard	Data that is free of material misstatements, and meets the California Registry's minimum level of accuracy of at least 95%.
Mobile Combustion*	Burning of fuels by transportation devices such as cars, trucks, airplanes, vessels, etc.
Organizational COI	Instances where the ability to render objective GHG verification services may be affected by the services provided by, shared management and/or financial resources with, or other situations created by a parent company or other related entities.

Outsourcing*	The contracting out of activities to other businesses.
Partner	An organization working through a lead firm (applicant) to respond to a State-issued RFA for Verifiers. A partner may or may not be a related entity. If the applicant submits an application wherein staff or financial capability is shared with either a parent firm or subsidiary of a parent firm, then that parent or subsidiary is considered a partner. If the applicant is part of a larger organization, but the application does not include any staff or financial capability from the larger organization, then the larger organization is not considered a partner.
Personal COI	A relationship of an employee or a partner employee that may impair the objectivity of the employee in performing a verification.
Process Emissions	Emissions from physical or chemical processing rather than from combustion, such as CO_2 emissions from cement manufacturing and PFC emissions from aluminum smelting.
Related Entity	An organization that is linked to the verifier by: common ownership or directors, contractual arrangement, a common name, informal understanding, or other means such that the related organization has a vested interest in the outcome of an assessment or has a potential ability to influence the outcome of an accredited management system assessment, greenhouse gas validation, or verification.
Reporting Uncertainty	The errors made in identifying emission sources and managing and calculating GHG emissions. This differs from inherent uncertainty due to incomplete understanding of climate science or a lack of ability to measure greenhouse gas emissions.
Stationary Combustion*	Burning of fuels to generate electricity, steam, or heat.

**Definitions of key terms obtained from "The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard," World Business Council for Sustainable Development and World Resources Institute, Switzerland, March 2004.*

Key Questions

Verifier Approval: *Who may qualify as a verifier?*

Only those firms accredited by the California Registry, the State of California, or The Climate Registry may provide verification services to California Registry participants

To become approved, a verifier must complete a two-step process: 1) Obtain accreditation as a GHG verifier from either the California Air Resources Board or from the American National Standards Institute (or other approved accreditation body as specified on the California Registry website) and 2) achieve California Registry approval by attending a verification training workshop facilitated by the California Registry.

Information on the ANSI GHG Verifier Accreditation is available at www.ansi.ghg.org. Information on CARB GHG accreditation is available at arb.ca.gov.

Applicants who wish to be qualified as approved verifiers need to demonstrate experience in GHG verification and verification of financial data, technical data, quality control, and/or environmental management systems. Verifiers must also demonstrate the means to accept financial liability for verification activities undertaken for a participant. *Firms providing verification services to a participant may not provide any non-verification services that create a high risk of COI to the same participant for three years prior to and one year after verification.*

Liability: *What liability will a verifier incur? What liability coverage must a verifier accept?*

At a minimum, a verifier is responsible for planning a participant's verification activities, conducting the verification activities, preparing a Verification Report and Opinion, and submitting authorized Verification Opinions to the California Registry via CARROT. If a California Registry-approved verifier fails to complete the contracted activities, they may be financially liable for the cost of hiring a different California Registry-approved verifier to complete a proper verification from start to finish (as defined in the contract between a verifier and a participant). The verifier may incur additional liability based on the negotiated terms of the contract. This liability may include the future value of GHG emissions or emission reductions, damages, or any other element agreed to by the verifier and the participant.

In their initial application, verifiers must demonstrate the means to accept financial liability for verification activities undertaken for a California Registry participant, specify such liability in any contract for verification activities, and make adequate arrangements (e.g., professional liability insurance coverage) to cover liabilities arising from its activities or operations. However, verifier liability may also be limited in the contract with the California Registry participant.

Resolution of Disputes: *What recourse is available if the participant does not accept the findings of the verification?*

There may be instances where a verifier and a participant cannot agree on identification of material misstatements and/or the findings of the Verification Opinion. In such instances, both parties can request the Dispute Resolution Committee, composed of qualified representatives from California state agencies, the California Registry, and one non-voting verifier, who serves pro bono on an annual, rotating basis. The participant and the verifier will each pay a filing fee equal to 5% of the participant's annual membership fee to submit the matter to the Dispute Resolution Committee.

The Dispute Resolution Committee will interview the participant and the verifier, review the area of dispute and reach a unanimous, binding decision concerning verifiability. The California Registry will notify the verifier and the participant of the Committee's decision. Thus, as part of contract negotiations, each California Registry participant and verifier will need to sign a form agreeing to this Dispute Resolution policy.

"Batch Verification": *How does it work? How will it affect bidding, contracting, and the overall verification process?*

In an effort to minimize the transaction costs of verification, the California Registry will help eligible participants with simple GHG emissions contract for "batch verification". Eligible participants have relatively simple GHG emissions (indirect emissions from purchased electricity and/or emissions from limited stationary and mobile sources) and produce less than 500 metric tons of CO_2e per year.

In batch verification, the California Registry will work with one verifier each year to verify the emissions reports of multiple organizations at one time. Emissions must be verified to the standards of the General Reporting Protocol. Because of the nature of the emissions, batch verification activities will consist of document review and phone conversations, but will not require a site visit. The California Registry will assist in negotiating a standardized contract and a flat fee for each organization. Standardizing the contract language will help to minimize the transaction costs of verification for small, office-based organizations.

A new batch verifier will be chosen each year. This finite verifier term is to minimize the risk from COI and to eliminate the cost associated with a case by case COI.

Verification Deadlines: *What is the deadline for completing the verification process?*

Emissions should be reported to the Registry no later than June 30 following the emissions year. Verification should be completed by October 31 following the emissions year. For instance, 2008 emissions should be reported by June 30, 2009 and verified by October 31, 2009.

Verification Report and Verification Opinion: *What are the Verification Report and Verification Opinion and how are they different?*

The Verification Report is a detailed report that a verifier prepares for a participant. The Verification Report should describe the scope of the verification activities, standards used, emission sources identified, sampling techniques, evaluation of a participant's compliance with the General Reporting Protocol, assumptions, and a list of material and immaterial misstatements, if any. The Verification Report is a confidential document between the verifier and the participant, and is only shared with the California Registry or the public at the participant's request.

The Verification Opinion is a brief, one-page summary of the verifier's findings that simply states if the participant's emissions report is verifiable or not. The Verification Opinion is submitted in hard copy by the verifier to the participant for approval.

Verification and Remediation: *What if a participant's emissions report is not verified?*

After completing verification activities, the verifier will prepare a Verification Report and forward it to the responsible official representing the participant. The responsible official includes anyone authorized by the participant to approve the GHG emissions report for submission to the California Registry and will typically be a corporate official or the technical manager of the verification contract.

If the verifier identifies material misstatements that prevent a favorable Verification Opinion, those material misstatements should be listed and described in the Verification Report. If possible, the participant may correct those material misstatements and resubmit the emissions report for verification within a reasonable amount of time. The participant may seek technical assistance to correct material misstatements but the verifier may not provide such technical assistance as it would constitute non-verification services, and create a conflict of interest.

The California Registry will retain the participant's unverified data in the California Registry database for up to two years, pending correction. After that time, the participant will need to re-enter the data.

Confidentiality: *Are the results of the verification kept confidential? Will emissions data be kept confidential?*

All aggregated entity-level emissions data and metrics reported to the California Registry will be available to the public. However, the California Registry will keep confidential all reported emissions, activity data, methodologies, and emissions factors that are reported at facility, project, or source levels. Confidential information will only be accessible to the participant, the California Registry, and the verifier, unless the participant allows others access to such information or wishes to have it available to the public. In instances where the State of California accompanies verifiers on site visits, the State may have access to confidential information as needed to oversee verification activities and evaluate the reasonableness of the participant's data and systems to track emissions. Representatives from the State, the Verifier, and the Participant who will view confidential information will all be required to sign the Standard Nondisclosure Agreement (NDA). As noted in an earlier question, the Verification Report is a private document between a participant and verifier, while the Verification Opinion is shared with the California Registry. A majority of the contents of the Verification Opinion will also be shared with the public.

General Verification Protocol Revision Policy: *Will this General Verification Protocol change over time? How can verifiers provide feedback to the California Registry?*

The California Registry expects to regularly review, revise, update, and augment this General Verification Protocol. The California Registry invites all parties, verifiers, California Registry participants, California State agencies, and the public to provide insights and experiences that will help improve the General Verification Protocol. Anyone with suggestions or concerns is encouraged to contact the California Registry at any time at 213-891-1444 or by email at info@climateregistry.org**.**

Stakeholders will also be able to present suggestions directly to the California Registry's Board of Directors for consideration at their meetings. All suggestions and requests for modifications must be made by utilizing the "Protocol Comment Form" available on the California Registry's website at **www.climateregistry.org/protocols**.

California Registry-Approved Technical Assistance Providers: *What role do they play?*

Some participants may desire outside assistance, either in terms of expertise or human resources, to collect, document and report their emissions to the California Registry and/or otherwise manage their GHG emissions. To assist participants in identifying a firm qualified to help them, the State and the California Registry approve firms qualified to serve as technical assistance providers (TAs). Participants are not required to use only approved TAs. However, approved companies have been approved as firms experienced in providing GHG emissions services, and many of them have attended California Registry-sponsored training sessions. Where a participant has retained the services of a TA, the participant may ask the TA to play a role in the verification process. Neither the California Registry nor the State is responsible for any consulting services or recommendations they may provide, nor do they specify any role that TAs should or should not play.

All firms approved as verifiers also are automatically qualified to act as TAs. However, a firm cannot provide both technical assistance and verification services to the same client at the same time.

Role of California State Agencies: *What is the relationship between the California Registry and state agencies?*

The Registry was established by California statute as a non-profit voluntary registry for greenhouse gas emissions inventories, to help organizations establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. The State of California was directed to offer its best efforts to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international GHG regulatory scheme.

The California Registry and state agencies work together and keep each other informed about current activities. The State of California continues to provide technical guidance to the California Registry and plays a direct oversight role in the verification process. The California Registry gives great weight to state agency guidance and relies in large part on these recommendations when developing California Registry policies, procedures and tools, including reporting and verification protocols and the online reporting tool. However, final policy and technical decisions are made independently by the California Registry's Board of Directors.

Updated Emissions Reports: *Once a report has been verified, will it ever change?*

Following verification of an annual GHG emissions report, there may be situations in which a verified report may change. A participant may wish to add information beyond the minimum reporting standards (add non-CO_2 gases during the first three years of reporting, report facilities outside of California, change the emission factor used, etc.). Participants can update their report at any time. However, any changes will need to be re-verified, and this information will need to be documented in CARROT. As understanding and sophistication of GHG accounting principles develops, the California Registry may elect to update accounting principles (e.g., alternate emission factors, Global Warming Potentials). Where participants have used CARROT to calculate their emissions, these changes do not need to be re-verified.

CARROT: *Am I required to use CARROT to communicate with the California Registry?*

Participants are required to report their emissions to the California Registry using CARROT. The participant-entered annual GHG emissions report generated by CARROT is the document on which the verifier provides its Verification Opinion to the California Registry. The Verification Opinion is submitted in separately by the participant. Verifiers are not restricted to only communicating with the California Registry via CARROT, but must use the online tool to submit an electronic Verification Form and Verification Activity Log. Questions about using CARROT may be directed to the California Registry at 213-891-1444 or **help@climateregistry.org**.

Additional Questions?

If you have any questions regarding GHG emissions reporting or verification under the California Registry Protocols, please contact the California Registry by phone (213-891-1444) or email (**help@climateregistry.org**).

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Golden State
Water Company
A Subsidiary of American States Water Company

Final Report

2010 Urban Water Management Plan
South San Gabriel

CORPORATE OFFICE
630 E. FOOTHILL BLVD.
SAN DIMAS CA 91773

August 2011

Kennedy/Jenks Consultants

Final Report

2010 Urban Water Management Plan—South San Gabriel

Golden State
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Corporate Office

630 E. Foothill Blvd.
San Dimas, CA 91773

August 2011

Kennedy/Jenks Consultants

10850 Gold Center Drive, Suite 350
Rancho Cordova, CA 95670

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Notice of Adoption

A meeting to solicit public comments on the 2010 Urban Water Management Plan for the Golden State Water Company South San Gabriel System was held on July 19, 2011 at 6 p.m. at the San Dimas Community Center in San Dimas, California. Notice of this meeting was published in accordance with Section 6066 of the Government Code in the San Gabriel Valley Tribune on May 17, 22, and June 15, 2011.

Copies of the Urban Water Management Plan were made available to the public at the Golden State Water Company Customer Service Office in Arcadia, California, at least one week prior to the public hearing.

Golden State Water Company, hereby, adopts the 2010 Urban Water Management Plan for the South San Gabriel System.

William C. Gedney
Vice President, Asset Management
Golden State Water Company

August 31, 2011

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Abbreviations

µg/L	micrograms per liter
ac-ft	acre-feet
ac-ft/yr or AFY	acre-feet per year
Act	Urban Water Management Planning Act
AMR	automatic meter reading
AWWA	American Water Works Association
BMPs	best management practices
Cal EMA	California Emergency Management Agency
CAL Green Code	California Green Building Standards Code
ccf	hundred cubic feet
CDPH	California Department of Public Health
CII	commercial, industrial, institutional
CIMIS	California Irrigation Management Information System
COG	Council of Governments
Council or CUWCC	California Urban Water Conservation Council
CPUC	California Public Utilities Commission
CRA	Colorado River Aqueduct
D/DBP	disinfectant/disinfection by-product
DMM	Demand Management Measure
DOF	Department of Finance
DSC	Discovery Science Center
DWF	dry weather flow
DWR	Department of Water Resources (California)
DWR Guidebook	Guidebook to Assist Water Suppliers in the Preparation of a 2010 Urban Water Management Plan

ERP	Emergency Response Plan
ETo	evapotranspiration
GAC	Granular Activated Carbon
GIS	Geographic Information System
gpcd	gallons per capita day
gpd	gallons per day
gpm	U.S. gallons per minute
GSWC	Golden State Water Company
HCD	Housing and Community Development
HECW	high-efficiency clothes washers
HET	high-efficiency toilets
IRP	Integrated Resources Plan
LACSD	Sanitation Districts of Los Angeles County
MAF	million acre-feet per year
MCL	maximum contaminant levels
Metropolitan	Metropolitan Water District of Southern California
MF	multi-family
mgd	million gallons per day
MOU	memorandum of understanding (regarding urban water conservation in California)
msl	mean sea level
N/A	not available, not applicable
NAICS	North American Industry Classification System
O&M	operation and maintenance
OSY	operating safe yield
pCi/L	picoCuries per liter
RAP	Resource Action Programs
RHNA	Regional Housing Needs Allocation

RTP	Regional Transportation Plan
RUWMP	Regional Urban Water Management Plan
SBX7-7	Senate Bill X7-7, The Water Conservation Act of 2009
SCAG	Southern California Association of Governments
SD	Science Discover
SDWA	Safe Drinking Water Act
SF	single-family
SWP	State Water Project
TAF	thousand acre-feet per year
ULFT	ultra-low-flush-toilet
Upper District	Upper San Gabriel Valley Municipal Water District
USEPA	U.S. Environmental Protection Agency
USGVMWD	Upper San Gabriel Valley Municipal Water District
UWMP	Urban Water Management Plan
VOCs	volatile organic compounds
WAP	Water Action Plan
WBIC	weather based irrigation controllers
WLCD	Water Loss Control Department
WRCC	Western Regional Climate Center
WRP	water reclamation plant
WSAP	Water Supply Allocation Plan
WSDM Plan	Water Surplus and Drought Management Plan
WSS	WaterSense Specification

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Definitions

Chapter 2, Part 2.6, Division 6 of the California Water Code provides definitions for the construction of the Urban Water Management Plans. Appendix A contains the full text of the Urban Water Management Planning Act.

CHAPTER 2. DEFINITIONS

Section 10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

Section 10611.5. "Demand management" means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

Section 10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

Section 10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

Section 10614. "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

Section 10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, and reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

Section 10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

Section 10616.5. "Recycled water" means the reclamation and reuse of wastewater for beneficial use.

Section 10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 4 (commencing with Section 116275) of Part 12 of Division 104 of the Health and Safety Code.

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Chapter 1: Plan Preparation

1.1 Background

This Urban Water Management Plan (UWMP) has been prepared for the Golden State Water Company (GSWC) South San Gabriel System in compliance with Division 6, Part 2.6, of the California Water Code, Sections 10608 through 10657 as last amended by Senate Bill No. 7 (SBX7-7), the Water Conservation Act of 2009. The original bill requiring an UWMP was enacted in 1983. SBX7-7, which became law in November 2009, requires increased emphasis on water demand management and requires the state to achieve a 20 percent reduction in urban per capita water use by December 31, 2020.

Urban water suppliers having more than 3,000 service connections or water use of more than 3,000 acre-feet per year (ac-ft/yr) for retail or wholesale uses are required to submit a UWMP every 5 years to the California Department of Water Resources (DWR). The UWMP typically must be submitted by December 31 of years ending in 0 and 5, however SBX7-7 extended the UWMP deadline to July 1, 2011 to provide for development by DWR of required evaluation methodologies for determining water demand reduction targets. GSWC prepared an UWMP for the South San Gabriel System in 1985, 1990, 1995, 2000, and 2005. This 2010 UWMP is an update to the 2005 plan.

GSWC water use targets for the South San Gabriel System were developed based on Compliance Method 3 and the Minimum Reduction requirement, as described by SBX7-7 and supplemental guidance from DWR.

The portion of the Urban Water Management Planning Act (Act) that describes the purpose and intent of the UWMP states and declares the following:

> *Section 10610.2.*
> *(a) The Legislature finds and declares all of the following:*
> *(1) The waters of the state are a limited and renewable resource subject to ever-increasing demands.*
> *(2) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.*
> *(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate.*
> *(4) As part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry water years.*
> *(5) Public health issues have been raised over a number of contaminants that have been identified in certain local and imported water supplies.*
> *(6) Implementing effective water management strategies, including groundwater storage projects and recycled water projects, may require specific water quality and salinity targets for meeting groundwater basins water quality objectives and promoting beneficial use of recycled water.*
> *(7) Water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities.*
> *(8) Changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.*
> *(9) The quality of source supplies can have a significant impact on water management strategies and supply reliability.*

(b) This part is intended to provide assistance to water agencies in carrying out their long-term resource planning responsibilities to ensure adequate water supplies to meet existing and future demands for water.

Section 10610.4. The Legislature finds and declares that it is the policy of the state as follows:

(a) The management of urban water demands and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The management of urban water demands and efficient use of urban water supplies shall be a guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to actively pursue the efficient use of available supplies.

1.2 System Overview

GSWC is an investor-owned public utility company which owns 38 water systems throughout California regulated by the California Public Utilities Commission (CPUC). This UWMP has been prepared for the South San Gabriel System.

Located in Los Angeles County, the South San Gabriel System serves half of the City of Rosemead, parts of the City of San Gabriel, the City of Monterey Park, and adjacent unincorporated areas of Los Angeles County. The service area is primarily characterized by residential and commercial areas. Figure 1-1 illustrates the location of the South San Gabriel System.

1.3 Notice of Document Use

GSWC is committed to implementation of the projects, plans, and discussions provided within this document. However, it is important to note that execution of the plan is contingent upon the regulatory limitations and approval of the CPUC and other state agencies. Additionally, this document merely presents the water supply, reliability, and conservation programs known and in effect at the time of adoption of this plan.

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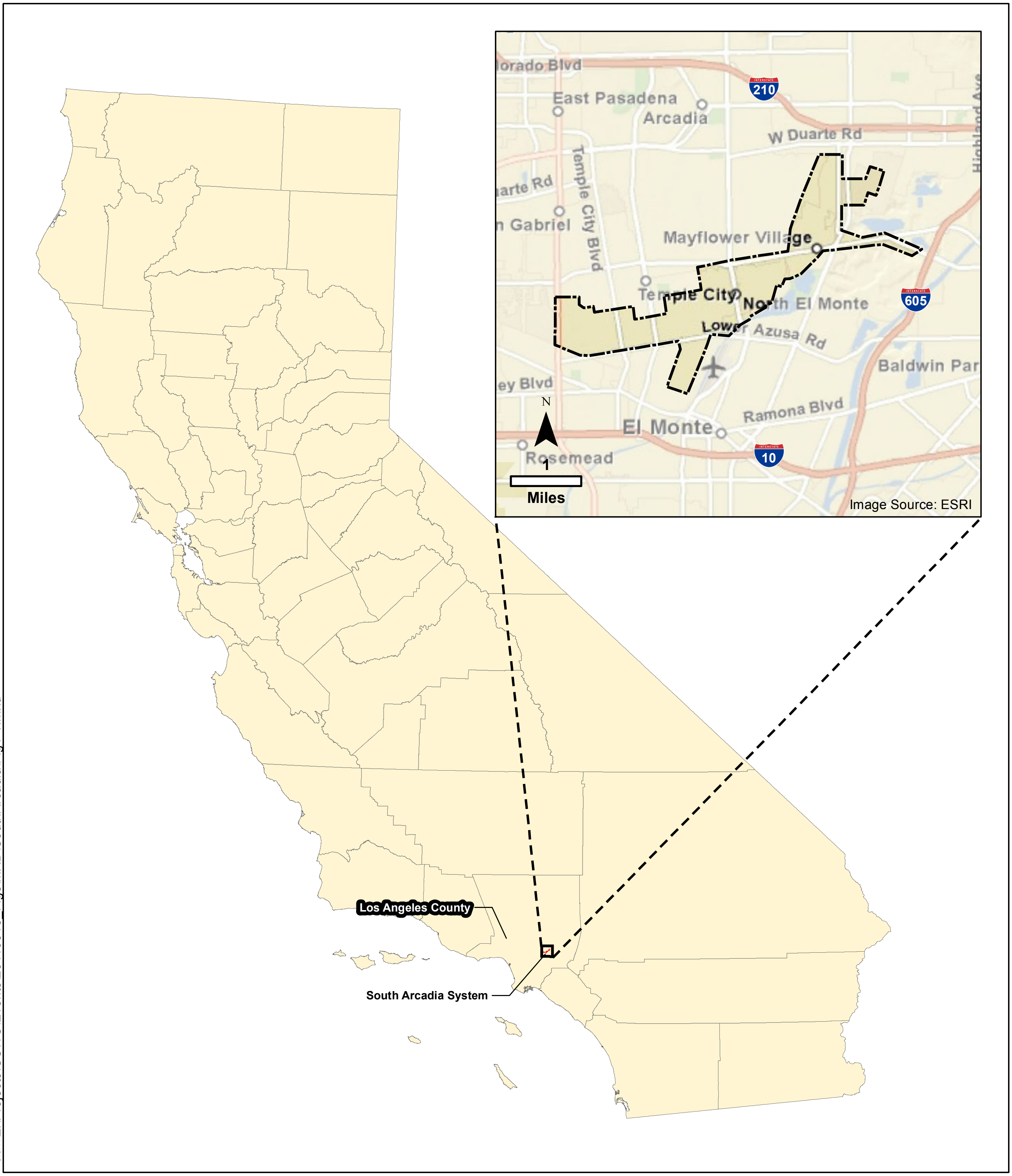

Legend

⬚ South Arcadia Service Area

Kennedy/Jenks Consultants

Golden State Water Company
2010 Urban Water Management Plan

South Arcadia System
Location Map

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August 2011

Figure 1-1

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1.4 Public Utility Commission 2010 Water Action Plan

The CPUC adopted the 2005 Water Action Plan (WAP) in December 2005 and an updated 2010 WAP in October 2010. The WAP is a general policy document, and specific implementation of policies and programs, along with modifications to CPUC ratemaking policies, and other programs including conservation, long-term planning, water quality and drought management programs are ongoing.

The purpose of the 2010 WAP update was to establish renewed focus on the following elements:

1. Maintain the highest standards of water quality;
2. Promote water infrastructure investment;
3. Strengthen water conservation programs to a level comparable to those of energy utilities;
4. Streamline CPUC regulatory decision-making;
5. Set rates that balance investment, conservation, and affordability; and
6. Assist low-income ratepayers.

GSWC has been actively involved with the CPUC in suggesting optimal approaches to the WAP. In particular, the GSWC has suggested specific implementation measures and modifications to certain CPUC rate setting practices so that regulated utilities are able as a practical matter to achieve the policy objectives of the WAP. These efforts are intended to include further investment in local resource optimization, reduced reliance on imported supplies, enhanced conservation, and intensification of company-wide efforts to optimize water resource mix, including planned water supply projects and programs to meet the long-term water supply needs of GSWC's customers.

1.5 Agency Coordination

The 2010 UWMP requirements for agency coordination include specific timetables and requirements as presented in this chapter. The required elements of the Act are as follows:

Section 10620.

(d) (2) Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.

Section 10621.

(b) Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

Section 10635.

(b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

> *Section 10642. Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area.*

Table 1-1 lists the agencies with which coordination occurred while preparing this 2010 UWMP. The initial coordination included the distribution of letter notification and request for information as indicated in Table 1-1 followed by telephone correspondence as necessary to obtain supporting data for the preparation of the UWMP. Table 1-1 also provides a checklist of agencies that have been provided the notifications and access to the documents.

Table 1-1: Coordination with Agencies

Agency	**Contacted for Assistance**	**Participated in UWMP Development**	**Commented on the Draft**	**Attended Public Meetings**	**Received Copy of the Draft**	**Sent Notice of Intent to Adopt**	**Not Involved/ No Information**
Southern California Association of Governments	✓						
City of Anaheim	✓	✓				✓	
City of Monterey Park	✓					✓	
City of Rosemead	✓					✓	
City of San Gabriel	✓	✓				✓	
Covina Irrigating Company	✓	✓				✓	
County of Los Angeles	✓					✓	
Upper San Gabriel Valley Municipal Water District	✓				✓	✓	
Los Angeles County Sanitation District	✓	✓				✓	

Note:
This table is based on DWR's *Guidebook to Assist Water Suppliers in the Preparation of a 2010 Urban Water Management Plan* (DWR Guidebook) Table 1.

1.6 Plan Adoption and Submittal

Public participation and plan adoption requirements are detailed in the following sections of the Act:

Section 10621.

(c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640)

Section 10642. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

Section 10644.

(a) An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption.

Section 10645. Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

A public hearing to review the 2010 South San Gabriel System UWMP was held on July 19, 2011 at the San Dimas Community Center in San Dimas, California. This public session was held for review and comment on the draft UWMP before approval by GSWC. Legal public notices for the public hearing and availability of the plan for review and comment were published in advance in the local newspapers in accordance with Government Code Section 6066. Notifications were also posted to GSWC's website (www.gswater.com).

In addition, notifications of preparation of the plan were provided to cities and counties within which GSWC provides water at least 60 days in advance of the public hearing as required by the Act. Copies of the draft plan were available to the public for review at GSWC's South San Gabriel office and posted on GSWC's website. Appendix B contains the following:

- Copy of the public hearing notice from the local newspaper,
- Screen capture of website posting of public hearing notice,
- Notifications and follow-up correspondence provided to cities and counties, and
- Meeting minutes from the public hearing pertaining to the UWMP.

The final UWMP, as adopted by GSWC, will be submitted to DWR, the California State Library, and cities and counties within which GSWC provides water within 30 days of adoption. Likewise, copies of any amendments or changes to the plan will be provided to the aforementioned entities within 30 days. This plan includes all information necessary to meet the requirements of California Water Code Division 6, Part 2.6 (Urban Water Management Planning). Adopted copies of this plan will be made available to the public at GSWC's South San Gabriel Customer Service Office no later than 30 days after submitting the final UWMP to DWR.

1.7 UWMP Preparation

GSWC prepared this UWMP with the assistance of its consultant, Kennedy/Jenks Consultants, as permitted by the following section of the Act:

> *Section 10620.*
>
> *(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.*

During the preparation of the UWMP, documents that have been prepared over the years by GSWC and other entities were reviewed and information from those documents incorporated, as applicable, into this UWMP. The list of references is provided in Chapter 9.

The adopted plan is available for public review at GSWC's South San Gabriel Office as required by Section 10645. Copies of the plan were submitted to DWR, cities and counties within the service area, the State Library, and other applicable institutions within 30 days of adoption as required by Section 10644. Appendix H includes copies of the transmittals included with the adopted plan as supporting documentation.

1.8 UWMP Implementation

> *Section 10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.*

GSWC is committed to the implementation of this UWMP concurrent with the scheduled activities identified herein as required by Section 10643 of the Act. Each system is managed through GSWC District offices and is afforded staff with appropriate regulatory approval to properly plan and implement responses identified in this document and other key planning efforts to proactively address water supply reliability challenges. Furthermore, each region of GSWC has a conservation coordinator that oversees the implementation of Demand Management Measures (DMMs) through GSWC participation in the California Urban Water Conservation Council's (Council) Memorandum of Understanding (MOU).

1.9 Content of the UWMP

This UWMP addresses all subjects required by Section 10631 of the Act as defined by Section 10630, which permits "levels of water management planning commensurate with the numbers of customers served and the volume of water supplied." All applicable sections of the Act are discussed in this UWMP, with chapters of the UWMP and DWR Guidebook Checklist cross-referenced against the corresponding provision of the Act in Table 1-2. Also, a completed copy of the 2010 Urban Water Management Plan Checklist organized by subject is included as Appendix J.

Table 1-2: Summary of UWMP Chapters and Corresponding Provisions of the California Water Code

Chapter	Corresponding Provisions of the Water Code		DWR Guidebook Checklist No.
Chapter 1: Plan Preparation	10642	Public participation	55 and 56
	10643	Plan implementation	58
	10644	Plan filing	59
	10645	Public review availability	60
	10620 (a)–(e)	Coordination with other agencies; document preparation	4
	10621 (a)–(c)	City and county notification; due date; review	6 and 54
	10621 (c)	UWMP adoption	7 and 57
	10620 (f)	Resource optimization	5
Chapter 2: System Description	10631 (a)	Area, demographics, population, and climate	8-12
Chapter 3: Water Use	10608	Urban water use targets	1
	10631 (e), (k)	Water use, data sharing	25 and 34
	10631 (k)	Data to wholesaler	33
Chapter 4: Water Supply	10631 (b)–(d), (h), (k)	Water sources, reliability of supply, transfers and exchanges, supply projects, data sharing	13-21, 24, 30, 33
	10631 (i)	Desalination	31
	10633	Recycled water	44-51
Chapter 5: Water Quality	10634	Water quality impacts on reliability	52
Chapter 6: Water Supply Reliability	10631 (c) (1)	Water supply reliability and vulnerability to seasonal or climatic shortage	22
	10631 (c) (2)	Factors resulting in inconsistency of supply	23
	10635 (a)	Reliability during normal, dry, and multiple-dry years	53
Chapter 7: Conservation Program and Demand Management Measures	10631 (f)–(g), (j),10631.5, 10608.26 (a), 10608.36	Conservation Program, DMMs, and SBX7-7 water use reduction plan	2, 26-29, 32
Chapter 8: Water Shortage Contingency Plan	10632	Water shortage contingency plan	35-43

1.10 Resource Optimization

Section 10620(f) of the Act asks urban water suppliers to evaluate water management tools and options to maximize water resources and minimize the need for purchased water from other regions. GSWC understands the limited nature of water supply in California and is committed to optimizing its available water resources. This commitment is demonstrated through GSWC's use of water management tools throughout the company to promote the efficient use of water supplies from local sources, wherever feasible. Additionally, GSWC takes efforts to procure local reliable water supplies wherever feasible and cost effective. GSWC is a regular participant in regional water resources planning efforts, has developed internal company water resource plans and robust water conservation programs.

GSWC has implemented a robust water conservation program, deployed through each region of the company. In an effort to expand the breadth of offered programs, GSWC partners with wholesale suppliers, energy utilities, and other agencies that support water conservation programs.

Chapter 2: System Description

Chapter 2 summarizes the South San Gabriel System's service area and presents an analysis of available demographics, population growth projections, and climate data to provide the basis for estimating future water requirements.

The water system description requirements are detailed in the following section of the Act:

Section 10631

(a) Describe the service area of the supplier, including current and projected population, climate, and other demographic factors affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

2.1 Area

The South San Gabriel System, located in Los Angeles County, serves half of the City of Rosemead, parts of City of San Gabriel, City of Monterey Park, and unincorporated area of Los Angeles County. The system is located in the westerly portion of the San Gabriel Valley and is divided by the San Bernardino Freeway. The service area is generally flat with some hills in the south part of the system. Figure 2-1 illustrates the service area of the South San Gabriel System. The service area is primarily characterized by residential and commercial areas.

2.2 Demographics

The City of Rosemead was chosen as demographically representative of the South San Gabriel System. According to 2000 U.S. Census Data, the median age of Rosemead's residents is 32.3 years. Rosemead has an average household size of 3.80 and a median household income of approximately $36,181 in 1999 dollars or $47,252 in 2010 dollars.

A General Plan or land use information is not available for the South San Gabriel System. Based on the San Gabriel System map and review of recent satellite imagery, it appears to be near build-out. There are only a few undeveloped individual parcels in the system and any growth occurring will likely be a combination of urban expansion, redevelopment, and in-fill. In a built-out or nearly built-out area, changes are typically minor and difficult to predict.

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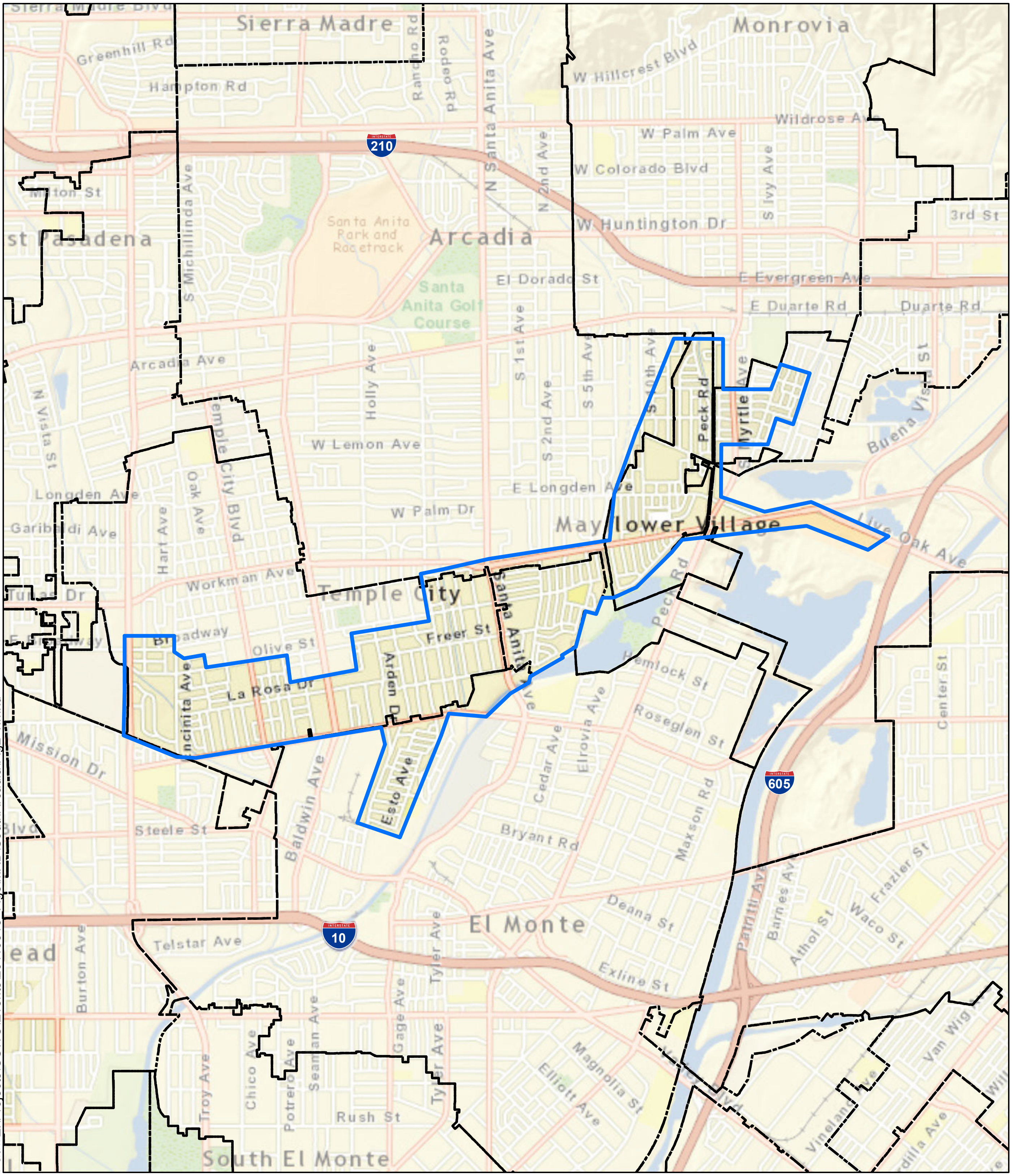

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South Arcadia System Boundary

City Boundary

Kennedy/Jenks Consultants

Golden State Water Company
2010 Urban Water Management Plan

South Arcadia System
Service Area

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Figure 2-1

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2.3 Population, Housing and Employment

Population, housing, and employment projections were developed for the South San Gabriel System using the Southern California Association of Governments (SCAG) population, housing and employment data. SCAG last updated its projections for population, household, and employment growth through the year 2035 using the 2008 “Integrated Growth Forecasting” process used in the 2008 Regional Transportation Plan (2008 RTP). SCAG’s methodology is described below, followed by the derivation of population projections for the South San Gabriel System. Previous and current projections utilize 2000 U.S. Census Data.

SCAG is currently in the process of developing its 2012 Regional Transportation Plan (2012 RTP) which will utilize a new population projection model based 2010 Census data. In certain cases, growth rates using these preliminary data are significantly reduced from the 2008 model. The population, household, and employment projections in this document use the adopted 2008 RTP data. Future UWMP updates will be able to utilize 2012 RTP projections as well as 2010 Census data.

2.3.1 SCAG Population Projection Development Methodology

Population, housing, and employment data are derived from the 2000 U.S. Census, which forms a baseline for local data projections. SCAG applies a statistical cohort-component model and the headship rate to the 2000 U.S. Census data for regional, county, and household demographic projections. To evaluate the South San Gabriel System, SCAG data was used in census tract form, the smallest geographic division of data that SCAG provides. SCAG projects subcounty and census tract demographic trends using the housing unit method.

The Integrated Growth Forecasting process uses a variety of estimates and projections from the federal and state governments. Sources include the U.S. Department of Labor, Internal Revenue Service (IRS), U.S. Citizenship and Immigration Services, U.S. Department of Health and Human Services, California Department of Finance (DOF), California Employment Development Department, and information received through the Intergovernmental Review process. A detailed explanation of the population projection process can be found in the adopted SCAG 2008 Regional Transportation Plan, Growth Forecast Report for SCAG.

2.3.2 Historical and Projected Population

SCAG-derived census-tract projections were used to determine historical and projected population from 1997 to 2035. The South San Gabriel System service area boundaries often contain multiple census tracts, many of which have boundaries that do not coincide exactly with service area boundaries. The population projection analysis consisted of superimposing service area boundaries over census tract boundaries, identifying the applicable overlapping census tracts, and developing a percentage estimate for each overlapping area. For a census tract 100 percent within the service area boundaries, it was assumed that 100 percent of the associated census tract population data was applicable to the South San Gabriel System. For areas where the overlap was not exact, the area of overlap as a percentage was applied to the data to develop an estimate of applicable population. Appendix G, Table G-1 lists the census tracts with a corresponding estimate of what percent of each tract lies within the South San Gabriel System. It was typically assumed that the various types of housing and employment within a census tract are distributed uniformly within all parts of that census tract, unless maps indicated non-uniform concentrations. In these cases, population estimates were either increased or decreased as applicable to match the existing land use. Appendix G, Table G-2 contains all of the SCAG's historic and projected demographic data for each census tract number from 2015 through 2035. Figure 2-2 details the census tracts within the South San Gabriel System.

Annual estimates of historical population between 1997 and 2010 required for SBX7-7 are provided in Table 2-1. The population estimates were developed following DWR Technical Methodology 2: Service Area Population. GSWC is considered a Category 2 water supplier because they maintain a Geographic Information System (GIS) of their service area. The per-connection methodology described in Appendix A of *Technical Methodology 2* was used since annual estimates of direct service area population from SCAG or other local government agencies were not available. This method estimates annual population by anchoring the ratio of year 2000 residential connections to the year 2000 U.S. Census population. This ratio was then linearly scaled to active residential connections data to estimate population for the non-census years in which water supply data were available: 1997 through 2010. The residential billing category includes traditional single-family residential connections; however since GSWC does not have a specific multi-family billing category that only encompasses apartment complexes and other types of multi-family housing units, the ratio of year 2000 U.S. Census total population per residential connections was used for projecting population growth.

Table 2-1: South San Gabriel System Historical Population

Year	Service Area Population
1997	27,589
1998	27,513
1999	27,646
2000	27,545(1)
2001	27,785
2002	27,855
2003	27,899
2004	28,038
2005	28,140
2006	28,317
2007	28,443
2008	28,608
2009	28,633
2010	28,715

Note:

1. Population for year 2000 from 2005 UWMP.

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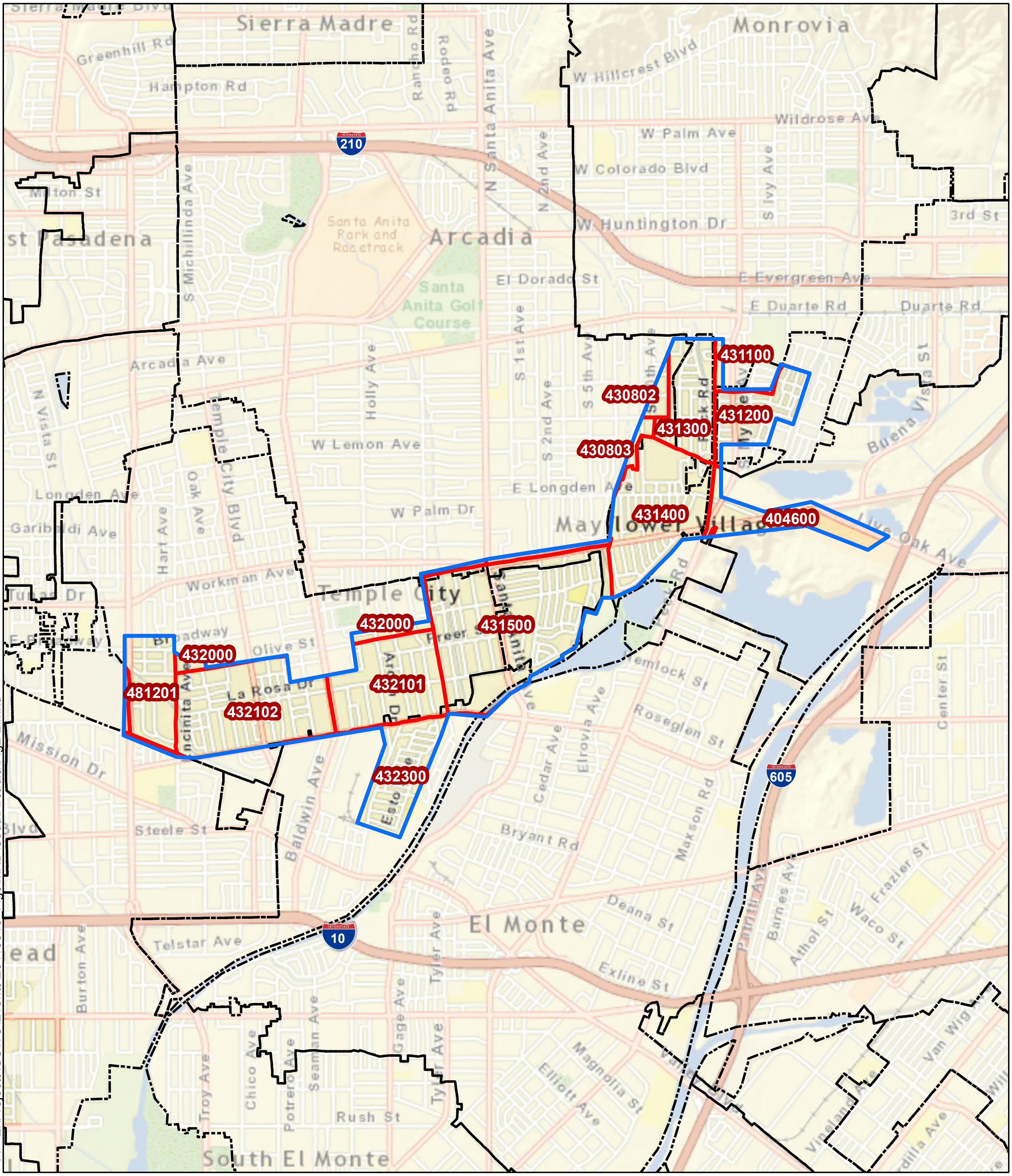

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🟦 South Arcadia System Boundary
🟥 Census Tract Boundary within Service Area
⬚ City Boundary

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Kennedy/Jenks Consultants

Golden State Water Company
2010 Urban Water Management Plan

South Arcadia System
Service Area with
Census Tract Boundary

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Figure 2-2

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As concluded from analysis of SCAG demographic data, the South San Gabriel System had an estimated population of 28,715 people in 2010 and is expected to reach 31,932 by 2035. A summary of historic and projected population, households, and employment within the South San Gabriel System (based on SCAG growth rate data) is presented in Table 2-2 and illustrated in Figure 2-3. To ensure consistency between the historical and projected population data required for this plan, projections for 2015 through 2035 were adjusted relative to the 2010 population benchmark using the appropriate SCAG percentage growth rates in each category. For this reason, SCAG projections after 2000 for the Census Tracts do not correlate precisely with the estimates included in this plan.

Table 2-2: South San Gabriel System Historical and Projected Population

Year	Service Area Population	Service Area Household	Service Area Employment	Data Source
2005	28,140	6,758	4,428	GSWC(3)
2010	28,715	6,945	4,610	GSWC(3)
2015	29,414	7,187	4,752	SCAG
2020	30,065	7,420	4,841	SCAG
2025	30,710	7,604	4,947	SCAG
2030	31,332	7,780	5,059	SCAG
2035	31,932	7,925	5,166	SCAG

Notes:

1. This table is based on the DWR Guidebook Table 2.
2. Dashed line represents division between historic and projected data.
3. Growth rates for population, household and employment are based on SCAG projections.

In summary, from 2005 to 2010 the South San Gabriel population increased 2 percent, which is a growth rate of approximately 0.5 percent per year. By 2035, population is expected to increase by a total of 11 percent, from 28,715 in 2010 to 31,932 in 2035, which is a 0.5 percent growth rate per year. The number of households is expected to grow 14 percent during the same period, which equates to an annual household growth rate of 0.6 percent. Employment is expected to grow 12 percent during the same period, which equates to an annual employment growth rate of 0.5 percent. Areas with the highest projected growth increases are also the areas that will see the largest increase in water use. SCAG's demographic analysis does not project any planned residential developments for future years. As discussed in demographic section, new development and redevelopment projects in the South San Gabriel System may contribute to future growth.

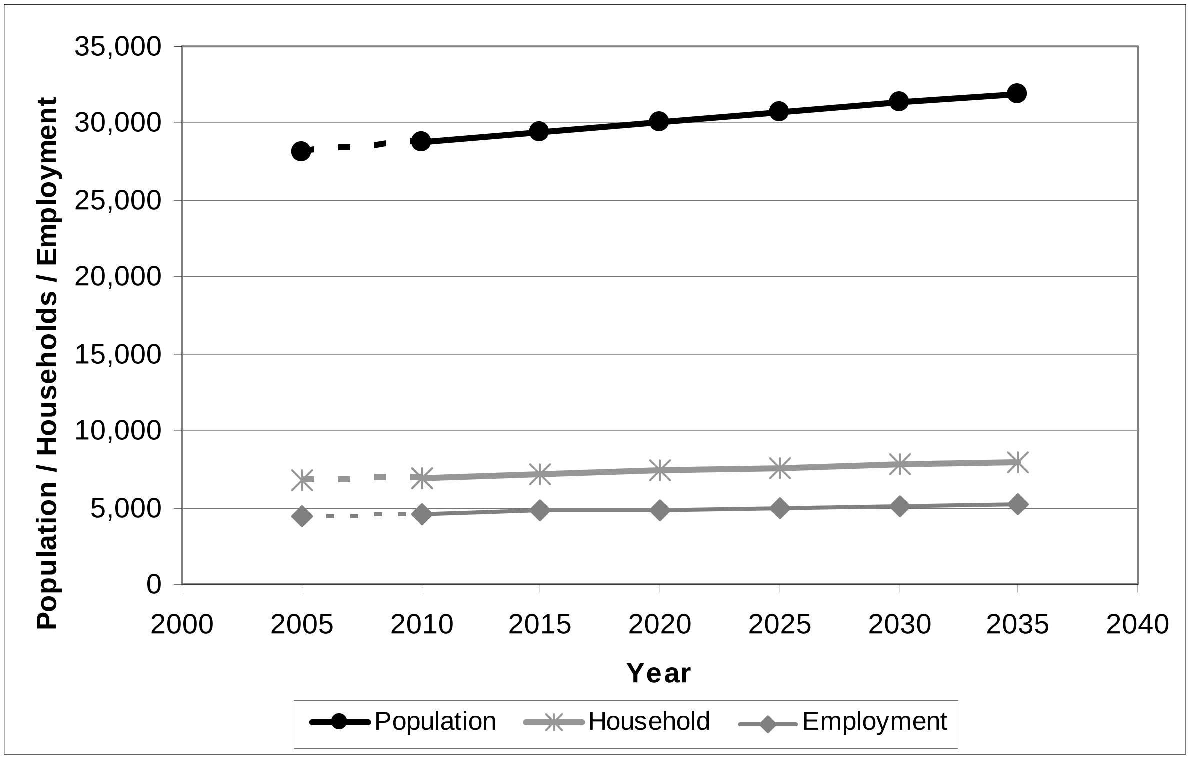

Figure 2-3: Historical and Projected Population, Household and Employment Growth within the South San Gabriel System

2.4 Climate

South San Gabriel System has cool, humid winters and warm, dry summers. Western Regional Climate Center (WRCC) has maintained 30-year historic climate data for selected cities throughout the West. The WRCC's website (www.wrcc.dri.edu) maintains climate records for the past 70 years for the San Gabriel Station. Table 2-3 presents the average climate summary based on the 70-year historical climate data for South San Gabriel System.

In the winter, the lowest average monthly temperature is approximately 42 degrees Fahrenheit. The highest average monthly temperature reaches approximately 90 degrees Fahrenheit in the summer. Figure 2-4 presents the monthly average precipitation based on 30-year historical data. The rainy season is typically from November to March. Monthly precipitation during the winter months ranges from 2 to 4 inches. Low humidity occurs in the summer months from May to October. The moderately hot and dry weather during the summer months typically results in moderately high water demand.

Similar to the WRCC in the South San Gabriel area, the California Irrigation Management Information System (CIMIS) website (http://www.cimis.water.ca.gov) tracks and maintains records of ETo for selected cities. ETo statistics used for this system come from the Monrovia station, which is the closest station (6 miles) to the South San Gabriel System. ETo is a standard measurement of environmental parameters that affect the water use of plants. ETo is given in inches per day, month, or year and is an estimate of the evapotranspiration from a large field of well-watered, cool-season grass that is 4- to 7-inches tall. The monthly average ETo is presented in inches in Table 2-3. As the table indicates, a greater quantity of water is evaporated during July and August in correlation to high temperatures and low humidity, which may result in high water demand.

Table 2-3: Monthly Average Climate Data Summary for South San Gabriel System

Month	Standard Monthly Average ETo[1] (inches)	Average Total Rainfall (inches)	Average Temperature (degrees Fahrenheit)	
			Max	Min
January	2.2	3.70	69.1	41.8
February	2.3	3.98	70.2	43.6
March	3.8	3.00	71.7	45.9
April	4.2	1.21	75.2	49.1
May	5.3	0.28	77.7	53.5
June	5.8	0.09	82.5	57.2
July	6.9	0.02	88.8	61.1
August	6.4	0.07	89.7	61.5
September	5.1	0.35	88.1	59.4
October	3.4	0.56	82.2	53.8
November	2.5	1.64	75.3	46.4
December	2.0	2.35	69.8	41.9

Note:

1. Evapotranspiration (ETo) from http://www.cimis.water.ca.gov/cimis/welcom.jsp.

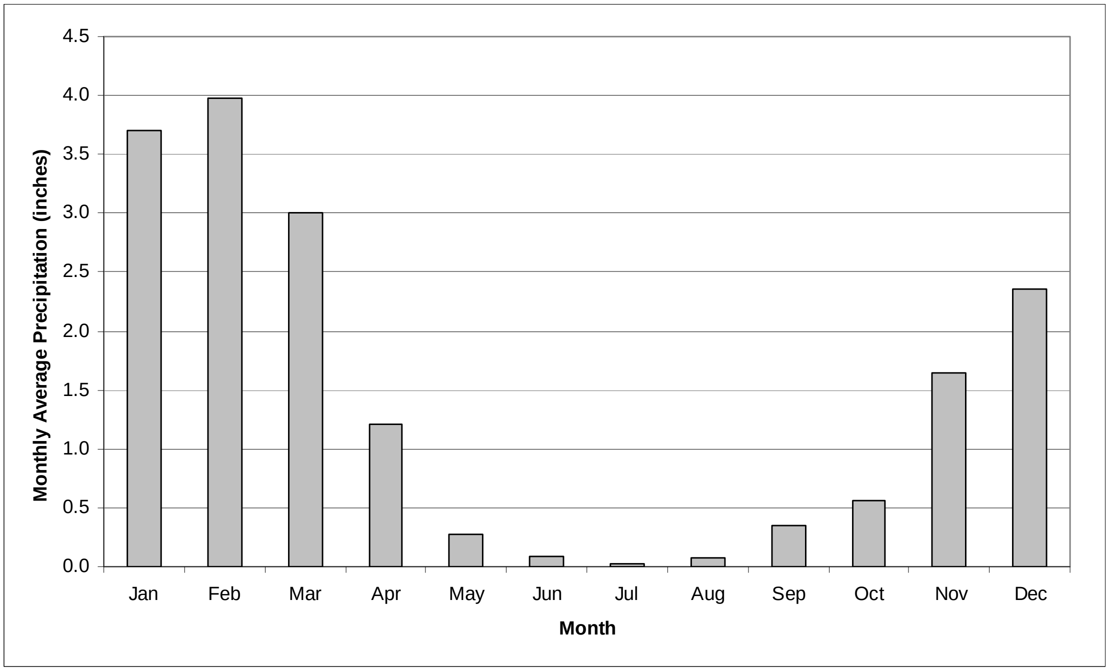

Figure 2-4: Monthly Average Precipitation in South San Gabriel System Based on 70-Year Historical Data

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Chapter 3: Water Use

Section 10631(e) of the Act requires that an evaluation of water use be performed for the South San Gabriel System. The Act states the following:

> *Section 10631.*
>
> *(e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water-use sectors including, but not necessarily limited to, all of the following uses:*
>
> *(A) Single-family residential*
>
> *(B) Multifamily*
>
> *(C) Commercial*
>
> *(D) Industrial*
>
> *(E) Institutional and governmental*
>
> *(F) Landscape*
>
> *(G) Sales to other agencies*
>
> *(H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof*
>
> *(I) Agricultural.*
>
> *(2) The water-use projections shall be in the same five-year increments described in subdivision (a).*

In addition, Section 10631(k) directs urban water suppliers to provide existing and projected water-use information to wholesale agencies from which water deliveries are obtained. The Act states the following:

> *Section 10631.*
>
> *(k) Urban water suppliers that rely upon a wholesale agency for a source of water, shall provide the wholesale agency with water-use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c).*

In conjunction with projecting total water demand, each urban water retail supplier must develop urban water use targets and an interim urban water use target in accordance with SBX7-7. SBX7-7 amends the Act and requires statewide urban demand reduction of 20 percent by the year 2020. The bill sets specific methods for calculating both the baseline water usage and water use targets in gallons per capita day (gpcd).

