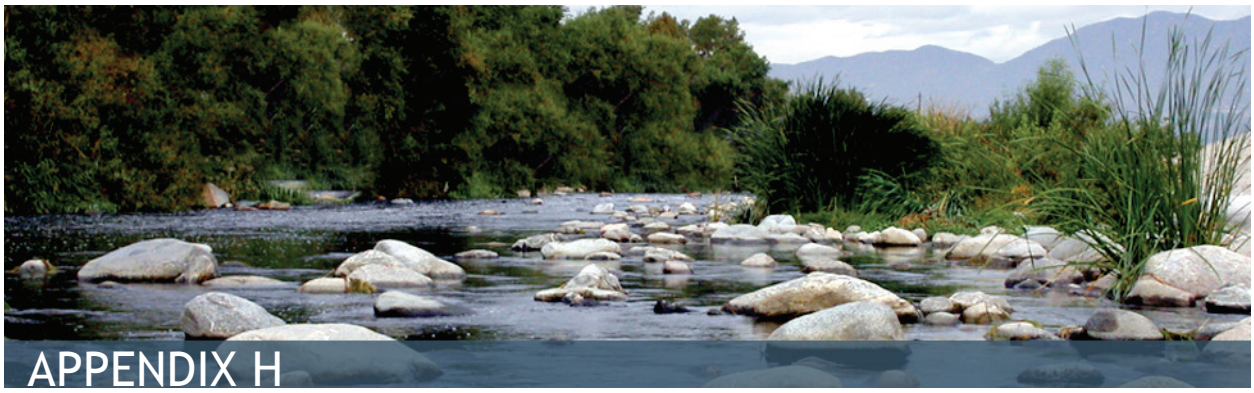

APPENDIX H

H. The Greater Los Angeles County Open Space, Habitat and Recreation Technical Memorandum

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Prepared for:

Greater Los Angeles County
Integrated Regional Water Management Plan

DRAFT FINAL
The Greater Los Angeles County Open Space Habitat and Recreation
Technical Memorandum

(Integrated Regional Water Management Plan Update – 2013)

Prepared by:

RMC Water and Environment
Geosyntec consultants
2M
Dr. Richard Ambrose
GreenInfo Network
SOLUTION strategies INTERNATIONAL

& Aubrey Dugger

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LIST OF ACRONYMS AND ABBREVATIONS

AF	acre-feet
AF/yr	acre-feet/year
ASBS	Areas of Special Biological Significance
BMP	best management practices
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CRAM	California Rapid Assessment Methodology
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
GLAC	Greater Los Angeles County
Hazus	a geographic information system-based natural hazard loss estimation software package developed and freely distributed by FEMA.
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedures
HGM	Hydrogeomorphic Aquatic habitat Assessment Model
IBI	Index of Biological Integrity
IPCC	Intergovernmental Panel on Climate Change
IRWMP	Integrated Regional Water Management Plan
LSGLA	Lower San Gabriel and Los Angeles River Subregion
MPA	Marine Protected Area
NCCP	Natural Communities Conservation Planning
NEPA	National Environmental Protection Act
NOAA	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System

LIST OF ACRONYMS AND ABBREVATIONS (CONTINUED)

NSMB	North Santa Monica Bay Subregion
NWI	National Wetlands Inventory
OSHARTM	Open Space, Habitat and Recreation Technical Memorandum
PDM	Post-Delisting Monitoring
Region	Greater Los Angeles County Region
RWQCB	Regional Water Quality Control Board
SAMP	Special Area Management Plans
SEA	Significant Ecological Area
SEATAC	Significant Ecological Area Technical Advisory Committee
SSMB	South Santa Monica Bay Subregion
TAR	Treatment Area Ratio
ULAR	Upper Los Angeles River Subregion
USACE	United States Army Corp of Engineers
USFWS	United States Fish and Wildlife Service
USGRH	Upper San Gabriel and Rio Hondo Subregion
WET	Aquatic habitats Evaluation Technique

EXECUTIVE SUMMARY

The Greater Los Angeles County (GLAC) region is 2,058 square miles and is one of the most densely populated, highly urbanized, and biologically diverse areas of the United States. Natural open space systems provide habitat and recreation opportunities, as well as other important functions related to water supply, water quality, and other services including flood management and climate adaptation. As the region has grown, much of these natural systems have been lost or fragmented.

The goal of the planning process is to provide direction for preserving, linking, restoring, and creating open space by providing a comprehensive regional framework for incorporating open space, both habitat and recreation, into water management project design features. To achieve this goal, this report presents information to assist water managers in more effectively including open space considerations in the development of water projects, as well as information for open space managers to easily incorporate water management objectives into their projects.