Section 10608.20(e) states the following:

> *Section 10608.20.*
>
> *(e) An urban retail water supplier shall include in its urban water management plan required pursuant to Part 2.6 (commencing with Section 10610) due in 2010 the baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.*

This chapter presents an analysis of water use data with the resulting projections for future water needs and water use targets in accordance with SBX7-7 for the South San Gabriel System.

3.1 Historical Water Use

Historical water use data from 1994 to 2010 were analyzed in order to provide an overview of historical water usage for the South San Gabriel System. Figure 3-1 shows the historical number of metered service connections and water use for the South San Gabriel System from 1994 through 2010.

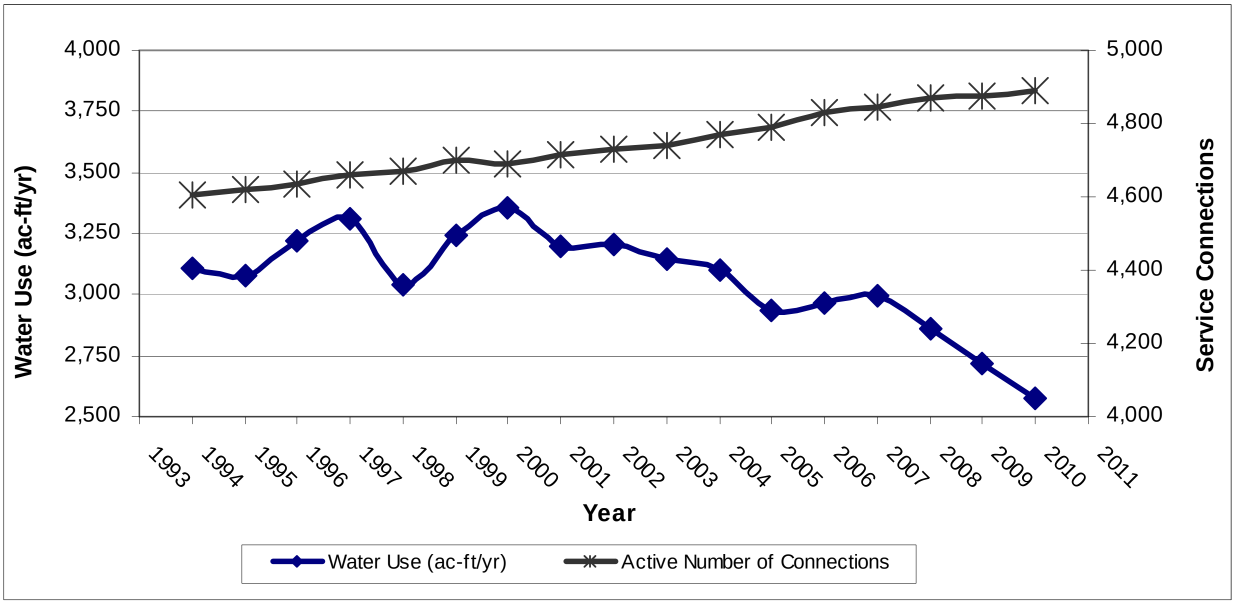

Figure 3-1: Historical Number of Metered Service Connections and Water Use

Figure 3-1 shows a decline in water use beginning in 2007 with an approximate 11 percent decline from 2008 to 2010. Review of similar data from other systems suggests the recent decline in water use has been widespread and is not isolated to the South San Gabriel System. The decline in water use is not yet fully understood, but may be a result of several factors including: several years of cool summers, a statewide drought that forced mandatory water reductions and conservation in many areas, and an economic downturn that has caused many businesses to close and increased housing vacancies.

The customer billing data for the system consists of annual water sales data. The water sales data was sorted by customer type using the assigned North American Industry Classification System (NAICS) codes. Then, the sorted water sales data were further grouped into the following seven categories: single-family, multi-family, industrial, commercial, institutional/government, landscape, and other. Table 3-1 shows the historical water use by customer type.

Table 3-1: Historical Water Use (ac-ft/yr) by Customer Type

YEAR	Commercial	Industrial	Institutional/ Government	Landscape	Multi-Family	Other	Single-Family	Total
1994	271	7	129	64	887	0	1,747	3,105
1995	305	4	96	72	927	0	1,673	3,077
1996	319	3	111	81	991	0	1,717	3,222
1997	353	5	140	86	1,007	0	1,722	3,313
1998	347	3	111	65	995	0	1,521	3,042
1999	422	2	158	114	1,058	0	1,489	3,243
2000	469	5	162	123	1,136	0	1,457	3,352
2001	451	5	162	94	1,097	4	1,387	3,200
2002	423	6	136	103	1,097	5	1,437	3,207
2003	491	6	125	74	1,062	6	1,382	3,146
2004	465	4	124	85	1,043	6	1,372	3,099
2005	429	3	114	90	978	6	1,315	2,935
2006	408	3	126	94	991	6	1,338	2,966
2007	403	4	124	87	986	5	1,385	2,994
2008	371	3	128	84	935	5	1,337	2,863
2009	368	2	105	90	887	4	1,262	2,718
2010	379	2	101	64	836	3	1,190	2,575

3.2 Water Use Targets

This section includes documentation of the water use targets commensurate with enactment of SBX7-7. The 2010 UWMP update is the first in which such targets have been required to be documented. The projected water use for each urban retail water supplier is required to be reduced by a total of up to 20 percent by the year 2020 from a calculated baseline gpcd as required by SBX7-7. The steps described throughout this section follow the guideline methodologies developed by DWR over the past year, as documented in Section D of the *Guidebook to Assist Urban Water Suppliers to Prepare a 2010 Urban Water Management Plan* (DWR Guidebook) issued March 2011. The three overall steps to determine the 2020 water use target are as follows:

- Step 1 – Calculate the baseline per capita water use, using the required methodologies.
- Step 2 – Calculate the per capita reduction using at least one of the four methodologies (including the minimum reduction target – which is a provision included to ensure all agencies achieve a minimum level of water savings).
- Step 3 – Select the target reduction methodology and set interim (2015) and compliance (2020) water use targets. The chosen methodology is the responsibility of the water supplier and may be changed in 2015.

The Act now stipulates that the state shall review the progress made towards reaching the statewide water savings targets as reported in the 2015 UWMP updates. Currently, no single urban water supplier is required to conserve more than 20 percent, however there are provisions in the law that could require additional conservation after 2015 if it is found that the program is not on track to reach 20 percent statewide water savings by 2020.

3.2.1 Baseline Per Capita Water Use

The first step in the process of determining the water use target is calculation of the baseline per capita water use (baseline gpcd). In order to calculate the baseline gpcd, service area population within the South San Gabriel System was estimated and compared to actual water use records. The following three baseline gpcd calculations identified in SBX7-7 were evaluated for the South San Gabriel System:

- Baseline Method 1 – Average water use over a continuous 10-year period ending no earlier than December 31, 2004 and no later than December 31, 2010.
- Baseline Method 2 – For retailers with at least 10 percent of 2008 demand served by recycled water (either retail-or wholesale-provided), this calculation may be extended to include an additional 5 years ending no earlier than December 31, 2004 and no later than December 31, 2010.
- Baseline Method 3 – Estimate of average gross water use reported in gpcd and calculated over a continuous 5-year period ending no earlier than December 31, 2007 and no later than December 31, 2010.

The Baseline Methods 1 and 3 were evaluated using water supply data for the years ending December 31, 1997 through December 31, 2010. The base water use was calculated for each year commencing with 1997 as this was the first year with production data records available. The South San Gabriel system does not currently receive recycled water; therefore Baseline Method 2 is not applicable. Table 3-2 below presents the base period ranges, total water deliveries and the volume of recycled water delivered in 2008; these data are used to determine the number of years that can be included in the base period range. Also shown are the actual start and end years for the selected base period range.

Table 3-2: Base Period Ranges

Base	Parameter	Value	Units
10-year base period	2008 total water deliveries	3,096	Ac-ft
	2008 total volume of delivered recycled water	0	Ac-ft
	2008 recycled water as a percent of total deliveries	0	Percent
	Number of years in base period	10	Years
	Year beginning base period range	1997	
	Year ending base period range	2006	
5-year base period	Number of years in base period	5	Years
	Year beginning base period range	2003	
	Year ending base period range	2007	

Note:
Table format based on DWR Guidebook Table 13.

The average annual daily per capita water use in gpcd from 1997 through 2010 is provided in Table 3-3. The gallons per day calculation includes potable water entering the distribution system.

Table 3-3: 1997-2010 Base Daily Use Calculation

Calendar Year	Distribution System Population	Gallons / Day	Daily per Capita Water Use, gpcd
1997	27,589	3,299,623	120
1998	27,513	3,091,203	112
1999	27,646	3,173,668	115
2000	27,545	3,260,774	118
2001	27,785	3,113,270	112
2002	27,855	3,080,299	111
2003	27,899	3,021,992	108
2004	28,038	3,067,966	109
2005	28,140	2,864,906	102
2006	28,317	3,023,029	107
2007	28,443	2,863,002	101
2008	28,608	2,763,565	97
2009	28,633	2,575,696	90
2010	28,715	2,400,543	84

Note:
Table format based on DWR Guidebook Tables 14 and 15.

The 10-year averages are presented in Table 3-4; and the 5-year averages are shown in Table 3-5. The 1997-2006 10-year and 2003-2007 5-year average base daily usages of 111 and 105 gpcd, respectively, were selected.

Table 3-4: 10-Year Average Base Daily Per Capita Water Use

10-Year Period	Average Base Daily Per Capita Water Use (gpcd)
1997-2006	111
1998-2007	110
1999-2008	108
2000-2009	105
2001-2010	102

Table 3-5: 5-Year Average Base Daily Per Capita Water Use

5-Year Period	Average Base Daily Per Capita Water Use (gpcd)
2003-2007	105
2004-2008	103
2005-2009	99
2006-2010	96

3.2.2 Urban Water Use Targets

Retail suppliers must identify their urban water use targets by utilizing one of four compliance methods identified in SBX7-7. The four urban water use target development methods are as follows:

- Compliance Method 1 – 80 percent of baseline gpcd water use.
- Compliance Method 2 – The sum of the following performance standards: indoor residential use (provisional standard set at 55 gpcd); plus landscape use, including dedicated and residential meters or connections equivalent to the State Model Landscape Ordinance (70 percent of reference ETo; plus 10 percent reduction in baseline commercial, industrial institutional (CII) water use by 2020.
- Compliance Method 3 – 95 percent of the applicable state hydrologic region target as identified in the 2020 Conservation Plan (DWR, 2010).
- Compliance Method 4 – A provisional method identified and developed by DWR through a public process released February 16, 2011, which aims to achieve a cumulative statewide 20 percent reduction. This method assumes water savings will be obtained through metering

of unmetered water connections and achieving water conservation measures in three water use categories: (1) indoor residential, (2) landscape, water loss and other water uses and (3) CII.

GSWC elected to evaluate Compliance Methods 1 and 3 for selecting urban water use targets for the 2010 plan. The following section provides an explanation of the target calculations and a summary of the interim and compliance water use targets.

Compliance Method 1 Calculation Summary

The Compliance Method 1 2020 water use target was calculated by multiplying the base daily gpcd by 80 percent. A 20 percent reduction in baseline water use would require reduction of 22 gpcd by 2020, as shown in Table 3-6. The 2015 interim target would be 100 gpcd with a 2020 water use target of 89 gpcd.

Table 3-6: 2020 Water Use Target Method 1 Calculation Summary

Description	Baseline	2015 Interim Target	2020 Compliance Target
Per Capita Water Use (gpcd)	111	100	89
Percent Reduction	N/A	10%	20%

Compliance Method 3 Calculation Summary

The Compliance Method 3 2020 water use target was calculated by multiplying the respective hydrologic region target by 95 percent. The South San Gabriel System is located in the South Coast region (Region 4), which has a hydrologic region target of 149 gpcd and a baseline water use of 180 gpcd. Ninety-five (95) percent of the Region 4 hydrologic region target results in a 2020 water use target of 142. Since the baseline of 111 gpcd is lower than 95 percent of the hydrologic regional target of 142 gpcd, a review of the minimum reduction target was triggered per the DWR methodologies to ensure minimum water conservation targets are established for the South San Gabriel System. Table 3-7 presents the results of the Method 3 calculation:

Table 3-7: 2020 Water Use Target Method 3 Calculation Summary

Description	Baseline	2015 Interim Target	2020 Compliance Target
Per Capita Water Use (gpcd)	111	126	142
Percent Reduction	N/A	N/A	N/A

Minimum Compliance Reduction Target

Systems with a 5-year baseline per capita water use of greater than 100 gpcd must calculate a minimum water use reduction, which the 2020 water use target cannot exceed. The minimum water use reduction compliance target is 95 percent of the 5-year rolling average base daily per capita water use (ending no earlier than December 31, 2007, and no later than December 31, 2010). By this method, the minimum 2020 water use target for the South San Gabriel System is 100 gpcd as presented in Table 3-8 below:

Table 3-8: Minimum 2020 Reduction

Description	5-Yr Average	2015 Interim Target	2020 Compliance Target
Minimum Allowable 2020 Target (gpcd)	105	103	100

3.2.3 Interim and Compliance Water Use Targets

The interim and compliance water use targets are provided per Section 10608.20(e) of the Act. Compliance Method 3 was selected by GSWC for the South San Gabriel System, which in turn triggered the minimum reduction target since the Method 3 hydrologic region target (142 gpcd) is greater than the Minimum 100 gpcd. As a result, Table 3-9 shows the 2020 SBX7-7 compliance target for the South San Gabriel System is 100 gpcd and the 2015 interim water use target is 103 gpcd. The implementation plan for achieving these targets is described in Section 4.8, Recycled Water and Chapter 7, Demand Management Measures.

Table 3-9: SBX7-7 Water Use Reduction Targets (gpcd)

Baseline	2015 Interim Target	2020 Compliance Target
111	103	100

3.3 Projected Water Use

Growth projections for the number of service connections and volume of water use were calculated for the year 2015 through 2035, in 5-year increments. Future water demands were estimated using two different methods, a population-based approach and a historical-trend approach, in order to present a projection range reflecting the inherent uncertainty in growth trends. Additionally, demand projections are provided showing a scenario where the South San Gabriel System fully meets water use target reductions by 2020 for comparison to current per capita water use trends. Detailed descriptions of how the population-based and historical-trend projections were calculated are provided below.

The range established between these two approaches is intended as supplemental information; all connection and demand estimates use the population-based growth rate projections which are higher and provide a more conservative estimate of future water use. The historical-trend projections are provided as ancillary information only.

Figure 3-2 shows the historical and projected number of metered service connections for the South San Gabriel System from 1994 through 2035. Figure 3-3 shows the historical and projected water use for the South San Gabriel System from 1994 until 2035.

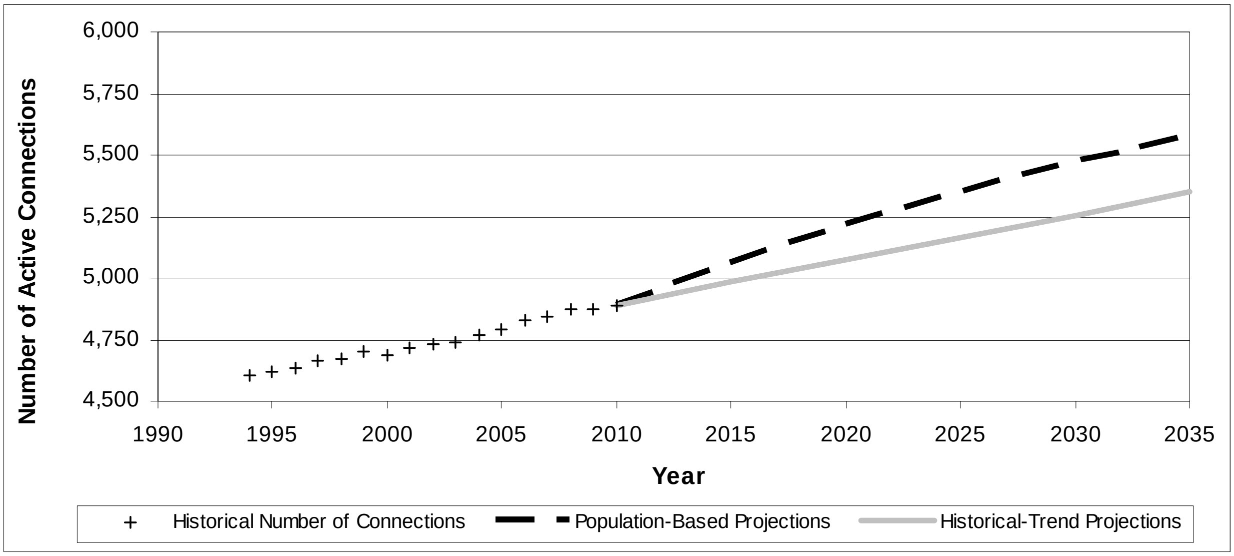

Figure 3-2: Historical and Projected Number of Metered Service Connections

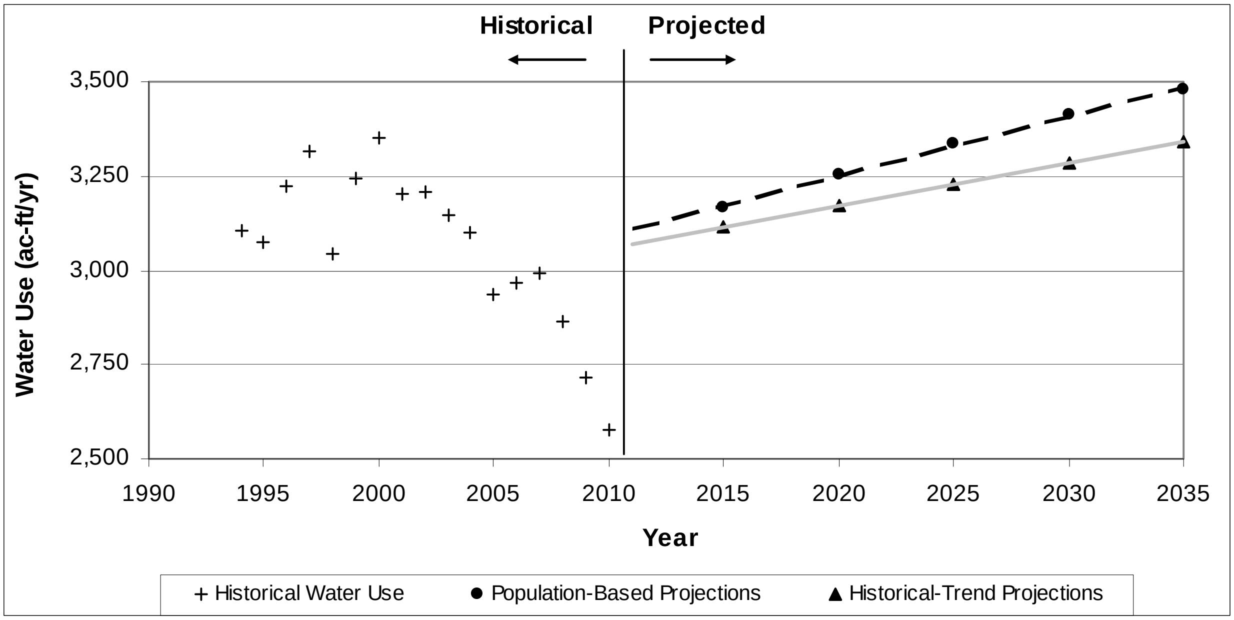

Figure 3-3: Historical Water Use and Future Water Use Projections

Historical water use records from 2000 through 2010 were analyzed to generate estimates of future water demands.

Water use factors were then developed for the projection of future water use. A water use factor was calculated for each category in order to quantify the average water used per metered connection. For a given customer type, the unit water use factor is calculated as the total water sales for the category divided by the number of active service connections for that category. The unit water use factors for each customer type were averaged over the data range from 2000 through 2010 in order to obtain a representative water use factor for determining water demand projections by customer type. Table 3-10 presents the water use factors calculated for each customer category.

Table 3-10: Water Use Factors for the South San Gabriel System

	Account Category						
	Single-Family	**Multi-family**	**Commercial**	**Industrial**	**Institutional/ Government**	**Landscape**	**Other**[2]
Water Use Factor[1]	0.40	0.95	1.96	0.61	1.72	2.31	1.34

Notes:

1. Based on customer water use data for calendar years 2000-2010.
2. Other accounts for any service connections not included in any other category, including idle or inactive connections.

The population-based water use projections are based on the population and housing growth rates described in Chapter 2. SCAG household projections were used to determine the growth in single-family and multi-family service connections for the years 2015, 2020, 2025, 2030, and 2035. For example, the percent growth rate in households from the year 2010 to year 2015 was multiplied by the number of residential service connections in 2000 to obtain a projection of the number of connections in the year 2015. Similarly, employment growth projections were used to determine the growth for commercial, industrial, institutional/government, and landscape service connections. The population-based projected water use was then calculated by multiplying the number of projected active service connections for each customer category by the corresponding customer average water use factor calculated above.

The historical-trend water use projections are based on a linear projection of the historical number of metered service connections. The average growth rate established by this historical trend was applied to the number of connections in each customer category to project the future number of service connections. The historical-trend projected water use was then calculated by multiplying the number of projected active service connections for each customer category with the corresponding customer average water use factor calculated above.

Figure 3-4 shows the population based water use projections by customer type. The population-based projections of the number of service connections, and the resulting water demand, are provided in Table 3-11.

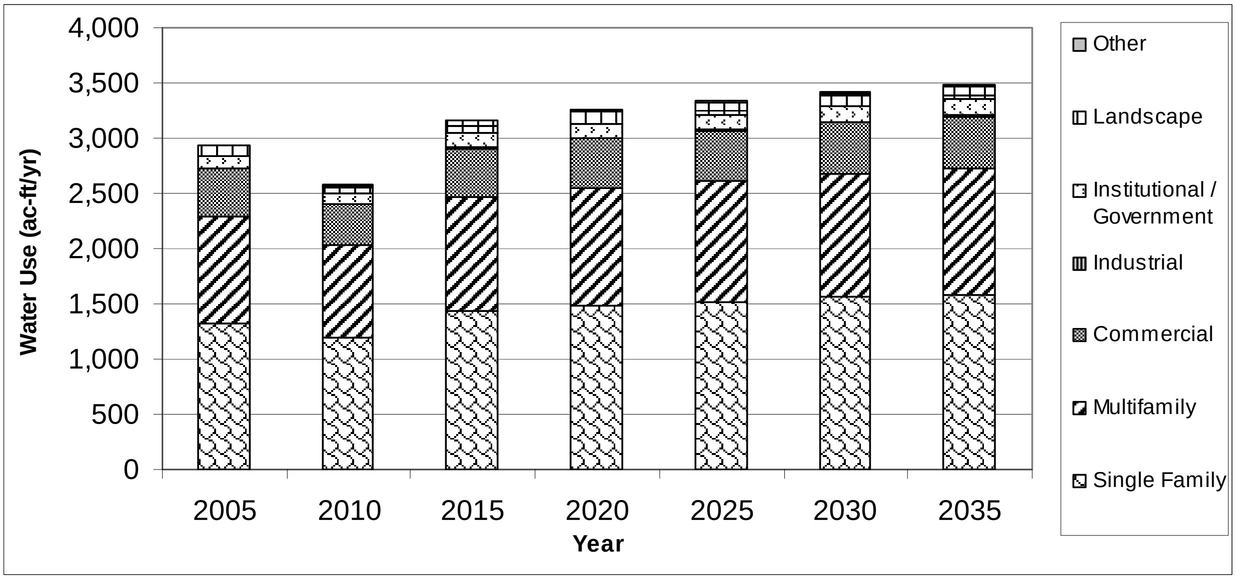

Figure 3-4: Projected Water Use by Customer Type

Table 3-11: Projections of the Number of Metered Service Connections and Water Use for the South San Gabriel System

Year	Projection Type	Accounts by Type							
		Single-Family	**Multi-family**	**Commercial**	**Industrial**	**Institutional/ Government**	**Landscape**	**Other[3]**	**Total**
2005[2]	*No. of Accounts*	3,395	1,053	220	6	75	39	4	4,792
	Water Use (ac-ft)	1,315	978	429	3	114	90	6	2,935
2010	*No. of Accounts*	3,492	1,047	218	7	75	45	5	4,889
	Water Use (ac-ft)	1,190	836	379	2	101	64	3	2,575
2015	*No. of Accounts*	3,614	1,084	225	8	78	47	6	5,062
	Water Use (ac-ft)	1,438	1,030	440	5	134	109	8	3,164
2020	*No. of Accounts*	3,731	1,119	229	8	79	48	6	5,220
	Water Use (ac-ft)	1,485	1,063	448	5	136	111	8	3,256
2025	*No. of Accounts*	3,824	1,147	234	8	81	49	6	5,349
	Water Use (ac-ft)	1,522	1,090	458	5	139	113	8	3,335
2030	*No. of Accounts*	3,912	1,173	240	8	83	50	6	5,472
	Water Use (ac-ft)	1,556	1,115	470	5	142	116	8	3,412
2035	*No. of Accounts*	3,985	1,195	245	8	85	51	6	5,575
	Water Use (ac-ft)	1,586	1,136	479	5	146	118	8	3,478

Notes:

1. This table is based on the DWR Guidebook Tables 3 through 7.
2. Based on calendar year.
3. Other accounts for any service connections not included in any other category, including idle or inactive connections.
4. All connections are metered.

3.4 Sales to Other Agencies

There are no sales to other agencies for the South San Gabriel System; therefore, Table 3-12 has intentionally been left blank.

Table 3-12: Sales to Other Agencies in ac-ft/yr

Water Distributed	2005[(2)]	2010	2015	2020	2025	2030	2035
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

1. This table is based on the DWR Guidebook Table 9.
2. Based on calendar year.

3.5 Other Water Uses and System Losses

In order to estimate total water demand, other water uses, as well as any water lost during conveyance, must be added to the customer demand. California regulation requires water suppliers to quantify any additional water uses not included as a part of water use by customer type. There are no other water uses in addition to those already reported in the South San Gabriel System.

System losses must be incorporated when projecting total water demand. System losses (also known as non-revenue water) are defined as the difference between annual water production and annual sales. Included are system losses due to leaks, reservoir overflows, or inaccurate meters, and other water used in operations such as system flushing and filter backwashing GSWC does not tabulate system losses separately from other water uses; such as operations. In the South San Gabriel System, from 1997 through 2010, system water losses have averaged approximately 8 percent of the total production; therefore, this rate was incorporated into water demand projections. Table 3-13 provides a summary of projected system losses in the South San Gabriel System.

Table 3-13: Additional Water Uses and Losses in ac-ft/yr

Water-Use Type	2005[(2)]	2010	2015	2020	2025	2030	2035
Other Water Uses	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unaccounted-for System Losses[(3)]	274	114	246	253	260	266	271
Total	274	114	246	253	260	266	271

Notes:

1. This table is based on the DWR Guidebook Table 10.
2. Based on calendar year.
3. Includes system losses due to leaks, reservoir overflows, and inaccurate meters, as well as water used in operations.

3.6 Total Water Demand

As described above, other water uses, as well as any water lost during conveyance, must be added to the customer demand in order to project total water demand for the South San Gabriel System. Although there are no other water uses contributing to the total water demand in the South San Gabriel System, other water uses and system water losses must be incorporated into the total water demand. Table 3-14 summarizes the projections of water sales, other water uses and system losses, and total water demand through the year 2035.

The projected water sales and system losses were added to estimate the total baseline water demand shown in Table 3-14. The baseline demand projections below do not include water use reductions due to additional implementation of future DMMs or other conservation activities. Baseline demands are used for supply reliability evaluation purposes throughout this UWMP for estimates of water supplies that may be required to meet system demands for the next 25 years. Figure 3-5 shows the projected total water demand through 2035.

Projected water demands assuming SBX7-7 compliance are also provided in Table 3-14 for reference purposes; assuming full compliance with the SBX7-7 interim and 2020 water use reduction targets. SBX7-7 compliance water demands were calculated by multiplying the projected population by the applicable water use target. Future water use that is exempt from SBX7-7, such as industrial process water or direct reuse recycled water is not included in this projection.

Table 3-14: Projected Total Water Demand and SBX7-7 Compliance Projections in ac-ft/yr

				SBX7-7 Compliance Projections	
Year[2]	**Projected Water Sales**	**Other Water Uses and System Losses**	**Total Baseline Water Demand**	**Water Savings**	**Total Water Demand with Savings**
2005	2,935	274	3,209	0	n/a
2010	2,575	114	2,689	0	n/a
2015	3,164	246	3,410	17	3,394
2020	3,256	253	3,509	141	3,368
2025	3,335	260	3,595	155	3,440
2030	3,412	266	3,678	168	3,510
2035	3,478	271	3,748	172	3,577

Notes:

1. This table is based on the DWR Guidebook Table 11.
2. Based on calendar year.

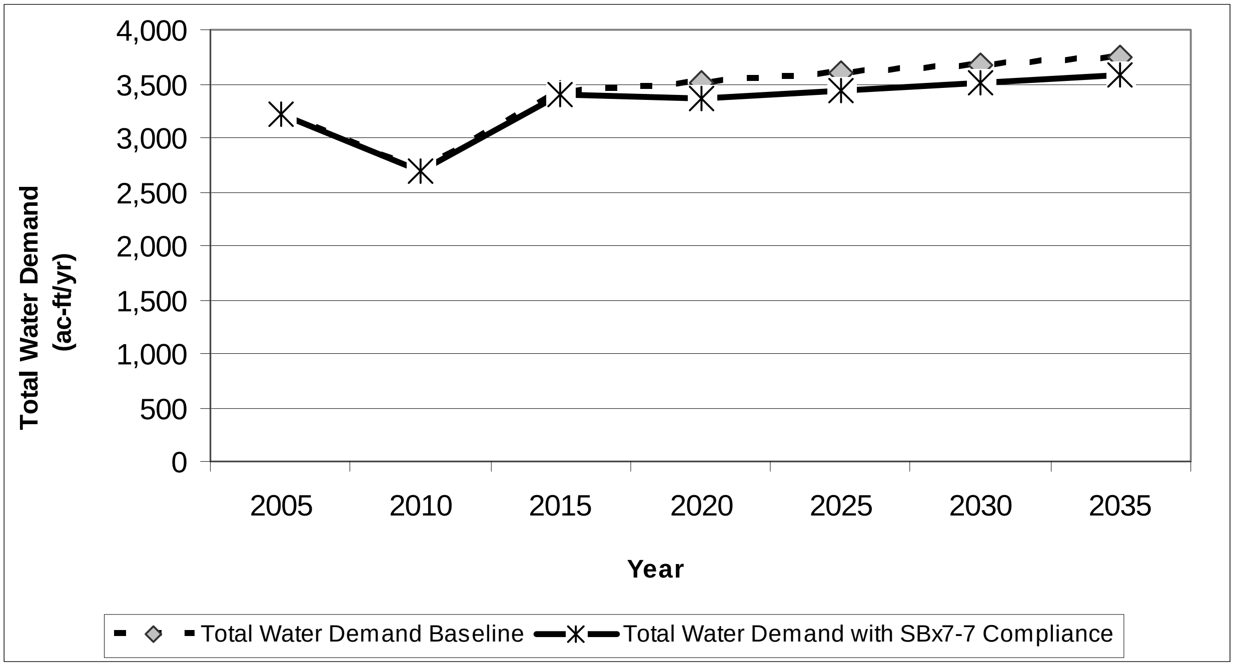

Figure 3-5: Total Water Demand

3.7 Data Provided to Wholesale Agency

GSWC provided the following projected water use data to the Upper San Gabriel Valley Municipal Water District (USGVMWD, Upper District), the wholesale water supplier for the South San Gabriel System, as summarized in Table 3-15. Since the preliminary projections were submitted in 2010, GSWC has refined projections by integrating actual 2010 water usage and supply data. As a result, the projections shown in Table 3-15 below do not agree with the demands presented in other chapters of this UWMP. As required per Section 10631(k) the supporting documentation providing the water use projections to the wholesale agency is included in Appendix I.

Table 3-15: Summary of South San Gabriel System Data Provided to USGVMWD in ac-ft/yr

Wholesaler	Contracted Volume	2010	2015	2020	2025	2030	2035
USGVMWD	N/A	2,896	3,200	3,500	3,745	3,969	4,044

Note:
This table is based on the DWR Guidebook Table 12.

3.8 Disadvantaged Community Water Use Projections

Section 10631.1 (a). Include projected water use for single-family and multi-family residential housing needed for lower income households, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

Senate Bill 1087 requires that water use projections of a UWMP include the projected water use for single-family and multi-family residential housing for lower income households as identified in the housing element of any city, county, or city and county in the service area of the supplier.

Housing elements rely on the Regional Housing Needs Allocation (RHNA) generated by the State Department of Housing and Community Development (HCD) to allocate the regional need for housing to the regional Council of Governments (COG) (or a HCD for cities and counties not covered by a COG) for incorporation into housing element updates. Before the housing element is due, the HCD determines the total regional housing need for the next planning period for each region in the state and allocates that need. The COGs then allocate to each local jurisdiction its “fair share” of the RHNA, broken down by income categories; very low, low, moderate, and above moderate, over the housing element’s planning period.

The County of Los Angeles last updated its housing element in 2006. A lower income house is defined as 80 percent median income, adjusted for family size. The County’s housing element identifies the target number of low-income households in the County from 2006 to 2013 as 15.7 percent and very low-income households as 24.7 percent. However, it is unknown what percentage of the low-income and very low-income households are within GSWC’s South San Gabriel service area. For this reason, it is not possible to project water use for lower income households separately from overall residential demand. However, to remain consistent with the intent of the SB-1087 legislation and to comply with the UWMP Act, an effort has been made to identify those water use projections for future single and multi-family households based on the aggregate percentage of both the low-income and very low-income categories. 40 percent was used to estimate the lower income demand projections as shown in Table 3-16 below.

Table 3-16: Low-Income Projected Water Demands in ac-ft/yr

	2015	2020	2025	2030	2035
Single-Family Residence	101	119	134	148	160
Multi-Family Residence	78	92	102	112	121
Total	179	211	237	261	281

Note:
This table is based on the DWR Guidebook Table 8.

GSWC will not deny or conditionally approve water services, or reduce the amount of services applied for by a proposed development that includes housing units affordable to lower income households unless one of the following occurs:

- GSWC specifically finds that it does not have sufficient water supply.
- GSWC is subject to a compliance order issued by the State Department of Public Health that prohibits new water connections.
- The applicant has failed to agree to reasonable terms and conditions relating to the provision of services.

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Chapter 4: Water Supply

A detailed evaluation of water supply is required by the Act. Sections 10631 (b) through (d) and (h) of the Act state the following:

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). If groundwater is identified as an existing or planned source of water available to the supplier, all of the following information shall be included in the plan:

(1) A copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management.

(2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For those basins for which a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree.

For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(c) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(1) An average water year.

(2) A single dry water year.

(3) Multiple dry water years.

For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

(d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

(h) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs, other than the demand management programs identified pursuant to paragraph (1) of subdivision (f), that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single dry, and multiple dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

This chapter addresses the water supply sources of the South San Gabriel System. The following chapter provides details in response to those requirements of this portion of the Act.

4.1 Water Sources

GSWC obtains its water supply for the South San Gabriel System from two primary sources: imported water and GSWC-operated groundwater wells. Imported water is purchased from the Upper San Gabriel Valley Municipal Water District (USGVMWD), also called the Upper District. The Upper District obtains its imported water supply from the Metropolitan Water District of Southern California (Metropolitan).

As described in Section 4.3.1, below, the groundwater rights for the South Arcadia System and the South San Gabriel System are shared and are not preferential to either system. GSWC manages the allocation between the two systems. South Arcadia does not have any water supply from purchased sources, and therefore is 100 percent reliant upon groundwater supply from the Main San Gabriel Basin. If demands increase beyond the allocated OSY shared water right for the South Arcadia or South San Gabriel systems, GSWC can either find additional water rights or purchase replenishment water. Water rights may be obtained by purchasing or leasing existing rights from other producers in the basin. Groundwater pumping in excess of the OSY and any additional purchased or leased rights is permitted when replaced in kind with available replenishment water that is purchased from the Basin's responsible agency. The Upper District is the responsible agency for the portion of the Basin from which groundwater is pumped from the South Arcadia and South San Gabriel Systems.

Table 4-1, below, summarizes the approximate amount of water supplied by each source in acre-feet per year. The availability of water from each source is estimated through the year 2035, in accordance with GSWC's long-term water supply planning projections and those of its wholesale suppliers. GSWC's water supply is projected to increase by about 39 percent from 2010 to 2035 to meet the projected water demands, with most of this increased demand being met by imported water from the Upper District. Water demand projections are documented in Chapter 3.

Table 4-1: Current and Planned Water Supplies for the South San Gabriel System in ac-ft/yr

Source	2010	2015	2020	2025	2030	2035
Purchased water from USGVMWD	338	2,097	2,375	2,604	2,828	3,015
Groundwater(1)	2,352	1,313	1,134	991	850	733
Recycled water	0	0	0	0	0	0
Total	2,689	3,410	3,509	3,595	3,678	3,748

Notes:

1. Based on projected use in the Main San Gabriel Groundwater Basin. 2015-2035 groundwater projections assume a long-term average OSY of 190,000 ac-ft.
2. 2010 water supplies are based on actual production records.
3. Table format based on DWR Guidebook Table 16.

This water supply summary is based on GSWC's groundwater management strategy for the South San Gabriel and South Arcadia Systems, and data provided by the Upper District. In the future, GSWC expects to use its Main Basin groundwater rights to supply the South Arcadia System, and shift the South San Gabriel System to rely more heavily on the Upper District imported water supply.

There is no recycled water supply planned for this system. The potential for future recycled water use is described in Section 4.8. Details of the water supply are presented in the following section, while water supply reliability is discussed in Chapter 6.

4.2 Purchased Water

The Upper District is a member agency of the Metropolitan, providing treated water to several agencies, including GSWC. Additional details regarding Upper District's imported water supply can be found in the Upper District's 2010 UWMP. The South San Gabriel System has one connection through which it receives water from the Upper District, named the USG-1 connection, with a capacity of 3,375 gallons per minute (gpm).

In addition, the South San Gabriel System has an emergency connection with the City of Monterey Park, with a capacity of 1,500 gpm. Two reservoirs with a total volume of 0.52 million gallons serve as storage in the South San Gabriel System.

4.3 Groundwater

This section provides a brief description of the Main San Gabriel Groundwater Basin, including the groundwater supplies available to GSWC. More detailed information can be found in the references cited in these sections.

Groundwater supplying GSWC's South San Gabriel System is pumped from a total of three active groundwater wells in the Main San Gabriel Basin, which has a surface area of approximately 154,000 acres (241 square miles). These wells have a current total normal year active capacity of 4,356 ac-ft/yr. Between 1999 and 2010, the actual production averaged 2,836 ac-ft/yr.

The Main San Gabriel Basin is bounded by the Raymond fault and the contact between Quaternary sediments and consolidated basement rocks of the San Gabriel Mountains on the north, by the Repetto, Merced, and Puente Hills on the south and west, and by the Chino and San Jose faults on the east.

Water-bearing units in the Main San Gabriel Basin are recent alluvium and the San Pedro Formation. The alluvium consists of Pleistocene and Holocene deposits with a total thickness ranging from 40 feet to over 4,000 feet. The Holocene alluvium consists of alluvial fans and stream deposits approximately 100 feet in thickness (DWR, 2004). The Pleistocene alluvium is composed of unsorted, angular to sub-rounded sedimentary deposits ranging from gravels near the San Gabriel Mountains to sands and silts in the central and western parts of the basin. These Pleistocene alluvium deposits constitute the most of the productive water-bearing units in the basin (DWR, 2004). The Pleistocene alluvium varies in thickness from 40 feet in the north to 4,100 feet in the central portion of the basin (DWR, 2004). The San Pedro formation also bears fresh water and consists of interbedded marine sand, gravel, and silt. The maximum thickness of the San Pedro formation is approximate 2,000 feet (DWR, 2004)

Estimates of the hydraulic conductivities in the Basin range from 270 feet per day (ft/d) for gravel to 0.001 ft/d for clay (CH2M HILL, 1986). Sand and gravel units were estimated to have a hydraulic conductivity of 135 ft/d and sandy clay estimated at 10 ft/d (CH2M HILL, 1986). These values of hydraulic conductivities are an estimate based on aquifer test and boring log descriptions of the sediments.

Groundwater levels have historically fluctuated in the basin. Since 1993, the water levels for the Baldwin Park Key Well have varied about from an elevation high of 272 feet to a historic low in 2009 of 189.2 feet (Upper District, 2010). The Watermaster reported in 2010 that the groundwater levels in the Baldwin Park Key Well have been just above the lower value of the operating range of storage for the groundwater basin at 204.2 feet as of June 26, 2010. One foot of elevation change of the Key Well is roughly equal to a change in water storage of 8,000 ac-ft. The total storage capacity of the San Gabriel Basin is estimated to be about 8.6 million ac-ft (Main San Gabriel Basin Watermaster, 2011). The historic high groundwater elevation was measured in 1916 at 329.1 feet at which time the Main San Gabriel Basin storage was estimated at 8.7 million ac-ft. The historic low groundwater elevation was 189.2 feet in 2009 when the Main San Gabriel Basin storage was estimated at 7.6 million ac-ft.

4.3.1 Main San Gabriel Basin Adjudication

In 1973, the rights to use groundwater from the San Gabriel Valley Basin were adjudicated in the case *Upper San Gabriel Valley Municipal Water District vs. City of Alhambra, et al* (Superior Court, County of Los Angeles, Case No. 924128, Appendix F). During the adjudication process, the safe yield of the basin was studied to help assign prescriptive pumping rights. The total prescriptive pumping right for the Main San Gabriel Basin was established at 197,634 ac-ft. This prescriptive right was used during the adjudication to determine the baseline share of pumping rights for each water producer in the basin.

The Main San Gabriel Basin Watermaster regulates groundwater production within the basin. Each year the Watermaster determines the operating safe yield (OSY) for the basin, which may be larger or smaller than the total prescriptive right of 197,634. The Watermaster performs hydrologic balance calculations to assess the groundwater conditions in the Main San Gabriel Basin. The hydrologic assessments are based on an evaluation of groundwater levels in the Basin, determination of the previous year’s recharge and extraction activities, estimates of the current year’s recharges and extractions, water quality, historic and current rainfall data, and the availability of imported water. The OSY has historically fluctuated to account for wet or dry conditions in the basin and to accommodate the availability of imported water that may be needed to supplement local water supplies and recharge of the basin.

The OSY is the amount of water that can be pumped from the basin before the Watermaster imposes a “Replacement Water Assessment” to replenish the basin with imported water. Each water right holder is entitled to a set percentage of the OSY annually. Because the OSY is recalculated each fiscal year (FY), the actual amount of water GSWC has rights to pump without paying a replenishment assessment fee can fluctuate annually. Since the basin was adjudicated in 1973, the OSY has ranged from a low of 140,000 (FY 1991 – 1992) to a high of 240,000 ac-ft (FY’s 2005 – 2007).

Water pumped in excess of the OSY is managed by Upper District, the applicable responsible agency, which is determined by geographic and political boundaries under terms of the Judgment. Upper District is responsible for ensuring that the basin is not overpumped in any given year, i.e. that total groundwater production equals OSY water rights plus replenishment water. Replenishment water must be available to allow pumping in excess of the OSY. For the past 2 years, replenishment water was not available when the producers over pumped in the basin. The responsible parties have implemented cyclic storage agreements to provide replenishment water supplies during periods of reduced imported water availability. Additional descriptions of groundwater supply reliability and cyclic storage are provided in Chapter 6.

GSWC has pumping rights to 2.92105 percent of the OSY for the Main San Gabriel Basin, which is shared between the South San Gabriel and South Arcadia Systems. GSWC's total pumping rights for these two Systems have varied from 4,089 ac-ft/yr to 6,718 ac-ft/yr as shown in Table 4-2. In May 2011, the Watermaster established an OSY of 210,000 ac-ft/yr for FY 2011-12, which means that GSWC's current pumping right is 6,134 ac-ft/yr. However, since the OSY is set annually by the Watermaster, it was conservatively assumed that the long-term average OSY will be equal to 190,000 ac-ft/yr, for a pumping right of 5,550 ac-ft/yr. This total could be augmented by purchasing or leasing water rights from other right-holders in the basin. Furthermore, the adjudication for the Main San Gabriel Basin permits producers to carry over water rights from previous years and to pump more than their share of the OSY, provided they pay a replenishment fee for all excess production. The historic low, high, and current operating safe yield for the Main San Gabriel Basin are shown in Table 4-2.

Table 4-2: Main San Gabriel Basin Groundwater Pumping Rights

Condition/Time Period	Operating Safe Yield (ac-ft/yr)	GSWC Pumping Rights(1) (ac-ft/yr)
Historic Low OSY (FY 1991 – 1992)	140,000	4,089
Historic High OSY (FY 2005 – 2007)	240,000	7,011
Current OSY (FY 2011 – 2012)	210,000	6,134

Notes:

1. GSWC pumping right is equal to 2.92105 percent of the OSY for the South Arcadia and South San Gabriel Systems.
2. OSY is reassessed on an annual basis.

GSWC's South San Gabriel System currently operates 3 active wells in the Main San Gabriel Groundwater Basin; they are listed in Table 4-3. Well production capacity is provided in terms of instantaneous capacity in gpm and annual yield in ac-ft/yr for the South San Gabriel System. The total normal year active well capacity for GSWC's South San Gabriel System is 2,700 gpm (4,356 ac-ft/yr).

Table 4-3: Well Name and Capacity

Well Name	Current Well Capacity (gpm)(1)	Current Well Capacity (ac-ft/yr)
Earle	0	0
Garvey No. 1	0	0
Garvey No. 2	0	0
San Gabriel No. 1	1,200	1,936
San Gabriel No. 2	0	0
Saxon No. 3	1,000	1,613
Saxon No. 4	500	807
Total Capacity	**2,700**	**4,356**

Note:

1. Estimated annual average current well production capacity is provided; actual and design instantaneous pumping capacity may be greater for each well.

Table 4-4 shows the groundwater pumping history for the South San Gabriel System for calendar years 2005 through 2010. The amount of water pumped from the Main San Gabriel Basin for the South San Gabriel System has varied through this 5 year period. From 2005 to 2010, groundwater represented between 68 and 92 percent of the total water supply for the South San Gabriel System.

Table 4-4: Groundwater Pumping History by South San Gabriel System (2005 to 2010) in ac-ft

Basin Name	Metered or Unmetered	2005	2006	2007	2008	2009	2010
Main San Gabriel	Metered	2,192	2,555	2,912	2,877	2,628	2,352
Percent of Total Water Supply		68%	74%	90%	92%	91%	87%

Notes:
1. Table format based on DWR Guidebook Table 18.
2. Years are reported in calendar years (January 1 – December 31).

The projected groundwater pumping volumes for the South San Gabriel System through 2035 are summarized in Table 4-5. If needed, the South San Gabriel System's share of the OSY could be augmented through the purchase or lease of pumping rights from other producers in the Main San Gabriel Basin. The adjudication for the Main San Gabriel Basin also permits a producer to pump more than its share of the OSY if replenishment water is available, and if the producer pays a replenishment fee for all production in excess of the allocated rights.

Table 4-5: Projected Groundwater Pumping Amounts by South San Gabriel System to 2035 in ac/ft

Basin Name	2010	2015	2020	2025	2030	2035
Main San Gabriel	2,352	1,313	1,134	991	850	733
Percent of Total Water Supply	87%	38%	32%	28%	23%	20%

Notes:
1. Table format based on DWR Guidebook Table 19.
2. Years are reported in calendar years (January 1 – December 31).

4.4 Transfers and Exchanges

GSWC has historically transferred groundwater rights for its holdings in the Main San Gabriel Basin between the San Dimas District and the San Gabriel District. Additionally, if GSWC's actual need for groundwater exceeds its share of the OSY, GSWC can lease available groundwater rights from other producers in the basin to increase their allowed pumping. GSWC has the ability to obtain leases for additional groundwater in the Main San Gabriel Basin annually, on an as-needed basis, following an evaluation of the economic benefits to their rate payers.

No specific transfer or exchange opportunities have been identified in the South San Gabriel System at this time; therefore, Table 4-6 has been left blank.

Table 4-6: Transfer and Exchange Opportunities

Source Transfer Agency	Transfer or Exchange	Short Term	Proposed Quantities	Long-Term	Proposed Quantities
GSWC	N/A	N/A	N/A	N/A	N/A

Note:
Table format based on DWR Guidebook Table 20.

4.5 Planned Water Supply Projects and Programs

GSWC, as a part of its normal maintenance and operations, will construct new wells, pipelines, and treatment systems as needed as a part of its ongoing Capital Investment Program to maintain its supply and meet distribution system requirements.

Additionally, GSWC participates with the Upper District in a variety of programs intended to enhance regional water supply. These projects include surface water treatment plant improvements, groundwater replenishment and recharge studies, recycled water, and groundwater cleanup. In addition, the Upper District is currently evaluating the expanded use of recycled water for groundwater recharge. See the Upper District’s 2010 UWMP for details.

A potential long-term water supply transfer opportunity that GSWC is evaluating is the Cadiz Valley Water Conservation, Recovery and Storage Project (Cadiz Project). The project is designed to capture and conserve thousands of acre-feet of native groundwater currently being lost to evaporation through an aquifer system beneath Cadiz’s property in eastern San Bernardino County, California. By implementing established groundwater management practices, the project will create a new, sustainable annual water supply for project participants. In addition, the project offers storage capacity that can be used by participants to carry-over – or “bank” – annual supplies, without the high rates of evaporative loss suffered by local surface reservoirs.

The Cadiz Project will produce up to 50,000 ac-ft/yr for fifty years. GSWC is one of five entities that have expressed an interest in receiving water from the project. In 2009, GSWC signed a letter of intent to purchase up to 5,000 ac-ft/yr and committed to paying a share of the cost of the project’s environmental evaluation. GSWC continues to evaluate the economics and technical feasibility of this project. Table 4-7 shows the potential water supply that could be provided by the Cadiz Project.

Table 4-7: Future Water Supply Projects in ac-ft

Project Name	Normal Year	Single-Dry Year	Multiple-Dry Years		
			Year 1	Year 2	Year 3
Cadiz Project	5,000	5,000	5,000	5,000	5,000

Note:
This table is based on the DWR Guidebook Table 26.

4.6 Wholesale Agency Supply Data

Table 4-8 provides the Upper District's existing and planned water sources available to the South San Gabriel System during normal years. These supplies are expected to meet the projected imported water demands.

Table 4-8: Existing and Planned Wholesale Water Supplies in ac-ft/yr

Wholesaler Sources	Contracted Volume	2010	2015	2020	2025	2030	2035
USGVMWD		338	2,097	2,375	2,604	2,828	3,015

Note:
This table is based on DWR Guidebook Table 17.

Table 4-9 demonstrates the reliability of wholesale water supply available to meet annual water demand under an average, single-dry year condition for the South San Gabriel System. The table includes single-dry year and multiple-dry year supplies for 2035. The Upper District is assured by Metropolitan of 100 percent reliability to meet the water demand through 2035 (Metropolitan RUWMP, 2010).

Table 4-9: Reliability of Wholesale Supply for Year 2035 in ac-ft/yr

			Multiple-Dry Water Years		
Wholesaler	Average / Normal Water Year Supply	Single-Dry	Year 1	Year 2	Year 3
USGVMWD	3,015	3,015	3,015	3,015	3,015
Percent Normal		100	100	100	100

Note:
Table format based on DWR Guidebook Table 31.

Table 4-10 lists factors affecting wholesale supply for the South San Gabriel System. Metropolitan intends to provide 100 percent supply reliability to the Upper District, which in turn provides 100 percent reliability of supply to the South San Gabriel System.

Table 4-10: Factors Affecting Wholesale Supply

Name of Supply	Legal	Environmental	Water Quality	Climatic
USGVMWD	N/A	N/A	N/A	N/A

Note:
Table format based on DWR Guidebook Table 29.

4.7 Desalination

This section presents a discussion of opportunities to use desalinated water as a supplemental future water supply source for the South San Gabriel System. Section 10631(i) of the Act requires an evaluation of desalination opportunities within the South San Gabriel System. The Act states the following:

> *Section 10631*
>
> *(i) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.*

GSWC obtains the majority of its water supply for the South San Gabriel System from local groundwater which has not been impacted by salinity issues and does not require desalination. There are currently no opportunities for using desalinated water as a source of water supply for the South San Gabriel System by GSWC or the groundwater basin responsible agency, Upper District. Therefore, Table 4-11 has been intentionally left blank.

Upper District has concluded that due to the high quality (low TDS concentration) groundwater, Upper District and its member agencies do not need to investigate the use of desalination to develop or reestablish a new long-term supply (Upper District, 2011). Likewise, while it is currently economically impractical and infeasible for GSWC to participate in a desalination program that directly benefits the South San Gabriel System, GSWC would be open to considering partnering opportunities with other water suppliers in the region who may participate in a desalination project that would provide a direct or indirect benefit through mechanisms such as groundwater replenishment.

Table 4-11: Summary of Opportunities for Water Desalination

Source of Water	Yield (ac-ft/yr)	Start Date	Type of Use	Other
None	N/A	N/A	N/A	N/A

4.8 Recycled Water Plan

This chapter covers Section 10633 which details the requirements of the Recycled Water Plan that are included in the Act. The Act states the following:

> *Section 10633. The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area and shall include all of the following:*
>
> *(a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.*
>
> *(b) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.*
>
> *(c) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse,*

groundwater recharge, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.

(d) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

(e) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre feet of, recycled water used per year.

(f) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

4.8.1 Coordination

Table 4-12 summarizes the role of the agencies that participate in the development of recycled water plans that affect the South San Gabriel System of the Golden State Water Company (GSWC).

Table 4-12: Role of Participating Agencies in the Development of the Recycled Water Plan

Participating Agencies	Role in Plan Development
Water agencies	GSWC works closely with the Los Angeles County Sanitation District (LACSD) in planning a potential recycled water distribution system and identifying potential recycled water customers. The Upper San Gabriel Valley Municipal Water District acting as the recycled water wholesaler, would lead the way in implementing the recycled water plan and distribution network.
Wastewater agencies	The LACSD provides a reliable supply of recycled water that meets California recycled water quality standards set forth in Title 22 of the California Code of Regulations.
Groundwater agencies	Not applicable for this System.
Planning agencies	Los Angeles County Sanitation District plays a key role in conducting data and customer assessments, as well as analyzing community and economic impacts.

4.8.2 Wastewater Quantity, Quality, and Current Uses

Wastewater in the South San Gabriel System is collected by gravity sewers and lift stations owned by the cities of Rosemead, San Gabriel, and Monterey Park, as well as by the Sanitation Districts of Los Angeles County (LACSD). The wastewater is transported through trunk sewers to LACSD's San Jose Creek and Whittier Narrows Water Reclamation Plants (WRP).

The San Jose Creek WRP provides primary, secondary, and tertiary treatment for an average dry weather flow (DWF) of 100 million gallons of wastewater per day (mgd). The plant serves a largely residential population of approximately one million people. About 35 mgd of treated effluent from San Jose Creek WRP is reused at 17 different sites. The recycled water is primarily used for groundwater recharge and agricultural and landscape irrigation. The remaining effluent (65 mgd) is discharged into the San Gabriel River (LACSD 2011).

The Whittier Narrows WRP provides primary, secondary, and tertiary treatment for an average DWF of 15 mgd. The plant serves a population of approximately 150,000 people. According to the LACSD, nearly all of the treated effluent is reused as groundwater recharge into the Rio Hondo and San Gabriel Coastal Spreading Grounds or for irrigation at an adjacent nursery. Any remaining effluent is discharged into the San Gabriel River (LACSD 2011).

Because the Whittier Narrows and San Jose Creek WRPs treat wastewater for a larger population than exists in the South San Gabriel System, an estimated per capita wastewater generation factor was used to calculate the volume of wastewater generated by GSWC's customers in South San Gabriel. Based on the populations served and the average wastewater treatment rates for the San Jose Creek and Whittier Narrows WRPs as detailed above, the average per capita wastewater generation factor for both of these WRPs is 100 gallons per person per day. This factor was used to estimate existing and projected volumes of wastewater collected and treated in the South San Gabriel System as summarized in Table 4-13.

Because all of the effluent from Whittier Narrows and San Jose Creek WRPs is treated to meet Title 22 recycled water standards, 100 percent of the treated effluent is included in Table 4-13 as meeting such standards. However, out of the combined wastewater effluent (115 mgd) from these two treatment plants, 50 mgd (43 percent) of the treated water is actively reused throughout the region. Therefore, the assumption is that 43 percent of the treated wastewater that is collected in the South San Gabriel System is recycled while the remaining 57 percent is discharged into the unlined portions of the San Gabriel River. Although the majority of the water that is discharged into the San Gabriel River will contribute to groundwater recharge through the riverbed, LACSD does not consider this an active recycled water use. Table 4-14 lists the estimates of existing and projected volumes of treated effluent collected from the South San Gabriel System that will be discharged into the San Gabriel River.

Although much of the wastewater generated in the South San Gabriel System is recycled, all of the reuse sites are elsewhere in the LACSD system, and there are no existing uses of recycled water within the boundaries of the South San Gabriel service area. Therefore, Table 4-15 has intentionally been left blank.

Table 4-13: Estimates of Existing and Projected Wastewater Collection and Treatment in ac-ft/yr (mgd) for the South San Gabriel System

	2005[3]	2010[3]	2015	2020	2025	2030	2035
Projected population in service area[2]	28,140	28,715	29,414	30,065	30,710	31,332	31,932
Wastewater collected and treated in service area[4]	3,152 (2.81 mgd)	3,216 (2.87 mgd)	3,295 (2.94 mgd)	3,368 (3.01 mgd)	3,440 (3.07 mgd)	3,510 (3.13 mgd)	3,577 (3.19 mgd)
Quantity that meets recycled water standard	3,152 (2.81 mgd)	3,216 (2.87 mgd)	3,295 (2.94 mgd)	3,368 (3.01 mgd)	3,440 (3.07 mgd)	3,510 (3.13 mgd)	3,577 (3.19 mgd)

Notes:

1. This table is based on the DWR Guidebook Table 21.
2. For population projections see Section 2.3.
3. Based on calendar year.
4. Volumes of wastewater collected and treated are estimated based on the per capita generation factor.
   WW = population x 100 gal/day.

Table 4-14: Estimates of Existing and Projected Disposal of Non-Recycled Wastewater in ac-ft/yr (mgd) for the South San Gabriel System

Method of Disposal	Treatment Level	2005(2)	2010(2)	2015	2020	2025	2030	2035
River Discharge	Tertiary	1,782 (1.59)	1,818 (1.62)	1,862 (1.66)	1,904 (1.70)	1,944 (1.74)	1,984 (1.77)	2,022 (1.80)

Notes:

1. This table is based on the DWR Guidebook Table 22.
2. Based on actual year.
3. Volumes of effluent discharged are estimated. For a description of the methodology, refer to the text.

Table 4-15: Existing Recycled Water Use in the South San Gabriel System

Type of Use	Treatment Level	2010 Use (ac-ft/yr)
N/A	N/A	N/A

4.8.3 Potential and Projected Use

Although the wastewater generated in the South San Gabriel System is treated by the San Jose Creek and Whittier Narrows WRPs, the recycled water distribution networks from these two facilities do not extend to the South San Gabriel System. It is the responsibility of LACSD, as owner and operator of these facilities, to determine the feasibility of extending the recycled water distribution network to South San Gabriel. At this time, LACSD does not have plans to extend their distribution network.

In addition to LACSD, the Upper San Gabriel Municipal Water District (Upper District), a member agency of the Metropolitan Water District of Southern California, and a water provider for the GSWC, has developed a direct reuse project located in the vicinity of the South San Gabriel System. The Direct Reuse project will supply approximately 1,800 ac-ft/yr of recycled water to irrigation customers in the Whittier Narrows area in order to replace groundwater and imported potable water that historically has been used for irrigation at these customer locations. However, this project does not include GSWC customers within the South San Gabriel System.

Since no potential or projected recycled water use has been identified for the South San Gabriel System, Table 4-16 and Table 4-17 were intentionally left blank. In the 2005 UWMP for the South San Gabriel System there were no projections of recycled water by the year 2010, so Table 4-18 has also been left blank.

Table 4-16: Potential Future Recycled Water Uses in ac-ft/yr

Type of Use	Treatment Level	Description	Feasibility	2015	2020	2025	2030	2035
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note:
This table is based on the DWR Guidebook Table 23.

Table 4-17: Projected Future Recycled Water Use in Service Area in ac-ft/yr

Type of Use	2015	2020	2025	2030	2035
N/A	N/A	N/A	N/A	N/A	N/A

Table 4-18: Comparison of Recycled Water Uses—Year 2000 Projections versus 2005 Actual

Type of Use	2005 Projection for 2010	2010 Actual Use
N/A	N/A	N/A

Note:
This table is based on the DWR Guidebook Table 24.

4.8.4 Optimization and Incentives for Recycled Water Use

If and when the LACSD and/or Upper District decide to extend the distribution of recycled water to South San Gabriel, where feasible, GSWC will support the projects by encouraging recycled water use among its customers. However, because no plans exist to provide recycled water to the South San Gabriel System, there are no actions in place at this time by which GSWC is encouraging the use of recycled water in this system. Therefore, Table 4-19 is not applicable for this system and has been intentionally left blank.

Table 4-19: Methods to Encourage Recycled Water Use and the Resulting Projected Use in ac-ft/yr

Actions	2015	2020	2025	2030	2035
N/A	N/A	N/A	N/A	N/A	N/A

Note:
This table is based on the DWR Guidebook Table 25.

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Chapter 5: Water Quality

Section 10634 of the Act requires an analysis of water quality issues and their impact to supply reliability. The Act states as follows:

> *Section 10634. The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631 and the manner in which water quality affects water management strategies and supply reliability.*

5.1 GSWC Measures for Water Quality Regulation Compliance

To facilitate full compliance with water quality laws and regulations, GSWC maintains an Environmental Quality Department that has independent lines of reporting authority within the organization. The Environmental Quality Department is headed by a company officer specifically assigned to oversee and manage the company's environmental and water quality programs. The Vice President of Environmental Quality has a staff of three managers, including two Water Quality Managers. The Water Quality Managers, in turn, manage a staff of Water Quality Engineers and Technicians that are assigned to district offices. Each district office is assigned one Water Quality Engineer and at least one Water Quality Technician to provide direct support to the local drinking water systems within the district.

The District Water Quality Engineer is the main point of contact for the California Department of Public Health (CDPH) as well as other regulatory agencies. The Water Quality Engineer also is responsible for coordinating compliance measures through scheduling required sample collection, preparing water quality related plans, maintaining a water quality database, providing training to operations, maintaining a cross connection control program, and preparing and submitting monitoring reports, permit applications and other regulatory related correspondence.

As a whole, the Environmental Quality Department monitors and participates in the implementation of new water quality related laws and regulations. Through routine department meetings and training, the District Water Quality Engineers are kept up to date with changing water quality regulations and related technology. These efforts contribute towards maintaining a pool of trained water quality professionals that can be utilized throughout the company. This provides the company the ability to respond to a wide variety of water quality issues or emergencies.

5.2 Water Quality Issues

The drinking water quality of the South San Gabriel System must comply with the Safe Drinking Water Act (SDWA), which is composed of primary and secondary drinking water standards regulated by the U.S. Environmental Protection Agency and CDPH. Water Quality sampling is performed at each well and within the distribution system to ensure compliance with the regulatory standards.

5.2.1 Surface Water Quality

Treated surface water purchased from the Upper San Gabriel Valley Municipal Water District (Upper District) enters the South San Gabriel System through a single inter-connection. Metropolitan and Upper District are responsible for meeting all drinking water standards as water leaves the surface water treatment plant and at all inter-connections with the South San Gabriel System.

5.2.2 Groundwater Quality Management

Significant groundwater contamination in the Main San Gabriel Basin has resulted from industrial solvents known as volatile organic compounds (VOCs) and agricultural practices which contribute nitrates to the groundwater. In an effort to create a coordinated response to the groundwater contamination issue and to minimize impacts to groundwater supply, Main Basin water agencies adopted a joint resolution in 1989. This resolution assigned the Main Basin Watermaster the responsibility of developing and maintaining a 5-Year Water Quality and Supply Plan, subject to review by the Los Angeles Regional Water Quality Control Board. The objective of the 5-Year Plan is to coordinate cleanup projects, and ensure that pumping does not lead to degradation of water quality in the Main Basin. The Upper District also maintains a basinwide groundwater quality management and remediation plan (Upper District, 2010). As a result of these coordinated efforts by the Main Basin Watermaster and Upper District, groundwater quality is carefully monitored and activities are regulated to ensure that the effect of contamination on producers, including GSWC, is minimized.

5.2.3 Groundwater Quality

Table 5-1 summarizes water quality issues and recommendations for wells within the water system. The groundwater wells in the South San Gabriel System meet all current California Title 22 drinking water standards before water is delivered to customers. The following discussion relates to contaminants with maximum contaminant levels (MCLs) that are either existing or have been proposed by the USEPA and/or CDPH.

Drinking water regulations pertaining to emerging contaminants of concern, such as chromium (VI), nitrosamines, and VOCs, and potential revisions to existing regulations are closely monitored by GSWC’s Environmental Quality Department. The appropriate sampling and action will be taken on any affected water supply sources as monitoring requirements, new or revised MCLs are promulgated by the USEPA or CDPH. It is anticipated that it will take approximately 2 to 5 years from official adoption of a new or revised MCL to implement wellhead treatment or alternative approach for a source, including all steps from procuring CPUC funding approval to planning, permitting, design, and construction. There is typically adequate time allotted from regulatory approval to promulgation of a new drinking water standard to address localized treatment requirements; therefore no direct impacts to water supply reliability from future water quality regulations are anticipated at this time.

Portions of the groundwater basin are impacted by contaminants from improper waste disposal. The contaminants consist primarily of volatile organic compounds (VOCs) and perchlorate. The water system has been able to compensate for the loss of the contaminated wells and maintain its extractions from the basin by upgrading equipment at existing well sites, and making other system improvements.

The water system currently includes a total of seven wells, four of which have been taken off-line due to groundwater contamination. These wells and associated contaminants are:

- Earle Well – VOCs
- Garvey Wells No. 1 and No. 2 – VOCs
- San Gabriel Well No. 2 – VOCs, perchlorate and nitrate

Perchlorate. To date, perchlorate has impacted two wells, San Gabriel Wells Nos. 1 and 2. In 2010, perchlorate treatment was removed due to a sustained decline in perchlorate levels at San Gabriel Well No. 1. In addition, granular activated carbon treatment is being provided to remove VOCs. An expansion of the treatment process is underway to bring San Gabriel Well No. 2 on-line.

VOCs. Volatile organic compounds (VOCs) have impacted the five wells, including the San Gabriel No. 1 Well for which granular activated carbon treatment is being used. VOC monitoring and actions at the other wells include drilling replacement wells, well destruction, or installation of wellhead treatment systems.

Nitrate. Nitrate currently impacts San Gabriel Well No. 2. There is currently no treatment in place for nitrate, and the well has been taken offline.

1,4-Dioxane. Recently, 1,4-Dioxane has been detected in San Gabriel Well No. 1. The average concentration is below the Notification Limit of 1 µg/L. 1,4-Dioxane monitoring occurs on a more frequent basis.

Should additional treatment for the constituents listed above including perchlorate, VOCs, or 1,4 dioxane removal be required in the future, it is anticipated it would take approximately 2 to 5 years to implement a best available technology wellhead treatment system such as ion exchange, GAC, or advanced oxidation. Consideration will also be included for alternative water quality management strategies such as blending or supply replacement.

Radon. Radon has also been detected in many of the wells in the system. In 1999, the USEPA has proposed a radon MCL at 300 pCi/L, with an alternative standard of 4,000 pCi/L if the state has an approved Multimedia Mitigation program to reduce the indoor radon risk from soil and rocks underneath homes and buildings. While the proposed radon rule has not proceeded to promulgation, the effect of the proposed radon MCL would be widespread in groundwater wells throughout California.

Groundwater production from most of the active wells in this system will be impacted if the radon MCL is set at 300 pCi/L. Best available technologies for radon removal include Packed Tower Aeration (PTA) and Granular Activated Carbon (GAC). Due to some critical operation concerns with the use of GAC, PTA is the most common and effective method for radon removal. Installation of treatment facilities at some of the well sites in this system may be problematic due to lack of available space for treatment equipment. It is expected the state will develop an approved Multimedia Mitigation program thus allow the alternative MCL standard. If an MCL is promulgated, Multimedia mitigation would be recommended for these wells.

Table 5-1: Summary of Assessment

Well	Current Well Capacity (gpm)[1]	Status	Water Quality Issue/Concern	Existing Treatment	Recommendations
Earle	0	Inactive	VOCs; Radon		Destroy
Garvey No. 1	0	Inactive	VOCs; Radon		Destroy
Garvey No. 2	0	Inactive	VOCs; Radon		Destroy
San Gabriel No. 1	1,200	Active	VOCs, Perchlorate & 1,4-Dioxane	GAC	Continue Treatment
San Gabriel No. 2	0	Inactive	VOCs perchlorate; nitrate, Radon		Provide Treatment; Future multimedia mitigation (radon)
Saxon No. 3	1,000	Active	Radon		Future Multimedia mitigation (radon)
Saxon No. 4	500	Active	Radon		Future Multimedia mitigation (radon)

Note:

1. Estimated annual average current well production capacity is provided; actual and design instantaneous pumping capacity may be greater for each well.

5.2.4 Distribution System Water Quality

Distribution system water quality monitoring is performed for several water quality parameters in the South San Gabriel System, including general physical parameters, presence of coliform bacteria, disinfectant and disinfection by-product levels. Corrosivity of the water is monitored by measuring lead and copper levels at customer water taps. The South San Gabriel System utilizes an approved Sample Siting Plan for the collection, recording, and reporting of all bacteriological analyses. All monitoring parameters and levels currently meet drinking water standards. The ability to continue to meet these standards is not expected to change in the foreseeable future. The South San Gabriel System has also established an aggressive cross-connection control program to reduce the hazard associated with backflow and back-siphonage. These programs are required to comply with DHS regulations on Waterworks Standards and Cross Connection Control. Drinking water standard levels for disinfection by-products will be lowered in the future in accordance with the Stage 2 D/DBP Rule. It is anticipated that the system will meet the new standard without treatment or operational changes.

5.3 Projected Water Quality Impacts

As the water system loses additional wells due to groundwater contamination (Table 5-2), evaluations will be made to determine replacement water supply, treatment options and/or drilling new wells in accordance with the requirements of the Upper District's groundwater quality management policies.

Table 5-2: Summary of Projected Water Supply Changes Due to Water Quality Issues

Water Source	Projected Change (ac-ft/yr)					
	2010	2015	2020	2025	2030	2035
Earle (to be destroyed)	(261)	0	0	0	0	0
Garvey No. 1 (to be destroyed)	(149)	0	0	0	0	0
Garvey No. 2 (to be destroyed)	(217)	0	0	0	0	0
San Gabriel No. 1	0	0	0	0	0	0
San Gabriel No. 2	0	0	0	0	0	0
Saxon No. 3	0	0	0	0	0	0
Saxon No. 4	0	0	0	0	0	0

Note:
Table format based on DWR Guidebook Table 30.

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Chapter 6: Water Supply Reliability

Sections 10631 and 10635 of the Act require that an assessment of water supply reliability for various climatic conditions be undertaken. The Act states:

> *Section 10631.*
>
> *(c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:*
>
> *(A) An average water year.*
>
> *(B) A single dry water year.*
>
> *(C) Multiple dry water years.*
>
> *(2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.*
>
> *Section 10635.*
>
> *(a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.*

6.1 Reliability of Supply

The South San Gabriel System obtains its water supply from two sources: Metropolitan imported water obtained from the Upper District San Gabriel Valley Municipal Water District (Upper District), and groundwater from the Main San Gabriel Groundwater Basin. The majority of the imported water delivered from the Upper District to its sub-agencies is used for groundwater recharge (Upper District, 2011). Upper District is the agency identified in the Main Basin Judgment that is responsible for importing water into the basin for the South Arcadia and South San Gabriel Systems. The Upper District imports water from Metropolitan, therefore, conditions in local and distant areas can impact the reliability of supplies. In general, GSWC's supply is expected to be 100 percent reliable through 2035. This is a result of the projected reliability of the Upper District as a member of Metropolitan, both of which intend to provide 100 percent reliable imported water supplies. Groundwater reliability is based on GSWC's share of the projected Main San Gabriel Basin annual OSY and the numerous current and planned projects in the Main San Gabriel Basin designed to increase the reliability of the groundwater supply. The following is a summary of the basis of this reliability.

6.1.1 Metropolitan Supply Reliability

Metropolitan member agencies in the San Gabriel Valley, including Upper District, are largely pass-through entities that obtain nearly all their imported water from Metropolitan, directly or indirectly. Metropolitan's resource management plans are intended to optimize the use of its available resources during surpluses and shortages to minimize the probability of severe shortages and eliminate the possibility of extreme shortages and shortage allocations

This section presents a brief discussion of the source reliability of Metropolitan's primary water supply sources: imported water supply from the Colorado River and the State Water Project, and Metropolitan's plans to ensure a reliable water supply into the future. Metropolitan maintains a diverse portfolio of water sources including surface water supply, aquifer recharge and recovery, desalination, and recycled water. The two primary components of Metropolitan's water supplies are also the most variable:

- ***Colorado River Supply:*** Metropolitan owns and operates the Colorado River Aqueduct (CRA), which connects the Colorado River to the Metropolitan regional distribution system. The CRA has a capacity of 1.25 Million AFY (MAF) to transport Metropolitan's current contracted entitlement of 550 Thousand AFY (TAF) of Colorado River water. Metropolitan also holds a priority for an additional 662 TAF and 180 TAF when surplus flows are available.

- ***State Water Project (SWP) Supply:*** The original State Water Project Contract called for an ultimate delivery capacity of 4.2 MAF, with Metropolitan holding a contract for 1.9 MAF. Since that time there have been significant challenges to meeting those delivery goals. DWR released a Water Allocation Analysis in 2010 that has resulted in a Metropolitan estimated reduction in SWP supplies of 150 – 200 TAF for 2010 (Metropolitan Draft Regional UWMP, 2010).

As a result of the inherent uncertainty in Colorado River and SWP supplies given various hydrologic, environmental, and legal considerations, Metropolitan has undertaken several planning initiatives, summarized below, to broaden its water resources reliability. Metropolitan has documented that, consistent with Section 4202 of its Administrative Code, the agency is prepared to provide its member agencies with adequate supplies of water to meet expanding and increasing needs in the years ahead. When additional water resources are required to meet increasing needs, Metropolitan has stated that it will be prepared to deliver such supplies. In its 2010 Regional Urban Water Management Plan, Section II.4, Metropolitan also states that as a result of investments made in supply and storage, it has identified a resource management plan that should result in 100 percent reliability for non-discounted non-interruptible demands through 2035.

- **Integrated Resources Plan Updates (IRP):** Metropolitan's IRP updates completed in 1996 and updated in 2004 and 2010, included assessments of potential future regional demand projections based upon anticipated population and economic growth as well as conservation potential. The IRP also includes regional supply strategies and implementation plans to better manage resources, meet anticipated demand, and ensure overall system reliability. Metropolitan intends to implement the 2010 IRP to further support member agency local resource development as well as to investigate generating its own local resources for distribution to member agencies. The development of local resources, as well as the furthering of existing conservation goals to meet the Water Conservation Act of 2009 targets, is anticipated to provide a supply buffer for member agencies to rely upon in times of drought and long-term climatic changes.

- **1999 Water Surplus and Drought Management Plan (WSDM):** The WSDM provides the policy guidance to manage the region's water supplies to achieve the reliability goals of the IRP. This is achieved by integrating the operating activities of surplus and shortage supplies through a series of stages and principles.

- **2008 Water Supply Allocation Plan (WSAP):** The WSAP includes the specific formula for calculating member agency supply allocations and the key implementation elements needed for administering the allocation. The need for the WSAP arose after the 2008 Bay-Delta biological opinions and rulings that limited SWP supplies to its contractors including Metropolitan. The WSAP formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level for shortages of Metropolitan supplies up to 50 percent.

  Since the 2008 Bay-Delta reductions, Metropolitan has been using the WSAP formulas to contend with the reduction in available imported supplies implementing a Stage 2 (Regional 10 percent reduction in supply allocation) of the WSAP from July 2009 to April 2011. During such allocations, Metropolitan institutes severe financial penalties should an entity request supply over their reduced allocation. This in effect, limits supply at the retail level. Although it is anticipated that the WSAP will continue to be in effect in the near–term, Metropolitan states in its 2010 Draft UWMP that there will be sufficient supply to meet member agency demands in single and multiple-dry years from 2015 through 2035. However, this is assuming that Metropolitan storage levels are at or above average levels prior to those cycles, and key programs come to fruition as assumed by Metropolitan in their projections. For example, Metropolitan assumes that a Delta conveyance solution will be in place by 2022. Also, Metropolitan has indicated that there is a 50 percent probability that storage levels will be lower than the assumption used. Based on the recent WSAP allocations and regulatory restrictions in the Delta. GSWC's conservative assumption is that Metropolitan's projections in their 2010 Draft UWMP may not be 100 percent reliable in all cases.

6.1.2 The Upper District's Water Supply Reliability

In addition to Metropolitan's reliability initiatives, the Upper District and GSWC participate in a variety of programs intended to enhance the reliability of regional water supply. These projects include surface water treatment plant improvements, percolation studies, recycled water, and groundwater cleanup. In addition, the Upper District is currently evaluating the expanded use of recycled water for groundwater recharge. See the Upper District's 2010 UWMP for details.

6.1.3 South San Gabriel System's Water Supply Reliability

Supply reliability for the South San Gabriel System depends upon the reliability of imported water and local groundwater pumping, as discussed above.

Under the Main San Gabriel Basin Judgment, the Watermaster is responsible for managing withdrawals from the Basin by monitoring groundwater levels at the Baldwin Park Key Well. The Judgment states that the Watermaster shall not spread replenishment water when the groundwater level at the Key Well exceeds 250 feet above mean sea level (msl). The Judgment also states that the Watermaster shall spread replacement water necessary to maintain the water level elevation above 200 feet msl. During the period of management under the Judgment, significant drought events have occurred from 1969 to 1977, 1983 to 1991, and 1998 to 2004. In each drought cycle the Main San Gabriel Basin was managed to maintain groundwater levels. Based on historic management practices, all pumpers from the Main San Gabriel Basin will have adequate supply over the next 25 years under single year and multiple year drought periods (Upper District, 2011). The Upper District's UWMP provides basin-wide details about the reliability of the Main San Gabriel Basin.

GSWC and other water producers participate with the responsible agency, Upper District, to ensure that the OSY is available to the pumpers in the Main San Gabriel Basin. The Upper District has a cyclic storage agreement with Metropolitan and the Main Basin Watermaster. Cyclic storage accounts have been used to increase storage in the basin since 1975. Metropolitan pre-delivers replenishment water to the Basin and later sells the stored water to the water districts at a reduced rate. Metropolitan can store up to 100,000 ac-ft of water for the Upper District. Currently, Metropolitan has 22,633 ac-ft of water in storage for Upper District (Main San Gabriel Basin Watermaster 2010).

The Main San Gabriel Groundwater Basin's pumping and reliability is subject to the OSY established each fiscal year by the Watermaster and the availability of replenishment water. Long-term cyclic storage provides a mechanism that allows the responsible agency to establish a buffer during droughts and periods of reduced OSY by allowing for storage recharge waters during times of available import supplies. Recharge in the basin occurs from percolation of precipitation, return flow of applied water, some septic system discharges, and stream flow. Recharge through streams and spreading basins is generated from runoff from surrounding mountains and imported water from the State Water Project and the Colorado River.

There are also pending amendments to the Judgment that would enhance groundwater reliability in the basin. The Watermaster has determined that its 1973 Judgment may require changes to reflect the current conditions and allow the Watermaster more flexibility in securing necessary supplemental supplies. The Watermaster expects proposed changes to be finalized and submitted to the Los Angeles Superior Court for approval after FY 2010-11 (Watermaster 2010). Some of the key proposed changes that would enhance basin groundwater reliability and reduce vulnerability to droughts and uncertain imported supplies include:

- Storage and export –allow for outside water to be stored and exported by agreement with Watermaster;
- Recycled water –remove the limit on recycled water that can be recharged in 1 year;
- Key Well –eliminate the 250-foot upper limit at the Key Well for spreading imported water;
- Assessments –provide a means for the Watermaster to levy assessments to support endeavors such as pre-purchasing Replacement Water, development of new supplemental water resources (such as the recycled water recharge project), and to buy supplemental water that may become available unexpectedly or on short notice.

In part, the Main Basin reliability may also be increased through the groundwater management and replenishment efforts of the other responsible agencies in the basin. For example, the Upper San Gabriel Municipal Water District will supply approximately 15,000 ac-ft/yr of recycled water to irrigation customers through the San Gabriel Valley Water Recycling Direct Reuse Project. This project will optimize the availability of Metropolitan's imported water supply, enhancing the reliability of regional water supplies. This project replaces untreated imported water used for groundwater replenishment and irrigation. There are four phases to this project, two of which have been completed in 2007. The remaining two phases include the following:

Phase IIA-Rosemead Extension expands Phase IIA-Whittier Narrows Project to provide recycled water in the near future to the Whittier Narrows Golf Course, several schools, parks and industrial complexes. The project began construction in September 2009 and is projected to be completed by summer of 2011. Pipeline construction is complete and retrofits are being designed. The facilities for Phase IIA-Rosemead Extension include an approximate 2.5-mile long pipeline. An approximate demand of 720 acre-feet per year of high-quality water is anticipated to be supplied from the Whittier Narrows Water Reclamation Plant. The 720 acre-feet will be available during an average year, single-dry year and multiple-dry years.

Phase IIB Industry Project is separated into packages. Phase IIB includes the construction of new joint and local conveyance, storage, and distribution facilities, providing improved and extended recycled water service to potential customers in the Cities of West Covina and Walnut. Construction began in 2010 and is projected to be constructed by summer 2013. Phase IIB will supply approximately 1,600 acre-feet per year of recycled water to several landfills, parks, schools, open areas and commercial establishments from the San Jose Creek and Whittier Narrows Water Reclamation Plants. The 1,600 acre-feet will be available during an average year, single-dry year and multiple-dry years.

Table 6-1 presents 2035 water supply projections for imported and groundwater sources during a normal year, a single-dry year, and multiple-dry years for the South San Gabriel System. The normal-year supply represents the expected supply under average hydrologic conditions, the dry-year supply represents the expected supply under the single driest hydrologic year, and the multiple-dry year supply represents the expected supply during a period of three consecutive dry years.

As described above, Metropolitan, which is the source of water to the Upper District, has indicated that it will maintain 100 percent reliability through 2035. GSWC bases its reliability projections for purchased supply beyond 2025 on Metropolitan's projections. The purchased water supply projections for a normal water year, single-dry year, and multiple-dry years are taken as the 2035 projection, which is equivalent to the imported water demand projected for 2035. It is assumed that the single-dry year and multiple-dry year supplies are the same as those for the normal years because the Upper District has stated that it will meet projected demands under all anticipated hydrologic conditions.

Table 6-1: Supply Reliability for the South San Gabriel System for Year 2035 in ac-ft/yr

Source	Normal Water Year	Single-Dry Water Year	Multiple-Dry Water Years		
			Year 1	Year 2	Year 3
Purchased water from USGVMWD	3,015	3,015	3,015	3,015	3,015
Groundwater	733	733	733	733	733
Total	3,748	3,748	3,748	3,748	3,748
Percent of Normal		100%	100%	100%	100%

Note:
Table format based on DWR Guidebook Table 28.

The San Gabriel Basin Watermaster adjusts the OSY annually to account for fluctuations in groundwater availability in the Main San Gabriel Groundwater Basin. The Upper District's 2010 UWMP states that all pumpers, including GSWC, will have adequate supply to meet their demands during normal year, single-dry year, and multiple-dry year periods (Upper District, 2010). Replenishment water is used to replace the water pumped beyond a producer's share of the OSY and to maintain groundwater levels in the Key Well above 200 feet msl. The replenishment water for the Main San Gabriel Basin will be supplied from imported water through the Upper District and Metropolitan. Metropolitan has provided its member agencies with a reliability analysis for imported water supplies, which indicates Metropolitan's plan to provide 100 percent reliability through 2035 (Metropolitan, 2010). Upper District has provided projections of up to 25,000 ac-ft/yr of untreated imported water and recycled water to be used for basin replenishment through Fiscal Year 2030-31 (Upper District, 2011).

The South San Gabriel System has pumped between 2,192 ac-ft/yr and 2,912 ac-ft/yr for the past 5 years. It is projected the South San Gabriel System will decrease pumping rates annually, pumping only 733 ac-ft/yr in 2035.

Table 6-2 lists single-dry year and multiple-dry year periods for groundwater supplies. The single-dry year and multiple-dry year periods are based on Upper District's and Metropolitan's analysis on the lowest average precipitation for a single year and consecutive multiple-year period, respectively. Metropolitan's estimates, based on average rainfall between 1922 and 2004, uses the average of these years for normal water year conditions. 1977 represents the single-dry year, and the years 1990-1992 represent the driest three consecutive years. Effective management by the Main San Gabriel Basin Watermaster is expected to ensure that the Basin will have sufficient storage to meet projected water demands for these periods, so the available supply is equal to the projected demands.

Table 6-2: Basis of Water Year Data

Water Year Type	Base Year(s)	Historical Sequence
Normal Water Year[(2)]	Average of 1922 - 2004	1922 - 2004
Single-Dry Water Year	1977	1922 - 2004
Multiple-Dry Water Years	1990 - 1992	1922 - 2004

Notes:
1. Based on Metropolitan Water District 2010 RUWMP analysis of climate data.
2. Normal Water Year calculated from average precipitation for 1922-2004.
3. Table format based on DWR Guidebook Table 27.

Again, the Main San Gabriel Basin storage is used and the basin is operated to store surplus waters (storm water, recycled water, and imported water) when these waters are available and then to draw down the basin in drier years to meet the requirements of the Watermaster established under the Main San Gabriel Basin Judgment. The Basin has proven to be very reliable under extreme climate conditions over the last 30+ years and is expected to remain reliable through 2035.

6.1.4 Factors Resulting in Inconsistency of Supply

Table 6-3 presents factors that could potentially result in inconsistency of supply for the South San Gabriel System.

Although there are no known factors that would results in an inconsistency in overall water supply, it should be noted that groundwater extractions in the San Gabriel Basin are regulated by the Watermaster. Annually, the Watermaster establishes basin-wide pumping limits based on local hydrologic conditions and groundwater levels within the basins. In dry years, when the operating safe yield (OSY) is low and GSWC's water right is correspondingly reduced, GSWC does have the option of leasing or purchasing water rights from other users in the basin and can thereby reliably meet all system demands. The adjudication for the Main San Gabriel Basin also permits a producer to pump more than its rights when replenishment water is available from the responsible agency. A replenishment fee is required for all production in excess of the allocated rights. As a result, GSWC does not foresee any inconsistency in its ability to supply the South San Gabriel System, and Table 6-3 is intentionally blank.

Table 6-3: Factors Resulting in Inconsistency of Supply

Name of Supply	Legal	Environmental	Water Quality	Climatic
USGVMWD	N/A	N/A	N/A	N/A
Groundwater, Main San Gabriel Groundwater Basin	N/A	N/A	N/A	N/A

Notes:

1. Table format based on DWR Guidebook Table 29.
2. N/A – Not Applicable.

6.2 Normal Water Year Analysis

Table 6-4 summarizes the service reliability assessment for a normal water year based on water supply and water demand projections.

Table 6-4: Comparison of Projected Normal Year Supply and Demand

	2015	2020	2025	2030	2035
Water Supply Total (ac-ft/yr)	3,410	3,509	3,595	3,678	3,748
Water Demand Total (ac-ft/yr)	3,410	3,509	3,595	3,678	3,748
Difference (supply minus demand)	0	0	0	0	0
Difference as Percent of Supply	0%	0%	0%	0%	0%
Difference as Percent of Demand	0%	0%	0%	0%	0%

Note:

Table format based on DWR Guidebook Table 32.

6.3 Single-Dry-Year Analysis

Table 6-5 demonstrates the reliability of water supplies to meet projected annual water demands for the South San Gabriel System in a single-dry year.

Table 6-5: Comparison of Projected Supply and Demand for Single-Dry Year

	2015	2020	2025	2030	2035
Supply Total (ac-ft/yr)	3,410	3,509	3,595	3,678	3,748
Demand Total (ac-ft/yr)	3,410	3,509	3,595	3,678	3,748
Difference (supply minus demand)	0	0	0	0	0
Difference as Percent of Supply	0%	0%	0%	0%	0%
Difference as Percent of Demand	0%	0%	0%	0%	0%

Note:
Table format based on DWR Guidebook Table 33.

6.4 Multiple-Dry-Year Analysis

Table 6-6 presents the projected multiple-dry year water supply and demand assessment. It is assumed that the multiple-dry year water supplies are the same as those for the normal years because Metropolitan (through Upper District) intends to meet projected purchased demands under all anticipated hydrologic conditions. The third year of the multiple-dry year water supply projection represents the end of each 3-year multiple-dry year period as required for the multiple-dry year analysis. Upper District has determined that they can meet projected water demands for multiple-dry years, so the water supply is projected to equal the demand.

Table 6-6 demonstrates that the water supplies are sufficient to meet the projected water demand for each multiple-dry year period because:

- Upper District determined that they can meet projected water demands for the multiple-dry year periods (see Chapter 3), and;

- Groundwater from the Main San Gabriel Groundwater Basin is expected to be 100 percent reliable in multiple-dry years.

It should be noted that the active connection capacity to deliver purchased water is significantly higher than the projected purchased water supply that is needed to meet these demands. Therefore, the purchased water supply is generally expected to be much greater than the expected projected water demands during multiple-dry years.

In summary, GSWC, Metropolitan, and Upper District have implemented and will continue to implement projects to ensure the purchased water demands can be met under normal year, single-dry year, and multiple-dry years.

Table 6-6: Projected Multiple-Dry Year Water Supply and Demand Assessment

Year	Supply (ac-ft/yr)	Demand (ac-ft/yr)	Difference	Difference as Percent of Supply	Difference as Percent of Demand
2011					
2012					
2013	3,122	3,122	0	0%	0%
2014	3,266	3,266	0	0%	0%
2015	3,410	3,410	0	0%	0%
2016					
2017					
2018	3,470	3,470	0	0%	0%
2019	3,489	3,489	0	0%	0%
2020	3,509	3,509	0	0%	0%
2021					
2022					
2023	3,560	3,560	0	0%	0%
2024	3,577	3,577	0	0%	0%
2025	3,595	3,595	0	0%	0%
2026					
2027					
2028	3,644	3,644	0	0%	0%
2029	3,661	3,661	0	0%	0%
2030	3,678	3,678	0	0%	0%
2031					
2032					
2033	3,720	3,720	0	0%	0%
2034	3,734	3,734	0	0%	0%
2035	3,748	3,748	0	0%	0%

Notes:

1. This assessment is based on the 3-year multiple-dry year period ending in 2015, 2020, 2025, 2030, and 2035.
2. Table format based on DWR Guidebook Table 34.

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Chapter 7: Conservation Program and Demand Management Measures

This Chapter addresses the water conservation requirements of the Act for the South San Gabriel System and includes a summary of current and planned Demand Management Measure (DMM) implementation and an overview of the proposed program for compliance with SBX7-7, which requires 20 percent statewide reduction in urban water use by 2020. The DMM portions of the Act state the following:

> *Section 10631.*
>
> *(f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:*
>
> > *(1) A description of each water demand management measure that is currently being implemented, or scheduled for implementation, including the steps necessary to implement any proposed measures, including, but not limited to, all of the following:*
> >
> > > *(A) Water survey programs for single-family residential and multifamily residential customers.*
> > > *(B) Residential plumbing retrofit.*
> > > *(C) System water audits, leak detection, and repair.*
> > > *(D) Metering with commodity rates for all new connections and retrofit of existing connections.*
> > > *(E) Large landscape conservation programs and incentives.*
> > > *(F) High-efficiency washing machine rebate programs.*
> > > *(G) Public information programs.*
> > > *(H) School education programs.*
> > > *(I) Conservation programs for commercial, industrial, and institutional accounts.*
> > > *(J) Wholesale agency programs.*
> > > *(K) Conservation pricing.*
> > > *(L) Water conservation coordinator.*
> > > *(M) Water waste prohibition.*
> > > *(N) Residential ultra-low-flush (ULF) toilet replacement programs.*
> >
> > *(2) A schedule of implementation for all water demand management measures proposed or described in the plan.*
> >
> > *(3) A description of the methods, if any, that the supplier will use to evaluate the effectiveness of water demand management measures implemented or described under the plan.*
> >
> > *(4) An estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the supplier's ability to further reduce demand.*
>
> *(g) An evaluation of each water demand management measure listed in paragraph (1) of subdivision (f) that is not currently being implemented or scheduled for implementation. In the course of the evaluation, first consideration shall be given to water demand management measures, or combination of measures, that offer lower incremental costs than expanded or additional water supplies. This evaluation shall do all of the following:*
>
> > *(1) Take into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.*
> >
> > *(2) Include a cost-benefit analysis, identifying total benefits and total costs.*
> >
> > *(3) Include a description of funding available to implement any planned water supply project that would provide water at a higher unit cost.*
> >
> > *(4) Include a description of the water supplier's legal authority to implement the measure and efforts to work with other relevant agencies to ensure the implementation of the measure and to share the cost of implementation.*
>
> *(j) For purposes of this part, urban water suppliers that are members of the California Urban Water Conservation Council shall be deemed in compliance with the requirements of subdivisions (f) and (g) by*

complying with all the provisions of the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated December 10, 2008, as it may be amended, and by submitting the annual reports required by Section 6.2 of that memorandum.

7.1 Conservation Program Background

In 1991, GSWC became a signatory to the MOU regarding water conservation in California and a member of the CUWCC, establishing a firm commitment to the implementation of the Best Management Practices (BMPs) or DMMs. The CUWCC is a consensus-based partnership of agencies and organizations concerned with water supply and conservation of natural resources in California. By becoming a signatory, GSWC committed to implement a specific set of locally cost-effective conservation practices in its service areas.

To facilitate efficient BMP reporting for water systems located in GSWC's three regions in California, GSWC established a number of BMP "Reporting Units" based on geographic proximity. GSWC's conservation program implementation for the San Gabriel Valley Reporting Unit includes the reporting of the South Arcadia and South San Gabriel systems. Therefore, this chapter includes the reporting for both systems.

As an investor-owned utility, GSWC's ability to obtain funding and implement conservation programs is contingent on approval of the General Rate Case by the CPUC. GSWC is currently in the process of reviewing and revising its existing conservation program as follows:

- In 2011, GSWC will be submitting a General Rate Case with the CPUC which will facilitate further development of cost-effective conservation programs, including compliance with SBX7-7.

- Subject to funding approval for each rate making area, GSWC will conduct a baseline water use efficiency assessment of each of its districts to identify the opportunities for cost-effective conservation. Results of the baseline assessment will be available by 2013 and will enable GSWC to define programs that target water savings in specific areas and meet DMM requirements.

- To the extent practicable, a companywide conservation program will then be implemented. Varying levels of program implementation will be scaled as appropriate for each district depending on funding availability, local wholesaler and regional participation levels, and SBX7-7 targets.

The MOU and associated BMPs were revised by the CUWCC in 2008, which is equated to the DMMs per Section 10631(j) of the Act. The revised BMPs now contain a category of "Foundational BMPs" that signatories are, for the first time and with few exceptions, expected to implement as a matter of their regular course of business. These include Utility Operations (metering, water loss control, pricing, conservation coordinator, wholesale agency assistance programs, and water waste ordinances) and Public Education (public outreach and school education programs). The remaining BMPs are called Programmatic BMPs and are divided into Residential, Large Landscape, and CII categories. These revisions are reflected in the CUWCC's BMP reporting database starting with reporting year 2009. The revised BMP organization is also reflected in the 2010 UWMP's DMM compliance requirements. A summary of the DMMs described in the Act and the current CUWCC BMP organization is presented in Table 7-1 for reference.

Table 7-1: CUWCC BMP and UWMP DMMs Organization and Names

CUWCC BMP Organization and Names (2009 MOU)				UWMP DMMs	
Type	**Category**	**BMP #**	**BMP name**	**DMM #**	**DMM name**
Foundational	Operations Practices	1.1.1	Conservation Coordinator	L	Water conservation coordinator
		1.1.2	Water Waste Prevention	M	Water waste prohibition
		1.1.3	Wholesale Agency Assistance Programs	J	Wholesale agency programs
		1.2	Water Loss Control	C	System water audits, leak detection, and repair
		1.3	Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections	D	Metering with commodity rates for all new connections and retrofit of existing connections
		1.4	Retail Conservation Pricing	K	Conservation pricing
	Education Programs	2.1	Public Information Programs	G	Public information programs
		2.2	School Education Programs	H	School education programs
Programmatic	Residential	3.1	Residential assistance program	A	Water survey programs for single-family residential and multi-family residential customers(1)
				B	Residential plumbing retrofit
		3.2	Landscape water survey	A	Water survey programs for single-family residential and multi-family residential customers(1)
		3.3	High-Efficiency Clothes Washing Machine Financial Incentive Programs	F	High-efficiency washing machine rebate programs
		3.4	WaterSense Specification (WSS) toilets	N	Residential ultra-low-flush toilet replacement programs
	Commercial, Industrial, and Institutional	4	Commercial, Industrial, and Institutional	I	Conservation programs for commercial, industrial, and institutional accounts
	Landscape	5	Landscape	E	Large landscape conservation programs and incentives

Note:

1. Components of DMM A (Water survey programs for single-family residential and multi-family residential customers) applies to both BMP 3.1 (Residential assistance program) and BMP 3.2 (Landscape water survey).

7.2 Implementation of BMPs/DMMs

This section provides a description of the various programs and conservation activities implemented in the San Gabriel Valley Reporting Unit water systems. Signatories to the MOU are permitted by Water Code Section 10631(j) to include their biennial CUWCC BMP reports in an UWMP to meet the requirements of the DMMs sections of the UWMP Act if the agency is meeting all provisions of the MOU. The San Gabriel Valley Reporting Unit BMP coverage report for 2009 through 2010 is attached as Appendix C and supplements the summary of BMP implementation activities provided in this chapter.

GSWC is progressing towards implementing all Foundational BMPs for these systems, as required in the revised MOU and UWMP Act. The Programmatic BMPs are currently being implemented through a BMP approach for the systems. The SBX7-7 conservation goals and proposed implementation plans are discussed further in Section 7.5.

GSWC plans to continue to implement and track conservation programs for systems in the San Gabriel Valley Reporting Unit. GSWC also partners on conservation activities with its wholesale water suppliers, including Metropolitan and Upper San Gabriel Valley Municipal Water District (Upper District). GSWC's customers are eligible for a number of conservation programs offered by Metropolitan, providing water savings to GSWC. Examples of programs offered by wholesale suppliers that are available to customers include High-Efficiency Clothes Washers (HECW) rebates, CII programs and rebates, and High-Efficiency Toilets (HET) rebates.

7.3 Foundational DMMs

7.3.1 Utility Operations

7.3.1.1 Conservation Coordinator

This BMP is implemented. GSWC maintains a fully staffed Conservation Department with a companywide Water Use Efficiency Manager, Water Conservation Analyst and one Water Conservation Coordinator for each of the three regions to administer conservation programs and support wholesaler programs which includes the San Gabriel Valley System. GSWC also employs a number of consultants to support program development and implementation.

7.3.1.2 Water Waste Prevention

Although GSWC does not have rule-making authority, it supports member agencies and local cities in efforts to adopt ordinances that will reduce water waste. This BMP is implemented through CPUC-approved rules provided in Appendix D, including Rule No. 14.1, the Water Conservation and Rationing Plan, and Rule 11, Discontinuance and Restoration of Service.

CPUC's methodology for water utilities to implement Rule 14.1 is documented in Standard Practice U-40-W, "Instructions for Water Conservation, Rationing, and Service Connection Moratoria." Rule No. 14.1 sets forth water use violation fines, charges for removal of flow restrictors, and the period during which mandatory conservation and rationing measures will be in effect. Water conservation restrictions include:

- Use of potable water for more than minimal landscaping.
- Use through a broken or defective water meter.

- Use of potable water which results in flooding or runoff in gutters or streets.
- Use of potable water for washing private cars or commercial aircrafts, cars, buses, boats, or trailers, except at a fixed location where water is properly maintained to avoid wasteful use.
- Use of potable water for washing buildings, structures, driveways, street cleaning or other hard-surfaced areas.
- Use of potable water to irrigate turf, lawns, gardens or ornamental landscaping.
- Use of potable water for construction purposes.
- Use of potable water for filling or refilling of swimming pools.

Rule No. 20 (approved in 1978) discourages wasteful use of water and promotes use of water saving devices. The stated purpose of the rule is to “ensure that water resources available to the utility are put to a reasonable beneficial use and that the benefits of the utility's water supply and service extend to the largest number of persons." Together, Rules 11, 14.1 and 20 prohibit negligent or wasteful use of water, create a process for mandatory conservation and rationing, and promote the use of water saving devices.

7.3.1.3 Water Loss Control

Unaccounted for water losses are monitored by the Water Loss Control Department (WLCD) by reviewing the Water Audit program’s survey results for each system. If the amount of unaccounted for water exceeds the established tolerance levels, a Leak Detection Audit is performed. This is conducted by the Water Loss Control Technician with the most current leak detection technology, a Sonic Leak Detection Sound Amplification Instrument. To pinpoint leaks, the technician conducts a comprehensive survey of the system by making physical contact with all available main line valves, hydrant valves and all service connections.

For calendar year 2009, GSWC implemented the American Water Works Association (AWWA) M36 Standard Water Audit methodology. The approach consists of a component analysis of leaks for designation into “revenue” and “non-revenue” categories and an economic analysis of recoverable loss. Results of the analysis are included in the BMP coverage report in Appendix C.

Before the AWWA Standard Water Audit M36 methodology was implemented, prescreening for water losses was conducted by comparing the total volume of water sales and other verifiable uses against the total water supply into the system. A full audit was triggered if the total sales and verifiable uses was less than 90 percent of the total supply (i.e., unaccounted-for-water exceeded 10 percent). Table 7-2 summarizes prescreening results.

Table 7-2: Water Loss Control Evaluation Summary

Report Year	Prescreen Completed	Prescreen Result
2006	No	-
2007	No	-
2008	Yes	93.20%
2009	Yes	97.70%

Note:
2010 Data Not applicable; M36 method implemented.

Implementation Steps and Schedule

Effective 2010, GSWC will continue to complete the Standard Audit and Water Balance worksheets following the AWWA M36 protocol for the next 4 years, taking measurable steps to improve data accuracy while cost-effectively reducing non-revenue water through repair of leaks and other measures.

GSWC used version 3.0 of the AWWA Water Audit software for its initial evaluation, and will use the current software for 2010 and all future evaluations. The current version includes metrics for evaluating the validity of the data. GSWC already has a work order system in place that documents leak locations and repair history.

7.3.1.4 Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections

All customers in San Gabriel Valley Reporting Unit are metered and billed by volume on a monthly basis. A meter maintenance and repair plan has been submitted to the CUWCC. In addition, GSWC follows the requirements of CPUC General Order 103-A which prescribes minimum water system design, operation and maintenance standards for water utilities includes requirements for calibrating, testing frequency, and replacing water meters.

7.3.1.5 Retail Conservation Pricing

All metered customers in the San Gabriel Valley Reporting Unit are billed volumetrically. In addition, effective December 2010, GSWC has implemented a third tier of a conservation pricing rate structure for residential customers, as approved by the CPUC for Region III. The current rate structure for residential customers has a fixed charge as well as volumetric escalating pricing tiers, depending on customer usage. Non-residential customers have a fixed charge and a fixed volumetric charge. Implementation of this revised pricing policy is the result of GSWC's collaboration with CPUC to implement conservation tiered rates for residential customers of investor-owned utilities. Tiered rates are consistent with the CPUC's Water Action Plan.

Implementation Steps and Schedule

2009 and 2010 volumetric and fixed price revenue data for the San Gabriel Valley Reporting Unit are summarized in the BMP Coverage Report located in Appendix C. Since 2010, GSWC has been adding third tier pricing structures and increasing volumetric charges. In 2010, volumetric revenue consisted of 63.1 percent of San Gabriel Valley Reporting Unit's total revenue which is on track to meet the 2012 MOU goal of 70 percent.

As previously discussed, GSWC will be submitting a General Rate Case filing to the CPUC in 2011, which includes a proposed rate increase for volumetric charges for South San Gabriel System customers. If approved, this rate increase will allow GSWC to increase volumetric revenues and progress towards fulfilling the requirements of the Retail Conservation Pricing BMP by 2015.

7.3.1.6 Education

Public Information Programs

San Gabriel Valley Reporting Unit customers are notified of various conservation programs by the Community Education Department. GSWC had a 2010 annual budget of $6,100 for public outreach in the San Gabriel Valley Reporting Unit. GSWC provides marketing and outreach materials to their customers by issuing press releases, publishing quarterly newsletters and using door tags and bill inserts. Customers can learn about rebates and other conservation programs on GSWC's website, which provides links to Metropolitan's website for detailed information. Outreach activities completed between 2006 and 2010 are summarized in Table 7-3.

In addition, the Upper District promotes water conservation through its many public information programs. The Upper District offers conservation brochures and posters, activity booklets, public outreach displays, oral presentations, and workshops to inform the public of conservation efforts. The Upper District also raises awareness about water conservation through paid advertising, press releases, news ads, media events, and through the Speaker's Bureau. Annually, Upper District hosts a water awareness festival (Water Fest) to raise public awareness about water conservation, water quality and other water-related issues.

Table 7-3: Outreach Activities

Item	2006	2007	2008	2009	2010
Paid Advertising	3	2	4	4	4
Public Service Announcement	2	1	3	4	4
Bill Inserts / Newsletters / Brochures	2	4	3	8	8
Bill showing water usage in comparison to previous year's usage	Yes	Yes	Yes	Yes	Yes
Demonstration Gardens	0	0	0	1	1
Special Events, Media Events	2	1	4	2	2
Speaker's Bureau	0	0	1	0	0
Program to coordinate with other government agencies, industry, public interest groups and media	Yes	Yes	Yes	Yes	Yes

School Education Programs

GSWC sponsors a school education program in South San Gabriel elementary schools, as implemented by The Discovery Science Center (DSC)), with a 2010 annual budget of $39,000. Students learn about conservation practices and receive a free conservation kit that includes a water survey, 1.5-gpm low-flow shower head, 1.5-gpm kitchen sink aerator and 1.0-gpm bathroom aerators, leak detection dye tablets, a watering gauge, and step-by-step instructions. The students are given homework assignments to complete a water audit form and replace inefficient showerheads and aerators with water-saving devices provided in the kit. The program has been a very effective way for GSWC to reach a large number of customers and educate students, who in turn educate their parents about water use efficiency practices and low-flow plumbing devices.

Results from the program are tracked, and a comprehensive Program Summary Report is generated at the end of each school year. This report documents the estimated reduction in water usage that was achieved through the retrofits and provides data on the percentage of students who participated in the program. Table 7-4 provides a summary of program participation results between 2006 and 2010.

Table 7-4: School Education Activities

	2006	2007	2008	2009	2010
Presentations	12	3	-	-	-
Grade	4th – 6th	4th – 6th	4 – 6th	-	-
Number of students	666	591	2,234	746	1,367

In addition, Upper District directly offers school education programs in an effort to raise awareness of water issues. Upper District started its school education programs in September 1992 and the materials and presentations meet state education framework requirements. The following is a list of Upper District's school educational programs.

- Water Awareness Art Contests
- Solar Cup Competition
- Water Education Grant Program
- Annual Art Poster Contest for grades K through 3rd and 4th through 6th
- T-shirt Art Contest for grades 7th through 12th
- Water Resource Library

In addition to the DSC and partnering with wholesalers and other public agencies, GSWC implements Resource Action Programs (RAP) and the Science Discover (SD) program. During the 2009/2010 school year, GSWC conducted school conservation education programs for an estimated 15,525 students company-wide.

Implementation Steps and Schedule

GSWC recognizes the value in increased customer awareness of the various conservation programs that are available. To that end, GSWC will review opportunities to enhance its outreach program over the next two (2) years to supplement DSC's existing public education efforts. Public information measures that will be evaluated include additional direct mail fliers, increased outreach participation at community functions, and an improved conservation website.

Going forward, GSWC plans to continue to use the RAP, DSC, and SD and internal staff to conduct its school conservation programs. RAP and DSC's school conservation education programs will continue to include annual reports, classroom education and the distribution and installation of conservation kits that are part of the school education program.

7.3.1.7 Methods Used to Evaluate Effectiveness and Water Savings from Foundational BMPs

Effective implementation of the Foundational BMPs is critical to ensuring the long-term success of GSWC's conservation efforts. GSWC will utilize quantitative methods to assess the effectiveness of each BMP, to the extent practicable. The effectiveness of the Water Waste Prevention and Water Loss Control BMPs can be measured, in part, by completing the annual M36 water loss audits and documenting the year-over-year change in unaccounted-for water as well as the number of repair projects completed. GSWC will track the impact of new conservation pricing by using its upgraded billing system to carefully monitor consumption of residential customers.

The effectiveness of implementing Public Education BMPs will be measured by tracking the number of public outreach events and education programs where customers receive information on conservation. A successful public information program should encourage customers to take advantage of conservation incentives being offered by GSWC, Upper District, and Metropolitan as Programmatic DMMs.

There are no direct estimates of water savings applicable to the Foundational BMPs; however, these measures will continue to contribute to reducing San Gabriel Valley Reporting Unit's demand.