The Open Space, Habitat and Recreation Technical Memorandum (OSHARTM) builds on information provided in the 2006 Greater Los Angeles County Integrated Regional Management Plan (IRWMP) and other significant regional planning efforts. It was developed through collaboration with key agency stakeholders throughout the GLAC Region, including the Los Angeles County Flood Control District, the Council for Watershed Health, the Santa Monica Bay Restoration Commission, and various City, County, and State agencies that serve on the IRWMP Habitat and Open Space Ad Hoc Subcommittee.

This planning effort continued to recognize the five subregional IRWMP watershed planning areas established by the 2006 IRWMP. The subregions are as follows:

- North Santa Monica Bay Watershed (NSMB)
- Upper Los Angeles River Watershed (ULAR)
- Upper San Gabriel River and Rio Hondo Watersheds (USGRH)
- Lower San Gabriel River and Los Angeles River Watersheds (LSGLA)
- South Santa Monica Bay Watershed (SSMB)

Objective of the Plan

The objective of the OSHARTM planning process and report is to provide a framework for the GLAC Region's water and land managers to assist in the development of integrated projects for funding through the IRWMP. This plan re-defines the habitat and recreation goals for the GLAC IRWMP, details more meaningful objectives for those goals, and quantifies measureable targets. Having said that, the open space, habitat and recreation targets developed herein for the GLAC IRWMP reflect the best available information at this time, but are based on numerous assumptions and are subject to change as better information about the potential for actual implementation, including information about the cost of attaining the targets, is developed at the Subregional and Regional level. However, as other funding and planning opportunities arise, the methods contained herein can easily be used, when applicable, by others working to improve open space, habitat and recreation in the Region.

Open Space

Open space encompasses a continuum of uses from natural resource lands to urban parks. The habitat continuum extends from upland areas to riparian and freshwater aquatic habitat areas to coastal tidal aquatic habitats, while the recreation continuum extends from natural open space areas to greenways to park and urban recreation areas.

By viewing open space habitat and recreation as a continuum that changes depending on location and the needs of the region, multiple options can be considered in determining how these elements can work together and complement each other in meeting the other IRWMP objectives for water supply, water quality, and flood management. To develop targets, criteria, and methodologies, the Open Space Team first looked at the interconnectivity of open space throughout the region as a whole and then looked at each of the subregions.

In the foothill cities, open space is differentiated from developed urban parklands and focuses on natural, undeveloped lands that have been designated as environmentally and ecologically significant. On the other hand, for the more urbanized areas of Los Angeles County or cities that are built out and contain little or no undeveloped or undisturbed lands, open space emphasizes urban lands used for recreation. These lands include neighborhood and community parks, sports fields, school facilities, greenways, bikeways, green streets, medians, utility easements, etc.

Open Space and Habitat

Southern California, along with the entire GLAC Region is an area rich in natural resources. Due the scale of the threat to its biodiversity, many scientists, including noted biologist E.O. Wilson, have designated it as a "biological hotspot." The objectives and targets for habitat seek to protect and restore these valuable natural resources in the context of water supply and management.

The objectives of the Open Space and Habitat section of the Plan are to increase the number of viable aquatic habitats within the region, to provide adequate buffers along aquatic systems, and to create wildlife linkages using riparian corridors and less densely populated hillsides. In addition, the establishment of wildlife linkages, allowing species to migrate as conditions change, will help address the effects of climate change.

Aquatic habitats

To simplify the presentation of aquatic habitat planning targets, aquatic habitats, as defined ecologically based on the National Wetlands Inventory, were classified into two general categories: (1) tidal aquatic habitats, (2) freshwater/riverine aquatic habitats. Three distinct types of aquatic habitat targets were developed: (1) protection of existing aquatic habitat, (2) enhancement of existing aquatic habitat, and (3) restoration or creation of aquatic habitat. For the GLAC Region, the total aquatic habitat area to be benefited by protection, enhancement, restoration or creation is 12,000 acres.

Uplands

Protection of water-dependent or aquatic habitat resources depends not only on managing the systems themselves, but also providing buffers to these systems and linkages through the landscape. Therefore, the provision of upland buffers and habitat linkages is important to maintaining habitat diversity. The targets for upland habitat acquisition and/or restoration were developed using Buffers and Buffer Zones (50 to 300-foot wide areas adjoining an aquatic habitat) and Wildlife Linkages or Corridors (wide areas of native vegetation that connect two or more large blocks of habitat). Targets are based on the acquisition and/or restoration of these two features. Targets for total potential linkage and buffer areas within the GLAC Region are 36,000 acres.