7.4 Programmatic DMMs

GSWC intends to continue to comply with the MOU using the BMP compliance approach for the San Gabriel Valley Reporting Unit. Implementation of the programmatic BMPs will continue to be a joint effort with Metropolitan and Upper District. The wholesalers are responsible for administering most of the Residential, Landscape, and CII BMPs currently being offered to San Gabriel Valley Reporting Unit customers. Additional detailed descriptions of wholesaler DMM implementation can also be found in Metropolitan's 2010 RUWMP, as well as Upper District's 2010 UWMP where appropriate. GSWC will continue to support Metropolitan activities and will focus on improving outreach to its customers and promoting awareness of the programs available to them.

Once the pending rate case is approved by the CPUC, GSWC will develop a prioritized water use efficiency program and implementation schedule for all customer service areas in the company focusing on systems with the highest SBX7-7 water use reduction targets, and those where specific conservation activities can be implemented that are locally cost-effective. Programs that are cost-effective to implement on a companywide basis will also be considered. At this time, all of the BMPs, are cost-effective for implementation in the San Gabriel Valley Reporting Unit, where the avoided cost of water is $926 per acre-foot.

7.4.1 Residential DMMs

7.4.1.1 Residential Assistance Programs

GSWC has an audit program targeting high-use single-family (SF) and multi-family (MF) residential customers. GSWC identifies these customers based on billing data and contacts them to offer free audits. Audits are also offered to walk-in customers at the local customer service area office. Additional home audits are conducted as part of the school education program (Section 7.3.1.6). The number of residential audits performed by GSWC and the number of low-flow devices that were distributed are summarized in Table 7-5. Low-flow devices are available for free to customers at the GSWC office and are distributed to students as part of the free conservation kits they receive in the school education program.

Table 7-5: Residential Surveys and Retrofits

	2006	2007	2008	2009	2010
Single-Family Accounts					
Surveys Offered	0	0	1,251	0	0
Surveys Completed	0	0	227	0	0
Multi-Family Accounts					
Surveys Offered	0	0	1,251	0	0
Surveys Completed	0	0	227	0	0
Devices					
Showerheads	569	0	2,234	0	0
Aerators	1,300	0	2,234	0	0

Implementation Steps and Schedule

Over the next 5 years, GSWC will continue distributing low flow showerheads and aerators to customers, and offering audits to high-use SF and MF customers until saturation requirements are satisfied for this BMP. It is estimated that 175 devices per year will need to be installed in SF and MF residences. Once saturation requirements are met, GSWC will continue to offer the programs as required by the MOU.

Methods Used to Evaluate Effectiveness and Water Savings

Effectiveness of implementation of this program is evaluated by GSWC by tracking customer participation rates in surveys and distribution of low flow showerheads. The following water savings estimates were developed using data provided by the CUWCC:

- Residential Assistance Surveys: According to the CUWCC, SF surveys are estimated to save 40 gpd and MF surveys are estimated to save 20 gpd. At 174 surveys per year, it is estimated that GSWC will save more than 300 ac-ft over the next 10 years.

- Plumbing Retrofit kits: Per the CUWCC, it is estimated that 7.7 gpd per unit is conserved from installation of low flow showerheads. At 75 percent saturation, the potential total savings is approximately 54 ac-ft over the next 10 years.

Program effectiveness and per capita use will continue to be monitored based on meter readings and billing data, and follow-up calls will be made to offer audits and other assistance to high-use customers. Implementation of the residential assistance programs BMP has no anticipated impacts on GSWC's ability to further reduce demands.

7.4.1.2 Landscape Water Surveys

GSWC offers landscape water surveys to high water-use SF and MF customers throughout the company. Since residential surveys include a landscape component, participation rates are included in the residential assistance program summary above. Introduction of the third tier of metered rates in late 2010 is expected to result in higher participation rates, and funding has been designated to improving program marketing.

Implementation Steps and Schedule

Residential assistance survey programs have a landscape component to them and are being implemented concurrently. A description of the proposed implementation strategy and schedule is provided in the section describing the Residential Assistance Program BMP.

Methods Used to Evaluate Effectiveness and Water Savings

See residential assistance programs description.

7.4.1.3 High-Efficiency Clothes Washers

GSWC customers are eligible to participate in the HECW rebate program provided by Metropolitan, which has been available since 2003. Metropolitan has supplemented its HECW rebate using state or federal grants whenever possible. The water efficiency of clothes washers is represented by the "water factor," which is a measure of the amount of water used to wash a standard load of laundry. Washers with a lower water factor save more water. Metropolitan has continued to transform the market by changing its program requirement to lower water factors. The program eligibility requirement is currently set at water factor 4.0, which saves more than 10,000 gallons per year per washer over a conventional top loading washer. GSWC does not contribute funds to the HECW rebate program. The GSWC conservation webpage advertises the rebates and provides a link to the Metropolitan website for full program details. A summary of the HECW Rebates received by GSWC customers in the San Gabriel Valley Reporting Unit is provided in Table 7-6.

Table 7-6: HECW Rebates

	2006	2007	2008	2009	2010	TOTAL
Rebates	44	0	149	0	282	475

Implementation Steps and Schedule

To comply with the BMP, rebates need to be issued to 104 customers per year in the San Gabriel Valley Reporting Unit until saturation requirements are met. GSWC intends to continue to participate in the HECW rebate program administered by Metropolitan and to increase program participation will increase marketing efforts to raise customer awareness that the program is being offered. GSWC will develop an updated conservation website, and prominently include HECW rebate incentive on future bill stuffers or other direct mail campaigns.

Methods Used to Evaluate Effectiveness and Water Savings

Metropolitan tracks customer participation in the HECW rebate program and estimates that 28 gallons per day are saved for each HECW installed. At the required implementation levels, it is estimated that GSWC will save a total of approximately 142 ac-ft from 104 annual HECW installations over the next 10 years. There are no anticipated impacts on GSWC's ability to further reduce demands.

7.4.1.4 WaterSense Specification (WSS) Toilets

GSWC customers have been eligible to participate in the HET rebate program administered by Metropolitan since 2008. Metropolitan has provided incentives for toilet programs since 1988, including ultra-low-flush toilet (ULFT) rebates. Currently, Metropolitan only provides funding for high-efficiency toilets (1.28 gallons per flush or less), which use 20 percent less than ultra-low-flush toilets (1.6 gallons per flush). ULFTs are the current standard defined by the plumbing code. Metropolitan uses the EPA's WaterSense list of tested toilets in its programs as qualifying models. The GSWC webpage for South San Gabriel advertises the rebates and provides a link to the Metropolitan website for full details. The number of rebates issued by Metropolitan to GSWC San Gabriel Valley Reporting Unit customers is provided in Table 7-7.

Table 7-7: Toilet Rebates and Replacements Received by San Gabriel Valley Reporting Unit Customers

Type	2006	2007	2008	2009	2010
Single-Family					
ULFT Rebate	350	0	11	0	0
HET Rebate	0	0	0	136	44
Multi-Family					
ULFT Rebate	0	0	9	0	0
HET Rebate	0	0	0	51	0

Implementation Steps and Schedule

To comply with the BMP, rebates need to be issued to 93 SF and 23 MF customers per year in the San Gabriel Valley Reporting Unit. GSWC intends to continue to participate in the HET rebate program administered by Metropolitan as described above. GSWC will also evaluate augmenting existing public outreach efforts through direct mail and enhanced website features to inform customers about current incentive opportunities and increase program participation.

Methods Used to Evaluate Effectiveness and Water Savings

Metropolitan tracks customer participation in the HET rebate program to measure effectiveness. According to the CUWCC research and evaluation committee, it is estimated that 21.1 and 26.6 gallons per day are saved for each HECW installed in SF and MF units, respectively. It is estimated that GSWC will save approximately 141 ac-ft from HET installations completed over the next 10 years at required implementation levels of 93 SF and 23 MF installations per year. There are no anticipated impacts on GSWC's ability to further reduce demands.

7.4.1.5 WaterSense Specification for Residential Development

Integration of WSS fixtures for new development will be accelerated by the 2010 California Green Building Standards Code (CAL Green Code), which became effective in January 2011. The CAL Green Code sets mandatory green building measures, including a 20 percent reduction in indoor water use, as well as dedicated meter requirements and regulations addressing landscape irrigation and design. Local jurisdictions, at a minimum, must adopt the mandatory measures; the CAL Green Code also identifies voluntary measures that set a higher standard of efficiency for possible adoption.

Implementation Exemption

GSWC is filing an exemption on implementation of the WSS specification for new developments due to lack of legal authority. As an investor-owned utility, GSWC does not have regulatory authority and cannot adopt ordinances or regulations; however, it does support standards that will achieve a reduction in indoor water use including implementation and use of WSS fixtures as well as adoption of the CAL Green Code by local jurisdictions, including Los Angeles County. GSWC will continue to support incentive programs for water efficient devices and standards.

The cost of implementing this BMP is non-quantifiable; therefore a cost-effectiveness evaluation was not completed.

7.4.1.6 Commercial, Industrial, and Institutional DMMs

The Commercial, Industrial, and Institutional (CII) programs are implemented by Metropolitan on behalf of GSWC. Table 7-8 provides a summary of CII program participation from GSWC's San Gabriel Valley Reporting Unit customers from 2006 to 2010. GSWC customers are eligible to participate in Upper District and Metropolitan's CII Save-A-Buck Program for Southern California businesses. Those who qualify are eligible for rebates to help encourage water efficiency and conservation. Devices available for rebates include: high efficiency toilets, zero water and ultra low water urinals, connectionless food steamers, air-cooled ice machines (Tier III), cooling tower and pH conductivity controllers, water brooms, dry vacuum pumps). Additionally, the Save-A-Buck program offers rebates for outdoor landscaping equipment such as: weather based irrigation controllers, central computer irrigation controllers, rotating spray nozzles retrofits, and high efficiency large rotary nozzle retrofits.

Table 7-8: CII Programs

Program	2006	2007	2008	2009	2010
CII HET Rebates	0	0	2	0	0
CII ULFT Rebates	0	0	0	0	0
Dual Flush Toilets	0	0	0	0	0
CII Urinal Rebates	0	0	16	1	37
CII HECW Rebates	0	0	0	0	0
Cooling Tower Controllers	0	0	0	0	0
Cash for Grass	0	0	0	0	0

Implementation Steps and Schedule

GSWC's goal for the next 3 to 5 years is to focus on advertising and outreach programs, including CII rebates, as described elsewhere in this chapter. If, after additional advertising efforts it is determined that Metropolitan's program is not meeting coverage requirements, GSWC will evaluate augmenting Metropolitan's program. To meet BMP requirements for the required 10 percent water savings (about 94 ac-ft/yr) by 2020, GSWC will need to support or augment Metropolitan's program to encourage customers to participate in rebate incentive programs. GSWC will also evaluate implementing additional CII water savings programs, such as industrial process water use reductions.

Methods Used to Evaluate Effectiveness and Water Savings

Effectiveness of the CII program will be evaluated by tracking multiple parameters, including program participation, metered CII water use, high water users, and measuring water savings from of specific CII activities where practicable to show a water savings of at least 9 ac-ft per year. There are no anticipated impacts on GSWC's ability to further reduce demands.

7.4.1.7 Large Landscape

GSWC's large landscape program consists of identifying and contacting high-use customers, providing information and offering water use surveys, voluntary landscape water use budgets, and landscape training. The program is available to all large landscape customers free of charge. An increase in conservation pricing rates in 2011 is expected to prompt increased participation, and funding has been designated for improved program marketing.

Upper District's large landscape conservation program includes the Synthetic Turf Grant School Program. The Goal of the Synthetic Turf Grant Program is to assist schools with funding for retrofitting large landscaped areas with synthetic turf. Through this program, Upper District offers grants of up to $75,000 per site to assist with the cost of installing synthetic turf. Since the start of the program in fiscal year 2005-06, five schools have participated in this program. Based on an estimated service life of 10 years for synthetic turf, the total annual water savings for the 5 synthetic turf programs is estimated at 53 acre-feet.

Implementation Steps and Schedule

Implementation of this BMP will be improved by promoting existing incentive opportunities s and raising customer awareness about existing audit program offerings. For the next 4 to 5 years, GSWC will work to increase program participation at schools and other institutional accounts to establish landscape water budgets and decrease overall water use. Additionally, GSWC will discuss with Metropolitan specific measures that could be implemented to encourage broader interest in the multiple CII programs that are currently being offered.

In order to meet BMP coverage requirements, GSWC/Metropolitan/Upper District will need to develop evapotranspiration-based landscape water budgets for 9 accounts with dedicated irrigation meters per year. GSWC will also continue to offer landscape water use surveys to customers without dedicated irrigation meters. Devices such as weather based irrigation controllers (WBIC) and precision nozzles will also be distributed to mix-metered high water use customers who have been determined not to be water efficient.

Methods Used to Evaluate Effectiveness and Water Savings

GSWC will track increased customer participation in the CII large landscape water budgeting and rebate programs. At the implementation rate described above, it is estimated that as much as 279 AF could be conserved by 2020 (Table 7-9). There are no anticipated impacts on GSWC's ability to further reduce demands.

Table 7-9: Water Savings for Large Landscape Programs

Large Landscape Conservation Program	Units per Year	Water savings over next 10 Years (ac- ft)
CII WBIC Rebates	9	46
CII WBIC Direct Install	9	46
CII Precision Nozzles Distribution	1,330	85
Dedicated Irrigation Surveys	9	102
TOTAL	1,357	279

7.5 SBX7-7 Compliance Strategy

The SBX7-7 water use baseline for the South San Gabriel System is 105 gpcd, and the 2020 compliance goal is 100 gpcd, as detailed in Chapter 3. Several factors have contributed to a rapid reduction in gpcd over the past few years Including the economic recession, recent mild climate conditions, implementation of a residential tiered conservation pricing structure m and other conservation measures. Over the past 3 years, there has been a recent 13 percent decline in gpcd in the South San Gabriel System from 97 gpcd in 2008 to an estimated 84 gpcd in 2010. Therefore, the South San Gabriel System is on track to meet its SBX7-7 goals, and will remain focused on maintaining these savings over the next 10 years.

However, if the gpcd begins to increase to previous levels, GSWC's continued commitment to complying with the CUWCC MOU and implementation of all BMPs should provide sufficient water savings to meet the goal of 100 gpcd. GSWC will assess implementation of a suite of programs over the next 2 to 3 years to meet conservation targets companywide. Implementation levels and specific program offerings will vary by system depending on system goals, including existing implementation levels, demographics, and hydrologic characteristics.

GSWC is developing a companywide approach that will include assessment of options such as accelerating the current programs, and adding additional programmatic, regulatory and information-based activities to meet the requirements of SBX7-7. This systematic approach may allow GSWC to do more with less, in essence, administering overall conservation program operations from a centralized location while allowing local resources for direct implementation of BMPs and other water savings practices. Funding for all conservation activities is subject to approval by the CPUC before programs can be implemented. Some of the programs that may be considered by GSWC if needed to meet SBX7-7 requirements include financial incentives, regulatory approaches, and information elements. These efforts will be planned to build on existing programs and activities. Programs that may be implemented by 2014 on a companywide basis include the following:

Conservation Pricing

GSWC is in the process of filing a General Rate Case application to increase tiered rates in its systems for residential and CII metered customers. If approved, increased tiered rates are expected to significantly increase water savings and participation in conservation incentive programs in many of GSWC’s systems.

Financial Incentives

Ongoing and/or additional financial incentives may be offered directly to customers by GSWC or in partnership with other agencies:

1. HECW rebates: Clothes washer rebates are already being implemented by Metropolitan on behalf of GSWC and will continue to provide measurable water savings.

2. Zero and low-flow urinal rebates: Rebates would include CII fixtures such as zero consumption and ultra-low volume urinals as well as CII specific HETs.

3. Expansion of fixture rebates to CII and MF customers in all systems: currently, the toilet rebate programs are only available to CII and MF customers in select systems. GSWC will evaluate expansion of the programs to all customers and there will be increased focus on marketing to large Home Owner Association accounts.

4. Larger variety of fixture rebates: This may include hot water distribution tanks, pressurized water brooms and high-pressure spray nozzles.

5. Cash-for-grass rebates: Customers will be provided with an incentive of up to $0.5 per square-foot of turf removed and replaced with landscape appropriate plants. The program is being considered for both residential and CII customers; it is currently being offered in select GSWC systems.

6. Expansion of large landscape program: GSWC will be evaluating the effectiveness of the current landscape program and making adjustments depending on the results. If the program is found to be successful at meeting reduction targets, the program may be accelerated and more devices will be offered, such as precision nozzles.

Building Code/New Standards

Although it does not have regulatory authority, GSWC supports adoption of new building standards, beyond those currently in code to enhance conservation. If all current code changes that improve the efficiency of fixtures and design are implemented, it could account for up to 60 percent of the expected reduction in demand. Some of the changes proposed will be captured in the CAL Green Code, adopted January 2011 as well as SB407 (Plumbing Retrofit on Resale) and standard updates for toilets and washers that are being phased in.

Information/Tracking

Information and tracking represents a new element to the existing programs focusing on collecting and processing information and ensuring that the programs are on track to meet the goals. These activities will also help in program design by providing more robust information about customers and their water use patterns. The immediate priorities include:

1. Automatic Meter Reading (AMR): GSWC currently follows the requirements of CPUC General Order 103-A, which prescribe minimum water system design, operation and maintenance standards for water utilities, and includes requirements for calibrating, testing frequency, and replacing water meters. GSWC will continue to follow this standard and consider the use of AMR in its systems as a priority to obtain real time data for water usage and identify customer-side leaks. This information can also help GSWC monitor the impacts of existing programs, make adjustments where necessary and develop new programs.

2. Water Use Tracking Tools: Another priority, GSWC will consider plans to design and develop database tracking tools for water savings associated with its conservation plans and increase flexibility in adding or changing program elements.

GSWC is developing a companywide approach that will include assessment of options such as accelerating the current programs, and adding additional programmatic, regulatory and information-based activities to meet the requirements of SBX7-7. This systematic approach may allow GSWC to do more with less, in essence, administering overall conservation program operations from a centralized location while allowing local resources for direct implementation of BMPs and other water savings practices. Funding for all conservation activities is subject to approval by the CPUC before programs can be implemented.

7.5.1 Consideration of Economic Impacts

Since funding for all conservation activities is subject to approval by the CPUC before programs can be implemented, the economic impacts of complying with SBX7-7 have not yet been fully determined. However, an economic analysis to help develop programs that avoid placing disproportionate burdens on any single sector will be prepared during development of the SBX7-7 water use efficiency program. The annual costs associated with implementing all traditional CUWCC programmatic BMPs cannot be determined because it represents the combined efforts of Metropolitan, Upper District, and GSWC, where funding levels, incentives and particular measures change from year to year. To continue benefiting customers, GSWC will take advantage of applicable partnership programs that will make conservation programs more efficient and cost effective.

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Chapter 8: Water Shortage Contingency Plan

Section 10632 of the Act details the requirements of the water-shortage contingency analysis. The Act states the following:

> *Section 10632. The plan shall provide an urban water-shortage contingency analysis that includes each of the following elements that are within the authority of the urban water supplier:*
>
> *(a) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions, which are applicable to each stage.*
>
> *(b) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.*
>
> *(c) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.*
>
> *(d) Additional, mandatory prohibitions against specific water-use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.*
>
> *(e) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water-use reduction consistent with up to a 50 percent reduction in water supply.*
>
> *(f) Penalties or charges for excessive use, where applicable.*
>
> *(g) An analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.*
>
> *(h) A draft water shortage contingency resolution or ordinance.*
>
> *(i) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.*

This chapter documents GSWC's Water Shortage Contingency Plan for the South San Gabriel System per requirements of Section 10632 of the Act. The Water Shortage Contingency Plan is based on Rule No. 14.1 Mandatory Water Conservation, Restrictions and Ratings Program adopted by GSWC and on file with CPUC. Appendix D contains the full text of the rule.

The purpose of the Water Shortage Contingency Plan is to provide a plan of action to be followed during the various stages of a water shortage. The plan includes the following elements: action stages, estimate of minimum supply available, actions to be implemented during a catastrophic interruption of water supplies, prohibitions, penalties and consumption reduction methods, revenue impacts of reduced sales, and water use monitoring procedures.

8.1 Action Stages

The Act requires documentation of actions to be undertaken during a water shortage. GSWC has developed actions to be undertaken in response to water supply shortages, including up to a 50 percent reduction in water supply. Implementation of the actions is dependent upon approval of the CPUC, especially for implementing mandatory water use restriction. CPUC has jurisdiction over GSWC because GSWC is an investor-owned water utility. Section 357 of the California Water Code requires that suppliers subject to regulation by the CPUC secure its approval before imposing water consumption regulations and restrictions required by water supply shortage emergencies.

GSWC has grouped the actions to be taken during a water shortage into four stages, I through IV, that are based on the water supply conditions. Table 8-1 describes the water supply shortage stages and conditions. The stages will be implemented during water supply shortages according to shortage level, ranging from 5 percent shortage in Stage I to 50 percent shortage in Stage IV. A water shortage declaration will be made by the American State Water Company Board. The water shortage stage determination during a water supply shortage will be made by the Regional Vice President Customer Service.

Table 8-1: Water Supply Shortage Stages and Conditions

Stage No.	Water Shortage Supply Conditions	Shortage Percent
I	Minimum	5 - 10
II	Moderate	10 - 20
III	Severe	20 - 35
IV	Critical	35 - 50

Note:
This table is based on the DWR Guidebook Table 35.

The actions to be undertaken during each stage include, but are not limited to, the following:

Stage I (5 - 10 percent shortage) – Water alert conditions are declared and voluntary conservation is encouraged. The drought situation is explained to the public and governmental bodies. GSWC explains the possible subsequent water shortage stages in order to forecast possible future actions for the customer base. The activities performed by GSWC during this stage include, but are not limited to:

- Public information campaign consisting of distribution of literature, speaking engagements, website updates, bill inserts, and conversation messages printed in local newspapers
- Educational programs in area schools
- Conservation Hotline, a toll-free number with trained Conservation Representatives to answer customer questions about conservation and water use efficiency

Stage II (10 - 20 percent shortage) – Stage II will include actions undertaken in Stage I. In addition, GSWC may propose voluntary conservation allotments and/or require mandatory conservation rules. The severity of actions depends upon the percent shortage. The level of voluntary or mandatory water use reduction requested from the customers is also based on the severity. It needs to be noted that prior to implementation of any mandatory reductions, GSWC must obtain approval from CPUC. If necessary, GSWC may also support passage of drought ordinances by appropriate governmental agencies.

Stage III (20 - 35 percent shortage) – Stage III is a severe shortage that entails or includes allotments and mandatory conservation rules. This phase becomes effective upon notification by the GSWC that water usage is to be reduced by a mandatory percentage. GSWC implements mandatory reductions after receiving approval from CPUC. Rate changes are implemented to penalize excess usage. Water use restrictions are put into effect, i.e. prohibited uses can include restrictions of daytime hours for watering, excessive watering resulting in gutter flooding, using a hose without a shutoff device, use of non-recycling fountains, washing down sidewalks or patios, unrepaired leaks, etc. GSWC monitors production weekly for compliance with necessary reductions. Use of flow restrictors is implemented if abusive practices are documented.

Stage IV (35 - 50 percent shortage) – This is a critical shortage that includes all steps taken in prior stages regarding allotments and mandatory conservation. All activities are intensified and production is monitored daily by GSWC for compliance with necessary reductions.

8.2 Minimum Supply

The Act requires an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for GSWC's existing water supply sources.

Table 8-2 summarizes the minimum volume of water available from each existing source during the next three-years based on multiple-dry water years and normal water year. The driest three-year historic sequence is provided in Chapter 6. The water supply quantities for 2011 to 2013 are calculated by linearly interpolating between the projected water supplies of 2010 and 2015 for normal years. The water supplies for 2010 and 2015 are presented in Chapter 4.

It is assumed that the multiple-dry year supplies will be the same as those for the normal years because purchased water supplies will meet projected imported water demands under all anticipated hydrologic conditions.

GSWC's supply for the South San Gabriel System is expected to be 100 percent reliable from 2011 to 2013. This reliability is a result of

- Adjudicated groundwater rights in the Main San Gabriel Basin,
- anticipated benefits of groundwater replenishment provisions and conjunctive use storage programs, and
- the projected reliability of Metropolitan water supplies purchased through USGVMWD, which are expected to be 100 percent reliable.

Table 8-2: Three-Year Estimated Minimum Water Supply in ac-ft/yr

Source	2011	2012	2013	2010 Average Year
Purchased water from USGVMWD	689	1,041	1,393	337
Groundwater	2,144	1,936	1,729	2,352
Recycled water	-	-	-	0
Total	2,833	2,978	3,122	2,689

Note:
This table is based on the DWR Guidebook Table 31.

8.3 Catastrophic Supply Interruption Plan

The Act requires documentation of actions to be undertaken by the water supplier to prepare for, and implement during, a catastrophic interruption of water supplies. A catastrophic interruption constitutes a proclamation of a water shortage and could result from any event (either natural or man-made) that causes a water shortage severe enough to classify as either a Stage III or Stage IV water supply shortage condition.

In order to prepare for catastrophic events, GSWC has prepared an Emergency Response Plan (ERP) in accordance with other state and federal regulations. The purpose of this plan is to design actions necessary to minimize the impacts of supply interruptions due to catastrophic events.

The ERP coordinates overall company response to a disaster in any and all of its districts. In addition, the ERP requires each district to have a local disaster plan that coordinates emergency responses with other agencies in the area. The ERP also provides details on actions to be undertaken during specific catastrophic events. Table 8-3 provides a summary of actions cross-referenced against specific catastrophes for three of the most common possible catastrophic events: regional power outage, earthquake, and malevolent acts.

In addition to specific actions to be undertaken during a catastrophic event, GSWC performs maintenance activities, such as annual inspections for earthquake safety, and budgets for spare items, such as auxiliary generators, to prepare for potential events.

Table 8-3: Summary of Actions for Catastrophic Events

Possible Catastrophe	Summary of Actions
Regional power outage	• Isolate areas that will take the longest to repair and/or present a public health threat. Arrange to provide emergency water. • Establish water distribution points and ration water if necessary. • If water service is restricted, attempt to provide potable water tankers or bottled water to the area. • Make arrangements to conduct bacteriological tests, in order to determine possible contamination. • Utilize backup power supply to operate pumps in conjunction with elevated storage.
Earthquake	• Assess the condition of the water supply system. • Complete the damage assessment checklist for reservoirs, water treatment plants, wells and boosters, system transmission and distribution. • Coordinate with Cal EMA utilities group or fire district to identify immediate fire fighting needs. • Isolate areas that will take the longest to repair and/or present a public health threat. Arrange to provide emergency water. • Prepare report of findings, report assessed damages, advise as to materials of immediate need and identify priorities including hospitals, schools and other emergency operation centers. • Take actions to preserve storage. • Determine any health hazard of the water supply and issue any “Boil Water Order” or “Unsafe Water Alert” notification to the customers, if necessary. • Cancel the order or alert information after completing comprehensive water quality testing. • Make arrangements to conduct bacteriological tests, in order to determine possible contamination.
Malevolent acts	• Assess threat or actual intentional contamination of the water system. • Notify local law enforcement to investigate the validity of the threat. • Get notification from public health officials if potential water contamination • Determine any health hazard of the water supply and issue any “Boil Water Order” or “Unsafe Water Alert” notification to the customers, if necessary. • Assess any structural damage from an intentional act. • Isolate areas that will take the longest to repair and or present a public health threat. Arrange to provide emergency water.

8.4 Prohibitions, Penalties, and Consumption Reduction Methods

The Act requires an analysis of mandatory prohibitions, penalties, and consumption reduction methods against specific water use practices which may be considered excessive during water shortages. Given that GSWC is an investor-owned entity, it does not have the authority to pass any ordinance enacting specific prohibitions or penalties. In order to enact or rescind any prohibitions or penalties, GSWC would seek approval from CPUC to enact or rescind Rule No. 14.1, Mandatory Conservation and Rationing, which is included in Appendix D. When Rule No. 14.1 has expired or is not in effect, mandatory conservation and rationing measures will not be in force.

Rule No. 14.1 details the various prohibitions and sets forth water use violation fines, charges for removal of flow restrictors, as well as establishes the period during which mandatory conservation and rationing measures will be in effect. The prohibitions on various wasteful water uses, include, but are not limited to, the hose washing of sidewalks and driveways using potable water, and cleaning for filling decorative fountains. Table 8-4 summarizes the various prohibitions and the stages during which the prohibition becomes mandatory.

Table 8-4: Summary of Mandatory Prohibitions

Examples of Prohibitions	Stage When Prohibition Becomes Mandatory
Uncorrected plumbing leaks	II, III, IV
Watering which results in flooding or run-off in gutters, waterways, patios, driveway, or streets	II, III, IV
Washing aircraft, cars, buses, boats, trailers, or other vehicles without a positive shut-off nozzle on the outlet end of the hose	II, III, IV
Washing buildings, structures, sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas in a manner which results in excessive run-off	II, III, IV
Irrigation of non-permanent agriculture	II, III, IV
Use of water for street watering with trucks or for construction purposes unless no other source of water or other method can be used	II, III, IV
Use of water for decorative fountains or the filling or topping off of decorative lakes or ponds	II, III, IV
Filling or refilling of swimming pools	II, III, IV

Note:
This table is based on the DWR Guidebook Table 36.

In addition to prohibitions during water supply shortage events requiring a voluntary or mandatory program, GSWC will make available to its customers water conservation kits as required by GSWC's Rule No. 20. GSWC will notify all customers of the availability of conservation kits.

In addition to prohibitions, Rule No. 14.1 provides penalties and charges for excessive water use. The enactment of these penalties and charges is contingent on approval of Rule 14.1 implementation by the CPUC. When the rule is in effect, violators receive one verbal and one written warning after which a flow-restricting device may be installed in the violator's service for a reduction of up to 50 percent of normal flow or 6 ccf per month, whichever is greater. Table 8-5 summarizes the penalties and charges and the stage during which they take effect.

Table 8-5: Summary of Penalties and Charges for Excessive Use

Penalties or Charges	Stage When Penalty Takes Effect
Penalties for not reducing consumption	III, IV
Charges for excess use	III, IV
Flat fine; Charge per unit over allotment	III, IV
Flow restriction	III, IV
Termination of service	III, IV

Note:
This table is based on the DWR Guidebook Table 38.

In addition to prohibitions and penalties, GSWC can use other consumption reduction methods to reduce water use up to 50 percent. Based on the requirements of the Act, Table 8-6 summarizes the methods that can be used by GSWC in order to enforce a reduction in consumption, where necessary.

Table 8-6: Summary of Consumption Reduction Methods

Consumption Reduction Method	Stage When Method Takes Effect	Projected Reduction Percentage
Demand reduction program	All Stages	N/A
Reduce pressure in water lines; Flow restriction	III, IV	N/A
Restrict building permits; Restrict for only priority uses	II, III, IV	N/A
Use prohibitions	II, III, IV	N/A
Water shortage pricing; Per capita allotment by customer type	II, IV	N/A
Plumbing fixture replacement	All Stages	N/A
Voluntary rationing	II	N/A
Mandatory rationing	III, IV	N/A
Incentives to reduce water consumption; Excess use penalty	III, IV	N/A
Water conservation kits	All Stages	N/A
Education programs	All Stages	N/A
Percentage reduction by customer type	III, IV	N/A

Note:
This table is based on the DWR Guidebook Table 37.

8.5 Revenue Impacts of Reduced Sales

Section 10632(g) of the Act requires an analysis of the impacts of each of the actions taken for conservation and water restriction on the revenues and expenditures of the water supplier. Because GSWC is an investor-owned water utility and, as such, is regulated by the CPUC, the CPUC authorizes it to establish memorandum accounts to track expenses and revenue shortfalls caused by both mandatory rationing and voluntary conservation efforts. Utilities with CPUC-approved water management plans are authorized to implement a surcharge to recover revenue shortfalls recorded in their drought memorandum accounts. Table 8-7 provides a summary of actions with associated revenue reductions; while Table 8-8 provides a summary of actions and conditions that impact expenditures. Table 8-9 summarizes the proposed measures to overcome revenue impacts. Table 8-10 provides a summary of the proposed measures to overcome expenditure impacts.

Table 8-7: Summary of Actions and Conditions that Impact Revenue

Type	Anticipated Revenue Reduction
Reduced sales	Reduction in revenue will be based on the decline in water sales and the corresponding quantity tariff rate
Recovery of revenues with CPUC-approved surcharge	Higher rates may result in further decline in water usage and further reduction in revenue

Table 8-8: Summary of Actions and Conditions that Impact Expenditures

Category	Anticipated Cost
Increased staff cost	Salaries and benefits for new hires required to administer and implement water shortage program
Increased O&M cost	Operating and maintenance costs associated with alternative sources of water supply
Increased cost of supply and treatment	Purchase and treatment costs of new water supply

Table 8-9: Proposed Measures to Overcome Revenue Impacts

Names of Measures	Summary of Effects
Obtain CPUC-approved surcharge	Allows for recovery of revenue shortfalls brought on by water shortage program
Penalties for excessive water use	Obtain CPUC approval to use penalties to offset portion of revenue shortfall

Table 8-10: Proposed Measures to Overcome Expenditure Impacts

Names of Measures	Summary of Effects
Obtain CPUC-approved surcharge	Allows for recovery of increased expenditures brought on by water shortage program
Penalties for excessive water use	Obtain CPUC approval to use penalties to offset portion of increased expenditures

8.6 Water-Use Monitoring Procedures

The Act asks for an analysis of mechanisms for determining actual reduction in water use when the Water Shortage Contingency Plan is in effect. Table 8-11 lists the possible mechanisms used by GSWC to monitor water use and the quality of data expected.

Table 8-11: Water-Use Monitoring Mechanisms

Mechanisms for Determining Actual Reductions	Type and Quality of Data Expected
Customer meter readings	Hourly/daily/monthly water consumption data for a specific user depending on frequency of readings
Production meter readings	Hourly/daily/monthly water production depending on frequency of readings; correlates to water use plus system losses

In addition to the specific actions that GSWC can undertake to verify level of conservation, GSWC can monitor long-term water use through regular bi-monthly meter readings, which give GSWC the ability to flag exceptionally high usage for verification of water loss or abuse.

Chapter 9: References

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Appendix A

Urban Water Management Planning Act

CALIFORNIA WATER CODE DIVISION 6
PART 2.6. URBAN WATER MANAGEMENT PLANNING

All California Codes have been updated to include the 2010 Statutes.

WATER CODE
SECTION 10610-10610.4

10610. This part shall be known and may be cited as the "Urban Water Management Planning Act."

10610.2. (a) The Legislature finds and declares all of the following:

(1) The waters of the state are a limited and renewable resource subject to ever-increasing demands.

(2) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate.

(4) As part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry water years.

(5) Public health issues have been raised over a number of contaminants that have been identified in certain local and imported water supplies.

(6) Implementing effective water management strategies, including groundwater storage projects and recycled water projects, may require specific water quality and salinity targets for meeting groundwater basins water quality objectives and promoting beneficial use of recycled water.

(7) Water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities.

(8) Changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.

(9) The quality of source supplies can have a significant impact

on water management strategies and supply reliability.

(b) This part is intended to provide assistance to water agencies in carrying out their long-term resource planning responsibilities to ensure adequate water supplies to meet existing and future demands for water.

10610.4. The Legislature finds and declares that it is the policy of the state as follows:

(a) The management of urban water demands and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The management of urban water demands and efficient use of urban water supplies shall be a guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to actively pursue the efficient use of available supplies.

WATER CODE
SECTION 10611-10617

10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

10611.5. "Demand management" means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

10614. "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

10616.5. "Recycled water" means the reclamation and reuse of wastewater for beneficial use.

10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 4 (commencing with Section 116275) of Part 12 of Division 104 of the Health and Safety Code.

WATER CODE
SECTION 10620-10621

10620. (a) Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) (1) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(2) Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

(f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

10621. (a) Each urban water supplier shall update its plan at least once every five years on or before December 31, in years ending in five and zero.

(b) Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

(c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

WATER CODE
SECTION 10630-10634

10630. It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

10631. A plan shall be adopted in accordance with this chapter that shall do all of the following:

(a) Describe the service area of the supplier, including current and projected population, climate, and other demographic factors affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). If groundwater is identified as an existing or planned source of water available to the supplier, all of the following information shall be included in the plan:

(1) A copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management.

(2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For those basins for which a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(A) An average water year.

(B) A single dry water year.

(C) Multiple dry water years.

(2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

(d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

(e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water use sectors, including, but not necessarily limited to, all of the following uses:

(A) Single-family residential.

(B) Multifamily.

(C) Commercial.

(D) Industrial.

(E) Institutional and governmental.

(F) Landscape.

(G) Sales to other agencies.

(H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof.

(I) Agricultural.

(2) The water use projections shall be in the same five-year increments described in subdivision (a).

(f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:

(1) A description of each water demand management measure that is currently being implemented, or scheduled for implementation, including the steps necessary to implement any proposed measures, including, but not limited to, all of the following:

(A) Water survey programs for single-family residential and multifamily residential customers.

(B) Residential plumbing retrofit.

(C) System water audits, leak detection, and repair.

(D) Metering with commodity rates for all new connections and retrofit of existing connections.

(E) Large landscape conservation programs and incentives.

(F) High-efficiency washing machine rebate programs.

(G) Public information programs.

(H) School education programs.

(I) Conservation programs for commercial, industrial, and institutional accounts.

(J) Wholesale agency programs.
(K) Conservation pricing.
(L) Water conservation coordinator.
(M) Water waste prohibition.
(N) Residential ultra-low-flush toilet replacement programs.

(2) A schedule of implementation for all water demand management measures proposed or described in the plan.

(3) A description of the methods, if any, that the supplier will use to evaluate the effectiveness of water demand management measures implemented or described under the plan.

(4) An estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the supplier's ability to further reduce demand.

(g) An evaluation of each water demand management measure listed in paragraph (1) of subdivision (f) that is not currently being implemented or scheduled for implementation. In the course of the evaluation, first consideration shall be given to water demand management measures, or combination of measures, that offer lower incremental costs than expanded or additional water supplies. This evaluation shall do all of the following:

(1) Take into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.

(2) Include a cost-benefit analysis, identifying total benefits and total costs.

(3) Include a description of funding available to implement any planned water supply project that would provide water at a higher unit cost.

(4) Include a description of the water supplier's legal authority to implement the measure and efforts to work with other relevant agencies to ensure the implementation of the measure and to share the cost of implementation.

(h) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs, other than the demand management programs identified pursuant to paragraph (1) of subdivision (f), that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

(i) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.

(j) For purposes of this part, urban water suppliers that are members of the California Urban Water Conservation Council shall be deemed in compliance with the requirements of subdivisions (f) and (g) by complying with all the provisions of the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated December 10, 2008, as it may be amended, and by submitting the annual reports required by Section 6.2 of that memorandum.

(k) Urban water suppliers that rely upon a wholesale agency for a source of water shall provide the wholesale agency with water use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c).

10631.1. (a) The water use projections required by Section 10631 shall include projected water use for single-family and multifamily residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

(b) It is the intent of the Legislature that the identification of projected water use for single-family and multifamily residential housing for lower income households will assist a supplier in complying with the requirement under Section 65589.7 of the Government Code to grant a priority for the provision of service to housing units affordable to lower income households.

10631.5. (a) (1) Beginning January 1, 2009, the terms of, and eligibility for, a water management grant or loan made to an urban water supplier and awarded or administered by the department, state board, or California Bay-Delta Authority or its successor agency shall be conditioned on the implementation of the water demand management measures described in Section 10631, as determined by the department pursuant to subdivision (b).

(2) For the purposes of this section, water management grants and loans include funding for programs and projects for surface water or groundwater storage, recycling, desalination, water conservation, water supply reliability, and water supply augmentation. This section does not apply to water management projects funded by the federal American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

(3) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if the urban water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the water demand management measures. The supplier may request grant or loan funds to implement the water demand management measures to the extent the request is consistent with the eligibility requirements applicable to the water management funds.

(4) (A) Notwithstanding paragraph (1), the department shall

determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if an urban water supplier submits to the department for approval documentation demonstrating that a water demand management measure is not locally cost effective. If the department determines that the documentation submitted by the urban water supplier fails to demonstrate that a water demand management measure is not locally cost effective, the department shall notify the urban water supplier and the agency administering the grant or loan program within 120 days that the documentation does not satisfy the requirements for an exemption, and include in that notification a detailed statement to support the determination.

(B) For purposes of this paragraph, "not locally cost effective" means that the present value of the local benefits of implementing a water demand management measure is less than the present value of the local costs of implementing that measure.

(b) (1) The department, in consultation with the state board and the California Bay-Delta Authority or its successor agency, and after soliciting public comment regarding eligibility requirements, shall develop eligibility requirements to implement the requirement of paragraph (1) of subdivision (a). In establishing these eligibility requirements, the department shall do both of the following:

(A) Consider the conservation measures described in the Memorandum of Understanding Regarding Urban Water Conservation in California, and alternative conservation approaches that provide equal or greater water savings.

(B) Recognize the different legal, technical, fiscal, and practical roles and responsibilities of wholesale water suppliers and retail water suppliers.

(2) (A) For the purposes of this section, the department shall determine whether an urban water supplier is implementing all of the water demand management measures described in Section 10631 based on either, or a combination, of the following:

(i) Compliance on an individual basis.

(ii) Compliance on a regional basis. Regional compliance shall require participation in a regional conservation program consisting of two or more urban water suppliers that achieves the level of conservation or water efficiency savings equivalent to the amount of conservation or savings achieved if each of the participating urban water suppliers implemented the water demand management measures. The urban water supplier administering the regional program shall provide participating urban water suppliers and the department with data to demonstrate that the regional program is consistent with this clause. The department shall review the data to determine whether the urban water suppliers in the regional program are meeting the eligibility requirements.

(B) The department may require additional information for any determination pursuant to this section.

(3) The department shall not deny eligibility to an urban water supplier in compliance with the requirements of this section that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of

the agencies participating in the project or plan is not implementing all of the water demand management measures described in Section 10631.

(c) In establishing guidelines pursuant to the specific funding authorization for any water management grant or loan program subject to this section, the agency administering the grant or loan program shall include in the guidelines the eligibility requirements developed by the department pursuant to subdivision (b).

(d) Upon receipt of a water management grant or loan application by an agency administering a grant and loan program subject to this section, the agency shall request an eligibility determination from the department with respect to the requirements of this section. The department shall respond to the request within 60 days of the request.

(e) The urban water supplier may submit to the department copies of its annual reports and other relevant documents to assist the department in determining whether the urban water supplier is implementing or scheduling the implementation of water demand management activities. In addition, for urban water suppliers that are signatories to the Memorandum of Understanding Regarding Urban Water Conservation in California and submit biennial reports to the California Urban Water Conservation Council in accordance with the memorandum, the department may use these reports to assist in tracking the implementation of water demand management measures.

(f) This section shall remain in effect only until July 1, 2016, and as of that date is repealed, unless a later enacted statute, that is enacted before July 1, 2016, deletes or extends that date.

10631.7. The department, in consultation with the California Urban Water Conservation Council, shall convene an independent technical panel to provide information and recommendations to the department and the Legislature on new demand management measures, technologies, and approaches. The panel shall consist of no more than seven members, who shall be selected by the department to reflect a balanced representation of experts. The panel shall have at least one, but no more than two, representatives from each of the following: retail water suppliers, environmental organizations, the business community, wholesale water suppliers, and academia. The panel shall be convened by January 1, 2009, and shall report to the Legislature no later than January 1, 2010, and every five years thereafter. The department shall review the panel report and include in the final report to the Legislature the department's recommendations and comments regarding the panel process and the panel's recommendations.

10632. (a) The plan shall provide an urban water shortage contingency analysis that includes each of the following elements that are within the authority of the urban water supplier:

(1) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions that are applicable to each stage.

(2) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic

sequence for the agency's water supply.

(3) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

(4) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.

(5) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

(6) Penalties or charges for excessive use, where applicable.

(7) An analysis of the impacts of each of the actions and conditions described in paragraphs (1) to (6), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

(8) A draft water shortage contingency resolution or ordinance.

(9) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.

(b) Commencing with the urban water management plan update due December 31, 2015, for purposes of developing the water shortage contingency analysis pursuant to subdivision (a), the urban water supplier shall analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code.

10633. The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area, and shall include all of the following:

(a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.

(b) A description of the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.

(c) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.

(d) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.

(e) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

(f) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.

(g) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

10634. The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability.

WATER CODE
SECTION 10635

10635. (a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

(b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

(c) Nothing in this article is intended to create a right or entitlement to water service or any specific level of water service.

(d) Nothing in this article is intended to change existing law concerning an urban water supplier's obligation to provide water service to its existing customers or to any potential future customers.

WATER CODE
SECTION 10640-10645

10640. Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630).

The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

10641. An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water demand management methods and techniques.

10642. Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

10644. (a) An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption.

(b) The department shall prepare and submit to the Legislature, on or before December 31, in the years ending in six and one, a report summarizing the status of the plans adopted pursuant to this part. The report prepared by the department shall identify the exemplary elements of the individual plans. The department shall provide a copy of the report to each urban water supplier that has submitted its plan to the department. The department shall also prepare reports and provide data for any legislative hearings designed to consider the effectiveness of plans submitted pursuant to this part.

(c) (1) For the purpose of identifying the exemplary elements of the individual plans, the department shall identify in the report those water demand management measures adopted and implemented by specific urban water suppliers, and identified pursuant to Section

10631, that achieve water savings significantly above the levels established by the department to meet the requirements of Section 10631.5.

(2) The department shall distribute to the panel convened pursuant to Section 10631.7 the results achieved by the implementation of those water demand management measures described in paragraph (1).

(3) The department shall make available to the public the standard the department will use to identify exemplary water demand management measures.

10645. Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

WATER CODE
SECTION 10650-10656

10650. Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

10651. In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plan by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplier is not supported by substantial evidence.

10652. The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans pursuant to this part or to the implementation of actions taken pursuant to Section 10632. Nothing in this part shall be interpreted as exempting from the California Environmental Quality Act any project that would significantly affect water supplies for fish and wildlife, or any project for implementation of the plan, other than projects implementing Section 10632, or any project for expanded or additional water supplies.

10653. The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board and the Public Utilities Commission, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board or the Public Utilities Commission requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board or the commission in obtaining that information. The requirements of this part shall be satisfied by any urban water demand management plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing urban water management plan which includes the contents of a plan required under this part.

10654. An urban water supplier may recover in its rates the costs incurred in preparing its plan and implementing the reasonable water conservation measures included in the plan. Any best water management practice that is included in the plan that is identified in the

"Memorandum of Understanding Regarding Urban Water Conservation in California" is deemed to be reasonable for the purposes of this section.

10655. If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

10656. An urban water supplier that does not prepare, adopt, and submit its urban water management plan to the department in accordance with this part, is ineligible to receive funding pursuant to Division 24 (commencing with Section 78500) or Division 26 (commencing with Section 79000), or receive drought assistance from the state until the urban water management plan is submitted pursuant to this article.

Appendix B

Public Hearing Notices, Notifications, and Meeting Minutes

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Arcadia
Corkran W. Nicholson
Planning Services Manager
240 W. Huntington Drive
Arcadia, CA 91006

Subject: ***REVISED***-Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Corkran:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review prior one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011,* and take place at:

San Dimas/Senior Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Arcadia
Philip A. Wray
City Engineer
240 W. Huntington Drive
Arcadia, CA 91006

Subject: ***REVISED***- Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP)Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Phillip:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

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110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas/Senior Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Claremont
Chris Veirs
City Planner
P.O. Box 880
Claremont, CA 91711

Subject: ***REVISED***-Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Chris:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

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San Dimas/Senior Community Center
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San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

May 17, 2011

City of Covina
Michael A. Marquez
Community Development Director
125 E. College Street
Covina, CA 91723

Subject: Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – San Dimas, Claremont, San Gabriel and South Arcadia Water Systems.

Dear Michael:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

San Dimas, Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review prior to the public hearing and can be reviewed during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plan at:

San Dimas Customer Service Office
121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP will be held at 6:00 p.m., on Tuesday, July 19, 2011 and take place at:

San Dimas Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of El Monte
James Troyer
Planning Services Manager
11333 Valley Blvd.
El Monte, Ca 91732

Subject: ***REVISED***-Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear James:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Irwindale
Tonya Pace
Director of Planning
5050 North Irwindale Ave.
Irwindale, CA 91706

Subject: ***REVISED-*** Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP)Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Tonya:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

May 17, 2011

City of La Verne
Hal Fredericksen
Community Development Director
3660 D Street
La Verne, CA 91723

Subject: Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – San Dimas, Claremont, San Gabriel and South Arcadia Water Systems.

Dear Hal:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

San Dimas, Claremont, San Gabriel and South Arcadia

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San Dimas Customer Service Office
121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP will be held at 6:00 p.m., on Tuesday, July 19, 2011 and take place at:

San Dimas Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Monrovia
Alice Griselle
Community Development Director
415 South Ivy Avenue
Monrovia, CA 91016

Subject: ***REVISED-*** Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Alice:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Montclair
Steve Lustro
Community Development Director
5111 Bento Street
Montclair, CA 91763

Subject: ***REVISED-*** Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Steve:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP’s will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Monterey Park
Ray Hamada
Planning Manager
320 West Newmark Avenue
Monterey Park, CA 91754

Subject: ***REVISED***- Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – Claremont, San Gabriel and South Arcadia Water Systems.

Dear Ray:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Pomona
Mark Laccaretto
Planning Division
505 South Garey Avenue
Pomona, CA 91766

Subject: ***REVISED-*** Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – Claremont, San Gabriel and South Arcadia Water Systems.

Dear Mark:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

The UWMP's will be available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Rosemead
Bradford Johnson
Planning Director
8838 Valley Blvd.
Rosemead, CA 91770

Subject: ***REVISED***- Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – Claremont, San Gabriel and South Arcadia Water Systems.

Dear Bradford:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

May 17, 2011

City of San Dimas
Dan Coleman
Planning Manager
245 East Bonita Avenue
San Dimas, CA 91773

Subject: Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – San Dimas, Claremont, San Gabriel and South Arcadia Water Systems.

Dear Dan:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

San Dimas, Claremont, San Gabriel and South Arcadia

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San Dimas Customer Service Office
121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP will be held at 6:00 p.m., on Tuesday, July 19, 2011 and take place at:

San Dimas Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of San Gabriel
Carol Banet
Planning Manager
425 South Mission Drive
San Gabriel, CA 91776

Subject: ***REVISED-*** Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Carol:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

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San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Temple City
Joseph Lambert
Community Development Director
9701 Las Tunas Drive
Temple City, CA 91780

Subject: ***REVISED*- **Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Joseph:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

City of Upland
Jeffrey Bloom
Planning Director
460 North Euclid Avenue
Upland, CA 91786

Subject: ***REVISED***-Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Jeffrey:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

May 17, 2011

City of Walnut
Tom Wiener
Director of Community Development
21201 La Puente Road
Walnut, CA 91789

Subject: Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – San Dimas, Claremont, San Gabriel and South Arcadia Water Systems.

Dear Tom:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

San Dimas, Claremont, San Gabriel and South Arcadia

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121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Center
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP will be held at 6:00 p.m., on Tuesday, July 19, 2011 and take place at:

San Dimas Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

May 17, 2011

Country of Los Angeles
Richard Brudckner
Director Department of Regional Planning
320 West Temple Street
Los Angeles, CA 90012

Subject: Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company – San Dimas, Claremont, San Gabriel and South Arcadia Water Systems.

Dear Richard:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

San Dimas, Claremont, San Gabriel and South Arcadia

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121 Exchange Place
San Dimas, CA 91773

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110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP will be held at 6:00 p.m., on Tuesday, July 19, 2011 and take place at:

San Dimas Community Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Golden State
Water Company
A Subsidiary of American States Water Company

July 19, 2011

Country of Los Angeles
Richard Brudckner
Director Department of Regional Planning
320 West Temple Street
Los Angeles, CA 90012

Subject: ***REVISED***- Notification of Public Hearing for the 2010 Urban Water Management Plan (UWMP) Golden State Water Company –Claremont, San Gabriel and South Arcadia Water Systems.

Dear Richard:

Golden State Water Company (GSWC) is providing you this notice pursuant to Water Code, section 10621, subdivision (b) of the Act, which requires an urban water supplier to notify any city or county within which it provides water that it is reviewing its plan and considering changes to the plan for the following water systems:

Claremont, San Gabriel and South Arcadia

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110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Center
689 West Foothill Blvd., Suite D
Claremont, CA 91711

A public hearing to solicit comments on the draft UWMP's will be held at 6:00 p.m., on *Thursday, August 18, 2011* and take place at:

San Dimas Community/Senior Center
201 E. Bonita Avenue
San Dimas, CA 91773

If you have any questions please contact me at (916) 853-3612.

Very truly yours,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

(Space below for use of County Clerk only)

SAN GABRIEL VALLEY TRIBUNE

Affiliated with
SGV Newspaper Group
1210 N. Azusa Canyon Road
West Covina, CA 91790

PROOF OF PUBLICATION
(2015.5 C.C.P.)

STATE OF CALIFORNIA

County of Los Angeles

I am a citizen of the United States, and a resident of the county aforesaid; I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principal clerk of the printer of **SAN GABRIEL VALLEY TRIBUNE**, a newspaper of general circulation which has been adjudicated as a newspaper of general circulation by the Superior Court of the County of Los Angeles, State of California, on the date of September 10, 1957, Case Number 684891. The notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

6/15/11, 6/22/11

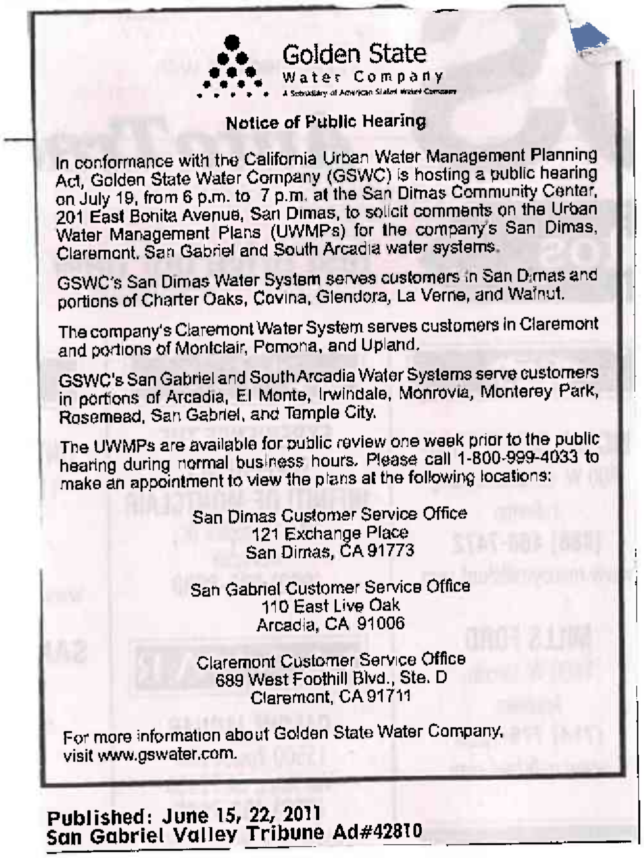
I declare under penalty of perjury that the foregoing is true and correct.

Executed at West Covina, LA Co. California
This 22nd day of June, 2011

Signature

12/22/9 *A000002258060*

Proof of Publication of



Golden State
Water Company
A Subsidiary of American States Water Company

Notice of Public Hearing

In conformance with the California Urban Water Management Planning Act, Golden State Water Company (GSWC) is hosting a public hearing on July 19, from 6 p.m. to 7 p.m. at the San Dimas Community Center, 201 East Bonita Avenue, San Dimas, to solicit comments on the Urban Water Management Plans (UWMPs) for the company's San Dimas, Claremont, San Gabriel and South Arcadia water systems.

GSWC's San Dimas Water System serves customers in San Dimas and portions of Charter Oaks, Covina, Glendora, La Verne, and Walnut.

The company's Claremont Water System serves customers in Claremont and portions of Montclair, Pomona, and Upland.

GSWC's San Gabriel and South Arcadia Water Systems serve customers in portions of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, and Temple City.

The UWMPs are available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Dimas Customer Service Office
121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Office
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Office
689 West Foothill Blvd., Ste. D
Claremont, CA 91711

For more information about Golden State Water Company, visit www.gswater.com.

Published: June 15, 22, 2011
San Gabriel Valley Tribune Ad#42810

2115207

SAN GABRIEL VALLEY TRIBUNE

affiliated with
SGV Newspaper Group
1210 N. Azusa Canyon Road
West Covina, CA 91790

PROOF OF PUBLICATION

(2015.5 C.C.P.)

STATE OF CALIFORNIA

County of Los Angeles

I am a citizen of the United States, and a resident of the county aforesaid; I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principal clerk of the printer of SAN GABRIEL VALLEY TRIBUNE, a newspaper of general circulation which has been adjudicated as a newspaper of general circulation by the Superior Court of the County of Los Angeles, State of California, on the date of September 10, 1957, Case Number 684891. The notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

5/17/11

I declare under penalty of perjury that the foregoing is true and correct.

Executed at West Covina, LA Co. California
this 17 day of MAY, 20 11

signature

Proof of Publication of

Golden State
Water Company
A Subsidiary of American States Water Company

Notice of Public Hearing

In conformance with the California Urban Water Management Planning Act, Golden State Water Company (GSWC) is hosting a public hearing on July 19, from 6 p.m. to 7 p.m. at the San Dimas Community Center, 201 East Bonita Avenue, San Dimas, to solicit comments on the Urban Water Management Plans (UWMPs) for the company's San Dimas, Claremont, San Gabriel and South Arcadia water systems.

GSWC's San Dimas Water System serves customers in San Dimas and portions of Charter Oaks, Covina, Glendora, La Verne, and Walnut.

The company's Claremont Water System serves customers in Claremont and portions of Montclair, Pomona, and Upland.

GSWC's San Gabriel and South Arcadia Water Systems serve customers in portions of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, and Temple City.

The UWMPs are available for public review one week prior to the public hearing during normal business hours. Please call 1-800-999-4033 to make an appointment to view the plans at the following locations:

San Dimas Customer Service Office
121 Exchange Place
San Dimas, CA 91773

San Gabriel Customer Service Office
110 East Live Oak
Arcadia, CA 91006

Claremont Customer Service Office
689 West Foothill Blvd., Ste. D
Claremont, CA 91711

For more information about Golden State Water Company visit www.gswater.com.

CNS"2102177
Published: May 17, 2011
San Gabriel Valley Tribune
Ad#201573

A000002245389

Golden State
Water Company
A Subsidiary of American States Water Company

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- Find Local Office Information
- Payment Options
- Understanding Your Bill
- How to Read Your Meter
- Definitions and Terminology
- Frequently Asked Questions
- New Customer Brochure

For 24-hour customer service or emergency please call

1-800-999-4033
24 hours, 7 days a week

877-933-9533
TTY (hearing impaired)

Find Local Office Information » San Gabriel Valley

San Gabriel Valley Customer Service Area

WATER CONSERVATION TIPS

Don't use the toilet as a wastebasket and save up to 200 gallons of water a month.

Areas Serviced
This Customer Service Area serves approximately 12,200 customers in portions of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, and Temple City

Office Location
San Gabriel CSA
110 East Live Oak
Arcadia, CA 91006

24 hour Customer Service and Emergency
800-999-4033 (24 hours, 7 days a week)
877-933-9533 (TTY hearing impaired)
Email: customerservice@gswater.com

Urban Water Management Plan Public Meeting Notice

Golden State Water Company (GSWC) is in the process of updating its existing Urban Water Management Plan and is seeking public input. The plan is expected to be available for review one week prior to the meeting date.

See public notice for more information.

Golden State Water Company (GSWC) Files a Cost of Capital Application

A Cost of Capital application was filed May 2, 2011 with the the California Public Utilities Commission (CPUC). The CPUC regulates GSWC to ensure adequate levels of service are provided at the lowest reasonable costs.

In this filing, GSWC is requesting for the CPUC to review and authorize an increase in the cost of capital reflected in rates for 2012, 2013, and 2014. A decision is expected in December 2011.

A copy of the application is here.

New Rates Established in San Gabriel Valley Customer Service Area for 2011 and 2012

The CPUC issued a final decision on the company's 2008 General Rate Case on Nov. 19, 2010. The decision established rates for GSWC to charge customers for 2010, 2011 and 2012 in its Region III, which includes the San Gabriel Valley Customer Service Area.

Fact Sheet

RATES, SCHEDULES & TARIFFS

Residential Metered Service
Non-Residential Metered Service
Mandatory Conservation-Rationing (Schedule 14.1)

CLICK HERE to view all our rates, tariffs and advice letters

Third Tier Added to Tiered Rates for San Gabriel Valley Customer Service Area to Encourage Water Use Efficiency

GSWC residential customers in the utility's San Gabriel Valley Customer Service Area (CSA) had a third tier added to their tiered rates to promote water use efficiency.

The change, approved by the California Public Utilities Commission, began in December 2010. GSWC will not exceed CPUC authorized revenues as a result of tiered rates.

Here's how tiered rates work. Customers get charged for each unit of water they use. A unit is equal to one hundred cubic feet of water, or Ccf (748 gallons). In the San Gabriel Valley CSA, residential customers will pay the lowest rate for each Ccf they use in tier one, up to 13 Ccf. For every unit of water used in tier two, which is 14-21 Ccf, customers will pay a 15 percent higher rate. In tier three, customers will pay an additional 15 percent for every unit of water from 22 Ccf and above.

The top of the first tier is based on the average winter month usage for the service area. The top of second tier is based on the midpoint between the annual average usage and the average summer month usage for the service area. The per unit price differential between each tier is approximately 15 percent, a sufficient amount to encourage water use efficiency.

For more information, see our Residential Metered Service tariff in the article above.

LOW INCOME PROGRAM
California Alternate Rates for Water (CARW)

Golden State Water Company offers a discount through the California Alternate Rates for Water (CARW) program to eligible customers. The amount of the discount is $8 per month, which is equal to 15 percent of the average bill in your customer service area.

If you qualify for a rate discount on your electricity, you may be eligible for a discount on your water bill. Qualifications are based on the number of people living in your home and your total household income, including wages, government checks and benefits, and other financial support you and members of your family receive.

For further information, see the application below or contact our CARW hotline at (866) 360-CARW (2279).

Application (English)
Application (Spanish)

Visit Golden State Water Company's Demonstration Garden

Golden State Water Company's demonstration garden which features over 25 different California-friendly plants, drought tolerant turf, and a water-wise smart irrigation system recently received the California Landscape Contractors Association (CLCA) state-wide trophy award for sustainability.

The CLCA trophy awards recognize companies, institutions, municipalities and residents for their interest in preserving and maintaining a beautiful California. The first of an inaugural award to be given by the CLCA, the award was designed to recognize those projects containing sustainable installation elements, including: water management, planting and plant selection, sustainable construction methods.

Since the completion of the project, Golden State Water Company has exceeded a 56-month return on investment goal of 40 percent water savings.

Golden State Water Company's Water Shortage Plan for San Gabriel Valley Customers

Golden State Water Company (GSWC) developed a water shortage plan (Schedule 14.1) for its San Gabriel Customer Service Area that asks customers to voluntarily reduce their usage based on historical averages. Read additional plan details here. Each water allocation is based on the customer's average historical usage in 2004, 2005, and 2006, minus 10 percent.

Additionally, water use restrictions are now in place. GSWC may issue fines to customers who are involved in water wasting activities such as using water in any manner that results in run-off in gutters, waterways, patios, driveways or streets. Repeated violations could lead to the installation of flow restrictors at the customer's cost and suspension of service. See list of restrictions.

Should a mandatory allocation stage be implemented, exception forms will be available for customers to request an allocation adjustment. For example, if a household added several people since 2006, or if customers require additional water for medical needs, they may be eligible for a higher water budget. Water conservation practices and devices may be evaluated as part of the exception evaluation process. Since the targeted reductions in the current stage for San Gabriel customers are voluntary, allocation forms will not be processed at this time.

For more information, see our list of frequently asked questions about the water shortage plan, or call 1-800-999-4033.

Golden State has Invested More Than $19.7 Million in the San Gabriel Customer Service Area Since 2000

Golden State is continually improving its water infrastructure to ensure its supply, distribution, and storage systems are adequate. From 2000 to 2009, Golden State spent more than $19.7 million on improvements in the San Gabriel Customer Service Area, which includes portions of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, and Temple City.

"To make high quality water readily available to all of our customers, we must continually invest in our water facilities, installing new infrastructure," said GSWC's Foothill District Manager Benjamin Lewis.

Golden State Water Company is regulated by the California Public Utilities Commission, which established a Water Action Plan. One of the objectives of the plan is to promote water infrastructure investment. Nationally, leaking pipes lose an estimated seven billion gallons of clean drinking water a day, according to the American Society of Civil Engineers.

WATER CONSERVATION REBATE PROGRAMS

Golden State Water Company partners with other agencies to offer various rebate programs as an incentive for customers to purchase water-efficient products. Here are some programs created for San Gabriel Valley Customer Service Area customers. Funding is limited.

High-Efficiency Clothes Washer (HECW) Rebates
For single-family homes call 1-888-376-3314 or visit www.socalwatersmart.com.
Up to $85 rebate for those who qualify.

High-Efficiency Toilet (HET) Rebates
Up to $125 for qualifying customers. Click here for application or call
1-800-999-4033.

Rotating Nozzles and Pressure Regulating Sprinkler Heads
Single-family homes, call 888-376-3314 or visit www.socalwatersmart.com.
Up to $4 per set rebate for those who qualify.

Weather-based Irrigation Controller (SmarTimer)
Single-family homes and multi-family buildings up to four units,
call 888-376-3314 or visit www.socalwatersmart.com.
Up to $25 rebate per station for those who qualify.

SmarTimer rebates for multi-family buildings with more than four units are currently no longer available due to overwhelming public response.

To learn more about any of our current rebate programs, please call customer service at 800-999-4033.

WATER QUALITY ANNUAL REPORT

South Arcadia
South San Gabriel

For 24-hour emergency and customer service, please call: 1-800-999-4033 or 877-933-9533 TTY (hearing impaired)
customerservice@gswater.com

Website design by NetPilot Web Solutions

AUGUST 18, 2011

2010 UWMP PUBLIC MEETING MINUTES FOR CLAREMONT,
SOUTH ARCADIA & SOUTH SAN GABRIEL

GSWC ATTENDEES: ADRIAN COMBES, BEN LEWIS, TOM TRAFFAS,
DIANE PINNICK

MEETING CALLED TO ORDER 6:02pm

SEE COMMENT CARDS FOR ALL QUESTIONS AND COMMENTS

MEETING ADJOURNED 7:06pm

Golden State
Water Company
A Subsidiary of American States Water Company

Comment Card
Claremont, South Arcadia, South San Gabriel
UWMP Public Hearing
Aug. 18, 2011

Name Richard Haskell

Service Address 421 Baughman Avenue

City Claremont

Question regarding future use of reclaimed waste water:

Does GSW have a vision for the use of reclaimed water in the Claremont community? How can GSW collaborate with Three Valleys, LACSD, + the City to provide reclaimed water for landscape irrigation? The section on reclaimed water is very disappointing.

Golden State
Water Company
A Subsidiary of American States Water Company

Comment Card
Claremont, South Arcadia, South San Gabriel
UWMP Public Hearing
Aug. 18, 2011

Name Marilee Scaff

Service Address 640 Alden Rd

City Claremont

Question Read comments

Response 2010 Urban Water Management Plan for CLAREMONT
Hearing at San Dimas Community Center, August 18, 2011

From: Marilee K. Scaff 640 Alden Road Apt 2, Claremont, Ca 91711
CoChair of the Water Task Force of League of Women Voters of Claremont Area

Golden State Water Company and Kennedy/Jenks Consultants are to be commended for the 2011 Revision of their Urban Water Management Plan for Claremont. It is comprehensive and detailed, and outlines well the current situation of water supplies for Pomona Valley.

However, there are errors and omissions and important issues not addressed which if corrected might make the Plan even more useful, and improve its function as a guide for future operations. I wpu ld like to call attention to the following:

1. Page vii. First, may I point out that advance notices of this public hearing are quite inadequate for inviting comment from citizens of Claremont. A notice in a newspaper in Covina is completely inaccessible to the reading public of Claremont; *Inland Valley Daily Bulletin* published in Pomona and *Claremont Courier* are the papers people in Pomona Valley read. Also you should remember that a great many of your clientele --several thousand college students, plus all residents of retirement communities, all persons living in multi-family housing and renters in single family homes never see their water bills, as they pay for water through their rents. Yet all of them should be concerned about their water supply.

2. Chapter 2. Demographics relies entirely on year 2000 population figures and uses these for projections. By the time the period covered by the report comes to an end, your figures will be 20 years out of date, and hence inadequate for planning.

One thing is sure: The next 20 years will not be like the last 20. Global warming, population increase, diminishing water availability from Sierra snow pack, changes in State Water Plan—all these and more will need to be taken into account.

As the 2010 Census figures are already available, a really useful plan must take the extra time and effort to put those into its calculations.

3. Claremont's population, furthermore, is quite unusual for a town of its size, and depending on SCAG's population projections do not fit this population. As a small town with eight colleges enrolling something like 14,000 students a majority of whom live in Residence Halls, plus four retirement communities with another 1,500 members, nearly half of the total population does not fit the expected pattern of household and employment projections adopted from 2008 RTP data. So your methodology for 2.3. section is inappropriate and will not give you reliable data.

This same problem infects your population projection of 39,015 by the year 2015 (Table 2.2). Claremont is essentially "built out"; there is almost no open space for normal community growth. Surely there must be other communities which do not fit this paradigm of never-ending growth. It certainly will affect planning and water distribution. This same inaccuracy I note in all your longer-range water use projections. You would more reasonably revise these projections.

4. May I commend the core of this report: Chapter 3 on historical water use, the present efforts at conservation, and future targets for reduction in per capita use. Claremont's "Sustainable City " Plan is in full agreement with GSWC on this subject and we all applaud both the data and your efforts.

However, one does note the inconsistency of amounts of water used by the residents, (Table 3-3) with per capita daily use varying between 269 and 345 in the last 6 years. Therefore, I am astonished that in face of this, you can we even speak of a target reduction of 50% to 142 by the year 2020? Is thata reasonable?

5. Affordable Housing/ Disadvantages resi8dents
Section 3-18 - Disadvantaged Community Water Projections implies that Claremont has no need of provision of affordable housing. This s not accurate. Claremont City lists at least the following:

Courier Village (City sponsored) is under construction on S. College for 45 seniors and 40 families (I'm less sure of the numbers)
Access Village (City sponsored) on N. Mountain for handicapped adults
Claremont Villa (City sponsored) on Indian Hill Blvd. for seniors, some affordable units.
Bonita Terrace for seniors
Claremont Village Green for seniors
Mountain Village for seniors
Emerson Village in Pomona, (to which Claremont refers seniors.)
Plus some Section 8 voucher-accepting commercial housing.

6. Ch 4.8 - 4.15 on Recycled water: thank you for the summary of the current situation about Recycled water. The Claremont College Consortium does expect to go ahead with recycling water for their own multiple-campus irrigation, which we hope will become a model for small scale recycling and that in the next 10 years there will be others.

7.One final addition: The State Water Plan calls for Southern California to seek to improve their reliance on local water supplies. What does GSWC plan about a possible **Water Emergency**, either because of a catastrophe on the delivery system of the State Water Project, or because of extended drought or damage to the Delta? The public should hear what kinds of thinking GSWC and MWD and TVMWD are doing in preparation for this really long-range possibility.

8. Finally, The League of Women Voters has a Water Task Force working for the last six years on water issues in the Claremont Area. This public-interest group has shared all our material with Golden State Water Company and all the other component users of water in Pomona Valley. Our aim has been to improve storm water spreading in Thompson Creek. We have a Feasibility Study, funded by Prop 84 bonds through the Los Angeles and San Gabriel Rivers and Mountains Conversancy which estimates that we could increase storm water spreading there by 30% to 150%. In addition the City of Claremont is willing to add this land to the Claremont Hills Wilderness Park, and manage it for the free usage by people from all over this region. Floyd Wicks as CEO of Golden State Water offered encouragement and support to this project. We urge Golden State Water Company to continue leadership in this project which would benefit the health and welfare of citizens all over this great Valley

how

Golden State
Water Company
A Subsidiary of American States Water Company

Comment Card
Claremont, South Arcadia, South San Gabriel
UWMP Public Hearing
Aug. 18, 2011

Name Freeman Allen

Service Address 394 Blaisdell Dr,

City Claremont

Question Written

Comments on the draft 2010 urban Water Management Plan - Claremont
August 18, 2011

The Urban Water Management Plan for Claremont contains a wealth of information, and is well written. The following comments address aspects that should be strengthened

1.1 Background

Solicitation of active participation of the population within the service area was minimal, and should be enhanced in the future.

Page 1-6. According to the Urban Water Management Plan Act:

Each urban water supplier shall encourage the active involvement of diverse social, cultural and economic elements of the population within the service area prior to and during the preparation of the Plan

In fact:

- Notice of the Hearings on July 19 and August 18 were not published in Claremont. The population in this part of the service area was not encouraged to be involved.
- No notice of the Hearing was posted in the Claremont office of Golden States Water. Upon inquiry as to the time and location of the Hearing the customer representative referred to the GSW web site for the information. The Notice of public Hearing printed from the web site instructs the customer to "call 1-800-999-4033 to make an appointment to view the plan at the (Claremont office)". At that number it was difficult to find anyone who knew of the Hearing. The information provided was to "contact the local office; no appointment is necessary".
- At the local office, earlier today, the only information offered about the Plan was reference to the web site.

I attended the July 19 hearing and suggested that the August 18 Heating be publicized in the local newspaper, the Claremont Courier, and that copies of the Plan be made easily accessible at locations such as the Claremont Public Library. That was not done.

Clearly involvement of the population in the service area has not been encouraged. This appears to be contrary to the intent of the Act, and an opportunity lost to involve the public in cooperative planning for the future of their water supply.

The relevant population should be involved and encouraged to participate. Golden States Water carries out a very active and well-publicized program encouraging water conservation. I suggest a similar active program be used to encourage involvement in water management planning.

If the Plan is to be relied on by the CPUC in regulatory decision-making accuracy and completeness will be important. The following comments relate to these features.

2.2 Demographics

Affordable housing units are presently being constructed. This Plan says they "may be implemented".

2.3 Population, Housing and Employment

It was apparently not possible to use the latest census data. More accurate and up-to-date data should be used in regulatory decisions.

4.1. Water Sources

The reference to the Covina Irrigation Company does not seem relevant.

Table 4.4.

Pumping for 2006 and 2007 appears to exceed pumping rights. Are these figures correct?

4.8.3 Potential and Projected Use (of recycled water).

Planning for a scalping plant at the Claremont Colleges is correctly stated to be in the preliminary stages. However, it now seems likely this plant will be constructed and in operation within a few years. If so, the recycled water used for irrigation will amount to about 5% of Claremont's total usage and similarly reduce the need for more expensive imported water. This should be a consideration in CPUC regulatory decisions.

6.1.3 Water Supply

PVPA also owns and operates the Thompson Creek Spreading Grounds. This source of water is much smaller than the San Antonio Spreading Grounds but it does provide water for the Six Basins Aquifer from the San Gabriel River watershed.

8.3 Catastrophic Supply Interruption Plan

This section should specifically address the possibility of disruption of the State Water System for long periods of time. The Sacramento/San Joaquin river delta is notably vulnerable.

C. Freeman Allen, PhD
Professor Emeritus Chemistry, Pomona College
Co-Chair, Sustainable Claremont
Director for Sustainability, League of Women Voters of the Claremont Area

Golden State
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Urban Water Management Planning Meeting
Sign-In Sheet
Claremont, South San Gabriel, South Arcadia Systems
Aug. 18, 2011

Name	Address	Phone	Email
Jim Pedroza	580 Cinderella Dr	909 864-2047	
Richard Haskell	421 Baughman Ave Claremont	909-625-2223	richard_haskell@hmc.ed
CHRIS VEIRS	PO BOX 880 CLAREMONT	(909) 399-5486	CVEIRS@CI.CLAREMONT.CA.U
Freeman Allen	394 Blaisdell Dr Claremont, CA 91711		cf1allen@aol.com
Marilee Scaff	620 Alden Rd Claremont CA 91711		marilee.scaff@verizon

Appendix C

Council Annual Reports for Demand Management Measures

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

Agency: Golden State Water Company **District Name:** San Gabriel Valley **CUWCC Unit #:** 5045
Retail

Primary Contact John Turner **Telephone** (909) 394-3600 Ext **Email:** johnturner@gswater.com

Compliance Option Chosen By Reporting Agency:
(Traditional, Flex Track or GPCD)
GPCD if used:

GPCD in 2010	**144**
GPCD Target for 2018	152

Year	Report	Target		Highest Acceptable Bound	
		% Base	GPCD	% Base	GPCD
2010	1	96.4%	179	100%	185
2012	2	92.8%	172	96%	179
2014	3	89.2%	165	93%	172
2016	4	85.6%	159	89%	165
2018	5	82.0%	152	82%	152

Not on Track if 2010 GPCD is ≥ than target

GPCD in 201	144
Highest Acceptable GPCD for	185

On Track

Agency: **Golden State Water Company** **District Name:** **San Gabriel Valley** **CUWCC Unit #:** **5045**
Retail

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

Foundational BMPs

BMP 1.1 Operational Practices

Conservation Coordinator provided with necessary resources to implement BMPs?

		2009	2010
1.Conservation Coordinator provided with necessary resources to implement BMPs?	Name	Albert Frias	Albert Frias
	Title	Water Conservation Coordinator	Water Conservation Coordinator
	Email		
		On Track	On Track

2. Water waste prevention documentation

Descriptive File	Rule 20 = Water Conservation. Rule 11B = Discontinuance of Service based upon Water Wastage. R	On Track if any one of the 6 ordinance actions done, plus documentation or links provided
Descriptive File 2010		
URL	Where negligent or wasteful use of water exists on customer's premises, the utility may discontinue the service if such practices are not remedied within five days after it has given the customer written notice to such effect.	
URL 2010	http://www.aswater.com/Organization/Rates_and_Regulations/Rates_and_Tariffs/Rule_11.pdf	
Describe Ordinance Terms		

On Track On Track

Agency: Golden State Water Company **District Name:** San Gabriel Valley **CUWCC Unit #:** 5045
Retail

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

BMP 1.2 Water Loss Control

	2009		
Complete a prescreening Audit			On Track if Yes
Metered Sales	**6,081**		
Verifiable Other Uses	**143**		
Total Supply	**6,511**		
(Metered Sales + System uses)/ Total Supply >0.89	0.96	**On Track**	On Track if =>.89, Not on Track if No
If ratio is less than 0.9, complete a full scale Audit in 2009?	**No**		On Track if Yes
Verify Data with Records on File?	**Yes**	**On Track**	On Track if Yes
Operate a system Leak Detection Program?	**Yes**	**On Track**	On Track if Yes

	2010		
Compile Standard Water Audit using AWWA Software?	Yes	**On Track**	On Track if Yes, Not on Track if No
AWWA file provided to CUWCC?	Yes	**On Track**	On Track if Yes, Not on Track if No
AWWA Water Audit Validity Score?	84		Info only until 2012
Completed Training in AWWA Audit Method?	Yes		Info only until 2012
Completed Training in Component Analysis Process?	No		
Complete Component Analysis?	No		Info only until 2012
Repaired all leaks and breaks to the extent cost effective?	Yes	**On Track**	On Track if Yes, Not on Track if No
Locate and repair unreported leaks to the extent cost effective.	Yes	**On Track**	On Track if Yes, Not on Track if No
Maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair.	Yes		Info only until 2012
Provided 7 types of Water Loss Control Info			Info only until 2012

Leaks Repaired	Value Real Losses	Value Apparent Losses	Miles Surveyed	Press Reduction	Cost of Interventions	Water Saved
18	$1,540.00	$1,540.00	38			41

Agency: **Golden State Water Company** **District Name:** **San Gabriel Valley** **CUWCC Unit #:** **5045**
Retail

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

1.3 METERING WITH COMMODITY RATES FOR ALL NEW CONNECTIONS AND RETROFIT OF EXISTING CONNECTIONS

		2009		2010		
Exemption or 'At least as Effective As' accepted by CUWCC						If signed MOU prior to 31 Dec 1997, On Track if all connections metered; If signed after 31 Dec 1997, complete meter installations by 1 July 2012 or within 6 yrs of signing and 20% biannual reduction of unmetered connections.
Numbered Unmetered Accounts	**2008**	0	**On Track**	0	**On Track**	On Track if no unmetered accounts
Metered Accounts billed by volume of use		Yes	**On Track**	Yes	**On Track**	Volumetric billing required for all connections on same schedule as metering
Number of CII accounts with Mixed Use meters		120		120		Info only
Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters?		No		No		Info only until 2012
Feasibility Study provided to CUWCC?		No	**On Track until 2012**	No	**On Track until 2012**	On Track if Yes, Not on Track if No
Completed a written plan, policy or program to test, repair and replace meters		Yes	**On Track**	Yes	**On Track**	On Track if Yes, Not on Track if No

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

Agency: Golden State Water Company **District Name:** San Gabriel Valley **CUWCC Unit #:** 5045
Retail

Primary Contact John Turner **Email:** johnturner@gswater.com

1.4 Retail Conservation Pricing

On Track if: Increasing Block, Uniform, Allocation, Standby Service; Not on Track if otherwise

Metered Water Rate Structure

Customer Class	2009 Rate Type	Conserving Rate?	Customer Class	2010 Rate Type	Conserving Rate?
Single-Family	Increasing Block	Yes	Single-Family	Increasing Block	Yes
Multi-Family	Increasing Block	Yes	Multi-Family	Increasing Block	Yes
Commercial	Uniform	Yes	Commercial	Uniform	Yes
Industrial	Uniform	Yes	Industrial	Uniform	Yes
Institutional	Uniform	Yes	Institutional	Uniform	Yes
	On Track			On Track	

Year Volumetric Rates began for Agencies with some Unmetered Accounts

Info only

Agencies with Partially Metered Service Areas: If signed MOU prior to 31 Dec. 1997, implementation starts no later than 1July 2010. If signed MOU after 31 Dec. 1997, implementation starts no later than 1July 2013, or within seven years of signing the MOU,

Agency: Golden State Water Company **District Name:** San Gabriel Valley **CUWCC Unit #:** 5045
Retail

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

Adequacy of Volumetric Rates) for Agencies with No Unmetered Accounts

Customer Class	2009 Rate Type	2009 Volumetric Revenues $1000s	2010 Rate Type	2010 Volumetric Revenues $1000s
Single-Family	Increasing Block	$ 2,994	Single-Family	$ 2,930
Multi-Family	Increasing Block	$ 370	Multi-Family	$ 362
Commercial	Uniform	$ 1,791	Commercial	$ 1,753
Industrial	Uniform	$ 26	Industrial	$ 26
Institutional	Uniform	$ 375	Institutional	$ 366
Dedicated Irrigation		$ 136		$ 133
Other		$ 35		$ 34
Total Revenue Commodity Charges (V):		$ 5,728		$ 5,605
Total Revenue Fixed Charges (M):		$ 3,343		$ 3,271
Calculate: V / (V + M):		63%		63%
		Info Only untill 2011		Info Only untill 2011

Agency Choices for rates:

A) Agencies signing MOU prior to 13 June2007, implementation starts 1 July2007: On Track if (V / (V + M) ≥ 70% x .8 = **56% for 2009** and 70%x0.90 = **63% for 2010**; Not on track if (V / (V + M)) < 70%;

B) Use Canadian model. Agencies signing MOU after 13June2007, implementation starts July 1 of year following signing.

	2009	2010
Canadian Water & Wastewater Rate Design Model Used and Provided to CUWCC	**No**	**No**
	Info Only untill 2011	Info Only untill 2011
If Canadian Model is used, was 1 year or 3 year period applied?		

Wastewater Rates

	2009	2010
Does Agency Provide Sewer Service?	**No**	**No**

If 'No', then wastewater rate info not required.

Customer Class	2009 Rate Type	Conserving Rate?	Customer Class	2010 Rate Type	Conserving Rate?
		Yes			Yes
		Yes			Yes
		Yes			Yes
		Yes			Yes
		Yes			Yes
		Yes			Yes
		Yes			Yes
		On Track			**On Track**

On Track if: 'Increasing Block', 'Uniform', 'based on long term marginal cost' or 'next unit of capacity'

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

BMP 2. EDUCATION PROGRAMS

BMP 2.1 Public Outreach Actions Implemented and Reported to CUWCC

	2009	2010	
Does a wholesale agency implement Public Outrach Programs for this unility's benefit?	Yes	**Yes**	Yes/No
Names of Wholesale Agencies	**Upper San Gabriel Valley Munipal Water District and MWD Los angeles**	**Upper San Gabriel Valley Munipal Water District and MWD Los angeles**	
1) Contacts with the public (minimum = 4 times per year)	18	18	
2) Water supplier contacts with media (minimum = 4 times per year, i.e., at least quarterly).	8	8	
3) An actively maintained website that is updated regularly (minimum = 4 times per year, i.e., at least quarterly).	Yes	Yes	All 6 action types implemented and reported to CUWCC to be 'On Track')
4) Description of materials used to meet minimum requirement.	Newspaper contacts Television contacts	Newspaper contacts Television contacts	
5) Annual budget for public outreach program.	$ 6,100	$ 6,100	
6) Description of all other outreach programs	Full description will be online in the BMP reporting database	Full description will be online in the BMP reporting database	
	On Track	**OnTrack**	

CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

Foundation Best Management Practices for Urban Water Efficiency

2.2 School Education Programs Implemented and Reported to CUWCC

	2009	2010	
Does a wholesale agency implement School Education Programs for this unility's benefit?	No	No	
Name of Wholesale Supplier?	Description available in the online BMP reporting system when available.	Description available in the online BMP reporting system when available.	
3) Materials Distributed to K-6?	Yes	Yes	
Materials distributed to 7-12 students?	No	No	Info Only
	On Track	**On Track**	

Appendix D

CPUC Water Conservation and Rationing Rules and Regulations

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE

A. Customer’s Request for Discontinuance of Service

1. A customer may have service discontinued by giving not less than two day’s advance notice thereof to the utility. Charges for service may be required to be paid until the requested date of discontinuance or such later date as will provide not less than the required two days’ advance notice.

2. When such notice is not given, the customer will be required to pay for service until two days after the utility has knowledge that the customer has vacated the premises or otherwise has discontinued water service.

B. Discontinuance of Service by Utility

1. For Nonpayment of Bills

a. Past-Due Bills. When bills are rendered monthly or bimonthly, they will be considered past due if not paid within 19 days from the date of mailing. The utility shall allow every residential customer at least 19 days from the date of mailing its bill for services, postage prepaid, to make payment of the bill. The utility may not discontinue residential service for nonpayment of a delinquent account unless the utility first gives notice of the delinquency and impeding discontinuance, at least 10 days prior to the proposed discontinuance, by means of a notice mailed, postage prepaid, to the customer to whom the service is provided if different than to whom the service is billed, not earlier than 19 days from the date of mailing the utility’s bill for services. The 10-day discontinuance of service notice shall not commence until five days after the mailing of the notice. (T)

b. When a bill for water service has become past due and a 10-day discontinuance of residential service notice or a 7-day discontinuance of residential service notice for nonpayment has been issued, service may be discontinued if bill is not paid within the time required by such notice. The customer’s service, however, will not be discontinued for nonpayment until the amount of any deposit made to establish credit for that service has been fully absorbed.

(Continued)

ISSUED BY Date Filed July 29, 1993
Advice Letter No. 925-W **F. E. WICKS** Effective Date September 7, 1993
Decision No. _________ President Resolution No. W 3770

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

c. Any customer, residential as well as nonresidential, who has initiated a billing complaint or requested an investigation within 5 days of receiving a disputed bill or who has, before discontinuance of service made a request for extension of the payment period of a bill asserted to be beyond the means of the customer to pay in full within the normal period for payment, shall not have residential water service discontinued for nonpayment during the pendency of an investigation by the utility of such customer complaint or request and shall be given an opportunity for review of the complaint, investigation, or request by a review manager of the utility. The review shall include consideration of whether a residential customer shall be permitted to make installment payments on any unpaid balance of the delinquent account over a reasonable period of time, not to exceed 12 months. Such service shall not be discontinued for nonpayment for any customer complying with an installment payment agreement entered into with the utility, provided the customer also keeps current his account for water service as charges accrue in each subsequent billing period. If a residential customer fails to comply with an installment payment agreement, the utility will give a 10-day discontinuance of service notice before discontinuing such service, but such notice shall not entitle the customer to further investigation by the utility.

d. Any customer whose complaint or request for an investigation pursuant to subdivision (c) has resulted in an adverse determination by the utility may appeal the determination to the Commission. Any subsequent appeal of the dispute or complaint to the Commission shall be in accordance with the Commission adopted Rules of Practice and Procedure.

e. Service to a residential water customer will not be discontinued for nonpayment when the customer has previously established to the satisfaction of the utility that:

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

e. (Continued)

(1) The customer is elderly (age 62 or over) or handicapped,* or upon certification of a licensed physical or surgeon that to discontinue water will be life threatening to the customer; and

*Proof of age must be supported by certificate of birth, driver's license, passport or other reliable document. Proof of handicap must be by certification from a licensed physician, surgeon, public health nurse or social worker.

(2) The customer is temporarily unable to pay for such service in accordance with the provisions of the utility's tariffs; and

(3) The customer is willing to arrange installment payments satisfactory to the utility, over a period not to exceed 12 months, including arrangements for prompt payment of subsequent bills.

However, service may be discontinued to any customer who does not comply with an installment payment agreement or keep current his account for water service as charges accrue in each subsequent billing period.

(f) A customer's residential service may be discontinued for nonpayment of a bill for residential service previously rendered him at any location served by the utility.

A nonresidential service may be discontinued for nonpayment of a bill for residential as well as nonresidential service previously rendered him at any location served by the utility.

The discontinuance of service notice as set forth in subdivision (b) will be given in both cases stated above before discontinuance of service takes place.

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

f. (Continued)

Residential services will not, however, be discontinued for nonpayment of bills for separate nonresidential service.

g. Service will not be discontinued by reason of delinquency in payment for service on any Saturday, Sunday, legal holiday, or at any time during which the business offices of the utility are not open to the public.

h. Where water service is provided to residential users in a multi-unit residential structure, mobilehome park, or permanent residential structures in a labor camp, where the owner, manager, or operator is listed by the utility as the customer of record, the utility will make every good faith effort to inform the users, when the account is in arrears, that service will be dicontinued. Notice will be in as prescribed in subdivision (a) above, and in Rules Nos. 5 and 8. (T)

(T)

(1) Where said users are individually metered. (N)

The utility is not required to make service available to these users unless each user agrees to the terms and conditions of service and meets the requirement of the law and the utility's rules and tariffs. However, if one or more users are willing and able to assume responsibility for subsequent charges by these users to the account to the satisfaction of the utility, and if there is a practical physical means, legally available to the utility of selectively providing services to these users who have met the requirements of the utility's rules and tariffs, the utility will make service available to these users. For these selected users establishment of credit will be as prescribed in Rule No. 6, except that where prior service for a period of time is a condition for establishing credit with the utility, proof that is acceptable to the utility of residence and prompt payment of rent or other credit obligation during that period of time is a satisfactory equivalent.

(N)

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

h. (Continued)

(2) Where said users are master metered. (N)

The utility is not required to make service available to these users unless each user agrees to the terms and conditions of service, and meets the requirements of the law and the utility's rules and tariffs and the following:

The same Rule 11, item B.1.h. (1) above which applies to individually metered users also applies to master metered users, except a representative may act on the behalf of a master metered user, and the utility will not discontinue service in any of the following situations:

(a) During the pendency of an investigation by the utility of a master-meter customer dispute or complaint.

(b) When the master-metered customer has been granted an extension of the period for repayment of a bill.

(c) For an indebtedness owned by the master metered customer to any other person or corporation or when the obligation represented by the delinquent account or any other indebtedness was incurred with a person or corporation other than the utility demanding payment therefor.

(d) When a delinquent account relates to another property owned, managed, or operated by the master-metered customer.

(e) When a public health or building officer certifies that determination would result in a significant threat to the health or safety of the residential occupants or the public. Proof of age or handicap are described in Rule 11.B.1.e. (N)

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

i. A reasonable attempt must be made by the utility to personally contact
an adult person on the residential customer's premises either by tele-
phone, or in person, at hours prior to discontinuance. For elderly or (C)
handicapped residential customers, the utility shall provide at least 48
hours' notice by telephone or in person. For these customers, if tele-
phone or personal contact cannot be made, a notice of discontinuance
of service shall be posted in a conspicuous location at the service
address at least 48 hours prior to discontinuance. Such notice shall be (N)
independent of and in addition to, other notices(s) as may be prescribed (N)
in the utility's tariffs. (N)

j. Residential Customer's Remedies Upon Receipt of Discontinuance Notice.

(1) If upon receipt of a 10 day discontinuance notice, a residential customer is unable to pay, he must contact the utility before discontinuance of service to make payment arrangements to avoid discontinuance of service.

(2) If, after contacting the utility, the residential customer alleges to the Commission an inability to pay and that he is unable to make payment arrangements with the utility he should write to the Commission's Consumer Affairs Branch (CAB) to make an informal complaint. This action must be taken within the 10-day discontinuance of service notice.

(3) The CAB's resolution of the matter will be reported to the utility and the residential customer within ten business days after receipt of the informal complaint. If the customer is not satisfied with such resolution, he must file, within ten business days after the date of the CAB's letter, a formal complaint with the Commission under Public Utilities Code Section 1702 on a form provided by the CAB.

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Discontinuance of Services by Utility (Continued)

1. For Nonpayment of Bills (Continued)

j. Residential Customer's Remedies Upon Receipt of Discontinuance Notice.

(4) Failure of the residential as well as the nonresidential customer to observe these time limits shall entitle the utility to insist upon payment or, upon failure to pay, to discontinue the customer's service.

k. Designation of a Third-Party Representative (Elderly or Handicapped only)

(1) Customer must inform utility if he desires that a third party receive discontinuance or other notices on his behalf.

(2) Utility must be advised of name, address and telephone number of third party with a letter from third party accepting this responsibility.

(3) Only customers who certify that they are elderly or handicapped are entitled to third-party representation.*

2. For Noncompliance with Rules

The utility may discontinue service to any customer for violation of these rules after it has given the customer at least five days' written notice of such intention. Where safety of water supply is endangered, service may be discontinued immediately without notice.

3. For Waste of Water

a. Where negligent or wasteful use of water exists on customer's premises, the utility may discontinue the service if such practices are not remedied within five days after it has given the customer written notice to such effect.

(Continued)

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* Proof of age must be supported by certificate of birth, driver's license, passport or other reliable document. Proof of handicap must be by certification from a licensed physician, public health nurse or social worker.

SOUTHERN CALIFORNIA WATER COMPANY
630 E. FOOTHILL BLVD. - P. O. BOX 9016
SAN DIMAS, CALIFORNIA 91773-9016

Revised Cal. P.U.C. Sheet No. 3748-W
Canceling Original Cal. P.U.C. Sheet No. 3077-W

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Decision No. _________	President	Resolution No. W 3770

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

B. Continuance of Services by Utility (Continued)

3. For Waste of Water (Continued)

b. In order to protect itself against serious and unnecessary waste or misuse of water, the utility may meter any flat rate service and apply the regularly established meter rates where the customer continues to misuse or waste water beyond five days after the utility has given the customer written notice to remedy such practices.

4. For Unsafe Apparatus or Where Service is Detrimental or Damaging to the Utility or its Customers

If an unsafe or hazardous condition is found to exist on the customer's premise, or if the use of water thereon by apparatus, appliances, equipment or otherwise is found to be detrimental or damaging to the utility or its customers, the service may be shutoff without notice. The utility will notify the customer immediately of the reasons for the discontinuance and the corrective action to be taken by the customer before service can be restored.

5. For Fraudulent Use of Service

When the utility has discovered that a customer has obtained service by fraudulent means, or has diverted the water service for unauthorized use, the service to that customer may be discontinued without notice. The utility will not restore service to such customer until that customer has complied with all filed rules and reasonable requirements of the utility and the utility has been reimbursed for the full amount of the service rendered and the actual cost to the utility incurred by reason of the fraudulent use.

C. Restoration of Service

1. Reconnection Charge

Where service has been discontinued for violation of these rules or for nonpayment of bills, the utility may charge $25.00 for reconnection of service during regular working hours or $37.50 (I)
for reconnection of service at other than regular working hours when the customer has requested that the reconnection be made at other than regular working hours.

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

C. Restoration of Service (Continued)

2. To be Made During Regular Working Hours

The utility will endeavor to make reconnections during regular working hours on the day of the request, if the conditions permit; otherwise reconnections will be made on the regular working day following the day the request is made.

3. To Be Made at Other Than Regular Working Hours

When a customer has requested that the reconnection be made at other than regular working hours, the utility will reasonably endeavor to so make the reconnection if practicable under the circumstances.

4. Wrongful Discontinuance

A service wrongfully discontinued by the utility, must be restored without charge for the restoration to the customer within 24 hours.

D. Refusal to Serve

1 Conditions for Refusal

The utility may refuse to serve an applicant for service under the following conditions:

a. If the applicant fails to comply with any of the rules as filed with the Public Utilities Commission.

b. If the intended use of the service is of such a nature that it will be detrimental or injurious to existing customers.

c. If, in the judgment of the utility, the applicant’s installation for utilizing the service is unsafe or hazardous, or of such nature that satisfactory service cannot be rendered.

(Continued)

Rule No. 11

DISCONTINUANCE AND RESTORATION OF SERVICE
(Continued)

C. Restoration of Service (Continued)

1. Conditions for Refusal (Continued)

d. Where service has been discontinued for fraudulent use, the utility will not serve an applicant until it has determined that all conditions of fraudulent use or practice has been corrected.

2. Notification to Customers

When an applicant is refused service under the provisions of this rule, the utility will notify the applicant promptly of the reason for the refusal to service and of the right of applicant to appeal the utility’s decision to the Public Utilities Commission.

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

GENERAL INFORMATION

(N)

1. If water supplies are projected to be insufficient to meet normal customer demand, and are beyond the control of the utility, the utility may elect to implement voluntary conservation using the portion of this plan set forth in Section A of this Rule, after notifying the Director of the Commission's Division of Water and Audits of its intent, via a letter in both hard-copy and e-mailed formats.

2. Prior to declaration of mandatory rationing, a utility may request authorization of a Schedule 14.1 – Staged Mandatory Water Conservation and Rationing tariff, via a Tier 2 advice letter.

3. If, in the opinion of the utility, more stringent water measures are required, the utility shall request Commission authorization to implement the staged mandatory conservation and rationing measures set forth in Sections B through E.

4. The utility shall file a Tier 1 advice letter to request activation of a particular stage of Schedule 14.1 – Staged Mandatory Water Conservation and Rationing tariff.

   a. If a Declaration of Mandatory Rationing is made by utility or governing agency, or

   b. If the utility is unable to address voluntary conservation levels set by itself, supplier, or governing agency, or

   c. If the utility chooses to subsequently activate a different stage

5. When Schedule 14.1 is in effect and the utility determines that water supplies are again sufficient to meet normal demands, and mandatory conservation and rationing measures are no longer necessary, the utility shall seek Commission approval via a Tier 1 advice letter to de-activate the particular stage of mandatory rationing that had been authorized.

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

GENERAL INFORMATION (Continued) (N)

6. In the event of a water supply shortage requiring a voluntary or mandatory program, the utility shall make available to its customers water conservation kits as required by its version of Rule 20. The utility shall notify all customers of the availability of conservation kits via a bill insert or direct mailers.

A. CONSERVATION - NON-ESSENTIAL OR UNAUTHORIZED WATER USE

No customer shall use utility-supplied water for non-essential or unauthorized uses, including but not limited to:

1. Use of potable water for more than minimal landscaping, as defined in the landscaping regulated of the jurisdiction or as described in Article 10.8 of the California Government Code in connection with new construction;
2. Use through any meter when the company has notified the customer in writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to effect such repairs within five business days;
3. Use of potable water which results in flooding or runoff in gutters or streets;
4. Individual private washing of cars with a hose except with the use of a positive action shut-off nozzle. Use of potable water for washing commercial aircraft, cars, buses, boats, trailers, or other commercial vehicles at any time, except at commercial or fleet vehicle or boat washing facilities operated at a fixed location where equipment using water is properly maintained to avoid wasteful use;
5. Use of potable water washing buildings, structures, , driveways, patios, parking lots, tennis courts, or other hard-surfaced areas, except in the cases where health and safety are at risk;
6. Use of potable water to irrigate turf, lawns, gardens, or ornamental landscaping by means other than drip irrigation, or hand watering without quick acting positive action shut-off nozzles, on a specific schedule, for example: 1) before 8:00 a.m. and after 7:00 p.m.; 2) every other day; or 3) selected days of the week; (N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

GENERAL INFORMATION (Continued)

(N)

7. Use of potable water for watering streets with trucks, except for initial wash-down for construction purposes (if street sweeping is not feasible), or to protect the health and safety of the public;
8. Use of potable water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.
9. Use of potable water for construction purposes unless no other source of water or other method can be used;
10. Use of potable water for street cleaning;
11. Operation of commercial car washes without recycling at least 50% of the potable water used per cycle;
12. Use of potable water for watering outside plants, lawn, landscape and turf areas during certain hours if and when specified in Schedule No. 14.1 when the schedule is in effect;
13. Use of potable water for decorative fountains or the filling or topping off of decorative lakes or ponds. Exceptions are made for those decorative fountains, lakes, or ponds which utilize recycled water;
14. Use of potable water for the filling or refilling of swimming pools.
15. Service of water by any restaurant except upon the request of a patron; and
16. Use of potable water to flush hydrants, except where required for public health or safety.

B. STAGED MANDATORY RATIONING OF WATER USAGE

1. Prior to declaration of mandatory rationing, a utility may request authorization of a Schedule 14.1 – Staged Mandatory Water Conservation and Rationing tariff, via a Tier 2 advice letter, with full justification. The utility may not institute Schedule 14.1 until it has been authorized to do so by the Commission.

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

(N)

STAGED MANDATORY RATIONING OF WATER USAGE (Continued)

a. A staged Schedule 14.1 that has been authorized by the Commission shall remain dormant until triggered by specific conditions detailed in the Schedule 14.1 tariff and utility has requested and received authorization for activating a stage by Commission.

b. Notice of the Tier 2 advice letter (example shown in Appendix C) and associated public participation hearing shall be provided to customers under General Order (GO) 96-B rules.

c. Utility shall comply with all requirements of Sections 350-358 of the California Water Code.

d. The Tier 2 advice letter requesting institution of a Schedule 14.1 shall include but not be limited to:

    i. Proposed Schedule 14.1 tariff, which shall include but not be limited to:

        1. Applicability,
        2. Territory applicable to,
        3. A detailed description of each Stage of Rationing,
        4. A detailed description of the Trigger that Activates each Stage of Rationing,
        5. A detailed description of each water use restriction for each stage of rationing.
        6. Water use violation levels, written warning levels, associated fines, and exception procedures,

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

STAGED MANDATORY RATIONING OF WATER USAGE (Continued)

7. Conditions for installation of a flow restrictor, (N)
8. Charges for removal of flow restrictors, and
9. Special Conditions

ii. Justification for, and documentation and calculations in support of plan, including but not limited to each item in B.1.d.i above.

2. Number of Stages requested by each utility/district may vary, depending on specifics of water shortage event.

3. The utility shall file a Tier 1 advice letter to request activation of a particular stage of Schedule 14.1 – Staged Mandatory Water Conservation and Rationing tariff.

   a. If a Declaration of Mandatory Rationing is made by utility or governing agency,

   b. If the utility is unable to address voluntary conservation levels set by itself or governing agency, or

   c. If the utility chooses to subsequently activate a different stage.

   d. The Tier 1 advice letter requesting activation of a Schedule 14.1 shall include but not be limited to:

      i. Justification for activating this particular stage of mandatory rationing, as well as period during which this particular stage of mandatory conservation and rationing measures will be in effect.

      ii. When the utility requests activation of a particular Stage, it shall notify its customers as detailed in Section E, below.

4. All monies collected by the utility through water use violation fines shall not be accounted for as income.

5. All expenses incurred by utility to implement Rule 14.1 and Schedule 14.1 that have not been considered in a General Rate Case or other proceeding, shall be recoverable by utility if determined to be reasonable by Commission.

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

STAGED MANDATORY RATIONING OF WATER USAGE (Continued)

(N)

a. These monies shall be accumulated by the utility in a separate memorandum account for disposition as directed or authorized from time to time by the Commission.

C. ENFORCEMENT OF STAGED MANDATORY CONSERVATION AND RATIONING

1. The water use restrictions of the conservation program, in Section A of this rule, become mandatory when the authorized Schedule 14.1-Staged Mandatory Rationing Program is triggered, the utility files a Tier 1 advice letter requesting activation of a particular stage, and authorization is received from the Commission.
   a. In the event a customer is observed to be using water for any nonessential or unauthorized use as defined in Section A of this rule, the utility may charge a water use violation fine in accordance with Schedule No. 14.1.

2. The utility may, after one written warning and one non-essential or unauthorized use violation notice , install a flow-restricting device on the service line of any customer observed by utility personnel to be using water for any non-essential or unauthorized use as defined in Section A above.

3. A flow restrictor shall not restrict water delivery by greater than 50% of normal flow. The restricting device may be removed only by the utility, only after a three-day period has elapsed, and only upon payment of the appropriate removal charge as set forth in Schedule No. 14.1.

4. After the removal of the restricting device, if any non-essential or unauthorized use of water shall continue, the utility may install another flow-restricting device. This device shall remain in place until water supply conditions warrant its removal and until the appropriate charge for removal has been paid to the utility.

5. Any tampering with flow restricting device by customer can result in fines or discontinuation of water use at the utility's discretion.

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

ENFORCEMENT OF STAGED MANDATORY CONSERVATION AND RATIONING
(Continued)

(N)

6. If, despite installation of such flow-restricting device pursuant to the provisions of the previous enforcement conditions, any such non-essential or unauthorized use of water shall continue, then the utility may discontinue water service to such customer. In such latter event, a charge as provided in Rule No. 11 shall be paid to the utility as a condition to restoration of service.

7. All monies collected by the utility through water use violation fines shall not be accounted for as income. All expenses incurred by utility to implement Rule 14.1 and Schedule 14.1 that have not been considered in a General Rate Case or other proceeding, shall be recoverable by utility if determined to be reasonable by Commission. These additional monies shall be accumulated by the utility in a separate memorandum account for disposition as directed or authorized from time to time by the Commission.

8. The charge for removal of a flow-restricting device shall be in accordance with Schedule No. 14.1.

D. APPEAL PROCEDURE

1. Any customer who seeks a variance from any of the provisions of this water conservation and rationing plan shall notify the utility in writing, explaining in detail the reason for such a variation. The utility shall respond to each such request in writing.

2. Any customer not satisfied with the utility's response may file an appeal with the staff of the Commission. The customer and the utility will be notified of the disposition of such appeal by letter from the Executive Director of the Commission.

(N)

(Continued)

ISSUED BY

Date Filed June 22, 2009

Advice Letter No.1325-WA

R. J. SPROWLS

Effective Date June 20, 2009

Decision No. _________

President

Resolution No.________

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

APPEAL PROCEDURE (Continued)

(N)

3. If the customer disagrees with such disposition, the customer shall have the right to file a formal complaint with the Commission. Except as set forth in this Section, no person shall have any right or claim in law or in equity, against the utility because of, or as a result of, any matter or thing done or threatened to be done pursuant to the provisions of this water conservation and rationing plan.

E. PUBLICITY

1. As stated under Section B.1.b and c, when a utility requests authorization of a Schedule 14.1 – Staged Mandatory Water Conservation and Rationing tariff, via a Tier 2 advice letter, it shall provide notice of the Tier 2 advice letter (example shown in Attachment C) and associated public meeting provided to customers, under General Order (GO) 96-B rules, and shall comply with all requirements of Sections 350-358 of the California Water Code (CWC), including but not limited to the following:
    a. In order to be in compliance with both the GO and CWC, the utility shall provide notice via both newspaper and bill insert/direct mailing.
    b. Utility shall file one notice for each advice letter filed, that includes both notice of the filing of the Tier 2 advice letter as well as the details of the public meeting (date, time, place, etc).
    c. The public meeting shall be held after the utility files the Tier 2 advice letter, and before the Commission authorizes implementation of the tariff.
    d. Utility shall consult with Division of Water and Audits staff prior to filing advice letter, in order to determine details of public meeting.
2. In the event that a Schedule 14.1-Staged Mandatory Rationing Plan is triggered, and an utility requests activation through the filing of a Tier 1 advice letter, the utility shall notify its customers and provide each customer with a copy of Schedule 14.1 by means of bill insert or direct mailing. Notification shall take place prior to imposing any fines associated with this plan.

(N)

(Continued)

RULE 14.1
WATER CONSERVATION AND RATIONING PLAN

PUBLICITY (Continued)

(N)

3. During the period that a stage of Schedule 14.1 is activated, the utility shall provide customers with updates in at least every other bill, regarding its water supply status and the results of customers' conservation efforts.

(N)

Rule No. 20

WATER CONSERVATION

(N)

A. Purpose

The purpose of this rule is to ensure that water resources available to the utility are put to a reasonable beneficial use and that the benefits of the utility's water water supply and service extend to the largest number of persons.

B. Waste of Water Discouraged

Refer to Rule 11 B. (3).

C. Use of Water-Saving Devices and Practices

Each customer of the utility is urged to install devices to reduce the quantity of water to flush toilets and to reduce the flow rate of showers.
Each customer is further urged to adopt such other water usage and reusage practices and procedures as are feasible and reasonable.

D. Water-Saving Kits

The utility will make available, without initial cost to the customer, for use in each residence receiving water service from the utility, a water-saving kit containing the following:

(1) A device or devices for reducing toilet flush water requirements;

(2) A device or devices for reducing shower flow rates;

(3) A dye tablet or tablets for determining if a toilet tank leaks;

(4) Other devices from time to time approved by the utility;

(5) Installation and other instructions and information pertinent to conservation of water. (N)

Appendix E

DMM Supporting Documents

GOLDEN STATE WATER COMPANY
630 EAST FOOTHILL BOULEVARD P.O. BOX 9016
SAN DIMAS, CA 91773-9016

Schedule No. R3-1-R
Region 3 Customer Service Areas
RESIDENTIAL METERED SERVICE

APPLICABILITY

Applicable to all residential metered water services provided to single-family residential customers.