Open Space and Recreation

Over 9,000,000 people who live within the GLAC Region have access to more than 2,000 park and open space areas totaling 101,000 acres. In addition, there are almost 300,000 acres of public multi-use lands in the Angeles National Forest.

While there are many opportunities for recreation in the region, the recreation demand exceeds the supply. Recreation ranges from highly structured parks and recreation sites within communities, to regional parks that may offer developed active and undeveloped passive uses, to natural habitat and wildlands that contain trail-related hiking, biking, and equestrian uses, as well as outdoor/environment education opportunities. Three general recreation objectives were established to guide targets:

- Assist in providing urban neighborhood and community park areas that are accessible to underserved populations (and disadvantaged communities) based on average of 4 acres per thousand population.
- Enhance existing and planned greenways and regional trails within open space areas with outdoor recreation and environmental educational opportunities.
- Create or assure the preservation of 6 acres of open space lands per 1000 population that are available for passive public outdoor recreation and education purposes. These lands may incorporate: all or a portion of greenways; county, state, or national parks; US Forest Service lands; regional trails routes; and/or dedicated open space areas or any jurisdiction.

Based on existing standards, there is a need for approximately 16,500 acres of additional urban parkland (neighborhood and community parks). In addition, there is a need for approximately 30,000 to 45,000 acres of additional regional park and open space lands for recreation. The developed urban park targets can be improved to consider reasonable accessibility criteria in every subregion.

Ecosystem Services

The benefits of open space lands within the region are extensive. In addition to water resource benefits, there is a full range of societal and economic benefits attributable to open space. Ecosystem services provide one approach for framing the values and benefits of open space.

Ecosystem services within the GLAC Region include, but are not limited to, the following benefits:

- Providing Fresh Water
- Infiltration and Groundwater Recharge
- Water Conservation
- Improving Water Quality
- Flood Management
- Preserving Biodiversity
- Providing Carbon Management
- Providing Aesthetics
- Cultural Values

Open space from a habitat perspective allows people to fulfill their desire to be connected to nature. This connection contributes to a greater sense of community. Recreation occurring in open space areas, whether it is passive or active, improves physical health, mental health, social function and youth development and provides environmental and economic benefits to people and communities.

Surface and Groundwater Resources Management Benefits

There are benefits to both surface and groundwater resource management that can be quantified using project-specific methodology. This methodology has been applied at the regional level using the assumption that the targets for habitat and recreation will be achieved. For example, there is an estimated potential to recharge an additional 28,000 acre feet of water per year on average throughout the GLAC Region if target habitat and recreation lands in areas with high recharge potential are developed or enhanced. As well, if the targets are met there is the potential to create 21,000 acre feet of storage for stormwater quality purposes if these open space lands are developed or enhanced with stormwater Best Management Practices (BMPs).

Climate Benefits

The effects of climate change are wide-reaching and must be incorporated into long-term planning efforts. There are a number of strategies that can be implemented within the

OSHARTM that will mitigate the effects of climate change. Climate benefits include carbon storage and sequestration by natural habitats (the carbon sequestration benefit will vary depending on the species planted); providing additional local recreation areas and "green" travel routes that encourage walking and cycling; and, creating habitat connectivity through wildlife linkages, corridors, and buffers.

Evaluating Open Space Projects

The OSHARTM Ad-Hoc subcommittee felt that it would be valuable to develop scoring metrics to determine the suitability of proposed projects in meeting overall goals and objectives. While draft project evaluation criteria were developed, further vetting of these criteria and integration with criteria to evaluate other types of projects is necessary before the draft scoring metrics are finalized. Further work on the scoring metrics may be continued in the future, as necessary.

Opportunities and Challenges

One of the main benefits to including open space for habitat and recreation metrics in the IRWMP is the opportunity it creates for a more connected region. The OSHARTM provides a mechanism for the County, cities, water resource agencies, conservancies, and stakeholders to work together to set region-wide goals and objectives. These goals and objectives can then be implemented at the subregional level through the IRWMP project grant program process.

The ability to form partnerships and collaborate to develop multi-purpose project and programs provides even greater opportunity to ensure the long-range success of the program. The 2006 IRWMP, as modified by subsequent updates, is considered a living document that will be reviewed and updated on a regular basis, which creates further opportunities to refine the criteria and targets developed during this planning effort as new information becomes available.

As with any undertaking that attempts to comprehensively address open spaces needs in a region the size of the GLAC there are challenges to be overcome. These include gaps in information, insufficient research, high levels of urbanization, and high land values. The OSHARTM includes a set of recommendations, which are intended to set forth strategies to reduce or overcome many of these challenges. Overall, one should be optimistic as challenges create opportunities.