TERRITORY

Barstow and vicinity, San Bernardino County, the City of Claremont, portions of Montclair, Pomona, Upland, within the area north of Thompson Creek and the Padua Hills Service Area, and adjacent unincorporated territory in Los Angeles and San Bernardino Counties, the City of Calipatria and community of Niland, and the adjacent territory in Imperial County, the vicinity of Victorville and Lucerne, San Bernardino County, all or portions of the Cities of Cypress, La Palma, Los Alamitos, Placentia, Seal Beach, Stanton, Yorba-Linda and vicinity, Cowan Heights, Orange County; San Dimas, Charter Oak and vicinity, Los Angeles County; and portions of the Cities of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, Temple City and vicinity, Los Angeles County.

RATES

Quantity Rate:

First 1,300 cu. Ft., per 100 cu. ft.	$ 2.673
Next 800 cu. Ft., per 100 cu. ft.	$ 3.074
Over 2,100 cu. Ft., per 100 cu. ft.	$ 3.535

Service Charges:	Per Meter Per Month
For 5/8 x 3/4-inch meter	$ 15.15
For 3/4-inch meter	22.70
For 1-inch meter	37.80
For 1 1/2 inch meter	75.65
For 2-inch meter	121.00
For 3-inch meter	227.00
For 4-inch meter	378.00
For 6-inch meter	756.00
For 8-inch meter	1,210.00
For 10-inch meter	1,739.00
Sprinkler System Services	$16.65

The Service Charge is a readiness-to-serve charge applicable to all metered service and to which is added the charge for water used computed at the Quantity Rate.

SPECIAL CONDITIONS

1. All bills are subject to the reimbursement fee set forth on Schedule No. UF.
2. Residential customers are defined as all single family customers with one dwelling unit that are individually metered.
3. As authorized by the California Public Utilities Commission, an amount of $0.156 per Ccf for Tier 1, $0.180 per Ccf for Tier 2 and $0.207 per Ccf for Tier 3 is to be added to the Quantity Rate for a period of 24 months, beginning on the effective date of Advice Letter 1381-W, which is March 21, 2010. This surcharge will apply to all customers covered by the WRAM in 2009 which includes metered customers in Barstow, Claremont, San Gabriel, Los Alamitos, Placentia, San Dimas and Calipatria customers who were billed at the metered rate as of December 31, 2009
4. As authorized by the California Public Utilities Commission, an amount of $0.0735 per Ccf for Tier 1, $0.0845 per Ccf for Tier 2 and $0.0972 per Ccf for Tier 3 is to be added to the Quantity Rate for a period of 12 months, beginning on the effective date of Advice Letter 1401-W, which is June 7, 2010. This surcharge will recover the undercollection in the CARW Balancing Account, as of December 31, 2009.
5. Pursuant to Decision 10-11-035, a surcharge of $0.0035 per Ccf will be applied to all metered customers bills excluding customers that are receiving the CARW credit, beginning on the effective date of Advice Letter 1417-W. This surcharge will offset the CARW credits and CARW administrative program costs recorded in the CARW Balancing Account.
6. As authorized by the California Public Utilities Commission in D. 10-11-035, an amount of $0.20214 per Ccf is to be added to the Quantity Rate for a period of 24 months, beginning on January 1, 2011. This surcharge recovers the difference between the interim rates and final rates for the period of January 1, 2010 through December 1, 2010.
7. As authorized by the California Public Utilities Commission, an amount of $0.0053 per Ccf for Tier 1 and $0.0061 per Ccf for Tier 2 is to be added to the Quantity Rate for a period of 12 months, beginning on the effective date of Advice Letter 1408-WA. This surcharge will recover the undercollection in the Orange County Annexation Memorandum Account, as of March 31, 2010. (N)
(N)
(N)
(N)

GOLDEN STATE WATER COMPANY Revised Cal. P.U.C. Sheet No. 6015-W
630 EAST FOOTHILL BOULEVARD P.O. BOX 9016
SAN DIMAS, CA 91773-9016 Canceling Revised Cal. P.U.C. Sheet No. 5963-W

Schedule No. R3-1-NR
Region 3 Customer Service Areas
NON-RESIDENTIAL METERED SERVICE

APPLICABILITY

Applicable to all metered water service except those covered under R3-1-R.

TERRITORY

Barstow and vicinity, San Bernardino County, the City of Claremont, portions of Montclair, Pomona, Upland, within the area north of Thompson Creek and the Padua Hills Service Area, and adjacent unincorporated territory in Los Angeles and San Bernardino Counties, the City of Calipatria and community of Niland, and the adjacent territory in Imperial County, the vicinity of Victorville and Lucerne, San Bernardino County, all or portions of the Cities of Cypress, La Palma, Los Alamitos, Placentia, Seal Beach, Stanton, Yorba-Linda and vicinity, Cowan Heights, Orange County; San Dimas, Charter Oak and vicinity, Los Angeles County; and portions of the Cities of Arcadia, El Monte, Irwindale, Monrovia, Monterey Park, Rosemead, San Gabriel, Temple City and vicinity, Los Angeles County.

RATES

Quantity Rate:

For all water delivered, per 100 cu. ft.	$ 2.489

Service Charges:	Per Meter Per Month
For 5/8 x 3/4-inch meter	$ 21.45
For 3/4-inch meter	32.15
For 1-inch meter	53.55
For 1 1/2 inch meter	107.00
For 2-inch meter	171.00
For 3-inch meter	321.00
For 4-inch meter	536.00
For 6-inch meter	1,071.00
For 8-inch meter	1,714.00
For 10-inch meter	2,464.00

The Service Charge is a readiness-to-serve charge applicable to all metered service and to which is added the charge for water used computed at the Quantity Rate.

SPECIAL CONDITIONS

1. All bills are subject to the reimbursement fee set forth on Schedule No. UF.
2. As authorized by the California Public Utilities Commission, an amount of $0.154 per Ccf is to be added to the Quantity Rate for a period of 24 months, beginning on the effective date of Advice Letter 1381-W, which is March 21, 2010. This surcharge will apply to all customers covered by the WRAM in 2009 which includes metered customers in Barstow, Claremont, San Gabriel, Los Alamitos, Placentia, San Dimas and Calipatria customers who were billed at the metered rate as of December 31, 2009.
3. As authorized by the California Public Utilities Commission, an amount of $0.06879 per Ccf is to be added to the Quantity Rate for a period of 12 months, beginning on the effective date of Advice Letter 1401-W, which is June 7, 2010. This surcharge will recover the undercollection in the CARW Balancing Account, as of December 31, 2009.
4. Pursuant to Decision 10-11-035, a surcharge of $0.0035 per Ccf will be applied to all metered customers bills excluding customers that are receiving the CARW credit, beginning on the effective date of Advice Letter 1417-W. This surcharge will offset the CARW credits and CARW administrative program costs recorded in the CARW Balancing Account.
5. As authorized by the California Public Utilities Commission in D. 10-11-035, an amount of $0.20214 per Ccf is to be added to the Quantity Rate for a period of 24 months, beginning on January 1, 2011. This surcharge recovers the difference between the interim rates and final rates for the period of January 1, 2010 through December 1, 2010.
6. As authorized by the California Public Utilities Commission, an amount of $0.0047 per Ccf is to be added to the Quantity Rate (N)
for a period of 12 months, beginning on the effective date of Advice Letter 1408-WA. This surcharge will recover the (N)
undercollection in the Orange County Annexation Memorandum Account, as of March 31, 2010. (N)

ISSUED BY Date Filed: January 20, 2011
Advice Letter No. 1408-WA **R. J. SPROWLS** Effective Date: January 25, 2011
Decision No. ______ President Resolution No. W-4862

AWWA WLCC Water Audit Software: Reporting Worksheet

WASv3.0

Back to Instructions

? Click to access definition

Water Audit Report for: Golden State Water Company - South San Gabriel
Reporting Year: 2008

Please enter data in the white cells below. Where possible, metered values should be used; if metered values are unavailable please estimate a value. Indicate this by selecting a choice from the gray box to the left, where M = measured (or accurately known value) and E = estimated.

All volumes to be entered as: ACRE-FEET PER YEAR

WATER SUPPLIED

Volume from own sources:	?	M	2,866.000	acre-ft/yr	
Master meter error adjustment:	?		0.000	under-registered	acre-ft/yr
Water imported:	?	M	295.000	acre-ft/yr	
Water exported:	?		0.000	acre-ft/yr	
WATER SUPPLIED:			3,161.000	acre-ft/yr	

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

					Pcnt:		Value:
Billed metered:	?	M	2,982.000	acre-ft/yr			
Billed unmetered:	?		0.000	acre-ft/yr			
Unbilled metered:	?	M	76.600	acre-ft/yr			
Unbilled unmetered:	?		39.513	acre-ft/yr	1.25%	● ○	
AUTHORIZED CONSUMPTION:			3,098.113	acre-ft/yr			

Use buttons to select percentage **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption)

62.888 acre-ft/yr

Apparent Losses

					Pcnt:		Value:
Unauthorized consumption:	?		7.903	acre-ft/yr	0.25%	● ○	
Customer metering inaccuracies:	?		62.420	acre-ft/yr	2.00%	● ○	
Systematic data handling errors:	?		0.000	acre-ft/yr			
Apparent Losses:			70.323	acre-ft/yr			

Check above input values; APPARENT LOSSES should be less than WATER LOSSES

Real Losses

Real Losses = (Water Losses - Apparent Losses):	-7.435	acre-ft/yr
WATER LOSSES:	62.888	acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER:	179.000	acre-ft/yr

SYSTEM DATA

Length of mains:	?	M	35.0	miles
Number of active AND inactive service connections:	?	M	5,054	
Connection density:			144	conn./mile main
Average length of customer service line:	?	E	30.0	ft (pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	?	M	62.8	psi

COST DATA

Total annual cost of operating water system:	?		**$1,988,855**	$/Year
Customer retail unit cost (applied to Apparent Losses):	?		**$25.44**	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	?		**$549.00**	$/acre-ft/yr

DATA REVIEW - Please review the following information and make changes above if necessary:

- Input values should be indicated as either measured or estimated. You have entered:
  - **7 as measured values**
  - **1 as estimated values**
  - **2 as default values**
  - **7 without specifying measured, estimated or default**
- Water Supplied Data: No problems identified
- Unbilled unmetered consumption: No problems identified
- Unauthorized consumption: No problems identified
- It is important to accurately measure the master meter - you have entered the measurement type as: measured
- Cost Data: No problems identified

PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume:	5.7%	
Non-revenue water as percent by cost:	42.2%	
Annual cost of Apparent Losses:	$779,295	
Annual cost of Real Losses:	-$4,082	

Operational Efficiency Indicators

Apparent Losses per service connection per day:	12.42	gallons/connection/day
Real Losses per service connection per day*:	-1.31	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	-0.02	gallons/connection/day/psi
? Unavoidable Annual Real Losses (UARL):	26.65	million gallons/year
? Infrastructure Leakage Index (ILI) [Real Losses/UARL]:	-0.09	

* only the most applicable of these two indicators will be calculated

Appendix F

Groundwater Basin Water Rights Stipulation/Judgment

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES

UPPER SAN GABRIEL VALLEY
MUNICIPAL WATER DISTRICT

Plaintiff,

vs.

CITY OF ALHAMBRA, et al,

Defendants.

No. 924128

AMENDED JUDGMENT
(and Exhibits Thereto),

Honorable Florence T. Pickard
Assigned Judge Presiding

Original Judgment
Signed and Filed: December 29, 1972;
Entered: January 4, 1973
Book 6741, Page 197

JUDGMENT AS AMENDED AUGUST 24, 1989

Ralph B. Helm
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4605 Lankershim Boulevard
North Hollywood, CA 91602
Telephone (818) 769-2002

Attorney for Watermaster

SUPERIOR COURT OF CALIFORNIA, COUNTY OF LOS ANGELES

UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT, Plaintiff, vs. CITY OF ALHAMBRA, et al., Defendants.	No. 924128 AMENDED JUDGMENT (And Exhibits Thereto)

HONORABLE FLORENCE T. PICKARD

Assigned Judge Presiding

DEPARTMENT 38

August 24, 1989

AMENDED JUDGMENT
TABLE OF CONTENTS

And
Amended Judgment Sections
Identified With Prior Judgment
Section Numbers

EXHIBITS

"A" -- Map entitled "San Gabriel River Watershed Tributary to Whittier Narrows"

Exhibits Continued

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Telephone (818) 769-2002

Attorney for Watermaster

SUPERIOR COURT OF CALIFORNIA, COUNTY OF LOS ANGELES

UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT,
Plaintiff,

vs.

CITY OF ALHAMBRA, et al.,
Defendants.

No. 924128

AMENDED JUDGMENT

Hearing: August 24, 1989
Department 38, 9:00 A.M.

The Petition of the MAIN SAN GABRIEL BASIN WATERMASTER for this AMENDED JUDGMENT herein, came on regularly for hearing in this Court before the HONORABLE FLORENCE T. PICKARD, ASSIGNED JUDGE PRESIDING, on August 24, 1989; Ralph B. Helm appeared as attorney for Watermaster - Petitioner; and good cause appearing, the following ORDER and AMENDED JUDGMENT are, hereby, made:

I. INTRODUCTION

1. Pleadings, Parties, and Jurisdiction. The complaint herein was filed on January 2, 1968, seeking an adjudication of water rights. By amendment of said complaint and dismissals of certain parties, said adjudication was limited to the Main San Gabriel Basin and its Relevant Watershed. Substantially all

defendants and the cross-defendant have appeared herein, certain defaults have been entered, and other defendants dismissed. By the pleadings herein and by Order of this Court, the issues have been made those of a full inter se adjudication of water rights as between each and all of the parties. This Court has jurisdiction of the subject matter of this action and of the parties herein.

2. Stipulation for Entry of Judgment. A substantial majority of the parties, by number and by quantity of rights herein Adjudicated, Stipulated for entry of a Judgment in substantially the form of the original Judgment herein.

3. Lis Pendens. (New) A Lis Pendens was recorded August 20, 1970, as Document 2650, in Official Records of Los Angeles County, California, in Book M 3554, Page 866.

4. Findings and Conclusions. (Prior Judgment Section 3) Trial was had before the Court, sitting without a jury, John Shea, Judge Presiding, commencing on October 30, 1972, and Findings of Fact and Conclusions of Law have been entered herein.

5. Judgment. (New) Judgment (and Exhibits Thereto), Findings of Fact and Conclusions of Law (and Exhibits thereto), Order Appointing Watermaster, and Initial Watermaster Order were signed and filed December 29, 1972, and Judgment was entered January 4, 1973, in Book 6791, Page 197.

6. Intervention After Judgment. (New) Certain defendants have, pursuant to the Judgment herein and the Court's continuing jurisdiction, intervened and appeared herein after entry of Judgment.

7. Amendments to Judgment. (New) The original Judgment herein was previously amended on March 29, 1979, by: (1) adding definition (r [1]) thereto, (2) amending definition (bb) therein, (3) adding Exhibit "K" thereto, (4) adding Sections 14.5 and 16.5 thereto, and (5) amending Sections 37(b), 37(c), 37(d), and Section 47 therein; it was again amended on December 21, 1979, by amending Section 38(c) thereof; again amended on February 21, 1980, by amending Section 24 thereof; again amended on September 12, 1980, by amending Sections 35(a), 37(a), and 38(a); again amended on December 22, 1987, by adding Section 37(e) thereto; and last amended on July 22, 1988 by amending Section 37(e) thereof and Ordering an Amended Judgment herein.

8. Transfers. (New) Since the entry of Judgment herein there have been numerous transfers of Adjudicated water rights. To the date hereof, said transfers are reflected in Exhibits "C", "D", and "E".

9. Producers and Their Designees. (New) The current status of Producers and their Designees is shown on Exhibit "L".

10. Definitions. (Prior Judgment Section 4) As used in this Judgment, the following terms shall have the meanings herein set forth:

(a) Base Annual Diversion Right -- The average annual quantity of water which a Diverter is herein found to have the right to Divert for Direct Use.

(b) Direct Use --Beneficial use of water other than for spreading or Ground Water recharge.

(c) Divert or Diverting -- To take waters of any surface stream within the Relevant Watershed.

(d) Diverter -- Any party who Diverts.

(e) Elevation -- Feet above mean sea level.

(f) Fiscal Year -- A period July 1 through June 30, following.

(g) Ground Water -- Water beneath the surface of the ground and within the zone of saturation.

(h) Ground Water Basin -- An interconnected permeable geologic formation capable of storing a substantial Ground Water supply.

(i) Integrated Producer -- Any party that is both a Pumper and a Diverter, and has elected to have its rights adjudicated under the optional formula provided in Section 18 of this Judgment.

(j) In-Lieu Water Cost -- The differential between a Producer's non-capital cost of direct delivery of Supplemental Water and the cost of Production of Ground Water (including depreciation on Production facilities) to a particular Producer who has been required by Watermaster to take direct delivery of Supplemental Water in lieu of Ground Water.

(k) Key Well -- Baldwin Park Key Well, being elsewhere designated as State Well No. 1S/10W-7R2, or Los Angeles County Flood Control District Well No. 3030-F. Said well has a ground surface Elevation of 386.7.

(l) Long Beach Case -- Los Angeles Superior Court Civil Action No. 722647, entitled, "Long Beach, et al., v. San Gabriel Valley Water Company, et al."

(m) Main San Gabriel Basin or Basin -- The Ground Water Basin underlying the area shown as such on Exhibit "A".

(n) Make-up Obligation -- The total cost of meeting the obligation of the Basin to the area at or below Whittier Narrows, pursuant to the Judgment in the Long Beach Case.

(o) Minimal Producer -- Any party whose Production in any Fiscal Year does not exceed five (5) acre feet.

(p) Natural Safe Yield -- The quantity of natural water supply which can be extracted annually from the Basin under conditions of long term average annual supply, net of the requirement to meet downstream rights as determined in the Long Beach Case (exclusive of Pumped export), and under cultural conditions as of a particular year.

(q) Operating Safe Yield -- The quantity of water which the Watermaster determines hereunder may be Pumped from the Basin in a particular Fiscal Year, free of the Replacement Water Assessment under the Physical Solution herein.

(r) Overdraft -- A condition wherein the total annual Production from the Basin exceeds the Natural Safe Yield thereof.

(s) Overlying Rights -- (Prior Judgment Section 4 (r) [1]) The right to Produce water from the Basin for use on Overlying Lands, which rights are exercisable only on specifically defined Overlying Lands and which cannot be separately conveyed or transferred apart therefrom.

(t) Physical Solution -- (Prior Judgment Section 4 (s)) The Court decreed method of managing the waters of the Basin so as to achieve the maximum utilization of the Basin and its water supply, consistent with the rights herein declared.

(u) Prescriptive Pumping Right -- (Prior Judgment

Section 4 (t)) The highest continuous extractions of water by a Pumper from the Basin for beneficial use in any five (5) consecutive years after commencement of Overdraft and prior to filing of this action, as to which there has been no cessation of use by that Pumper during any subsequent period of five (5) consecutive years, prior to the said filing of this action.

(v) <u>Produce or Producing</u> -- (Prior Judgment Section 4 (u)) To Pump or Divert water.

(w) <u>Producer</u> -- (Prior Judgment Section 4 (v)) A party who Produces water.

(x) <u>Production</u> -- (Prior Judgment Section 4 (w)) The annual quantity of water Produced, stated in acre feet.

(y) <u>Pump or Pumping</u> -- (Prior Judgment Section 4 (x)) To extract Ground Water from the Basin by Pumping or any other method.

(z) <u>Pumper</u> -- (Prior Judgment Section 4 (y)) Any party who Pumps water.

(aa) <u>Pumper's Share</u> -- (Prior Judgment Section 4 (z)) A Pumper's right to a percentage of the entire Natural Safe Yield, Operating Safe Yield and appurtenant Ground Water storage.

(bb) <u>Relevant Watershed</u> -- (Prior Judgment Section 4(aa)) That portion of the San Gabriel River watershed tributary to Whittier Narrows which is shown as such on Exhibit "A", and the exterior boundaries of which are described in Exhibit "B".

(cc) <u>Replacement Water</u> -- (Prior Judgment Section 4 (bb)) Water purchased by Watermaster to replace:

(1) Production in excess of a Pumper's Share of Operating Safe Yield; (2) The consumptive use portion resulting from the exercise of an Overlying Right; and (3) Production in excess of a Diverter's right to Divert for Direct Use.

(dd) <u>Responsible Agency</u> -- (Prior Judgment Section 4 (cc)) The municipal water district which is the normal and appropriate source from whom Watermaster shall purchase Supplemental Water for replacement purposes under the Physical Solution, being one of the following:

(1) <u>Upper District</u> -- Upper San Gabriel Valley Municipal Water District, a member public agency of The Metropolitan Water District of Southern California (MWD).

(2) <u>San Gabriel District</u> -- San Gabriel Valley Municipal Water District, which has a direct contract with the State of California for State Project Water.

(3) <u>Three Valleys District</u> -- Three Valleys Municipal Water District, formerly, "Pomona Valley Municipal Water District", a member public agency of MWD.

(ee) <u>Stored Water</u> -- (Prior Judgment Section 4 (dd)) Supplemental Water stored in the Basin pursuant to a contract with Watermaster as authorized by Section 34(m).

(ff) <u>Supplemental Water</u> -- (Prior Judgment Section 4 (ee)) Nontributary water imported through a Responsible Agency.

(gg) <u>Transporting Parties</u> -- (Prior Judgment Section 4 (ff)) Any party presently transporting water (i.e., during the 12 months immediately preceding the making of the findings herein) from the Relevant Watershed or Basin to an area outside thereof, and any party presently or hereafter having an interest in lands or having a service area outside the Basin or Relevant Watershed contiguous to lands in which it has an interest or a service area within the Basin or Relevant Watershed. Division by a road, highway, or easement shall not interrupt contiguity. Said term shall also include the City of Sierra Madre, or any party supplying water thereto, so long as the corporate limits of said City are included within one of the Responsible Agencies and if said City, in order to supply water to its corporate area from the Basin, becomes a party to this action bound by this Judgment.

(hh) Water Level -- (Prior Judgment Section 4 (gg)) The measured Elevation of water in the Key Well, corrected for any temporary effects of mounding caused by replenishment or local depressions caused by Pumping.

(ii) Year -- (Prior Judgment Section 4 (hh)) A calendar year, unless the context clearly indicates a contrary meaning.

11. Exhibits. (Prior Judgment Section 5) The following exhibits are attached to this Judgment and incorporated herein by this reference:

Exhibit "A" -- Map entitled "San Gabriel River Watershed Tributary to Whittier Narrows", showing the boundaries and relevant geologic and hydrologic features in the portion of the watershed of the San Gabriel River lying upstream from Whittier Narrows.

Exhibit "B" -- Boundaries of Relevant Watershed.

Exhibit "C" -- Table Showing Base Annual Diversion

Rights of Certain Diverters.

Exhibit "D" -- Table Showing Prescriptive Pumping Rights and Pumper's Share of Each Pumper.

Exhibit "E" -- Table Showing Production Rights of Each Integrated Producer.

Exhibit "F" -- Table Showing Special Category Rights.

Exhibit "G" -- Table Showing Non-consumptive Users.

Exhibit "H" -- Watermaster Operating Criteria.

Exhibit "J" -- Puente Narrows Agreement.

Exhibit "K" -- Overlying Rights, Nature of Overlying Right, Description of Overlying Lands to which Overlying Rights are Appurtenant, Producers Entitled to Exercise Overlying Rights and their Respective Consumptive Use Portions, and Map of Overlying Lands.

Exhibit "L" -- (New) List of Producers And Their Designees, as of June 1988.

Exhibit "M" -- (New) Watermaster Members, Officers and Staff, Including Calendar Year 1989.

II. <u>DECREE</u>

NOW, THEREFORE, IT IS HEREBY DECLARED, ORDERED, ADJUDGED AND DECREED:

A. DECLARATION OF HYDROLOGIC CONDITIONS

12. Basin as Common Source of Supply. (Prior Judgment Section 6) The area shown on Exhibit "A" as Main San Gabriel Basin overlies a Ground Water basin. The Relevant Watershed is the watershed area within which rights are herein adjudicated. The waters of the Basin and Relevant Watershed constitute a common source of natural water supply to the parties herein.

13. <u>Determination of Natural Safe Yield.</u> (Prior Judgment Section 7) The Natural Safe Yield of the Main San Gabriel Basin is found and declared to be one hundred fifty-two thousand seven-hundred (152,700) acre feet under Calendar Year 1967 cultural conditions.

14. <u>Existence of Overdraft.</u> (Prior Judgment Section 8) In each and every Calendar Year commencing with 1953, the Basin has been and is in Overdraft.

B. <u>DECLARATION OF RIGHTS</u>

15. <u>Prescription.</u> (Prior Judgment Section 9) The use of water by each and all parties and their predecessors in interest has been open, notorious, hostile, adverse, under claim of right, and with notice of said overdraft continuously from January 1, 1953 to January 4, 1973. The rights of each party herein declared are prescriptive in nature. The following aggregate consequences of said prescription within the Basin and Relevant Watershed are hereby declared:

(a) <u>Prior Prescription.</u> Diversions within the Relevant Watershed have created rights for direct consumptive use within the Basin, as declared and determined in Sections 16 and 18 hereof, which are of equal priority <u>inter</u> <u>se</u>, but which are prior and paramount to Pumping Rights in the Basin.

(b) <u>Mutual Prescription.</u> The aggregate Prescriptive Pumping Rights of the parties who are Pumpers now exceed, and for many years prior to filing of this action, have exceeded, the Natural Safe Yield of the Basin. By reason of said condition, all rights of said Pumpers are declared to be mutually prescriptive and of equal priority, _inter se_.

(c) Common Ownership of Safe Yield and Incidents Thereto. By reason of said Overdraft and mutual Prescription, the entire Natural Safe Yield of the Basin, the Operating Safe Yield thereof and the appurtenant rights to Ground Water storage capacity of the Basin are owned by Pumpers in undivided Pumpers' Shares as hereinafter individually declared, subject to the control of Watermaster, pursuant to the Physical Solution herein decreed. Nothing herein shall be deemed in derogation of the rights to spread water pursuant to rights set forth in Exhibit "G".

16. Surface Rights. (Prior Judgment Section 10) Certain of the aforesaid prior and paramount prescriptive water rights of Diverters to Divert for Direct Use stream flow within the Relevant Watershed are hereby declared and found in terms of Base Annual Diversion Right as set forth in Exhibit "C". Each Diverter shown on Exhibit "C" shall be entitled to Divert for Direct Use up to two hundred percent (200%) of said Base Annual Diversion Right in any one (1) Fiscal Year; provided that the aggregate quantities of water Diverted in any consecutive ten (10) Fiscal Year period shall not exceed ten (10) times such Diverter's Base Annual Diversion Right.

17. Ground Water Rights. (Prior Judgment Section 11) The Prescriptive Pumping Right of each Pumper, who is not an Integrated Producer, and his Pumper's Share are declared as set forth in Exhibit "D".

18. Optional Integrated Production Rights. (Prior Judgment Section 12) Those parties listed on Exhibit "E" have elected to be treated as Integrated Producers. Integrated Production Rights have two (2) historical components:

(1) a fixed component based upon historic Diversions for Direct Use; and

(2) a mutually prescriptive Pumper's Share component based upon Pumping during the period 1953 through 1967.

Assessment and other Watermaster regulation of the rights of such parties shall relate to and be based upon each such component. So far as future exercise of such rights is concerned, however, the gross quantity of the aggregate right in any Fiscal Year may be exercised, in the sole discretion of such party, by either Diversion or Pumping or any combination or apportionment thereof; provided, that for Assessment purposes the first water Produced in any Fiscal Year (other than "carry-over", under Section 49 hereof) shall be deemed an exercise of the Diversion component, and any Production over said quantity shall be deemed Pumped water, regardless of the actual method of Production.

19. Special Category Rights. (Prior Judgment Section 13) The parties listed on Exhibit "F" have water rights in the Relevant Watershed which are not ordinary Production rights. The nature of each such right is as described in Exhibit "F".

20. Non-consumptive Practices. (Prior Judgment Section 14) Certain Producers have engaged in Water Diversion and spreading practices which have caused such Diversions to have a

non-consumptive or beneficial impact upon the aggregate water supply available in the Basin. Said parties, and a statement of the nature of their rights, uses and practices, are set forth in Exhibit "G". The Physical Solution decreed herein, and particularly its provisions for Assessments, shall not apply to such non-consumptive uses. Watermaster may require reports on the operations of said parties.

21. Overlying Rights. (Prior Judgment Section 14.5) Producers listed in Exhibit "K" hereto were not parties herein at the time of the original entry of Judgment herein. They have exercised in good faith Overlying Rights to Produce water from the Basin during the periods subsequent to the entry of Judgment herein and have by self-help initiated or maintained appurtenant Overlying Rights. Such rights are exercisable without quantitative limit only on specifically described Overlying Land and cannot be separately conveyed or transferred apart therefrom. As to such rights and their exercise, the owners thereof shall become parties to this action and be subject to Watermaster Replacement Water Assessments under Section 45 (b) hereof, sufficient to purchase Replenishment Water to offset the net consumptive use of such Production and practices. In addition, the gross amount of such Production for such overlying use shall be subject to Watermaster Administrative Assessments under Section 45 (a) hereof and the consumptive use portion of such Production for overlying use shall be subject to Watermaster's In-Lieu Water Cost Assessments under Section 45 (d) hereof. The Producers presently entitled to exercise Overlying Rights, a description of the Overlying Land to which

Overlying Rights are appurtenant, the nature of use and the consumptive use portion thereof are set forth in Exhibit "K" hereto. Watermaster may require reports and make inspections of the operations of said parties for purposes of verifying the uses set forth in said Exhibit "K", and, in the event of a material change, to redetermine the net amount of consumptive use by such parties as changed in the exercise of such Overlying Rights. Annually, during the first two (2) weeks of June in each Calendar Year, such Overlying Rights Producers shall submit to Watermaster a verified statement as to the nature of the then current uses of said Overlying Rights on said Overlying Lands for the next ensuing Fiscal Year, whereupon Watermaster shall either affirm the prior determination or redetermine the net amount of the consumptive use portion of the exercise of such Overlying Right by said Overlying Rights Producer.

C. INJUNCTION

22. Injunction Against Unauthorized Production. (Prior Judgment Section 15) Effective July 1, 1973, each and every party, its officers, agents, employees, successors and assigns, to whom rights to waters of the Basin or Relevant Watershed have been declared and decreed herein is ENJOINED AND RESTRAINED from Producing water for Direct Use from the Basin or the Relevant Watershed except pursuant to rights and Pumpers' Shares herein decreed or which may hereafter be acquired by transfer pursuant to Section 55, or under the provisions of the Physical Solution in this Judgment and the Court's continuing jurisdiction, provided that no party is enjoined from Producing up to five (5) acre feet per Fiscal Year.

23. Injunction re Non-consumptive Uses. (Prior Judgment Section 16) Each party listed in Exhibit "G", its officers, agents, employees, successors and assigns, is ENJOINED AND RESTRAINED from materially changing said non-consumptive method of use.

24. Injunction Re Change in Overlying Use Without Notice Thereof To Watermaster. (Prior Judgment Section 16.5) Each party listed in Exhibit "K", its officers, agents, employees, successors and assigns, is ENJOINED AND RESTRAINED from materially changing said overlying uses at any time without first notifying Watermaster of the intended change of use, in which event Watermaster shall promptly redetermine the consumptive use portion thereof to be effective after such change.

25. Injunction Against Unauthorized Recharge. (Prior Judgment Section 17) Each party, its officers, agents, employees, successors and assigns, is ENJOINED AND RESTRAINED from spreading, injecting or otherwise recharging water in the Basin except pursuant to: (a) an adjudicated non-consumptive use, or (b) consent and approval of or Cyclic Storage Agreement with Watermaster, or (c) subsequent order of this Court.

26. Injunction Against Transportation From Basin or Relevant Watershed. (Prior Judgment Section 18) Except upon further order of Court, all parties, other than Transporting Parties and MWD in its exercise of its Special Category Rights, to the extent authorized therein, are ENJOINED AND RESTRAINED from transporting water hereafter Produced from the Relevant Watershed or Basin outside the areas thereof. For purposes of

this Section, water supplied through a city water system which lies chiefly within the Basin shall be deemed entirely used within the Basin. Transporting Parties are entitled to continue to transport water to the extent that any Production of water by any such party does not violate the injunctive provisions contained in Section 22 hereof; provided that said water shall be used within the present service areas or corporate or other boundaries and additions thereto so long as such additions are contiguous to the then existing service area or corporate or other boundaries; except that a maximum of ten percent (10%) of use in any Fiscal Year may be outside said then existing service areas or corporate or other boundaries.

D. CONTINUING JURISDICTION

27. Jurisdiction Reserved. (Prior Judgment Section 19) Full jurisdiction, power and authority are retained by and reserved to the Court for purposes of enabling the Court upon application of any party or of the Watermaster, by motion and upon at least thirty (30) days notice thereof, and after hearing thereon, to make such further or supplemental orders or directions as may be necessary or appropriate for interim operation before the Physical Solution is fully operative, or for interpretation, enforcement or carrying out of this Judgment, and to modify, amend or amplify any of the provisions of this Judgment or to add to the provisions thereof consistent with the rights herein decreed. Provided, that nothing in this paragraph shall authorize:

(1) modification or amendment of the quantities specified in the declared rights of any party;

(2) modification or amendment of the manner of exercise of the Base Annual Diversion Right or Integrated Production Right of any party; or

(3) the imposition of an injunction prohibiting transportation outside the Relevant Watershed or Basin as against any Transporting Party transporting in accordance with the provisions of this Judgment or against MWD as to its Special Category Rights.

E. WATERMASTER

28. Watermaster to Administer Judgment. (Prior Judgment Section 20) A Watermaster comprised of nine (9) persons, to be nominated as hereinafter provided and appointed by the Court, shall administer and enforce the provisions of this Judgment and any subsequent instructions or orders of the Court thereunder.

29. Qualification, Nomination and Appointment. (Prior Judgment Section 21) The nine (9) member Watermaster shall be composed of six (6) Producer representatives and three (3) public representatives qualified, nominated and appointed as follows:

(a) Qualification. Any adult citizen of the State of California shall be eligible to serve on Watermaster; provided, however, that no officer, director, employee or agent of Upper District or San Gabriel District shall be qualified as a Producer member of Watermaster.

(b) Nomination of Producer Representatives. A meeting of all parties shall be held at the regular meeting of Watermaster in November of each year, at the offices of Watermaster. Nomination of the six (6) Producer representatives shall be by cumulative voting, in person or by proxy, with each Producer entitled to one (1) vote for each one hundred (100) acre feet, or portion thereof, of Base Annual Diversion Right or Prescriptive Pumping Right or Integrated Production Right.

(c) Nomination of Public Representatives. On or before the regular meeting of Watermaster in November of each year, the three (3) public representatives shall be nominated by the boards of directors of Upper District (which shall select two [2]) and San Gabriel District (which shall select one [1]). Said nominees shall be members of the board of directors of said public districts.

(d) Appointment. All Watermaster nominations shall be promptly certified to the Court, which will in ordinary course confirm the same by an appropriate order appointing said Watermaster; provided, however, that the Court at all times reserves the right and power to refuse to appoint, or to remove, any member of Watermaster.

30. Term and Vacancies. (Prior Judgment Section 22) Each member of Watermaster shall serve for a one (1) year term commencing on January 1, following his appointment, or until his successor is appointed. In the event of a vacancy on Watermaster, a successor shall be nominated at a special meeting to be called by Watermaster within ninety (90) days (in the case of a Producer representative) or by action of the appropriate district board of directors (in the case of a public representative).

31. Quorum. (Prior Judgment Section 23) Five (5) members

of the Watermaster shall constitute a quorum for the transaction of affairs of the Watermaster. Action by the affirmative vote of five (5) members shall constitute action by Watermaster, except that the affirmative vote of six (6) members shall be required:

(a) to approve the purchase, spreading or injection of water for Ground Water recharge, or

(b) to enter in any Agreement pursuant to Section 34 (m) hereof.

32. Compensation. (Prior Judgment Section 24) Each Watermaster member shall receive compensation of One Hundred Dollars ($100.00) per day for each day's attendance at meetings of Watermaster or for each day's service rendered as a Watermaster member at the request of Watermaster, together with any expenses incurred in the performance of his duties required or authorized by Watermaster. No member of the Watermaster shall be employed by or compensated for professional services rendered by him to Watermaster, other than the compensation herein provided, and any authorized travel or related expense.

33. Organization. (Prior Judgment Section 25) At its first meeting in each year, Watermaster shall elect a chairman and a vice chairman from its membership. It shall also select a secretary, a treasurer and such assistant secretaries and assistant treasurers as may be appropriate, any of whom may, but need not be, members of Watermaster.

(a) Minutes. Minutes of all Watermaster meetings shall be kept which shall reflect all actions taken by Watermaster. Draft copies thereof shall be furnished to any party who files a request therefor in writing with Watermaster. Said draft copies of minutes shall constitute notice of any Watermaster action therein reported; failure to request copies thereof shall constitute waiver of notice.

(b) Regular Meetings. Watermaster shall hold regular meetings at places and times to be specified in Watermaster's rules and regulations to be adopted by Watermaster. Notice of the scheduled or regular meetings of Watermaster and of any changes in the time or place thereof shall be mailed to all parties who shall have filed a request therefor in writing with Watermaster.

(c) Special Meetings. Special meetings of Watermaster may be called at any time by the chairman or vice chairman or by any three (3) members of Watermaster by written notice delivered personally or mailed to each member of Watermaster and to each party requesting notice, at least twenty-four (24) hours before the time of each such meeting in the case of personal delivery, and forty-eight (48) hours prior to such meeting in the case of mail. The calling notice shall specify the time and place of the special meeting and the business to be transacted at such meeting. No other business shall be considered at such meeting.

(d) Adjournments. Any meeting of Watermaster may be adjourned to a time and place specified in the order of adjournment. Less than a quorum may so adjourn from time to time. A copy of the order or notice of adjournment shall be conspicuously posted on or near the door of the place where the meeting was held within twenty-four (24) hours after adoption of the order of adjournment.

34. Powers and Duties. (Prior Judgment Section 26) Subject to the continuing supervision and control of the Court, Watermaster shall have and may exercise the following express powers, and shall perform the following duties, together with any specific powers, authority and duties granted or imposed elsewhere in this Judgment or hereafter ordered or authorized by the Court in the exercise of its continuing jurisdiction.

(a) Rules and Regulations. To make and adopt any and all appropriate rules and regulations for conduct of Watermaster affairs. A copy of said rules and regulations and any amendments thereof shall be mailed to all parties.

(b) Acquisition of Facilities. To purchase, lease, acquire and hold all necessary property and equipment; provided, however, that Watermaster shall not acquire any interest in real property in excess of year-to-year tenancy for necessary quarters and facilities.

(c) Employment of Experts and Agents. To employ such administrative personnel, engineering, geologic, accounting, legal or other specialized services and consulting assistants as may be deemed appropriate in the carrying out of its powers and to require appropriate bonds from all officers and employees handling Watermaster funds.

(d) Measuring Devices, etc. To cause parties, pursuant to uniform rules, to install and maintain in good operating condition, at the cost of each party, such necessary measuring devices or meters as may be appropriate; and to inspect and test any such measuring device as may be necessary.

(e) Assessments. To levy and collect all Assessments specified in the Physical Solution.

(f) Investment of Funds. To hold and invest any and all funds which Watermaster may possess in investments authorized from time to time for public agencies in the State of California.

(g) Borrowing. To borrow in anticipation of receipt of Assessment proceeds an amount not to exceed the annual amount of Assessments levied but uncollected.

(h) Purchase of and Recharge with Supplemental Water. To purchase Supplemental Water and to introduce the same into the Basin for replacement or cyclic storage purposes, subject to the affirmative vote of six (6) members of Watermaster.

(i) Contracts. To enter into contracts for the performance of any administrative powers herein granted, subject to approval of the Court.

(j) Cooperation With Existing Agencies. To act jointly or cooperate with agencies of the United States and the State of California or any political subdivision, municipality or district to the end that the purposes of the Physical Solution may be fully and economically carried out. Specifically, in the event Upper District has facilities available and adequate to accomplish any of the administrative functions of Watermaster, consideration shall be given to performing said functions under contract with Upper District in order to avoid duplication of facilities.

(k) <u>Assumption of Make-up Obligation</u>. Watermaster shall assume the Make-up Obligation for and on behalf of the Basin.

(m) <u>Water Quality</u>. Water quality in the Basin shall be a concern of Watermaster, and all reasonable steps shall be taken to assist and encourage appropriate regulatory agencies to enforce reasonable water quality regulations affecting the Basin, including regulation of solid and liquid waste disposal.

(n) <u>Cyclic Storage Agreements</u>. To enter into appropriate contracts, to be approved by the Court, for utilization of Ground Water storage capacity of the Basin for cyclic or regulatory storage of Supplemental Water by parties and non-parties, for subsequent recovery or Watermaster credit by the storing entity, pursuant to uniform rules and conditions, which shall include provision for:

(1) Watermaster control of all spreading or injection and extraction scheduling and procedures for such stored water;

(2) calculation by Watermaster of any special costs, damages or burdens resulting from such operations;

(3) determination by Watermaster of, and

accounting for, all losses in stored water, assuming that such stored water floats on top of the Ground Water supplies, and accounting for all losses of water which otherwise would have replenished the Basin, with priorities being established as between two or more such contractors giving preference to parties over non-parties; and

(4) payment to Watermaster for the benefit of the parties hereto of all special costs, damages or burdens incurred (without any charge, rent, assessment or expense as to parties hereto by reason of the adjudicated proprietary character of said storage rights, nor credit or offset for benefits resulting from such storage); provided, that no party shall have any direct interest in or control over such contracts or the operation thereof by reason of the adjudicated right of such party, the Watermaster having sole custody and control of all Ground Water storage rights in the Basin pursuant to the Physical Solution herein, and subject to review of the Court.

(o) Notice List. Maintain a current list of party designees to receive notice hereunder, in accordance with Section 54 hereof.

35. Policy Decisions -- Procedure. (Prior Judgment Section 27) It is contemplated that Watermaster will exercise discretion in making policy decisions relating to Basin management under the Physical Solution decreed herein. In order to assure full participation and opportunity to be heard for

those affected, no policy decision shall be made by Watermaster until thirty (30) days after the question involved has been raised for discussion at a Watermaster meeting and noted in the draft of minutes thereof.

36. Reports. (Prior Judgment Section 28) Watermaster shall annually file with the Court and mail to the parties a report of all Watermaster activities during the preceding year, including an audited statement of all accounts and financial activities of Watermaster, summary reports of Diversions and Pumping, and all other pertinent information. To the extent practical, said report shall be mailed to all parties on or before November 1.

37. Review Procedures. (Prior Judgment Section 29) Any action, decision, rule or procedure of Watermaster (other than a decision establishing Operating Safe Yield, see Section 43[c]) shall be subject to review by the Court on its own motion or on timely motion for an Order to Show Cause by any party, as follows:

(a) Effective Date of Watermaster Action. Any order, decision or action of Watermaster shall be deemed to have occurred on the date that written notice thereof is mailed. Mailing of draft copies of Watermaster minutes to the parties requesting the same shall constitute notice to all such parties.

(b) Notice of Motion. Any party may, by a regularly noticed motion, petition the Court for review of said Watermaster's action or decision. Notice of such motion shall be mailed to Watermaster and all parties. Unless so ordered by the Court, such petition shall not operate to stay the effect of such Watermaster action.

(c) Time for Motion. Notice of motion to review any Watermaster action or decision shall be served and filed within ninety (90) days after such Watermaster action or decision.

(d) De Novo Nature of Proceeding. Upon filing of such motion for hearing, the Court shall notify the parties of a date for taking evidence and argument, and shall review de novo the question at issue on the date designated. The Watermaster decision or action shall have no evidentiary weight in such proceeding.

(e) Decision. The decision of the Court in such proceeding shall be an appealable Supplemental Order in this case. When the same is final, it shall be binding upon the Watermaster and the parties.

F. PHYSICAL SOLUTION

38. Purpose and Objective. (Prior Judgment Section 30) Consistent with the California Constitution and the decisions of the Supreme Court, the Court hereby adopts and Orders the parties to comply with this Physical Solution. The purpose and objective of these provisions is to provide a legal and practical means for accomplishing the most economic, long term, conjunctive utilization of surface, Ground Water, Supplemental Water and Ground Water storage capacity to meet the needs and requirements of the water users dependent upon the Basin and Relevant Watershed, while preserving existing equities.

39. Need for Flexibility. (Prior Judgment Section 31) In

order that Watermaster may be free to utilize both existing and new and developing technological, social and economic concepts for the fullest benefit of all those dependent upon the Basin, it is essential that the Physical Solution hereunder provide for maximum flexibility and adaptability. To that end, the Court has retained continuing jurisdiction to supplement the broad discretion herein granted to the Watermaster.

40. Watermaster Control. (Prior Judgment Section 32) In order to develop an adequate and effective program of Basin management, it is essential that Watermaster have broad discretion in the making of Basin management decisions within the ambit hereinafter set forth. Withdrawal and replenishment of supplies of the Basin and Relevant Watershed and the utilization of the water resources thereof, and of available Ground Water storage capacity, must be subject to procedures established by Watermaster in implementation of the provisions of this Judgment. Both the quantity and quality of said water resource are thereby preserved and its beneficial utilization maximized.

41. General Pattern of Contemplated Operation. (Prior Judgment Section 33) In general outline (subject to the specific provisions hereafter and to Watermaster Operating Criteria set forth in Exhibit "H"), Watermaster will determine annually the Operating Safe Yield of the Basin and will notify each Pumper of his share thereof, stated in acre feet per Fiscal Year. Thereafter, no party may Produce in any Fiscal Year an amount in excess of the sum of his Diversion Right, if any, plus his Pumper's Share of such Operating Safe Yield, or his

Integrated Production Right, or the terms of any Cyclic Storage Agreement, without being subject to Assessment for the purpose of purchasing Replacement Water. In establishing the Operating Safe Yield, Watermaster shall follow all physical, economic, and other relevant parameters provided in the Watermaster Operating Criteria. Watermaster shall have Assessment powers to raise funds essential to implement the management plan in any of the several special circumstances herein described in more detail.

42. Basin Operating Criteria. (Prior Judgment Section 34) Until further order of the Court and in accordance with the Watermaster Operating Criteria, Watermaster shall not spread Replacement Water when the water level at the Key Well exceeds Elevation two hundred fifty (250), and Watermaster shall spread Replacement Water, insofar as practicable, to maintain the water level at the Key Well above Elevation two hundred (200).

43. Determination of Operating Safe Yield. (Prior Judgment Section 35) Watermaster shall annually determine the Operating Safe Yield applicable to the succeeding Fiscal Year and estimate the same for the next succeeding four (4) Fiscal Years. In making such determination, Watermaster shall be governed in the exercise of its discretion by the Watermaster Operating Criteria. The procedures with reference to said determination shall be as follows:

(a) Preliminary Determination. On or before Watermaster's first meeting in April of each year, Watermaster shall make a Preliminary Determination of the Operating Safe Yield of the Basin for each of the succeeding five Fiscal Years. Said determination shall be made in the form of a report containing a summary statement of the considerations, calculations and factors used by Watermaster in arriving at said Operating Safe Yield.

(b) Notice and Hearing. A copy of said Preliminary Determination and report shall be mailed to each Pumper and Integrated Producer at least ten (10) days prior to a hearing to be held at Watermaster's regular meeting in May, of each year, at which time objections or suggested corrections or modifications of said determinations shall be considered. Said hearing shall be held pursuant to procedures adopted by Watermaster.

(c) Watermaster Determination and Review Thereof. Within thirty (30) days after completion of said hearing, Watermaster shall mail to each Pumper and Integrated Producer a final report and determination of said Operating Safe Yield for each such Fiscal Year, together with a statement of the Producer's entitlement in each such Fiscal Year stated in acre feet. Any affected party, within thirty (30) days of mailing of notice of said Watermaster determination, may, by a regularly noticed motion, petition the Court for an Order to Show Cause for review of said Watermaster finding, and thereupon the Court shall hear such objections and settle such dispute. Unless so ordered by the Court, such petition shall not operate to stay the effect of said report and determination. In the absence of such review proceedings, the Watermaster determination shall be final.

44. Reports of Pumping and Diversion. (Prior Judgment

Section 36) Each party (other than Minimal Producers) shall file with the Watermaster quarterly, on or before the last day of January, April, July and October, a report on a form to be prescribed by Watermaster showing the total Pumping and Diversion (separately for Direct Use and for non-consumptive use, if any,) of such party during the preceding calendar quarter.

45. Assessments -- Purpose. (Prior Judgment Section 37) Watermaster shall have the power to levy and collect Assessments from the parties (other than Minimal Producers, non-consumptive users, or Production under Special Category Rights or Cyclic Storage Agreements) based upon Production during the preceding Fiscal Year. Said Assessments may be for one or more of the following purposes:

(a) Watermaster Administration Costs. Within thirty (30) days after completion of the hearing on the Preliminary Determination of the Operating Safe Yield of the Basin and Watermaster's determination thereof, pursuant to Section 43 hereof, Watermaster shall adopt a proposed budget for the succeeding Fiscal Year and shall mail a copy thereof to each party, together with a statement of the level of Administration Assessment levied by Watermaster which will be collected for purposes of raising funds for said budget. Said Assessment shall be uniformly applicable to each acre foot of Production.

(b) Replacement Water Costs. Replacement Water Assessments shall be collected from each party on account of such party's Production in excess of its Diversion

Rights, Pumper's Share or Integrated Production Right, and on account of the consumptive use portion of Overlying Rights, computed at the applicable rate established by Watermaster consistent with the Watermaster Operating Criteria.

(c) Make-Up Obligation. An Assessment shall be collected equally on account of each acre foot of Production, which does not bear a Replacement Assessment hereunder, to pay all necessary costs of Administration and satisfaction of the Make-Up Obligation. Such Assessment shall not be applicable to water Production for an Overlying Right.

(d) In-Lieu Water Cost. Watermaster may levy an Assessment against all Pumping to pay reimbursement for In-Lieu Water Costs except that such Assessment shall not be applicable to the non-consumptive use portion of an Overlying Right.

(e) Basin Water Quality Improvement. For purposes of testing, protecting or improving the water quality in the Basin, Watermaster may, after a noticed hearing thereon, fix terms and conditions under which it may waive all or any part of its Assessments on such ground water Production and if such Production, in addition to his other Production, does not exceed such Producer's Share or entitlement for that Fiscal Year, such stated Production shall be allowed to be carried over for a part of such Producer's next Fiscal Year's Producer's Share or entitlement. In connection therewith, Watermaster may also waive the provisions of Sections 25, 26 and 57 hereof, relating to Injunction Against Unauthorized Recharge, Injunction Against Transportation From Basin or Relevant Watershed, and Intervention After Judgment, respectively. Nothing in this Judgment is intended to allow an increase in any Producer's annual entitlement nor to prevent Watermaster, after hearing thereon, from entering into contracts to encourage, assist and accomplish the clean up and improvement of degraded water quality in the Basin by non-parties herein. Such contracts may include the exemption of the Production of such Basin water therefor from Watermaster Assessments and, in connection therewith, the waiver of the provisions of Judgment Sections 25, 26, and 57 hereof.

46. Assessments -- Procedure. (Prior Judgment Section 38) Assessments herein provided for shall be levied and collected as follows:

(a) Levy and Notice of Assessment. Within thirty (30) days of Watermaster's annual determination of Operating Safe Yield of the Basin for each Fiscal Year and succeeding four (4) Fiscal Years, Watermaster shall levy applicable Administration Assessments, Replacement Water Assessments, Make-up Water Assessments and In-Lieu Water Assessments, if any. Watermaster shall give written notice of all applicable Assessments to each party on or before August 15, of each year.

(b) Payment. Each Assessment shall be payable, and each party is Ordered to pay the same, on or before

September 20, following such Assessment, subject to the rights reserved in Section 37 hereof.

(c) Delinquency. Any Assessment which becomes delinquent after January 1, 1980, shall bear interest at the annual prime rate plus one percent (1%) in effect on the first business day of August of each year. Said prime interest rate shall be that fixed by the Bank of America NT&SA for its preferred borrowing customers on said date. Said prime interest rate plus one percent (1%) shall be applicable to any said delinquent Assessment from the due date thereof until paid. Provided, however, in no event shall any said delinquent Assessment bear interest at a rate of less than ten percent (10%) per annum. Such delinquent Assessment and interest may be collected in a Show Cause proceeding herein or any other legal proceeding instituted by Watermaster, and in such proceeding the Court may allow Watermaster its reasonable costs of collection, including attorney's fees.

47. Availability of Supplemental Water From Responsible Agencies. (Prior Judgment Section 39) If any Responsible Agency shall, for any reason, be unable to deliver Supplemental Water to Watermaster when needed, Watermaster shall collect funds at an appropriate level and hold them in trust, together with interest accrued thereon, for purchase of such water when available.

48. Accumulation of Replacement Water Assessment Proceeds. (Prior Judgment Section 40) In order to minimize fluctuation in Assessments and to give Watermaster flexibility in Basin

management, Watermaster may make reasonable accumulations of Replacement Water Assessments. Such moneys and any interest accrued thereon shall only be used for the purchase of Replacement Water.

49. Carry-over of Unused Rights. (Prior Judgment Section 41) Any Pumper's Share of Operating Safe Yield, and the Production right of any Integrated Producer, which is not Produced in a given Fiscal Year may be carried over and accumulated for one Fiscal Year, pursuant to reasonable rules and procedures for notice and accounting which shall be adopted by Watermaster. The first water Produced in the succeeding Fiscal Year shall be deemed Produced pursuant to such Carry-over Rights.

50. Minimal Producers. (Prior Judgment Section 42) In the interest of Justice, Minimal Producers are exempted from the operation of this Physical Solution, so long as such party's annual Production does not exceed five (5) acre feet. Quarterly Production reports by such parties shall not be required, but Watermaster may require, and Minimal Producers shall furnish, specific periodic reports. In addition, Watermaster may conduct such investigation of future operations of any Minimal Producer as may be appropriate.

51. Effective Date. (Prior Judgment Section 43) The effective date for commencing accounting and operation under this Physical Solution, other than for Replacement Water Assessments, shall be July 1, 1972. The first Assessment for Replacement Water shall be payable on September 20, 1974, on account of Fiscal Year 1973-74 Production.

G. MISCELLANEOUS PROVISIONS

52. Puente Narrows Flow. (Prior Judgment Section 44) The Puente Basin is tributary to the Main San Gabriel Basin. All Producers within said Puente Basin have been dismissed herein, based upon the Puente Narrows Agreement (Exhibit "J"), whereby Puente Basin Water Agency agreed not to interfere with surface inflow and to assure continuance of historic subsurface contribution of water to Main San Gabriel Basin. The Court declares said Agreement to be reasonable and fair and in full satisfaction of claims by Main San Gabriel Basin for natural water from Puente Basin.

53. San Gabriel District - Interim Order. (Prior Judgment Section 45) San Gabriel District has a contract with the State of California for State Project Water, delivered at Devil Canyon in San Bernardino County. San Gabriel District is **HEREBY ORDERED** to proceed with and complete necessary pipeline facilities as soon as practical.

Until said pipeline is built and capable of delivering a minimum of twenty-eight thousand eight-hundred (28,800) acre feet of State Project water per year, defendant cities of Alhambra, Azusa, and Monterey Park shall pay to Watermaster each Fiscal Year a Replacement Assessment at a uniform rate sufficient to purchase Replenishment Water when available, which rate shall be declared by San Gabriel District. When water is available through said pipeline, San Gabriel District shall make the same available to Watermaster, on his reasonable demand, at said specified rate per acre foot. Interest accrued on such funds shall be paid to San Gabriel

District.