1 INTRODUCTION

1.1 Background/Purpose

1.1.1 Overview of Integrated Regional Water Management Plan for the Greater Los Angeles County

The purpose of the 2006 Integrated Regional Water Management Plan (IRWMP) is to define a clear vision and direction for the sustainable management of water resources in the Greater Los Angeles County (GLAC). The plan provides a framework for the development of solutions that meet regional planning targets while integrating projects into other important issues that make up the urban context of the GLAC Region, including transportation, public education, land use, economic development, and quality of life. It also identifies the costs and benefits of those solutions to aid the GLAC in securing funding for the projects, both locally and with partners outside the region.

The IRWMP incorporates the following objectives to identify water resource management issues, increase the region's ecosystem services, and meet future water supply needs:

- Improve water supply
- Improve water quality
- Enhance open space for habitat and wildlands
- Enhance open space for recreation and greenways
- Sustain flood management

1.2 IRWMP Planning Areas

1.2.1 The Region

Given the size and complexity of the GLAC Region and the number of stakeholders and agencies, five subregional planning areas were established generally based on the watershed approach (Greater Los Angeles County Integrated Water Management Plan Region Acceptance Process Application, April 28 2009). Shown in Figure 1, the subregions are as follows:

1. North Santa Monica Bay Watersheds
2. Upper Los Angeles River Watersheds
3. Upper San Gabriel River and Rio Hondo Watersheds
4. Lower San Gabriel and Los Angeles Rivers Watersheds
5. South Santa Monica Bay Watersheds

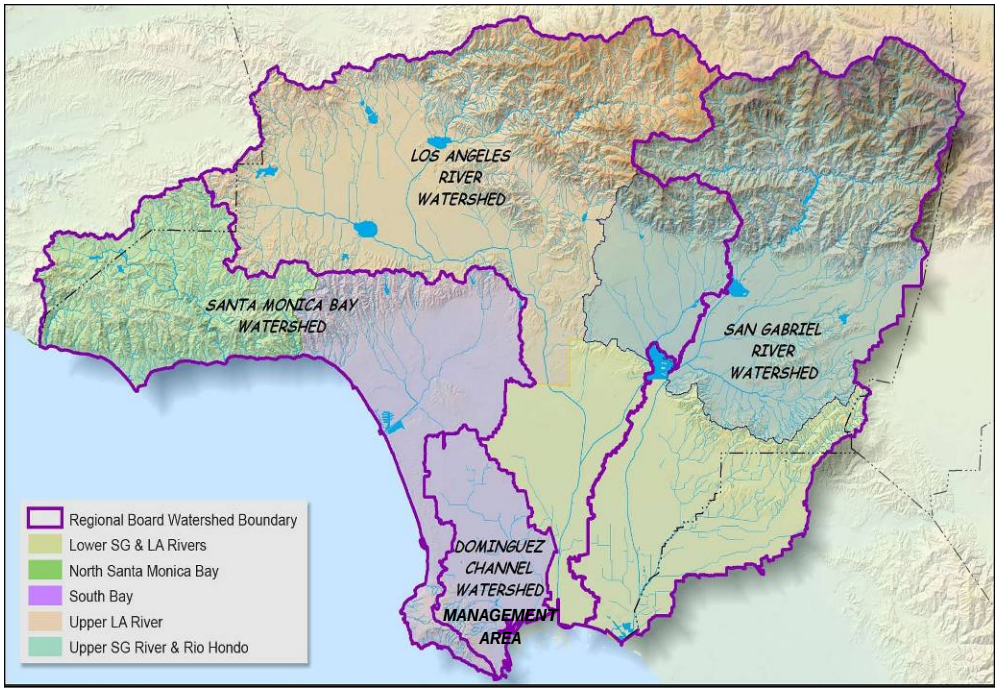

Figure 1. GLAC Subregional and Watershed Boundaries

1.3 2012 IRWMP Update

1.3.1 Living Document

The IRWMP is a living document. It is not intended to be filed away on a shelf, but rather to serve as the catalyst for solutions that can be implemented throughout the GLAC subregions.

The document is also intended to be reviewed regularly and updated as new information, technologies, and data become available.

1.3.2 IRWMP Planning Grant

The California Department of Water Resources (DWR) IRWM Program was created to encourage integrated regional strategies for managing water resources and to provide funding for both planning and implementation of projects that support management of water supply, water quality, environmental interests, drought protection, flood protections, and reduction of dependence on imported water. The current GLAC IRWM Plan was adopted in 2006.