54. Service Upon and Delivery to Parties of Various Papers. (Prior Judgment Section 46) Service of the Judgment on those parties who have executed the Stipulation for Judgment shall be made by first class mail, postage prepaid, addressed to the Designee and at the address designated for that purpose in the executed and filed counterpart of the Stipulation for Judgment, or in any substitute designation filed with the Court.

Each party who has not heretofore made such a designation shall, within thirty (30) days after the Judgment shall have been served upon that party, file with the Court, with proof of service of a copy thereof upon Watermaster, a written designation of the person to whom and the address at which all future notices, determinations, requests, demands, objections, reports and other papers and processes to be served upon that party or delivered to that party are to be so served or delivered.

A later substitute designation filed and served in the same manner by any party shall be effective from the date of filing as to the then future notices, determinations, requests, demands, objections, reports and other papers and processes to be served upon or delivered to that party.

Delivery to or service upon any party by Watermaster, by any other party, or by the Court, of any item required to be served upon or delivered to a party under or pursuant to the Judgment may be made by deposit thereof (or by copy thereof) in the mail, first class, postage prepaid, addressed to the Designee of the party and at the address shown in the latest designation filed by that party.

55. Assignment, Transfer, etc., of Rights. (Prior Judgment Section 47) Any rights Adjudicated herein except Overlying Rights, may be assigned, transferred, licensed or leased by the owners thereof; provided however, that no such assignment shall be complete until the appropriate notice procedures established by Watermaster have been complied with. No water Produced pursuant to rights assigned, transferred, licensed, or leased may be transported outside the Relevant Watershed except by:

(1) a Transporting Party, or

(2) a successor in interest immediate or mediate to a water system on lands or portion thereof, theretofore served by such a Transporting Party, for use by such successor in accordance with limitations applicable to Transporting Parties, or

(3) a successor in interest to the Special Category rights of MWD.

The transfer and use of Overlying Rights shall be limited, as provided in Section 21 hereof, as exercisable only on the specifically defined Overlying Lands and they cannot be separately conveyed or transferred apart therefrom.

56. Abandonment of Rights. (Prior Judgment Section 48) It is in the interest of reasonable beneficial use of the Basin and its water supply that no party be encouraged to take and use more water in any Fiscal Year than is actually required. Failure to Produce all of the water to which a party is entitled hereunder shall not, in and of itself, be deemed or constitute

an abandonment of such party's right, in whole or in part. Abandonment and extinction of any right herein Adjudicated shall be accomplished only by:

(1) a written election by the party, filed in this case, or

(2) upon noticed motion of Watermaster, and after hearing.

In either case, such abandonment shall be confirmed by express subsequent order of this Court.

57. Intervention After Judgment. (Prior Judgment Section 49) Any person who is not a party or successor to a party and who proposes to Produce Water from the Basin or Relevant Watershed, may seek to become a party to this Judgment through a Stipulation For Intervention entered into with Watermaster. Watermaster may execute said Stipulation on behalf of the other parties herein but such Stipulation shall not preclude a party from opposing such Intervention at the time of the Court hearing thereon. Said Stipulation For Intervention must thereupon be filed with the Court, which will consider an order confirming said Intervention following thirty (30) days' notice to the parties. Thereafter, if approved by the Court, such Intervenor shall be a party bound by this Judgment and entitled to the rights and privileges accorded under the Physical Solution herein.

58. Judgment Binding on Successors, etc. (Prior Judgment Section 50) Subject to specific provisions hereinbefore contained, this Judgment and all provisions thereof are applicable to and binding upon and inure to the benefit of not

only the parties to this action, but as well to their respective heirs, executors, administrators, successors, assigns, lessees, licensees and to the agents, employees and attorneys in fact of any such persons.

59. Water Rights Permits. (Prior Judgment Section 51) Nothing herein shall be construed as affecting the relative rights and priorities between MWD and San Gabriel Valley Protective Association under State Water Rights Permits Nos. 7174 and 7175, respectively.

60. Costs. (Prior Judgment Section 52) No party shall recover any costs in this proceeding from any other party.

61. Entry of Judgment. (New) The Clerk shall enter this Judgment.

DATED: August 24, 1989.

s/ Florence T. Pickard
Florence T. Pickard, Judge
Specially Assigned

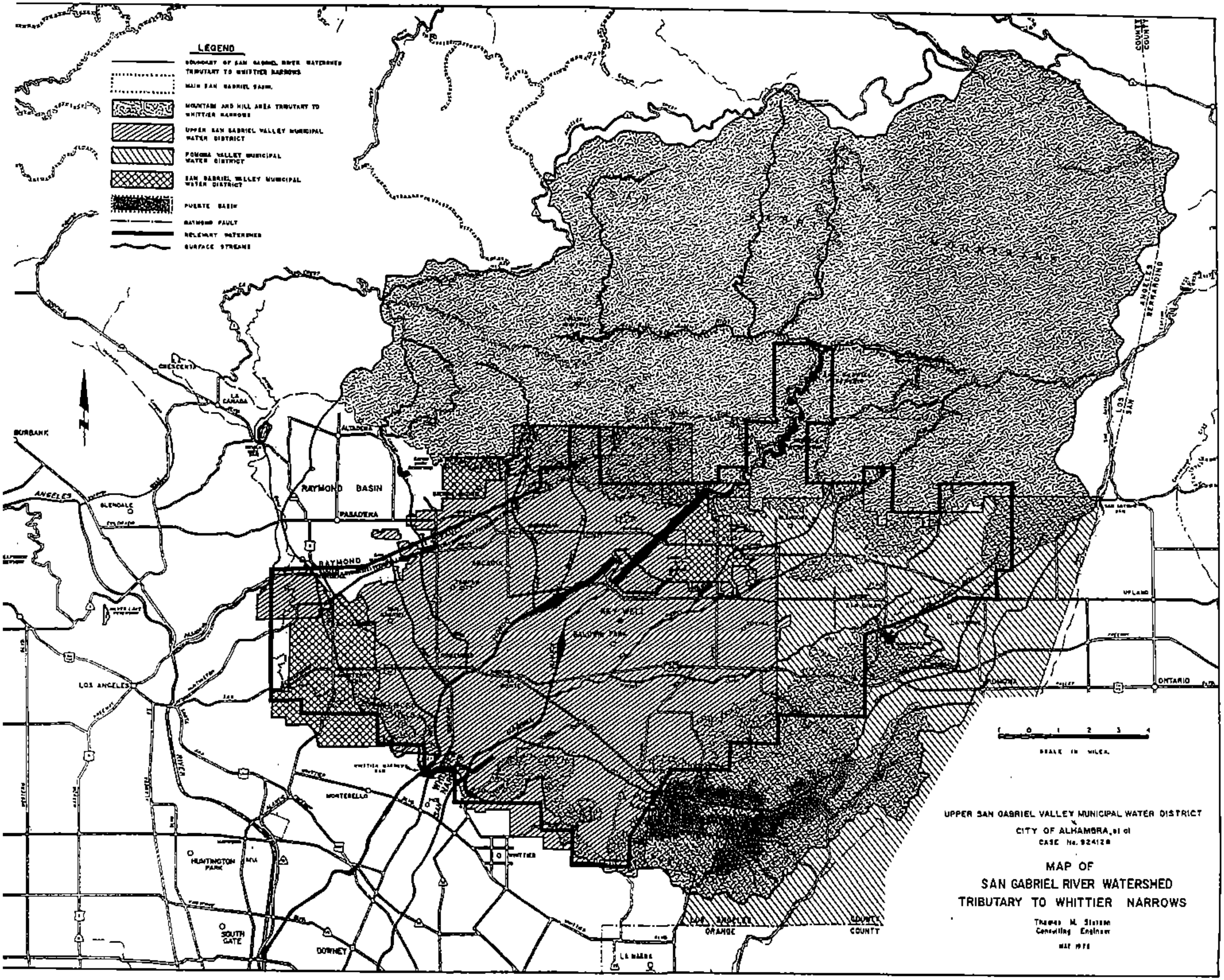

LEGEND
BOUNDARY OF SAN GABRIEL RIVER WATERSHED TRIBUTARY TO WHITTIER NARROWS
MAIN SAN GABRIEL BASIN
MOUNTAIN AND HILL AREA TRIBUTARY TO WHITTIER NARROWS
UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT
POMONA VALLEY MUNICIPAL WATER DISTRICT
SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT
PUENTE BASIN
RAYMOND FAULT
RELEVANT WATERSHED
SURFACE STREAMS
N
BURBANK
CRESCENTA
LA CANADA
ALTADENA
RAYMOND BASIN
PASADENA
GLENDALE
RAYMOND
LOS ANGELES
RIVER
MONTEBELLO
WHITTIER
HUNTINGTON PARK
SOUTH GATE
DOWNEY
LA HABRA
UPLAND
ONTARIO
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
LOS ANGELES COUNTY
ORANGE COUNTY
0 1 2 3 4
SCALE IN MILES
UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT
v.
CITY OF ALHAMBRA, et al
CASE No. 924128
MAP OF
SAN GABRIEL RIVER WATERSHED
TRIBUTARY TO WHITTIER NARROWS
Thomas M. Stetson
Consulting Engineer

Exhibit "B"

BOUNDARIES OF RELEVANT WATERSHED

The following described property is located in Los Angeles County, State of California:

Beginning at the Southwest corner of Section 14, Township 1 North, Range 11 West, San Bernardino Base and Meridian;

Thence Northerly along the West line of said Section 14 to the Northwest corner of the South half of said Section 14;

Thence Easterly along the North line of the South half of Section 14 to the East line of said Section 14;

Thence Northerly along the East line of said Section 14, Township 1 North, Range 11 West and continuing Northerly along the East line of Section 11 to the Northeast corner of said Section 11;

Thence Easterly along the North line of Section 12 to the Northeast corner of said Section 12;

Thence Southerly along the East line of said Section 12 and continuing Southerly along the East line of Section 13 to the Southeast corner of said Section 13, said corner being also the Southwest corner of Section 18, Township 1 North, Range 10 West;

Thence Easterly along the South line of Sections 18, 17, 16 and 15 of said Township 1 North, Range 10 West to the Southwest corner of Section 14;

Thence Northerly along the West line of Section 14 to the Northwest corner of the South half of Section 14;

Thence Easterly along the North line of the South half of Section 14 to the East line of said section;

Thence Northerly along the East line of said Section 14, and continuing Northerly along the West line of Section 12 of said Township 1 North, Range 10 West to the North line of said Section 12;

Thence Easterly along the North line of said Section 12, to the Northeast corner of said Section 12, said corner being also the Southwest corner of Section 6, Township 1 North, Range 9 West;

Thence Northerly along the West line of said Section 6 and continuing Northerly along West line of Sections 31 and 30, Township 2 North, Range 9 West to the Westerly prolongation of the North line of said Section 30;

Thence Easterly along said Westerly prolongation of the North line of said Section 30 and continuing Easterly along the North line of Section 29 to the Northeast corner of said Section 29;

Thence Southerly along the East line of said Section 29 and continuing Southerly along the East line of Section 32, Township 2 North, Range 9 West, and thence continuing Southerly along the East line of Section 5, Township 1 North, Range 9 West to the Southeast corner of said Section 5;

Thence Westerly along the South line of said Section 5 to the Southwest corner of said Section 5, said point being also the Northwest corner of Section 8;

Thence Southerly along the West line of said Section 8 and continuing Southerly along the West line of Section 17, to the Southwest corner of said Section 17, said corner being also the Northwest corner of Section 20;

Thence Easterly along the North line of Sections 20 and 21 to the Northwest corner of Section 22, said corner being also the Southwest corner of Section 15;

Thence Northerly along the West line of said Section 15 to the Northwest corner of the South half of said Section 15;

Thence Easterly along the North line of said South half of Section 15 to the Northeast corner of said South half of Section 15;

Thence Southerly along the East line of Section 15 and continuing Southerly along the East line of Section 22 to the Southeast corner of said Section 22, said point being also the Southwest corner of Section 23;

Thence Easterly along the South line of Sections 23 and 24 to the East line of the West half of said Section 24;

Thence Northerly along said East line of the West half of Section 24 to the North line thereof;

Thence Easterly along said North line of Section 24 to the Northeast corner thereof, said point also being the Northwest corner of Section 19, Township 1 North, Range 8 West;

Thence continuing Easterly along the North line of Section 19 and Section 20 of said Township 1 North, Range 8 West to the Northeast corner of said Section 20;

Thence Southerly along the East line of Sections 20, 29 and 32 of said Township 1 North, Range 8 West to the Southeast corner of said Section 32;

Thence Westerly along the South line of Section 32 to the Northwest corner of the East half of Section 5, Township 1 South, Range 8 West;

Thence Southerly along the West line of the East half of said Section 5 to the South line of said Section 5;

Thence West to the East line of the Northerly prolongation of Range 9 West;

Thence South 67° 30′ West to an intersection with the Northerly prolongation of the West line of Section 27, Township 1 South, Range 9 West;

Thence Southerly along the Northerly prolongation of said West line of Section 27 and continuing Southerly along the West line of Section 27 to the Southwest corner of said Section 27, said point being also the Southeast corner of Section 28;

Thence Westerly along the South line and Westerly projection of the South line of said Section 28 to the Northerly prolongation of the West line of Range 9 West;

Thence Southerly along said prolongation of the West line of Range 9 West to the Westerly prolongation of the North line of Township 2 South;

Thence Westerly along said Westerly prolongation of the North line of Township 2 South, a distance of 8,500 feet;

Thence South a distance of 4,500 feet;

Thence West a distance of 10,700 feet;

Thence South 29° West to an intersection with the Northerly prolongation of the West line of Section 20, Township 2 South, Range 10 West;

Thence Southerly along said Northerly prolongation of the West line of said Section 20 and continuing Southerly along the West line of Section 20 to the Southwest corner of said Section 20;

Thence South a distance of 2,000 feet;

Thence West a distance of two miles, more or less, to an intersection with the East line of Section 26, Township 2 South, Range 11 West;

Thence Northerly along said East line of Section 26 and continuing Northerly along the East line of Section 23, Township 2 South, Range 11 West to the Northeast corner of said Section 23;

Thence Westerly along the North line of said Section 23 to the Northwest corner thereof, said point being also the Southeast corner of Section 15, Township 2 South, Range 11 West;

Thence Northerly and Westerly along the East and North lines, respectively, of said Section 15, Township 2 South, Range 11 West, to the Northwest corner thereof;

Thence continuing Westerly along the Westerly prolongation of said North line of Section 15, Township 2 South, Range 11 West to an intersection with a line parallel to and one mile East of the West line of Range 11 West;

Thence Northerly along said parallel line to an intersection with the Northerly boundary of the City of Pico Rivera as said City of Pico Rivera existed on July 17, 1970;

Thence Westerly along said City boundary to an intersection with the East line of Range 12 West;

Thence Northerly along said East line of Range 12 West to the North line of Township 2 South;

Thence Westerly along the North line of Township 2 South to an intersection with the Southerly prolongation of the East line of the West half of Section 26, Township 1 South, Range 12 West;

Thence Northerly along said Southerly prolongation of said East line of the West half of said Section 26 to the Southeast corner of said West half;

Thence Westerly along the South line of Sections 26, 27 and 28, Township 1 South, Range 12 West, to the Southeast corner of Section 29, Township 1 South, Range 12 West;

Thence Northerly along the East line of said Section 29 to the Northeast corner of the South half of said Section 29;

Thence Westerly along the North line of the South half of said Section 29 to the Northwest corner thereof;

Thence Northerly along the West line of Sections 29, 20, 17 and 8, Township 1 South, Range 12 West;

Thence continuing Northerly along the Northerly prolongation of the West line of Section 8, Township 1 South, Range 12 West to an intersection with the North line of Township 1 South;

Thence Easterly along said North line of Township 1 South to the Northeast corner of Section 3, Township 1 South, Range 12 West;

Thence North 64° 30′ East to an intersection with the West line of Section 23, Township 1 North, Range 11 West;

Thence Northerly along the West line of said Section 23 to the Northwest corner thereof, said point being the Southwest corner of Section 14, Township 1 North, Range 11 West and said point being also the point of beginning.

Exhibit "B"

<u>Exhibit "C"</u>

TABLE SHOWING BASE ANNUAL DIVERSION RIGHTS OF CERTAIN DIVERTERS

	Base Annual Diversion Right Acre-Feet
Covell, Ralph (Successor to Rittenhouse, Catherine and Rittenhouse, James)	2.12
Maddock, A. G.	3.40
Rittenhouse, Catherine (Transferred to Covell, Ralph)	0
Rittenhouse, James (Transferred to Covell, Ralph)	0
Ruebhausen, Arline (Held in common with Ruebhausen, Victor) (Transferred to City of Glendale)	0
Ruebhausen, Victor (See Ruebhausen, Arline, above)	0
TOTAL	5.52

Exhibit "D"

TABLE
SHOWING PRESCRIPTIVE PUMPING RIGHTS AND PUMPER'S SHARE OF EACH PUMPER AS OF JUNE, 1988

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share Percent (%)
Adams Ranch Mutual Water Company	100.00	0.05060
A & E Plastik Pak Co., Inc. (Transferred to Industry Properties, Ltd.)	0	0
Alhambra, City of	8,812.05	4.45876
Amarillo Mutual Water Company	709.00	0.35874
Anchor Plating Co., Inc. (Successor to Bodger & Sons) (Transferred to Crown City Plating Co.)	0	0
Anderson, Ray L. and Helen T., Trustees (Successor to Covina-Valley Unified School District)	50.16	0.02538
Andrade, Marcario and Consuelo; and Andrade, Robert and Jayne (Successor to J. F. Isbell Estate, Inc.)	8.36	0.00423
Arcardia, City of	9,252.00	4.68137
(Successor to First National Finance Corporation)	60.90	0.03081
(Transferred to City of Monrovia)	951.00	0.48119
	8,361.90	4.23099
Associated Southern Investment Company (Transferred to Southern California Edison Company)	0	0
AZ-Two, Inc. (Lessee of Southwestern Portland Cement Co.)	0	0
Azusa, City	3,655.99	1.84988
Azusa-Western Inc. (Transferred to Southwestern Portland Cement Co.)	0	0
Bahnsen & Beckman Ind., Inc. (Transferred to Woodland, Richard)	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Bahnsen, Betty M. (Transferred to Dawes, Mary Kay)	0	0
Baldwin Park County Water District (See Valley County Water District)	-	-
Banks, Gale C. (Successor to Doyle, Mr. and Mrs.; and Madruga, Mr. and Mrs.)	50.00	0.02530
Base Line Water Company	430.20	0.21767
Beverly Acres Mutual Water Company	93.00	0.04706
Birenbaum, Max (Held in common with Birenbaum, Sylvia; Schneiderman, Alan; Schneiderman, Lydia; Wigodsky, Bernard; Wigodsky, Estera) (Transferred to City of Whittier)	0	0
Birenbaum, Sylvia (See Birenbaum, Max)	-	-
Blue Diamond Concrete Materials Div., The Flintkote Company (Transferred to Sully-Miller Contracting Co.)	0	0
Bodger & Sons DBA Bodger Seeds Ltd. (Transferred to Anchor Plating Co., Inc.)	0	0
Botello Water Company	0	0
Burbank Development Company	50.65	0.02563
Cadway, Inc. (Successor to:		
Corcoran, Jack S. and R. L.)	100.00	0.05060
Corcoran, Jack S. and R. L.)	100.00	0.05060
	200.00	0.10120
Cal Fin (Transferred to Suburban Water Systems)	0	0
California-American Water Company (San Marino System)	7,868.70	3.98144
California Country Club	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
California Domestic Water Company	11,024.82	5.57839
(Successor to:		
Cantrill Mutual Water Company	42.50	0.02150
Industry Properties, Ltd.	73.50	0.03719
Modern Accent Corporation	256.86	0.12997
Fisher, Russell)	19.00	0.00961
	11,416.68	5.77666
California Materials Company	0	0
Cantrill Mutual Water Company (Transferred to California Domestic Water Co.)	0	0
Cedar Avenue Mutual Water Company	121.10	0.06127
Champion Mutual Water Company	147.68	0.07472
Chronis, Christine (See Polopolus, et al)	-	-
Clayton Manufacturing Company	511.80	0.25896
Collison, E. O.	0	0
Comby, Erma M. (See Wilmott, Erma M.)	-	-
Conrock Company		
(Formerly Consolidated Rock Products Co.)	1,465.35	0.74144
(Successor to Manning Bros. Rock & Sand Co.)	328.00	0.16596
	1,793.35	0.90740
Consolidated Rock Products Co. (See Conrock Company)	-	-
Corcoran, Jack S.		
(Held in common with Corcoran, R. L.)		
(Transferred to:	747.00	0.37797
Cadway, Inc.	100.00	0.05060
Cadway, Inc.)	100.00	0.05060
	547.00	0.27677
Corcoran, R. L. (See Corcoran, Jack S.)	-	-
County Sanitation District No. 18 of Los Angeles County	4.50	0.00228

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Covell, et al. (Successor to Rittenhouse, Catherine and Rittenhouse, James) (Held in common with Jobe, Darr; Goedert, Lillian E.; Goedert, Marion W.; Lakin, Kendall R.; Lakin, Kelly R.; Snyder, Harry)	111.05	0.05619
Covina, City of	2,507.89	1.26895
(Transferred to Covina Irrigating Company)	1,734.00	0.87737
(Transferred to Covina Irrigating Company)	300.00	0.15179
	473.89	0.23979
Covina-Valley Unified School District (Transferred to Anderson, Ray)	0	0
Crevolin, A. J.	2.25	0.00114
Crocker National Bank, Executor of the Estate of A. V. Handorf (Transferred to Modern Accent Corp.)	0	0
Cross Water Company (Transferred to City of Industry)	0	0
Crown City Plating Company	190.00	0.09614
(Successor to Anchor Plating Co., Inc.)	10.00	0.00506
	200.00	0.10120
Davidson Optronics, Inc.	22.00	0.01113
Dawes, Mary Kay (Successor to Bahnsen, Betty M.)	441.90	0.22359
Del Rio Mutual Water Company	199.00	0.10069
Denton, Kathryn W., Trustee for San Jose Ranch Company (Transferred to White, June G., Trustee of the June G. White Share of the Garnier Trust)	0	0
Doyle, Mr. and Mrs.; and Madruga, Mr. and Mrs. (Successor to Sawpit Farms, Ltd.) (Transferred to Banks, Gale C.)	0	0
Driftwood Dairy	163.80	0.08288
Duhalde, L. (Transferred to El Monte Union High School District)	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Dunning, George (Held in common with Dunning, Vera H.) (Successor to Vera H. Dunning)	324.00	0.16394
Dunning, Vera H. (Transferred to George Dunning)	-	-
East Pasadena Water Company, Ltd.	1,407.69	0.71227
Eckis, Rollin (Successor to Sawpit Farms, Ltd.) (Transferred to City of Monrovia)	0	0
El Encanto Properties (Transferred to La Puente Valley County Water District)	0	0
El Monte, City of	2,784.23	1.40878
El Monte Cemetary Association	18.50	0.00936
El Monte Union High School District (Successor to Duhalde, L.) (Transferred to City of Whittier)	0	0
Everett, Mrs. Alda B. (Held in common with Everett, W. B., Executor of the Estate of I. Worth Everett)	0	0
Everett, W. B., Executor of the Estate of I. Worth Everett (See Everett, Mrs. Alda B.)	-	-
Faix, Inc. (Successor to Frank F. Pellissier & Sons, Inc.) (Transferred to Faix, Ltd.)	0	0
Faix, Ltd. (Successor to Faix, Inc.)	6,490.00	3.28384
First National Finance Corporation (Transferred to City of Arcadia)	0	0
Fisher, Russell (Held in common with Hauch, Edward and Warren, Clyde) (Transferred to California Domestic Water Company)	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Frank F. Pellissier & Sons, Inc. (Transferred to Faix, Inc.)	0	0
Fruit Street Water Company (Transferred to: Gifford, Brooks, Jr. City of La Verne)	0	0
Gifford, Brooks, Jr. (Successor to: Fruit Street Water Co., Mission Gardens Mutual Water Company) (Transferred to City of Whittier)	0	0
Gilkerson, Frank B. (Transferred to Jobe, Darr)	-	-
Glendora Unified High School District (Transferred to City of Glendora)	0	0
Goedert, Lillian E. (See Covell, et al)	-	-
Goedert, Marion W. (See Covell, et al)	-	-
Graham, William (Transferred to Darr Jobe)	-	-
Green, Walter	71.70	0.03628
Grizzle, Lissa B. (Held in common with Grizzle, Mervin A.; Wilson, Harold R.; Wilson, Sarah C.) (Transferred to City of Whittier)	0	0
Grizzle, Mervin A. (See Grizzle, Lissa B.)	0	0
Hansen, Alice	0.75	0.00038
Hartley, David	0	0
Hauch, Edward (See Fisher, Russell)	0	0
Hemlock Mutual Water Company	166.00	0.08399

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Hollenbeck Street Water Company (Transferred to Suburban Water Systems)	0	0
Hunter, Lloyd F. (Successor to R. Wade)	4.40	0.00223
Hydro-Conduit Corporation	0	0
Industry Waterworks System, City of (Successor to Cross Water Company)	1,103.00	0.55810
Industry Properties, Ltd. (Successor to A & E Plastik Pak Co., Inc.) (Transferred to California Domestic Water Co.)	0	0
J. F. Isbell Estate, Inc. (Transferred to Andrade, Macario and Consuelo; and Andrade, Robert and Jayne)	0	0
Jerris, Helen (See Polopolus, et al)	-	-
Jobe, Darr (See Covell, et al)	-	-
Kirklen Family Trust (Formerly Kirklen, Dawn L.) (Held in common with Kirklen, William R.) (Successor to San Dimas-La Verne Recreational Facilities Authority)	375.00 62.50 437.50	0.18974 0.03162 0.22136
Kirklen, Dawn L. (See Kirklen Family Trust)	-	-
Kirklen, William R. (See Kirklen, Dawn L.)	-	-
Kiyan, Hideo (Held in common with Kiyan, Hiro)	30.00	0.01518
Kiyan, Hiro (See Kiyan, Hideo)	-	-
Knight, Kathryn M. (Successor to William Knight)	227.88	0.11530
Knight, William (Transferred to Kathryn M. Knight)	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Lakin, Kelly R. (See Covell, et al)	-	-
Lakin, Kendall R. (See Covell, et al)	-	-
Landeros, John	0.75	0.00038
La Grande Source Water Company (Transferred to Suburban Water Systems)	0	0
Lang, Frank (Transferred to San Dimas-La Verne Recreational Facilities Authority)	0	0
La Puente Cooperative Water Company (Transferred to Suburban Water Systems)	0	0
La Puente Valley County Water District (Successor to El Encanto Properties)	1,097.00 33.40 1,130.40	0.55507 0.01690 0.57197
La Verne, City of (Successor to Fruit Street Water Co.)	250.00 105.71 355.71	0.12650 0.05349 0.17999
Lee, Paul M. and Ruth A.; Nasmyth, Virrginia; Nasmyth, John	0	0
Little John Dairy	0	0
Livingston-Graham, Inc.	1,824.40	0.92312
Los Flores Mutual Water Company (Transferred to City of Monterey Park)	0	0
Loucks, David	3.00	0.00152
Manning Bros. Rock & Sand Co. (Transferred to Conrock Company)	0	0
Maple Water Company	118.50	0.05996
Martinez, Frances Mercy (Held in common with Martinez, Jaime)	0.75	0.00038
Martinez, Jaime (See Martinez, Frances Mercy)	-	-
Massey-Ferguson Company	0	0

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Miller Brewing Company	111.01	0.05617
(Successor to:		
Maechtlen, Estate of J. J.	151.50	0.07666
Phillips, Alice B., et al)	50.00	0.02530
	312.51	0.15813
Mission Gardens Mutual Water Company (Transferred to Gifford, Brooks, Jr.)	0	0
Modern Accent Corporation (Successor to Crocker National Bank, Executor of the Estate of A. V. Handorf) (Transferred to California Domestic Water Co.)	0	0
Monterey Park, City of	6,677.48	3.37870
(Successor to Los Flores Mutual Water Co.)	26.60	0.01346
	6,704.08	3.39216
Murphy Ranch Mutual Water Company (Transferred to Southwest Suburban Water)	0	0
Namimatsu Farms (Transferred to California Cities Water Company)	0	0
Nick Tomovich & Sons	0.02	0.00001
No. 17 Walnut Place Mutual Water Co. (Transferred to San Gabriel Valley Water Company)	0	0
Orange Production Credit Association	0	0
Owl Rock Products Co.	715.60	0.36208
Pacific Rock & Gravel Co. (Transferred to: City of Whittier Rose Hills Memorial Park Association)	0	0
Park Water Company (Transferred to Valley County Water District)	0	0
Penn, Margaret (See Polopolus, et al)	-	-
Pico County Water District	0.75	0.00038
Polopolus, John (See Polopolus, et al)	-	-

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Polopolus, et al (Successor to Polopolus, Steve) (Held in common with Chronis, Christine; Jerris, Helen; Penn, Margaret; Polopolus, John)	22.50	0.01138
Polopolus, Steve (Transferred to Polopolus, et al)	-	-
Rados, Alexander (Held in common with Rados, Stephen and Rados, Walter)	43.00	0.02176
Rados, Stephen (See Rados, Alexander)	-	-
Rados, Walter (See Rados, Alexander)	-	-
Richwood Mutual Water Company	192.60	0.09745
Rincon Ditch Company	628.00	0.31776
Rincon Irrigation Company	314.00	0.15888
Rittenhouse, Catherine (Transferred to Covell, Ralph)	0	0
Rittenhouse, James (Transferred to Covell, Ralph)	0	0
Rose Hills Memorial Park Association (Successor to Pacific Rock & Gravel Co.)	594.00 200.00 794.00	0.30055 0.10120 0.40175
Rosemead Development, Ltd. (Successor to Thompson, Earl W.)	1.00	0.00051
Rurban Homes Mutual Water Company	217.76	0.11018
Ruth, Roy	0.75	0.00038
San Dimas-La Verne Recreational Facilities Authority (Successor to Lang, Frank) (Transferred to Kirklen, Dawn L. and William R.)	0	0
San Gabriel Country Club	286.10	0.14476
San Gabriel County Water District	4,250.00	2.15044

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
San Gabriel Valley Municipal Water District	0	0
San Gabriel Valley Water Company (Successor to:	16,659.00	8.42920
Vallecito Water Co.	2,867.00	1.45066
No. 17 Walnut Place Mutual Water Co.)	21.50	0.01088
	19,547.50	9.89074
Sawpit Farms, Limited (Transferred to: Eckis, Rollin Doyle and Madruga)	0	0
Schneiderman, Alan (See Birenbaum, Max)	-	-
Schneiderman, Lydia (See Birenbaum, Max)	-	-
Security Pacific National Bank, Co-Trustee for the Estate of Winston F. Stoody (See Stoody, Virginia A.) (Transferred to City of Whittier)	0	0
Sierra Madre, City of	0	0
Sloan Ranches	129.60	0.06558
Smith, Charles	0	0
Snyder, Harry (See Covell, et al)	-	-
Sonoco Products Company	311.60	0.15766
South Covina Water Service	992.30	0.50209
Southern California Edison Company	155.25	0.07855
(Successor to: Associated Southern Investment Company)	16.50	0.00835
	171.75	0.08690
Southern California Water Company, San Gabriel Valley District	5,773.00	2.92105
South Pasadena, City of	3,567.70	1.80520
Southwest Suburban Water (See Suburban Water Systems)	-	-

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Southwestern Portland Cement Company (Successor to Azusa Western, Inc.)	742.00	0.37544
Speedway 605, Inc.	0	0
Standard Oil Company of California	2.00	0.00101
Sterling Mutual Water Company	120.00	0.06072
Stoody, Virginia A., Co-Trustee for the Estate of Winston F. Stoody (See Security Pacific National Bank, Co-Trustee)	-	-
Suburban Water Systems (Formerly Southwest Suburban Water) (Successor to:	20,462.47	10.35370
Hollenbeck Street Water Company	646.39	0.32706
La Grande Source Water Company	1,078.00	0.54545
La Puente Cooperative Water Co.	1,210.90	0.61270
Valencia Valley Water Company	651.50	0.32965
Victoria Mutual Water Company	469.60	0.23761
Cal Fin	118.10	0.05976
Murphy Ranch Mutual Water Co.	223.23	0.11295
	24,860.19	12.57888
Sully-Miller Contracting Company (Successor to Blue Diamond Concrete Materials Division, The Flintkote Co.)	1,399.33	0.70804
Sunny Slope Water Company	2,228.72	1.12770
Taylor Herb Garden (Transferred to Covina Irrigating Company)	0	0
Texaco, Inc.	50.00	0.02530
Thompson, Earl W. (Held in common with Thompson, Mary) (Transferred to Rosemead Development, Ltd.)	0	0
Thompson, Mary (See Thompson, Earl W.)	-	-
Tyler Nursery	3.21	0.00162
United Concrete Pipe Corporation (See U. S. Pipe & Foundry Company)	-	-

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
U. S. Pipe & Foundry Company (Formerly United Concrete Pipe Corporation)	376.00	0.19025
Valencia Heights Water Company	861.00	0.43565
Valencia Valley Water Company (Transferred to Suburban Water Systems)	0	0
Vallecito Water Company (Transferred to San Gabriel Valley Water Company)	0	0
Valley County Water District (Formerly Baldwin Park County Water District) (Successor to Park Water Company)	5,775.00 184.01 5,959.01	2.92206 0.09311 3.01517
Valley Crating Company	0	0
Valley View Mutual Water Company	616.00	0.31169
Via, H. (See Via, H., Trust of)	-	-
Via, H., Trust of (Formerly Via, H.)	46.20	0.02338
Victoria Mutual Water Company (Transferred to Suburban Water Systems)	0	0
Wade, R. (Transferred to Lloyd F. Hunter)	0	0
Ward Duck Company	1,217.40	0.61599
Warren, Clyde (See Fisher, Russell)	-	-
W. E. Hall Company	0.20	0.00010
White, June G., Trustee of the June G. White Share of the Garnier Trust (Successor to Denton, Kathryn W., Trustee for the San Jose Ranch Company)	185.50	0.09386

Pumper	Prescriptive Pumping Right Acre-feet	Pumper's Share %
Whittier, City of	7,620.23	3.85572
(Successor to:		
Grizzle, Lissa B.	184.00	0.09310
Pacific Rock and Gravel Co.)	208.00	0.10524
Security Pacific National Bank, Co-Trustee for the Estate of Winston F. Stoody	38.70	0.01958
El Monte Union High School District	16.20	0.00820
Gifford, Brooks, Jr.	198.25	0.10031
Birenbaum, Max)	6.00	0.00304
	8,271.38	4.18519
Wigodsky, Bernard (See Birenbaum, Max)	-	-
Wigodsky, Estera (See Birenbaum, Max)	-	-
Wilmott, Erma M. (Formerly Comby, Erma M.)	0.75	0.00038
Wilson, Harold R. (See Grizzle, Lissa B.)	-	-
Wilson, Sarah C. (See Grizzle, Lissa B.)	-	-
Woodland, Frederick G.	-	-
Woodland, Richard (Successor to: Bahnsen and Beckman Ind., Inc.)	840.50	0.42528
Totals for Exhibit "D"	166,800.68	78.83276
Totals from Exhibit "E"	41 833.75 ~~38,626.25~~	21.16724 ~~19.54431~~
GRAND TOTALS	197,634.43	100.00000

TABLE
SHOWING PRODUCTION RIGHTS OF EACH INTEGRATED PRODUCER
AS OF JUNE 1988

Party	Diversion Component Acre-feet	Prescriptive Pumping Component Acre-feet	Pumping Component Share Percent (%)
Azusa Agricultural Water Company	1,000.00	1,732.20	0.87647
Azusa Foot-Hill Citrus Water Company (Transfered to Monrovia Nursery Company)	0	0	0
Azusa Valley Water Company	2,422.00	8,274.00	4.18652
California-American Water Company (Duarte System)	1,672.00	3,649.00	1.84634
California Cities Water Company (See Southern California Water Company, San Dimas District)	-	-	-
Covina Irrigating Company	2,514.00	4,140.00	2.09478
(Successor to:			
City of Covina,		1,734.00	0.87737
City of Covina, and		300.00	0.15179
Taylor Herb Garden)		6.00	0.00304
	2,514.00	6,180.00	3.12698
Glendora, City of	17.00	8,258.00	4.17842
(Successor to:			
Maechtlen, Estate of J. J.,		150.00	0.07590
Maechtlen, Trust of P. A.,		50.00	0.02530
Ruebhausen, Arline, and	18.34		
Glendora Unified High School District)		9.00	0.05009
	35.34	8,557.00	4.32971
Los Angeles, County of	310.00	3,721.30	1.88292
Maechtlen, Estate of J. J.	0	301.50	0.15256
(Transferred to:			
City of Glendora		-150.00	-0.07590
Miller Brewing Company)		-151.50	-0.07666
	0	0	0

Exhibit "E"

Party	Diversion Componet Acre-feet	Prescriptive Pumping Component Acre-feet	Pumping Component Share %
Maechtlen, Estate of J. J.	1.49	0	0
Maechtlen, Trust of P. A.	0.50	100.50	0.05085
(Transferred to:			
City of Glendora		-50.00	-0.02530
Alice B. Phillips, et al)	-0.50	-50.50	-0.02555
	0	0	0
The Metropolitan Water District of Southern California	9.59	165.00	0.08349
Monrovia, City of	1,098.00	5,042.22	2.55129
(Sucessor to:			
Eckis, Rollin		123.00	0.06224
City of Arcadia)		951.00	0.48119
	1,098.00	6,116.22	3.09472
Monrovia, Nursery Company	239.50	0	0
(Successor to:			
Azusa Foot-Hill Citrus Co.)	718.50	0	
Phillips, Alice B., et al			
(Successor to:			
Maechtlen, Trust of P. A.)	0.50	50.50	0.02530
(Transferred to:			
Miller Brewing Company)		-50.00	-0.02530
	0.50	0.50	0.00025
Southern California Water Company (San Dimas Dist.)	500.00	3,242.53	1.64076
(Formerly California Cities Water Company)			
(Successor to:			
Namimatsu Farms)		196.00	0.09917
	500.00	3,438.53	1.73984
TOTAL for Exhibit "E"	10,520.92	41,833.75	21.16724

Exhibit "F"

TABLE SHOWING
SPECIAL CATAGORY RIGHTS

PARTY	Nature of Right
The Metropolitan Water District of Southern California	Morris Reservoir Storage and Withdrawal (a) A right to divert, store and use San Gabriel River Water, pursuant to Permit No. 7174. (b) Prior and paramount right to divert 72 acre-feet annually to offset Morris Reservoir evaporation and seepage losses and to provide the water supply necessary for presently existing incidential Morris Dam facilities.
Los Angeles County Flood Control District (Now Los Angeles County Department of Public Works)	Puddingstone Reservoir Prior Prescriptive right to divert water from San Dimas Wash for storage in Puddingstone Reservoir in quantities sufficient to offset annual evaporation and seepage losses of the reservoir at approximate elevation 942.

Exhibit "G"

TABLE SHOWING NON-CONSUMPTIVE USERS

Party	Nature of Right
Covina Irrigating Company Azusa Valley Water Company Azusa Agricultural Water Co. Azusa Foot-Hill Citrus Co. Monrovia Nursery Company	"Committee-of-Nine" Spreading Right To continue to divert water from the San Gabriel River pursuant to the 1888 Settlement, and to spread in spreading grounds within the Basin all water thus diverted without the right to recapture water in excess of said parties' rights as adjudicated in Exhibit "E".
California-American Water Company (Duarte System)	Spreading Right To continue to divert water from the San Gabriel River pursuant to the 1888 Settlement, and to continue to divert water from Fish Canyon and to spread said waters in its spreading grounds in the Basin without the right to recapture water in excess of said party's rights as adjudicated in Exhibit "E".
City of Glendora	Spreading Right To continue to spread the water of Big and Little Dalton Washes, pursuant to License No. 2592 without the right to recapture water in excess of said party's rights as adjudicated in Exhibit "E".
San Gabriel Valley Protective Association	Spreading Right To continue to spread San Gabriel River water pursuant to License Nos. 9991 and 12,209, without the right to recapture said water.
California Cities Water Company	Spreading Right To continue to spread waters from San Dimas Wash without the right to recapture water in excess of said party's rights as adjudicated in Exhibit "E".
Los Angeles County Flood Control District	Temporary storage of storm flow for regulatory purposes; Spreading and conservation for general benefit in streambeds, reservoirs and spreading grounds without the right to recapture said water. Maintenance and operation of dams and other flood control works.

EXHIBIT "H"

WATERMASTER OPERATING CRITERIA

1. Basin Storage Capacity. The highest water level at the end of a water year during the past 40 years was reached at the Key Well on September 30, 1944 (elevation 316). The State of California, Department of Water Resources, estimates that as of that date, the quantity of fresh water in storage in the Basin was approximately 8,600,000 acre-feet. It is also estimated by said Department that by September 30, 1960, the quantity of fresh water in storage had decreased to approximately 7,900,000 acre-feet (elevation 237) at the Key Well).

The lowest water level at the end of a water year during the past 40 years was reached at the Key Well on September 30, 1965 (elevation 209). It is estimated that the quantity of fresh water in storage in the Basin on that date was approximately 7,700,000 acre-feet.

Thus, the maximum utilization of Basin storage was approximately 900,000 acre-feet, occurring between September 30, 1944, and September 30, 1965 (between elevations 316 and 209 at the Key Well). This is not to say that more than 900,000 acre-feet of storage space below the September 30, 1944 water levels cannot be utilized. However, it demonstrates that pumpers have deepened their wells and lowered their pumps so that such 900,000 acre-feet of storage can be safely and economically utilized.

The storage capacity of the Basin between elevations of 200 and 250 at the Key Well represents a usable volume of approximately 400,000 acre-feet of water.

2. Operating Safe Yield and Spreading. Watermaster in determining Operating Safe Yield and the importation of Replacement Water shall be guided by water level elevations in the Basin. He shall give recognition to, and base his operations on, the following general objectives insofar as practicable:

(a) The replenishment of ground water from sources of supplemental water should not cause excessively high levels of ground water and such replenishment should not cause undue waste of local water supplies.

(b) Certain areas within the Basin are not at the present time capable of being recharged with supplemental water. Efforts should be made to provide protection to such areas from excessive ground water lowering either through the "in lieu" provisions of the Judgment or by other means.

(c) Watermaster shall consider and evaluate the long-term consequences on ground water quality, as well as quantity, in determining and establishing Operating Safe Yield. Recognition shall be given to the enhancement of ground water quality insofar as practicable, especially in the area immediately upstream of Whittier Narrows where degradation of water quality may occur when water levels at the Key Well are maintained at or below elevation 200.

(d) Watermaster shall take into consideration the comparative costs of supplemental and Make-up Water in determining the savings on a present value basis of temporary or permanent lowering or raising of water levels and other economic data and analyses indicating both the short-term and long-term propriety of adjusting Operating Safe Yield in order to derive optimum water levels during any period. Watermaster shall utilize the provisions in the Long Beach Judgment which will result in the least cost of delivering Make-up Water.

3. Replacement Water -- Sources and Recharge Criteria. The following criteria shall control purchase of Replacement Water and Recharge of the Basin by Watermaster.

(a) Responsible Agency From Which to Purchase. Watermaster, in determining the Responsible Agency from which to purchase supplemental water for replacement purposes, shall be governed by the following:

(1) Place of Use of Water which is used primarily within the Basin or by cities within San Gabriel District in areas within or outside the Basin shall control in determining the Responsible Agency. For purposes of this subparagraph, water supplied through a municipal water system which lies chiefly within the Basin shall be deemed entirely used within the Basin; and

(2) Place of production of water shall control in determining the Responsible Agency as to water exported from the Basin, except as to use within San Gabriel District.

Any Responsible Agency may, at the request of Watermaster, waive its right to act as the source for such supplemental water, in which case Watermaster shall be free to purchase such water from the remaining Responsible Agencies which are the most beneficial and appropriate sources; provided, however, that a Responsible Agency shall not authorize any sale of water in violation of the California Constitution.

(b) Water Quality. Watermaster shall purchase the best quality of supplemental water available for replenishment of the Basin, pursuant to subsection (a) hereof.

(c) Reclaimed Water. It is recognized that the technology and economic and physical necessity for utilization of reclaimed water is increasing. The purchase of reclaimed water in accordance with the Long Beach Judgment to satisfy the Make-up Obligation is expressly authorized. At the same time, water quality problems involved in the reuse of water within the Basin pose serious questions of increased costs and other problems to the pumpers, their customers and all water users. Accordingly, Watermaster is authorized to gather information, make and review studies, and make recommendations on the feasibility of the use of reclaimed water for replacement purposes; provided that no reclaimed water shall be recharged in the Basin by Watermaster without the prior approval of the court, after notice to all parties and hearing thereon.

4. Replacement Assessment Rates. The Replacement Assessment rates shall be in an amount calculated to allow Watermaster to purchase one acre-foot of supplemental water for each acre-foot of excess Production to which such Assessment applies.

EXHIBIT "J"

PUENTE NARROWS AGREEMENT

THIS AGREEMENT is made and entered into as of the 8th day of May, 1972, by and between PUENTE BASIN WATER AGENCY, herein called "Puente Agency", and UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT, herein called "Upper District".

A. RECITALS

1. Puente Agency. Puente Agency is a joint powers agency composed of Walnut Valley Water District, herein called "Walnut District", and Rowland Area County Water District, herein called "Rowland District". Puente Agency is formed for the purpose of developing and implementing a ground water basin management program for Puente Basin. Pursuant to said purpose, said Agency is acting as a representative of its member districts and of the water users and water right claimants therein in the defense and maintenance of their water rights within Puente Basin.

2. Upper District. Upper District is a municipal water district overlying a major portion of the Main San Gabriel Basin. Upper District is plaintiff in the San Gabriel Basin Case, wherein it seeks to adjudicate rights and implement a basin management plan for the Main San Gabriel Basin.

3. Puente Basin is a ground water basin tributary to the Main San Gabriel Basin. Said area was included within the scope of the San Gabriel Basin Case and substantially

all water rights claimants within Puente Basin were joined as defendants therein. The surface contribution to the Main San Gabriel Basin from Puente Basin is by way of the paved flood control channel of San Jose Creek, which passes through Puente Basin from the Pomona Valley area. Subsurface outflow is relatively limited and moves from the Puente Basin to the Main San Gabriel Basin through Puente Narrows.

4. Intent of Agreement. Puente Agency is prepared to assure Upper District that no activity within Puente Basin will hereafter be undertaken which will (1) interfere with surface flows in San Jose Creek, or (2) impair the subsurface flow from Puente Basin to the Main San Gabriel Basin. Walnut District and Rowland District, by operation of law and by express assumption endorsed hereon, assume the covenants of this agreement as a joint and several obligation. Based upon such assurances and the covenants hereinafter contained in support thereof, Upper District consents to the dismissal of all Puente Basin parties from the San Gabriel Basin Case. By reason of said dismissals, Puente Agency will be free to formulate a separate water management program for Puente Basin.

B. DEFINITIONS AND EXHIBITS

5. Definitions. As used in this Agreement, the following terms shall have the meanings herein set forth:

(a) Annual or Year refers to the fiscal year July 1 through June 30.

(b) Base Underflow. The underflow through

Exhibit "J"

Puente Narrows which Puente Agency agrees to maintain, and on which accrued debits and credits shall be calculated.

(c) Make-up Payment. Make-up payments shall be an amount of money payable to the Watermaster appointed in the San Gabriel Basin Case, sufficient to allow said Watermaster to purchase replacement water on account of any accumulated deficit as provided in Paragraph 9 hereof.

(d) Puente Narrows. The subsurface geologic constriction at the downstream boundary of Puente Basin, located as shown on Appendix "B".

(e) Main San Gabriel Basin, the ground water basin shown and defined as such in Exhibit "A" to the Judgment in the San Gabriel Basin Case.

(f) San Gabriel Basin Case. Upper San Gabriel Valley Municipal Water District v. City of Alhambra, et al., L. A. Sup. Ct. No. 924128, filed January 2, 1968.

6. Appendices. Attached hereto and by this reference made a part hereof are the following appendices:

"A" -- Location Map of Puente Basin, showing major geographic, geologic, and hydrologic features.

"B" -- Map of Cross-Section Through Puente Narrows, showing major physical features and location of key wells.

Exhibit "J"

"C" -- Engineering Criteria, being a description of a method of measurement of subsurface outflow to be utilized for Watermaster purposes.

C. COVENANTS

7. Watermaster. There is hereby created a two member Watermaster service to which each of the parties to this agreement shall select one consulting engineer. The respective representatives on said Watermaster shall serve at the pleasure of the governing body of each appointing party and each party shall bear its own Watermaster expense.

a. Organization. Watermaster shall perform the duties specified herein on an informal basis, by unanimous agreement. In the event the two representatives are unable to agree upon any finding or decision, they shall select a third member to act, pursuant to the applicable laws of the State of California. Thereafter, until said issue is resolved, said three shall sit formally as a board of arbitration. Upon resolution of the issue in dispute, the third member shall cease to function further.

b. Availability of Information. Each party hereto shall, for itself and its residents and water users, use its best efforts to furnish all appropriate information to the Watermaster in order that the required determination can be made.

c. Cooperation With Other Watermasters. Watermaster hereunder shall cooperate and coordinate activities with the Watermasters appointed in the San Gabriel Basin Case and in Long Beach v. San Gabriel Valley Water Company, et al.

d. Determination of Underflow. Watermaster shall annually determine the amount of underflow from Puente Basin to the San Gabriel Basin, pursuant to Engineering Criteria.

e. Perpetual Accounting. Watermaster shall maintain a perpetual account of accumulated base underflow, accumulated subsurface flow, any deficiencies by reason of interference with surface flows, and the offsetting credit for any make-up payments. Said account shall annually show the accumulated credit or debit in the obligation of Puente Agency to Upper District.

f. Report. Watermaster findings shall be incorporated in a brief written report to be filed with the parties and with the Watermaster in the San Gabriel Basin Case. Said report shall contain a statement of the perpetual account heretofore specified.

8. Base Underflow. On the basis of a study and review of historic underflow from Puente Basin to the Main San Gabriel Basin, adjusted for the effect of the paved flood control channel and other relevant considerations, it is

mutually agreed by the parties that the base underflow is and shall be 580 acre feet per year, calculated pursuant to Engineering Criteria.

9. Puente Agency's Obligation. Puente Agency covenants, agrees and assumes the following obligation hereunder:

a. Noninterference with Surface Flow. Neither Puente Agency nor any persons or entities within the corporate boundaries of Walnut District or Rowland District will divert or otherwise interfere with or utilize natural surface runoff now or hereafter flowing in the storm channel of San Jose Creek; provided, however, that this covenant shall not prevent the use, under Watermaster supervision, of said storm channel by the Puente Agency or Walnut District or Rowland District for transmission within Puente Agency of supplemental or reclaimed water owned by said entities and introduced into said channel solely for transmission purposes. In the event any unauthorized use of surface flow in said channel is made contrary to the covenant herein provided, Puente Agency shall compensate Upper District by utilizing any accumulated credit or by make-up payment in the same manner as is provided for deficiencies in subsurface outflow from Puente Basin.

b. Subsurface Outflow. To the extent that the accumulated subsurface outflow falls below the accumulated base underflow and the result thereof is an accumulated deficit in the Watermaster's annual accounting, Puente Agency agrees to provide make-up payments during the next year in an amount not less than one-third of the accumulated deficit.

c. Purchase of Reclaimed Water. To the extent that Puente Agency or Walnut District or Rowland District may hereafter purchase reclaimed water from the facilities of Sanitation District 21 of Los Angeles County, such purchaser shall use its best efforts to obtain waters originating within San Gabriel River Watershed.

10. Puente Basin Parties Dismissal. In consideration of the assumption of the obligation hereinabove provided by Puente Agency, Upper District consents to entry of dismissals as to all Puente Basin parties in San Gabriel Basin Case. This agreement shall be submitted for specific approval by the Court and a finding that it shall operate as full satisfaction of any and all claims by the parties within Main San Gabriel Basin against Puente Basin parties by reason of historic surface and subsurface flow.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed as of the day and date first above written.

Approved as to form:
CLAYSON, STARK, ROTHROCK & MANN

By ______________________
Attorneys for Puente Agency

PUENTE BASIN AGENCY

By ______________________
EDMOND M. BIEDERMAN
President

Approved as to form:

By ______________________
Attorney for Upper District

UPPER SAN GABRIEL VALLEY
MUNICIPAL WATER DISTRICT

By ______________________
Howard H. Hawkins
President

The foregoing agreement is approved and accepted, and the same is acknowledged as the joint and several obligation of the undersigned.

Approved as to form:

____
Attorney for Walnut District

WALNUT VALLEY WATER DISTRICT

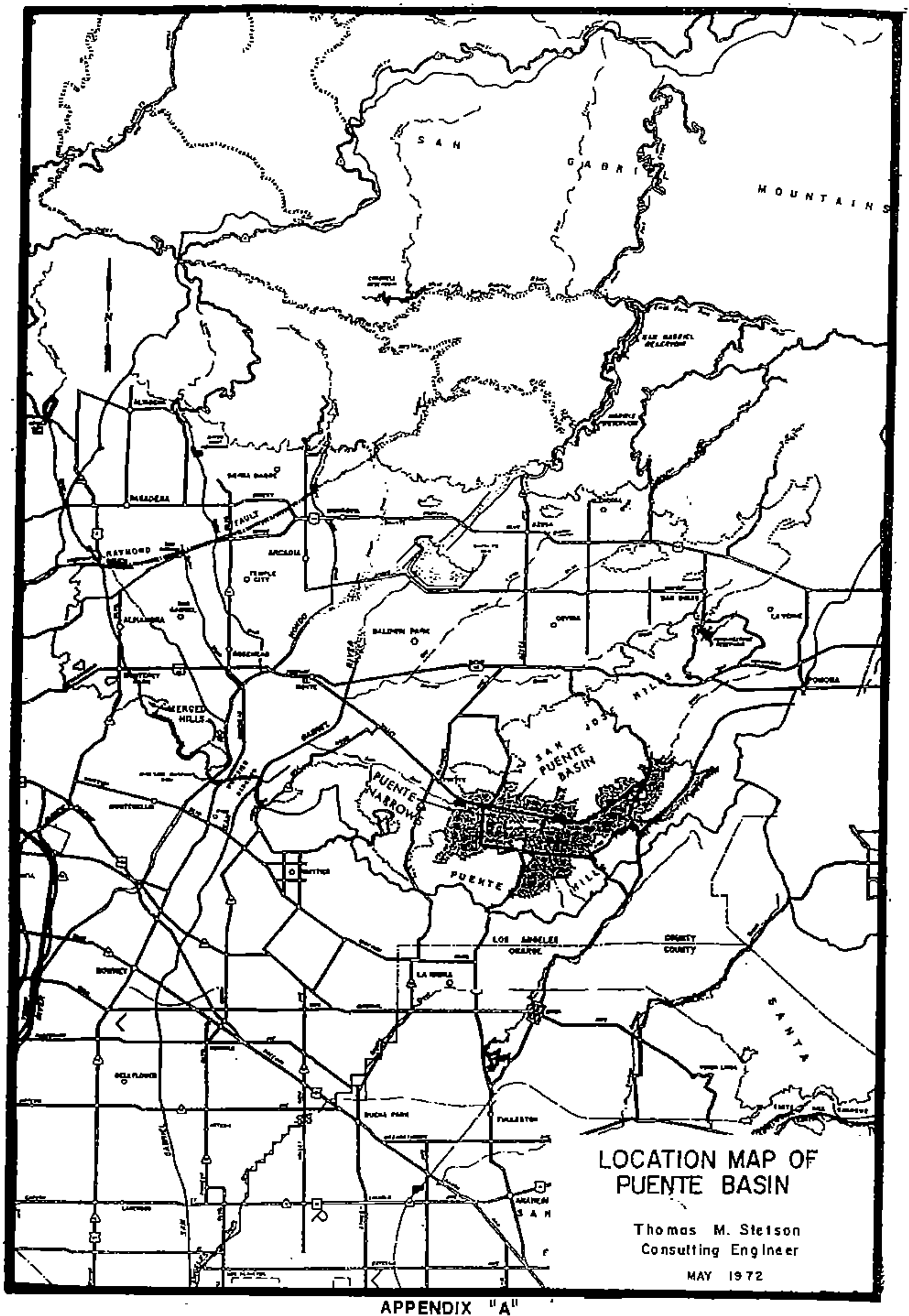
By ______________________
J. P. BOURDET
Vice President

Approved as to form:

____
Attorneys for Rowland District

ROWLAND AREA COUNTY WATER
DISTRICT

By ______________________
President
Wm. A. Simmons

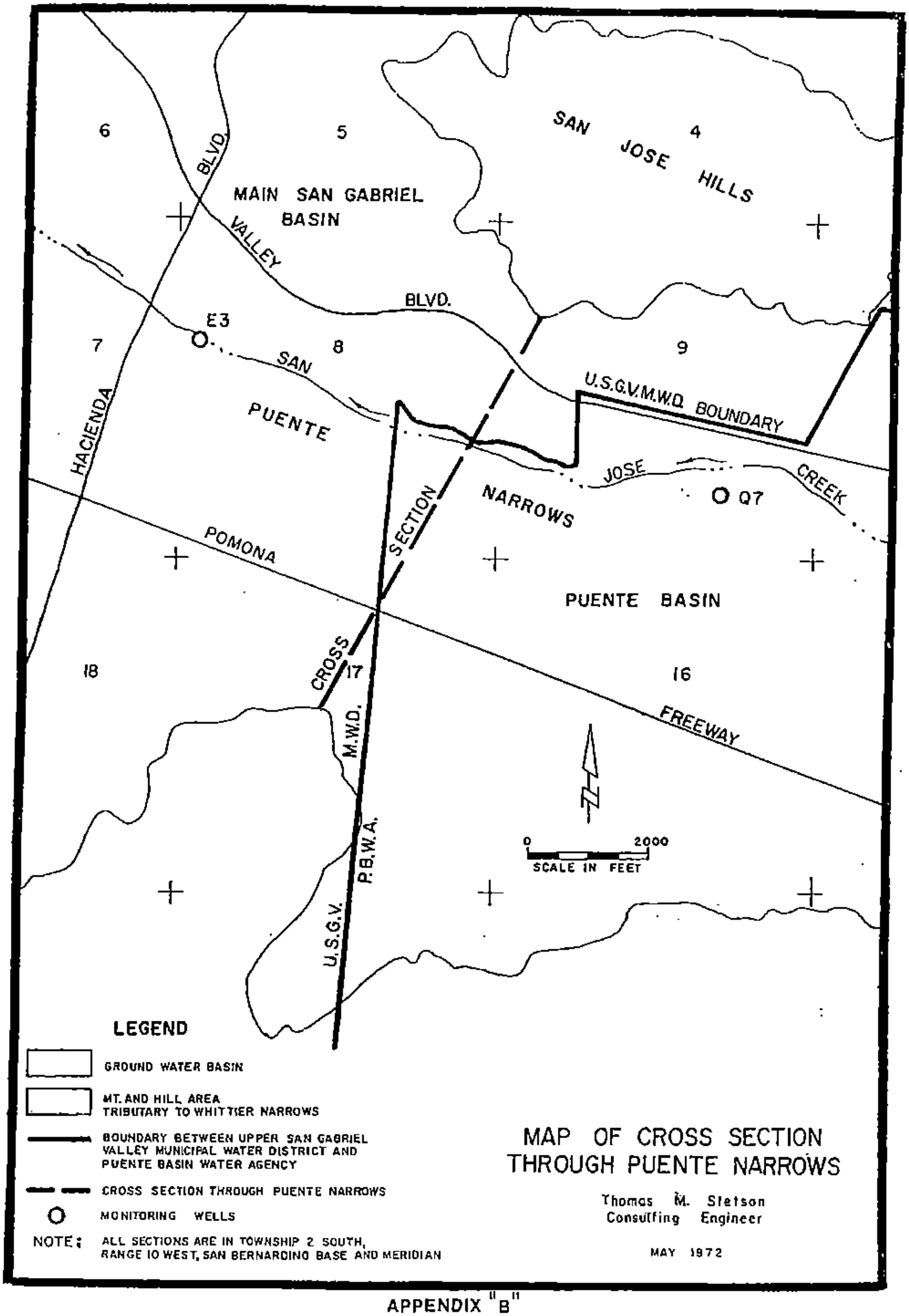


LOCATION MAP OF PUENTE BASIN

Thomas M. Stetson
Consulting Engineer

MAY 1972

APPENDIX "A"
EXHIBIT "J"



MAP OF CROSS SECTION THROUGH PUENTE NARROWS

Thomas M. Stetson
Consulting Engineer

MAY 1972

ENGINEERING CRITERIA

APPENDIX "C"

1. Monitoring Wells. The wells designated as State Wells No. 2S/10W-9Q7 and 2S/10W-8E3 and Los Angeles County Flood Control District Nos. 3079M and 3048B, respectively, shall be used to measure applicable ground water elevations. In the event either monitoring well should fail or become unrepresentative, a substitute well shall be selected or drilled by Watermaster. The cost of drilling a replacement well shall be the obligation of the Puente Agency.

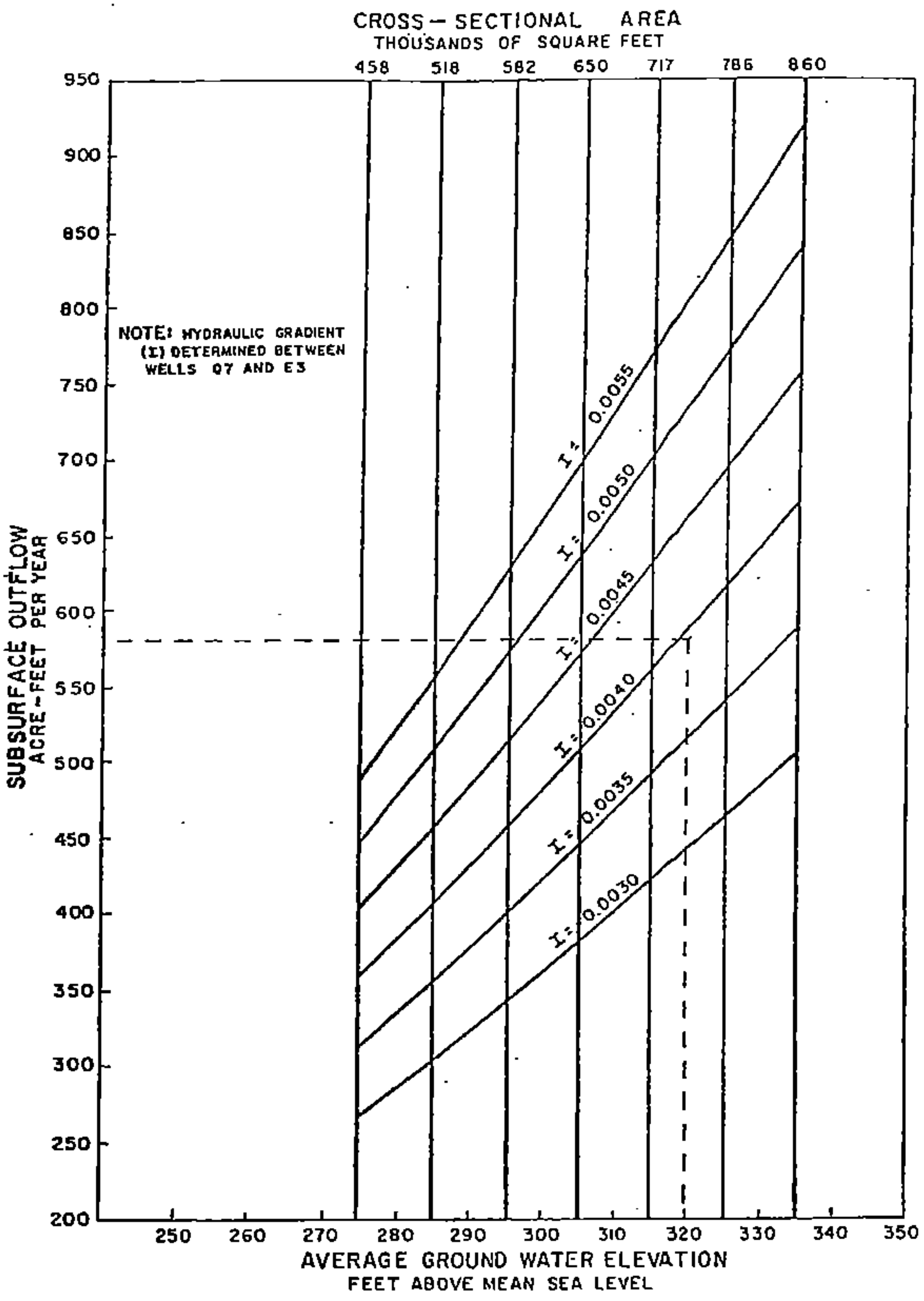
2. Measurement. Each monitoring well shall be measured and the ground water elevation determined semi-annually on or about April 1 and October 1 of each year. Prior to each measurement, the pump shall be turned off for a sufficient period to insure that the water table has recovered to a static or near equilibrium condition.

3. Hydraulic Gradient. The hydraulic gradient, or slope of the water surface through Puente Narrows, shall be calculated between the monitoring wells as the difference in water surface elevation divided by the distance, approximately 9,000 feet, between the wells. The hydraulic gradient shall be determined for the spring and fall and the average hydraulic gradient calculated for the year.

4. Ground Water Elevation at Puente Narrows Cross Section. The ground water elevation at the Puente Narrows

cross section midway between the monitoring wells shall be the average of the ground water elevation at the two wells. This shall be determined for the spring and fall and the average annual ground water elevation calculated for the year.

5. Determination of Underflow. The chart attached is a photo-reduction of a full scale chart on file with the Watermaster. By applying the appropriate average annual hydraulic gradient (I) to the average annual ground water elevation at the Puente Narrows cross section (involving the appropriate cross-sectional area [A]), it is possible to read on the vertical scale the annual acre feet of underflow.



RELATIONSHIP OF AVERAGE GROUND WATER ELEVATION AT PUENTE NARROWS AND APPLICABLE CROSS-SECTIONAL AREA WITH SUBSURFACE OUTFLOW THROUGH PUENTE NARROWS FOR VARIOUS HYDRAULIC GRADIENTS

Thomas M. Stetson
Consulting Engineer
MAY 1972

EXHIBIT "K"

OVERLYING RIGHTS

I. NATURE OF OVERLYING RIGHT

An "Overlying Right" is the right to Produce water from the Main San Gabriel Basin for use on the overlying lands hereinafter described. Such rights are exercisable without quantitative limit only on said overlying land and cannot be separately conveyed or transferred apart therefrom. The exerciser of such right is assessable by Watermaster as provided in Paragraph 21 of the Amended Judgment herein (prior Paragraph 14.5 of the Judgment herein) and is subject to the other provisions of said Paragraph.

II. OVERLYING LANDS (Description)

The overlying lands to which Overlying Rights are appurtenant are described as follows:

> "Those portions of Lots 1 and 2 of the lands formerly owned by W.A. Church, in the Rancho San Francisquito, in the City of Irwindale, County of Los Angeles, State of California, as shown on recorder's filed map No. 509, in the office of the County Recorder of said County, lying northeasterly of the northeasterly line and its southeasterly prolongation of Tract 1888, as shown on map recorded in Book 21 page 183 of Maps, in the office of the County Recorder of said County.
>
> "EXCEPT the portions thereof lying northerly and northwesterly of the center line of Arrow Highway described 'Sixth' and the center line of Live Oak Avenue described 'Third' in a final decree of condemnation, a certified copy of which was recorded August 18, 1933 as Instrument No. 354, in Book 12289, Page 277, Official Records.
>
> "ALSO EXCEPT that portion of said land described in the final decree of condemnation entered in Los Angeles County Superior Court Case No. 805008, a certified copy of which was recorded September 21, 1964, as Instrument No. 3730, in Book D-2634, Page 648, Official Records."

III. PRODUCERS ENTITLED TO EXERCISE OVERLYING RIGHTS AND THEIR RESPECTIVE CONSUMPTIVE USE PORTIONS

The persons entitled to exercise Overlying Rights are both the owners of Overlying Rights and persons and entities licensed by such owners to exercise such Overlying Rights. The persons entitled to exercise Overlying Rights and their respective Consumptive Use portions are as follows:

OWNER PRODUCERS	CONSUMPTIVE USE PORTION
BROOKS GIFFORD, SR. BROOKS GIFFORD, JR. PAUL MNOIAN JOHN MGRDICHIAN J. EARL GARRETT	3.5 acre-feet per year
Present User: Nu-Way Industries	
PRODUCERS UNDER LICENSE	
A. WILLIAM C. THOMAS and EVELYN F. THOMAS, husband and wife, and MALCOLM K. GATHERER and JACQUELINE GATHERER, husband and wife, doing business by and through B & B REDI-I-MIX CONCRETE, INC., a corporation	45.6 acre-feet per year
B. PRE-STRESS CRANE RIGGING & TRUCK CO., INC., a corporation	1.0 acre-foot per year
Present Users: Pre-Stress Crane Rigging & Truck Co., Inc., a corporation	
Total	50.1 acre-feet per year

IV. ANNUAL GROSS AMOUNT OF PRODUCTION FROM WHICH CONSUMPTIVE USE PORTIONS WERE DERIVED	183.65 acre-feet

Exhibit "L"

LIST OF PRODUCERS AND THEIR DESIGNEES
June, 1989

Producer Name	Designee
A	
Adams Ranch Mutual Water Company	Goji Iwakiri
Alhambra, City of	T. E. Shollenberger
Amarillo Mutual Water Company	Ester Guadagnolo
Anderson, Ray	Ray Anderson
Andrade, Macario, et al.	Macario R. Andrade
Arcadia, City of	Eldon Davidson
AZ-Two, Inc.	R. S. Chamberlain
Azusa, City of	William H. Redcay
Azusa Ag. Water Company	Robert E. Talley
Azusa Valley Water Company	Edward Heck
B	
Baldwin Park County Water District (See Valley County Water District)	-
Banks, Gale C.	Gale C. Banks
Base Line Water Company	Everett W. Hughes, Jr.
Beverly Acres Mutual Water User's Assn. (Formerly Beverly Acres Mutual Water Co.)	Eloise A. Moore
Burbank Development Company	Darrell A. Wright
C	
Cadway, Inc.	P. Geoffrey Nunn
California-American Water Company (San Marino System)	Andrew A. Krueger
California-American Water Company (Duarte System)	Andrew A. Krueger
California Country Club	Henri F. Pellissier
California Domestic Water Company	P. Geoffrey Nunn
Cedar Avenue Mutual Water Company	Austin L. Knapp

Exhibit "L"

Producer Name	Designee
Champion Mutual Water Company	Margaret Bauwens
Chevron, USA, Inc.	Ms. Margo Bart
Clayton Manufacturing Company	Don Jones
Conrock Company	Gene R.Block
Corcoran Brothers	Ray Corcoran
County Sanitation District No. 18	Charles W. Curry
Covell, et al.	Darr Jobe
Covell, Ralph	Ralph Covell
Covina, City of	Wayne B. Dowdey
Covina Irrigating Company	William R. Temple
Crevolin, A. J.	A. J. Crevolin
Crown City Plating Company	N. G. Gardner
D	
Davidson Optronics, Inc.	James McBride
Dawes, Mary Kay	Mary Kay Dawes
Del Rio Mutual Water Company	Gonzalo Galindo
Driftwood Dairy	James E. Dolan
Dunning, George	George Dunning
E	
East Pasadena Water Company	Robert D. Mraz
El Monte, City of	Robert J. Pinniger
El Monte Cemetery Association	Linn E. Magoffin
F	
Faix, Ltd.	Henri F. Pellissier
G	
Glendora, City of	Arthur E. Cook
Green, Walter	Dr. Walter Green
H	
Hansen, Alice	Alice Hansen

Exhibit "L"

Producer Name	Designee
Hartley, David	David Hartley
Hemlock Mutual Water Company	Bud Selander
Hunter, Lloyd F.	Lloyd F. Hunter
I	
Industry Waterworks System, City of	Mary L. Jaureguy
K	
Kiyan Farm Kiyan, Hideo	Mrs. Hideo Kiyan
Kirklen Family Trust	Dawn Kirklen
Knight, Kathryn M.	William J. Knight
L	
Landeros, John	John Landeros
La Puente Valley County Water District	Mary L. Jaureguy
La Verne, City of	N. Kathleen Hamm
Livingston-Graham	Gary O. Tompkins
Los Angeles, County of	Robert L. Larson
Loucks, David	David Loucks
M	
Maddock, A. G.	Ranney Draper, Esq.
Maechtlen, Trust of J. J.	Jack F. Maechtlen
Maple Water Company, Inc.	Charles King
Martinez, Francis Mercy	Francis Mercy Martinez
Metropolitan Water District of Southern California	Fred Vendig, Esq.
Miller Brewing Company	Dennis B. Puffer
Mnoian, Paul, et al.	Mal Gatherer
Monrovia, City of	Robert K. Sandwick
Monrovia Nursery	Miles R. Rosedale
Monterey Park, City of	Nels Palm

Exhibit "L"

Producer Name	Designee
N	
Nick Tomovich & Sons	Nick Tomovich
O	
Owl Rock Products Company	Peter L. Chiu
P	
Phillips, Alice B., et al.	Jack F. Maechtlen
Pico County Water District	Robert P. Fuller
Polopolus, et al.	Christine Chronis
R	
Rados Brothers	Alexander S. Rados
Richwood Mutual Water Company	Bonnie Pool
Rincon Ditch Company	K. E. Nungesser
Rincon Irrigation Company	K. E. Nungesser
Rose Hills Memorial Park Association	Allan D. Smith
Rosemead Development, Ltd.	John W. Lloyd
Rurban Homes Mutual Water Company	George W. Bucey
Ruth, Roy	Roy Ruth
S	
San Dimas - La Verne Recreational Facilities Authority	R. F. Griszka
San Gabriel Country Club	Fran Wolfe
San Gabriel County Water District	Philip G. Crocker
San Gabriel Valley Municipal Water District	Bob Stallings
San Gabriel Valley Water Company	Robert H. Nicholson, Jr.
Sloan Ranches	Larry R. Sloan
Sonoco Products Company	Elaine Corboy
South Covina Water Service	Anton C. Garnier
Southern California Edison Company	S. R. Shermoen

Exhibit "L"

Producer Name	Designee
Southern California Water Company -San Dimas District	J. F. Young
Southern California Water Company -San Gabriel Valley District	J. F. Young
South Pasadena, City of	John Bernardi
Southwestern Portland Cement Company	Dale W. Heineck
Standard Oil Company of California	John A. Wild
Sterling Mutual Water Company	Bennie L. Prowett
Suburban Water Systems	Anton C. Garnier
Sully-Miller Contracting Company	R. R. Munro
Sunny Slope Water Company	Michael J. Hart
T	
Taylor Herb Garden	Paul S. Taylor
Texaco, Inc.	E. O. Wakefield
Tyler Nursery	James K. Mitsumori, Esq.
U	
United Concrete Pipe Corporation	Doyle H. Wadley
United Rock Products Corporation	William S. Capps, Esq.
V	
Valencia Heights Water Company	Herman Weskamp
Valley County Water District (Formerly Baldwin Park County Water District)	Stanley D. Yarbrough
Valley View Mutual Water Company	Robert T. Navarre
Via, H., Trust of	Marverna Parton
W	
Ward Duck Company	Richard J. Woodland
W. E. Hall Company	Thomas S. Bunn, Jr., Esq.
White, June G., Trustee	June G. Lovelady
Whittier, City of	Neil Hudson
Wilmott, Erma M.	Erma M. Wilmott

Exhibit "M"

WATERMASTER MEMBERS

FOR CALENDAR YEAR 1973

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

RICHARD L. ROWLAND (Producer Member), Secretary

BOYD KERN (Public Member), Treasurer

WALKER HANNON (Producer Member)

HOWARD H. HAWKINS (Public Member)

M. E. MOSLEY (Producer Member)

CONRAD T. REIBOLD (Public Member)

HARRY C. WILLS (Producer Member)

STAFF

Carl Fossette, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1974

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

RICHARD L. ROWLAND (Producer Member), Secretary

BOYD KERN (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

M. E. MOSLEY (Producer Member)

CONRAD T. REIBOLD (Public Member)

HARRY C. WILLS (Producer Member)

STAFF

Carl Fossette, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1975

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

HARRY C. WILLS (Producer Member), Secretary

BOYD KERN (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

D. J. LAUGHLIN (Producer Member)

M. E. MOSLEY (Producer Member)

CONRAD T. REIBOLD (Public Member)

STAFF

Carl Fossette, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1976

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

HARRY C. WILLS (Producer Member), Secretary

BOYD KERN (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

D. J. LAUGHLIN (Producer Member)

M. E. MOSLEY (Producer Member)

CONRAD T. REIBOLD (Public Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1977

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

HARRY C. WILLS (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

BOYD KERN (Public Member)

D. J. LAUGHLIN (Producer Member)

R. H. NICHOLSON, JR. (Producer Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer)
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1978

ROBERT T. BALCH (Producer Member), Chairman

LINN E. MAGOFFIN (Producer Member), Vice Chairman

D. J. LAUGHLIN (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

L. E. MOELLER (Producer Member)

R. H. NICHOLSON, JR. (Producer Member)

WILLIAM M. WHITESIDE (Public Member)

STAFF

Jane M. Bray, Assistant Secrretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1979

LINN E. MAGOFFIN (Producer Member), Chairman

D. J. LAUGHLIN (Producer Member), Vice Chairman

R. H. NICHOLSON, JR. (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

WALKER HANNON (Producer Member)

BURTON E. JONES (Public Member)

L. E. MOELLER (Producer Member)

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Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1980

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

WILLIAM M. WHITESIDE (Pulic Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

ROBERT G. BERLIEN (Producer Member)

ANTON C. GARNIER (Producer Member)

TRAVIS L. MANNING (Public Member)

L. E. MOELLER (Producer Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson. Engineer

FOR CALENDAR YEAR 1981

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

WILLIAM M. WHITESIDE (Public Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

ROBERT G. BERLIEN (Producer Member)

ANTON C. GARNIER (Producer Member)

TRAVIS L. MANNING (Public Member)

L. E. MOELLER (Producer Member)

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Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1982

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

WILLIAM M. WHITESIDE (Public Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

ROBERT G. BERLIEN (Producer Member)

ANTON C. GARNIER (Producer Member)

L. E. MOELLER (Producer Member)

ALFRED F. WITTIG (Public Member)

STAFF

Jane M. Bray, Assistant Secrretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

Exhibit "M"

FOR CALENDAR YEAR 1983

LINN E, MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

ROBERT G. BERLIEN (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

DONALD F. CLARK (Public Member)

ANTON C. GARNIER (Producer Member)

L. E. MOELLER (Producer Member)

ALFRED R. WITTIG (Public Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1984

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

ROBERT G. BERLIEN (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

DONALD F. CLARK (Public Member)

ANTON C. GARNIER (Producer Member)

L. E. MOELLER (Producer Member)

ALFRED R. WITTIG (Public Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

Exhibit "M"

FOR CALENDAR YEAR 1985

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

ROBERT G. BERLIEN (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producr Member)

DONALD F. CLARK (Public Member)

ANTON C. GARNIER (Producer Member)

L. E. MOELLER (Producer Member)

ALFRED R. WITTIG (Public Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1986

LINN E. MAGOFFIN (Producer Member), Chairman

R. H. NICHOLSON, JR. (Producer Member), Vice Chairman

ROBERT G. BERLIEN (Producer Member), Secretary

CONRAD T. REIBOLD (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

DONALD F. CLARK (Public Member)

L. E. MOELLER (Producer Member)

REGINOLD A. STONE (Producer Member)

ALFRED R. WITTIG (Public Member)

STAFF

Jane M. Bray, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1987

LINN E. MAGOFFIN (Producer Member), Chairman

REGINALD A. STONE (Producer Member), Vice Chairman

L. E. MOELLER (Producer Member), Secretary

ALFRED R. WITTIG (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

GERALD J. BLACK (Producer Member)

DONALD F. CLARK (Public Member)

EDWARD R. HECK (Producer Member)

JOHN E. MAULDING (Public Member)

STAFF

Robert G. Berlien, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1988

LINN E. MAGOFFIN (Producer Member), Chairman

REGINALD A. STONE (Producer Member), Vice Chairman

L. E. MOELLER (Producer Member), Secretary

ALFRED R. WITTIG (Public Member), Treasurer

ROBERT T. BALCH (Producer Member)

GERALD J. BLACK (Producer Member)

DONALD F. CLARK (Public Member)

EDWARD R. HECK (Producer Member)

JOHN E. MAULDING (Public Member)

STAFF

Robert G. Berlien, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

FOR CALENDAR YEAR 1989

LINN E. MAGOFFIN (Producer Member), Chairman

REGINALD A. STONE (Producer Member), Vice Chairman

GERALD G. BLACK (Producer Member), Secretary

ALFRED R. WITTIG (Public Member), Treasurer

ROBERT T. BALCH (Producer Member) *

DONALD F. CLARK (Public Member)

EDWARD R. HECK (Producer Member)

BURTON E. JONES (Public Member)

NELS PALM (Producer Member) **

THOMAS E. SCHOLLENBERGER (Producer Member)

STAFF

Robert G. Berlien, Assistant Secretary-Assistant Treasurer
Ralph B. Helm, Attorney
Thomas M. Stetson, Engineer

* DECEASED APRIL 25, 1989

** Appointed August 24, 1989, for the balance of the calendar year term, to replace deceased member, Robert T. Balch.

Ralph B. Helm - Bar No. 022004
4605 Lankershim Boulevard, #214
North Hollywood, CA 91602

Telephone (818) 769-2002

Attorney for Watermaster - Petitioner

RECEIVED
FEB - 1 1991
STETSON ENGINEERS INC.

SUPERIOR COURT OF CALIFORNIA, COUNTY OF LOS ANGELES

UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT, Plaintiff, vs. CITY OF ALHAMBRA, et al., Defendants.	No. 924129 ORDER AMENDING JUDGMENT TO EXPAND WATERMASTER'S POWERS TO INCLUDE MAINTENANCE, IMPROVEMENT, AND CONTROL OF BASIN WATER QUALITY WITH ALLOWABLE FUNDING THROUGH IN-LIEU ASSESSMENTS Hearing: August 7, 1990 Department 38, 9:15 A. M.

The Petition of the Main San Gabriel Basin Watermaster (Watermaster) for Amendment to Judgment herein to expand its powers to include maintenance, improvement, and control of Basin water quality by controlling pumping in the Basin, with allowable funding for associated costs to be paid through its In-Lieu Assessments, was continued on July 31, 1990, to August 7, 1990, when it duly and regularly came on for hearing, at 9:15 o'clock A. M. in Department 38 of the above entitled Court, the Honorable FLORENCE T. PICKARD, Assigned Judge Presiding. Ralph B. Helm appeared as Attorney for Watermaster - Petitioner; Wayne K. Lemieux appeared for Defendant, San Gabriel Valley Municipal Water District, in support of the Petition; Fred Vendig, General

Counsel, Karen L. Tachiki, Assistant General Counsel, and Victor E. Gleason, Senior Deputy General Counsel, by Victor E. Gleason, appeared for Defendant, The Metropolitan Water District of Southern California, in support of the Petition; Timothy J. Ryan appeared for Defendant, San Gabriel Valley Water Company, in opposition to the Petition; Lagerlof, Senecal, Drescher & Swift, by H. Jess Senecal, appeared for Defendants, Calmat Company, Livingston-Graham, Owl Rock Products, AZ-Two, Inc., and Sully-Miller Contracting Company, in opposition to the Petition; Ira Reiner, Los Angeles County District Attorney, by Jan Chatten-Brown, Special Assistant to the District Attorney, appeared in opposition to the Petition; and Sarah F. Bates and Laurens H. Silver, by Sarah F. Bates, appeared on behalf of Amicus Curiae Sierra Club, in opposition to the Petition.

The Court acknowledged receipt and consideration of: letters in support of the Petition by the California Regional Water Quality Control Board - Los Angeles Region and by the State Water Resources Control Board; a copy of a letter addressed to the Attorney for Petitioner, from the US Environmental Protection Agency - Region IX, by Mark J. Klaiman, Assistant Regional Counsel, regarding several matters of federal law which EPA believed might ultimately affect the subject Petition; a letter in opposition to the Petition by East Valleys Organization; and a FAX communication to the Court, in opposition to the Petition, from Congressman Esteban E. Torres, which was not communicated to nor seen by the parties.

Members of the public, present in Court, were invited to, and did, present oral testimony during the hearing.

Under date of December 10, 1990 the Court entered its Intended Decision Re Amendment To Judgment and, by minute order duly entered and mailed to Counsel for Petitioner, ordered copies thereof mailed forthwith to all appearing parties, including those appearing as friends of the court, and to all other affected parties on the case's current mailing list.

A Proof Of Service by mail on December 13, 1990, Of Intended Decision Re Amendment To Judgment, as ordered, has been filed with the Court.

Opposition to Petitioner's Proposed Order were filed by Amicus Curiae Sierra Club, Amicus Curiae Los Angeles District Attorney, and by Producer Parties Calmat Co., Livingston-Graham, Owl Rock Products Company, AZ-Two, Inc., and Sully-Miller Contracting Company.

Proof being made to the satisfaction of the Court and good cause appearing:

IT IS, HEREBY, ORDERED:

1. That the Amended Judgment herein be further amended by amending Subsection (j) of Section 10 thereof, Definitions, and Section 40 thereof, Division F, Physical Solution, to read as follows:

"10 (j) In-Lieu Water Cost - - The differential between a particular Producer's cost of Watermaster directed produced, treated, blended, substituted, or Supplemental Water delivered or substituted to, for, or taken by, such Producer in-lieu of his cost of otherwise normally Producing a like amount of Ground Water from the Basin.

"40. Watermaster Control. (Prior Judgment Section 32)

In order to develop an adequate and effective program of Basin management, it is essential that Watermaster have broad discretion in the making of Basin management decisions within the ambit hereinafter set forth. The maintenance, improvement, and control of the water quality and quantity of the Basin, withdrawal and replenishment of supplies of the Basin and Relevant Watershed, and the utilization of the water resources thereof, must be subject to procedures established by Watermaster in implementation of the Physical Solution provisions of this Judgment. Both the quantity and quality of said water resource are thereby preserved and its beneficial utilization maximized.

"(a) Watermaster shall develop an adequate and effective program of Basin management. The maintenance, improvement, and control of the water quality and quantity of the Basin, withdrawal and replenishment of supplies of the Basin and Relevant Watershed, and the utilization of the water resources thereof, must be subject to procedures established by Watermaster in implementation of the Physical Solution provisions of this Judgment. All Watermaster programs and procedures shall be adopted only after a duly noticed public hearing pursuant to Sections 37 and 40 of the Amended Judgment herein.

"(b) Watermaster shall have the power to control pumping in the Basin by water Producers therein for Basin cleanup and water quality control so that specific well production can be directed as to a lesser amount, to total cessation, as to an increased amount, and even to require pumping in a new location in the

Basin. Watermaster's right to regulate pumping activities of Producers shall be subordinate to any conflicting Basin cleanup plan established by the EPA or other public governmental agency with responsibility for ground water management or clean up.

"(c) Watermaster may act individually or participate with others to carry on technical and other necessary investigations of all kinds and collect data necessary to carry out the herein stated purposes. It may engage in contractual relations with the EPA or other agencies in furtherance of the clean up of the Basin and enter into contracts with agencies of the United States, the State of California, or any political subdivision, municipality, or district thereof, to the extent allowed under applicable federal or state statutes. Any cooperative agreement between the Watermaster and EPA shall require the approval of the appropriate Agency(s) of the State of California.

"(d) For regulation and control of pumping activity in the Basin, Watermaster shall adopt Rules and Regulations and programs to promote, manage and accomplish clean up of the Basin and its waters, including, but not limited to, measures to confine, move, and remove contaminants and pollutants. Such Rules and Regulations and programs shall be adopted only after a duly Noticed Public Hearing by Watermaster and shall be subject to Court review pursuant to Section 37 of the Amended Judgment herein.

"(e) Watermaster shall determine whether funds from local, regional, state or federal agencies are available for regulating pumping and the various costs associated with, or arising from such activities. If no public funds are available from local, regional, state, or federal agencies, the costs shall be obtained and paid by way of an In-Lieu Assessment by Watermaster pursuant to Section 10 (j) of the Amended Judgment herein. Provided such In-Lieu Assessments become necessary, the costs shall be borne by all Basin Producers.

"(f) Watermaster is a Court empowered entity with limited powers, created pursuant to the Court's Physical Solution Jurisdiction under Article X, Section 2 of the California Constitution. None of the Powers granted herein to Watermaster shall be construed as designating Watermaster a political subdivision of the State of California or authorizing Watermaster to act as 'lead agency' to administer the federal Superfund for clean up of the Basin."

2. This Amended Judgment shall continue in full force and effect as hereby Ordered and Amended.

Dated: January 29, 1991.

/s/Florence T. Pickard
FLORENCE T. PICKARD
Judge of the Superior Court,
Specially Assigned

Appendix G

Summary of Population Based on Census Data

Appendix G-1: Census Tracts within the South San Gabriel System

County	Subregion	City	Census Tract	Percentage of Tract in System
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	433602	4%
Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	481401	4%
Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	482301	61%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482303	88%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482304	100%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482401	25%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482402	60%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482502	100%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482503	100%
Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	482521	100%
Los Angeles	San Gabriel Valley Assoc. of Cities	Unincorporated	482521	45%
Los Angeles	San Gabriel Valley Assoc. of Cities	Monterey Park city	482600	4%

Table G-2: Population, Household and Employment Projections for South San Gabriel System

Census Tract	County	Subregion	City	Population							Percentage of Tract in System
				2005	2010	2015	2020	2025	2030	2035	
433602	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	2,992	3,064	3,109	3,159	3,206	3,252	3,296	4%
481401	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	6,382	6,411	6,649	6,782	6,932	7,076	7,221	4%
482301	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	5,525	5,560	5,850	6,016	6,204	6,385	6,565	61%
482303	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	6,141	6,276	6,361	6,456	6,547	6,634	6,718	88%
482304	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	4,142	4,232	4,289	4,352	4,413	4,473	4,530	100%
482401	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	4,178	4,278	4,342	4,411	4,477	4,540	4,601	25%
482402	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	5,519	5,637	5,713	5,796	5,876	5,953	6,026	60%
482502	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	3,638	3,713	3,761	3,816	3,868	3,919	3,967	100%
482503	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	4,603	4,697	4,757	4,824	4,889	4,952	5,012	100%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	122	127	132	137	142	146	150	100%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Unincorporated	6,064	6,475	6,944	7,412	7,864	8,303	8,723	45%
482600	Los Angeles	San Gabriel Valley Assoc. of Cities	Monterey Park city	7,202	7,684	8,127	8,517	8,872	9,186	9,504	4%
Total Population Based on SCAG				29,021	29,729	30,452	31,127	31,795	32,439	33,060	
SCAG Growth Rate						2%	2%	2%	2%	2%	

Census Tract	County	Subregion	City	Households							Percentage of Tract in System
				2005	2010	2015	2020	2025	2030	2035	
433602	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	724	746	765	786	802	818	831	0%
481401	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	1,877	1,886	1,989	2,055	2,107	2,157	2,196	0%
482301	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	1,333	1,340	1,422	1,476	1,518	1,558	1,590	0%
482303	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	1,473	1,517	1,559	1,603	1,638	1,671	1,699	0%
482304	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	1,006	1,030	1,053	1,077	1,096	1,114	1,129	0%
482401	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	947	974	999	1,026	1,046	1,066	1,083	0%
482402	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	1,488	1,531	1,571	1,614	1,647	1,680	1,706	0%
482502	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	830	850	868	887	903	917	930	0%
482503	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	1,028	1,053	1,076	1,100	1,119	1,138	1,153	0%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	11	11	11	11	12	12	12	0%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Unincorporated	1,486	1,588	1,723	1,865	1,976	2,084	2,172	0%
482600	Los Angeles	San Gabriel Valley Assoc. of Cities	Monterey Park city	2,283	2,325	2,392	2,429	2,455	2,484	2,504	0%
Total Population Based on SCAG				6,976	7,169	7,419	7,659	7,849	8,031	8,180	
SCAG Growth Rate						3%	3%	2%	2%	2%	

Census Tract	County	Subregion	City	Employment							Percentage of Tract in System
				2005	2010	2015	2020	2025	2030	2035	
433602	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	4,464	4,535	4,592	4,627	4,669	4,713	4,756	0%
481401	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	1,730	1,754	1,774	1,787	1,802	1,819	1,834	0%
482301	Los Angeles	San Gabriel Valley Assoc. of Cities	San Gabriel city	280	351	408	443	484	529	571	0%
482303	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	419	422	425	427	429	431	434	0%
482304	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	671	691	708	718	731	744	757	0%
482401	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	540	558	573	582	593	605	617	0%
482402	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	1,613	1,714	1,793	1,841	1,898	1,958	2,016	0%
482502	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	551	563	572	578	585	592	599	0%
482503	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	989	1,000	1,008	1,013	1,020	1,027	1,033	0%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Rosemead city	295	312	325	334	345	357	368	0%
482521	Los Angeles	San Gabriel Valley Assoc. of Cities	Unincorporated	322	345	361	370	380	390	400	0%
482600	Los Angeles	San Gabriel Valley Assoc. of Cities	Monterey Park city	449	485	507	525	548	567	585	0%
Total Population Based on SCAG				4,559	4,745	4,892	4,983	5,092	5,207	5,318	
SCAG Growth Rate						3%	2%	2%	2%	2%	

Appendix H

Documentation of submittal to Library, Cities and Counties

Golden State
Water Company
A Subsidiary of American States Water Company

September 1, 2011

City of Monterey Park
Ray Hamada
Planning Manager
320 West Newmark Avenue
Monterey Park, CA 91754

Dear: Ray Hamada

RE: Golden State Water Company- 2010 Urban Water Management Plan

Golden State Water Company (GSWC) adopted the 2010 Urban Water Management Plan (UWMP) following a public hearing on August 18, 2011. The 2010 UWMP was adopted in accordance with the Urban Water Management Planning Act and filed with DWR and the California Sate Library.

Pursuant to Section 10644(a) of the California Water Code, GSWC is required to file a copy of the adopted 2010 UWMP with any city or county within which GSWC provided water. Enclosed for your files is one copy of GSWC's adopted 2010 UWMP. It is also on our website at www.gswater.com.

If you have any questions you can contact me at (916) 853-3612.

Sincerely,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Enclosure

Golden State
Water Company
A Subsidiary of American States Water Company

September 1, 2011

City of Rosemead
Bradford Johnson
Planning Director
8838 Valley Boulevard
Rosemead, CA 91770

Dear: Bradford Johnson

RE: Golden State Water Company- 2010 Urban Water Management Plan

Golden State Water Company (GSWC) adopted the 2010 Urban Water Management Plan (UWMP) following a public hearing on August 18, 2011. The 2010 UWMP was adopted in accordance with the Urban Water Management Planning Act and filed with DWR and the California Sate Library.

Pursuant to Section 10644(a) of the California Water Code, GSWC is required to file a copy of the adopted 2010 UWMP with any city or county within which GSWC provided water. Enclosed for your files is one copy of GSWC's adopted 2010 UWMP. It is also on our website at www.gswater.com.

If you have any questions you can contact me at (916) 853-3612.

Sincerely,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Enclosure

Golden State
Water Company
A Subsidiary of American States Water Company

September 1, 2011

City of San Gabriel
Carol Banet
Planning Manager
425 South Mission Drive
San Gabriel, CA 91776

Dear: Carol Banet

RE: Golden State Water Company- 2010 Urban Water Management Plan

Golden State Water Company (GSWC) adopted the 2010 Urban Water Management Plan (UWMP) following a public hearing on August 18, 2011. The 2010 UWMP was adopted in accordance with the Urban Water Management Planning Act and filed with DWR and the California Sate Library.

Pursuant to Section 10644(a) of the California Water Code, GSWC is required to file a copy of the adopted 2010 UWMP with any city or county within which GSWC provided water. Enclosed for your files is one copy of GSWC's adopted 2010 UWMP. It is also on our website at www.gswater.com.

If you have any questions you can contact me at (916) 853-3612.

Sincerely,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Enclosure

Golden State
Water Company
A Subsidiary of American States Water Company

September 1, 2011

County of Los Angeles
Richard Brudckner
Director Department of Regional Planning
320 West Temple Street
Los Angeles, CA 90012

Dear: Richard Brudckner

RE: Golden State Water Company- 2010 Urban Water Management Plan

Golden State Water Company (GSWC) adopted the 2010 Urban Water Management Plan (UWMP) following a public hearing on August 18, 2011. The 2010 UWMP was adopted in accordance with the Urban Water Management Planning Act and filed with DWR and the California Sate Library.

Pursuant to Section 10644(a) of the California Water Code, GSWC is required to file a copy of the adopted 2010 UWMP with any city or county within which GSWC provided water. Enclosed for your files is one copy of GSWC's adopted 2010 UWMP. It is also on our website at www.gswater.com.

If you have any questions you can contact me at (916) 853-3612.

Sincerely,
GOLDEN STATE WATER COMPANY

Ernest A. Gisler
Planning Manager

Enclosure

Appendix I

Documentation of Water Use Projections Submittal

Golden State
Water Company
A Subsidiary of American States Water Company

11 February 2011

Mr. Steve Sherman
Field Operations Superintendent
Covina Irrigating Company
146 E College Street
Covina, CA 91723

Subject: Golden State Water Company - Claremont, San Dimas, South Arcadia, and South San Gabriel System
2010 Urban Water Management Plan Preparation Notification and Supply Reliability Information Request

Dear Mr. Sherman:

Golden State Water Company (GSWC) is currently preparing its 2010 Urban Water Management Plan (UWMP) for the Claremont, San Dimas, South Arcadia, and South San Gabriel System as required by the Urban Water Management Planning Act (Act). Since Covina Irrigating Company is a wholesale water supplier to GSWC, water use projections through 2035 are enclosed (Table 1) pursuant to §10631(k) of the Act. We would like to request confirmation of the anticipated water supply reliability, water supply sources, and other information as described below. This information may be provided by either (a) providing a copy of your Draft UWMP if all requested information is included or, (b) completing the enclosed tables and providing any additional documents as required.

1. Supply projections to 2035 (Table 2)
2. Single Dry Year Reliability to 2035 (Table 3)
3. Normal, single dry, and multiple dry year reliability (Table 4)
4. Basis of water year data (Table 5)
5. Factors resulting in inconsistency of supply (Table 6)
6. Assumptions used to determine retail agency supply projections, including conservation.
7. Recycled water projections to the Claremont, San Dimas, South Arcadia, and South San Gabriel service area (if applicable) (Table 7)
8. Describe any regional desalination opportunities, if any for the Claremont, San Dimas, South Arcadia, and South San Gabriel system (if applicable)

We appreciate your timely attention to the information requested above and ask you provide a response no later than **18 February 2011**. Kennedy/Jenks Consultants is assisting GSWC with preparation of the 2010 UWMP and will be contacting you directly within the next week to follow up on this request. In the meantime, should you have any questions or concerns please feel free to contact me at (916) 853-3612.

Very truly yours,

GOLDEN STATE WATER COMPANY

Ernest Gisler
Planning Manager

Enclosures

cc: Sean Maguire, Kennedy/Jenks Consultants

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Golden State
Water Company
A Subsidiary of American States Water Company

11 February 2011

Mr. Timothy C. Jochem
General Manager
Upper San Gabriel Valley Municipal Water District
11310 Valley Blvd.
El Monte, CA 91731

Subject: Golden State Water Company - South San Gabriel System
2010 Urban Water Management Plan Preparation Notification and Supply Reliability Information Request

Dear Mr. Jochem:

Golden State Water Company (GSWC) is currently preparing its 2010 Urban Water Management Plan (UWMP) for the South San Gabriel System as required by the Urban Water Management Planning Act (Act). Since Upper San Gabriel Valley Municipal Water District is a wholesale water supplier to GSWC, water use projections through 2035 are enclosed (Table 1) pursuant to §10631(k) of the Act. We would like to request confirmation of the anticipated water supply reliability, water supply sources, and other information as described below. This information may be provided by either (a) providing a copy of your Draft UWMP if all requested information is included or, (b) completing the enclosed tables and providing any additional documents as required.

1. Supply projections to 2035 (Table 2)
2. Single Dry Year Reliability to 2035 (Table 3)
3. Normal, single dry, and multiple dry year reliability (Table 4)
4. Basis of water year data (Table 5)
5. Factors resulting in inconsistency of supply (Table 6)
6. Assumptions used to determine retail agency supply projections, including conservation.
7. Recycled water projections to the South San Gabriel service area (if applicable) (Table 7)
8. Describe any regional desalination opportunities, if any for the South San Gabriel system (if applicable)

We appreciate your timely attention to the information requested above and ask you provide a response no later than **18 February 2011**. Kennedy/Jenks Consultants is assisting GSWC with preparation of the 2010 UWMP and will be contacting you directly within the next week to follow up on this request. In the meantime, should you have any questions or concerns please feel free to contact me at (916) 853-3612.

Very truly yours,

GOLDEN STATE WATER COMPANY

Ernest Gisler
Planning Manager

Enclosures

cc: Sean Maguire, Kennedy/Jenks Consultants

Appendix J

Urban Water Management Plan Checklist

Table I-2 Urban Water Management Plan checklist, organized by subject

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
PLAN PREPARATION					
4	Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.	10620(d)(2)		1.6	1-7
6	Notify, at least 60 days prior to the public hearing on the plan required by Section 10642, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Any city or county receiving the notice may be consulted and provide comments.	10621(b)		1.6	1-7
7	Provide supporting documentation that the UWMP or any amendments to, or changes in, have been adopted as described in Section 10640 et seq.	10621(c)		1.6	1-7
54	Provide supporting documentation that the urban water management plan has been or will be provided to any city or county within which it provides water, no later than 60 days after the submission of this urban water management plan.	10635(b)		Appendix H	
55	Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan.	10642		1.6	1-7
56	Provide supporting documentation that the urban water supplier made the plan available for public inspection and held a public hearing about the plan. For public agencies, the hearing notice is to be provided pursuant to Section 6066 of the Government Code. The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. Privately-owned water suppliers shall provide an equivalent notice within its service area.	10642		Page vii	Vii
57	Provide supporting documentation that the plan has been adopted as prepared or modified.	10642		1.6	1-7
58	Provide supporting documentation as to how the water supplier plans to implement its plan.	10643		1.8	1-8

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
59	Provide supporting documentation that, in addition to submittal to DWR, the urban water supplier has submitted this UWMP to the California State Library and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. This also includes amendments or changes.	10644(a)		1.7 Appendix H	1-8
60	Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the urban water supplier has or will make the plan available for public review during normal business hours	10645		1.7	1-8
SYSTEM DESCRIPTION					
8	Describe the water supplier service area.	10631(a)		2.1	2-1
9	Describe the climate and other demographic factors of the service area of the supplier	10631(a)		2.2 & 2.4	2-1 & 2-10
10	Indicate the current population of the service area	10631(a)	Provide the most recent population data possible. Use the method described in “Baseline Daily Per Capita Water Use.” See Section M.	2.3	2-5
11	Provide population projections for 2015, 2020, 2025, and 2030, based on data from State, regional, or local service area population projections.	10631(a)	2035 and 2040 can also be provided to support consistency with Water Supply Assessments and Written Verification of Water Supply documents.	2.3.2	2-5
12	Describe other demographic factors affecting the supplier’s water management planning.	10631(a)		2.2 & 2.4	2-1 & 2-10
SYSTEM DEMANDS					
1	Provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.	10608.20(e)		3.2	3-3

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
2	*Wholesalers:* Include an assessment of present and proposed future measures, programs, and policies to help achieve the water use reductions. *Retailers:* Conduct at least one public hearing that includes general discussion of the urban retail water supplier's implementation plan for complying with the Water Conservation Bill of 2009.	10608.36 10608.26(a)	Retailers and wholesalers have slightly different requirements	4.6	4-8
3	Report progress in meeting urban water use targets using the standardized form.	10608.40		Not Applicable	
25	Quantify past, current, and projected water use, identifying the uses among water use sectors, for the following: (A) single-family residential, (B) multifamily, (C) commercial, (D) industrial, (E) institutional and governmental, (F) landscape, (G) sales to other agencies, (H) saline water intrusion barriers, groundwater recharge, conjunctive use, and (I) agriculture.	10631(e)(1)	Consider 'past' to be 2005, present to be 2010, and projected to be 2015, 2020, 2025, and 2030. Provide numbers for each category for each of these years.	3.3	3-8
33	Provide documentation that either the retail agency provided the wholesale agency with water use projections for at least 20 years, if the UWMP agency is a retail agency, OR, if a wholesale agency, it provided its urban retail customers with future planned and existing water source available to it from the wholesale agency during the required water-year types	10631(k)	Average year, single dry year, multiple dry years for 2015, 2020, 2025, and 2030.	3.7 Appendix I	3-15
34	Include projected water use for single-family and multifamily residential housing needed for lower income households, as identified in the housing element of any city, county, or city and county in the service area of the supplier.	10631.1(a)		3.8	3-16
SYSTEM SUPPLIES					
13	Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, and 2030.	10631(b)	The 'existing' water sources should be for the same year as the "current population" in line 10. 2035 and 2040 can also be provided.	4.1	4-2

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
14	Indicate whether groundwater is an existing or planned source of water available to the supplier. If yes, then complete 15 through 21 of the UWMP Checklist. If no, then indicate “not applicable” in lines 15 through 21 under the UWMP location column.	10631(b)	Source classifications are: surface water, groundwater, recycled water, storm water, desalinated sea water, desalinated brackish groundwater, and other.	4.3	4-3
15	Indicate whether a groundwater management plan been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	10631(b)(1)		4.3	4-3
16	Describe the groundwater basin.	10631(b)(2)		4.3	4-3
17	Indicate whether the groundwater basin is adjudicated? Include a copy of the court order or decree.	10631(b)(2)		4.3 & Appendix F	4-3
18	Describe the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. If the basin is not adjudicated, indicate “not applicable” in the UWMP location column.	10631(b)(2)		4.3	4-3
19	For groundwater basins that are not adjudicated, provide information as to whether DWR has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition. If the basin is adjudicated, indicate “not applicable” in the UWMP location column.	10631(b)(2)		Not Applicable	
20	Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years	10631(b)(3)		4.3	4-3
21	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	10631(b)(4)	Provide projections for 2015, 2020, 2025, and 2030.	4.3	4-3
24	Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.	10631(d)		4.4	4-7

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
30	Include a detailed description of all water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years, excluding demand management programs addressed in (f)(1). Include specific projects, describe water supply impacts, and provide a timeline for each project.	10631(h)		4.5	4-7
31	Describe desalinated water project opportunities for long-term supply, including, but not limited to, ocean water, brackish water, and groundwater.	10631(i)		4.7	4-9
44	Provide information on recycled water and its potential for use as a water source in the service area of the urban water supplier. Coordinate with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area.	10633		4.8	4-9
45	Describe the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.	10633(a)		4.8.2	4-11
46	Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.	10633(b)		4.8.2	4-11
47	Describe the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.	10633(c)		4.8.2	4-11
48	Describe and quantify the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.	10633(d)		4.8.3	4-12
49	The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected.	10633(e)		4.8	4-9
50	Describe the actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.	10633(f)		4.8.4	4-13

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
51	Provide a plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.	10633(g)		4.8.4	4-13
WATER SHORTAGE RELIABILITY AND WATER SHORTAGE CONTINGENCY PLANNING [b]					
5	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	10620(f)		1.10	1-10
22	Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage and provide data for (A) an average water year, (B) a single dry water year, and (C) multiple dry water years.	10631(c)(1)		6.1	6-1
23	For any water source that may not be available at a consistent level of use - given specific legal, environmental, water quality, or climatic factors - describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.	10631(c)(2)		6.1.4	6-6
35	Provide an urban water shortage contingency analysis that specifies stages of action, including up to a 50-percent water supply reduction, and an outline of specific water supply conditions at each stage	10632(a)		8.1	8-1
36	Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.	10632(b)		8.2	8-3
37	Identify actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.	10632(c)		8.3	8-4
38	Identify additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.	10632(d)		8.4	8-6
39	Specify consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.	10632(e)		8.4	8-6
40	Indicated penalties or charges for excessive use, where applicable.	10632(f)		8.4	8-6

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
41	Provide an analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.	10632(g)		8.5	8-8
42	Provide a draft water shortage contingency resolution or ordinance.	10632(h)		8.4 & Appendix D	8-6
43	Indicate a mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.	10632(i)		8.6	8-10
52	Provide information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments, and the manner in which water quality affects water management strategies and supply reliability	10634	For years 2010, 2015, 2020, 2025, and 2030	5	5-1
53	Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. Base the assessment on the information compiled under Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.	10635(a)		6.2 – 6.4	6-7
DEMAND MANAGEMENT MEASURES					
26	Describe how each water demand management measures is being implemented or scheduled for implementation. Use the list provided.	10631(f)(1)	Discuss each DMM, even if it is not currently or planned for implementation. Provide any appropriate schedules.	7.1	7-2
27	Describe the methods the supplier uses to evaluate the effectiveness of DMMs implemented or described in the UWMP.	10631(f)(3)		7.1	7-2
28	Provide an estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the ability to further reduce demand.	10631(f)(4)		7.2	7-4

No.	UWMP requirement [a]	Calif. Water Code reference	Additional clarification	UWMP location	Page Number
29	Evaluate each water demand management measure that is not currently being implemented or scheduled for implementation. The evaluation should include economic and non-economic factors, cost-benefit analysis, available funding, and the water suppliers' legal authority to implement the work.	10631(g)	See 10631(g) for additional wording.	7.2	7-4
32	Include the annual reports submitted to meet the Section 6.2 requirements, if a member of the CUWCC and signer of the December 10, 2008 MOU.	10631(j)	Signers of the MOU that submit the annual reports are deemed compliant with Items 28 and 29.	N/A	

[a] The UWMP Requirement descriptions are general summaries of what is provided in the legislation. Urban water suppliers should review the exact legislative wording prior to submitting its UWMP.

[b] The Subject classification is provided for clarification only. It is aligned with the organization presented in Part I of this guidebook. A water supplier is free to address the UWMP Requirement anywhere with its UWMP, but is urged to provide clarification to DWR to facilitate review.

California Climate Action Registry
523 West Sixth Street, Suite 428
Los Angeles, California 90014
Tel: 213 891 1444
Email: info@climateregistry.org
www.climateregistry.org