In September 2010, the GLAC Region applied for $1,000,000 in Proposition 84 Planning Grant funds from DWR and on April 11, 2011, was awarded this sum. Funds from this grant are being used to update and expand the 2006 IRWMP.

1.3.3 Open Space Planning

One of the goals of the grant application was to develop a long-term open space, habitat and recreation TM vision for the GLAC Region that is supported by a clear rationale and based on the best available science and information.

The GLAC IRWMP Planning Grant Application stated that previous open space planning in the region had not been comprehensive. Instead it had focused on a geographic perspective and was often limited to specific areas or resources (e.g. the National Forest or coastal aquatic habitats). The IRWMP open space planning effort embodied in this TM is more comprehensive and addresses habitat conservation and restoration, human recreation, and water management in and around the urbanized areas at the scale of the GLAC IRWMP Region.

1.3.4 Landscape Scale Approach

To address the need to provide a comprehensive strategy for open space planning in the context of water resource management, the GLAC Open Space, Habitat and Recreation TM (OSHARTM) uses a landscape-scale approach to identifying opportunities to enhance aquatic and upland resources, improve planning for recreational opportunities, and facilitate the continuation of valuable ecosystem and cultural services across the region.

1.3.5 OSHARTM Component to the IRWMP

As stated earlier, developing the OSHARTM is part of the 2011-2013 IRWMP revision process. As mentioned in the GLAC IRWMP grant application, previous open space planning has not been comprehensive. The OSHARTM provides an opportunity to integrate open space resource management into the regional water management solutions.

To integrate habitat and recreation and other recognized ecosystem services into a comprehensive framework, the current OSHARTM builds on information provided in the 2006 IRWMP and other significant regional planning efforts.

By understanding how habitat and recreation support water quality and water supply and developing opportunities to incorporate the targets into the design of projects, the habitat and recreation objectives of the IRWMP can be realized. This will aid individual agencies, cities, and subregions in effectively implementing projects and programs that address more than one of the identified water management strategies.

1.4 OSHARTM Planning Process

In preparation for OSHARTM, many regional Los Angeles County planning efforts were examined. Exhibit A, Planning Documents Reviewed, details the projects, studies, and reports that were reviewed for references to watershed issues and habitat linkages.

The OSHARTM was developed through collaboration with key agency stakeholders throughout the GLAC Region, including the Council for Watershed Health, Santa Monica Bay Restoration Commission (see Table 1) and various city and county agencies, who comprised the IRWMP Habitat and Open Space Ad Hoc Subcommittee. This collaboration occurred primarily through monthly subregional meetings, as well as four Habitat and Open Space Subcommittee meetings that were held at the Los Angeles River Center on the following dates: September 27, 2011; November 14, 2011; December 21, 2011; and April 23, 2011. During these meetings, OSHARTM targets were developed through an iterative process, with targets presented and subsequent meetings used to further refine target methodology based on input from previous meetings. Subcommittee involvement also included additional in-person or phone meetings as requested by individual stakeholders, as well as email correspondence, to discuss methodology details. The draft OSHARTM was released on April 6, 2012 to the subcommittee for comment. Comments were received from multiple stakeholders throughout the GLAC Region, which were incorporated into the final version of the TM.

Table 1. List of Participating Agencies/Groups and Representative(s)

Organization	Representative
Army Corps of Engineers	Erin Jones
Arroyo Seco Foundation	Meredith McKenzie Tim Brick
Cities of Agoura Hills and Westlake Village	Joe Bellomo
City of Los Angeles Planning	Claire Bowin
City of Malibu	Barbara Cameron
Council for Watershed Health	Blake Whittington Nancy Steele
Los Angeles County	Timothy Pershing
Los Angeles County Flood Control	Phil Doudar Russ Bryden Rochelle Paras
Los Angeles County Parks and Recreation	Camille Johnson Norma Garcia
Las Virgenes Municipal Water District	Jan Dougall Randal Orton
Mountains Recreation and Conservation Authority	Dash Stolarz
Mountains Restoration Trust	Jo Kitz
Palos Verdes Peninsula Land Conservancy	Andrea Vona
Resource Conservation District of the Santa Monica Mountains	Clark Stevens Melina Watts
Rivers and Mountains Conservancy	Belinda Faustinos Mark Stanley Marybeth Vergara
Regional Water Quality Control Board	Shirley Birosik
Santa Monica Bay Restoration Commission	Shelley Luce
State Water Resources Control Board	Guangyu Wang
Tree People	Rebecca Drayse

2 THE OPEN SPACE CONTINUUM (NATURAL RESOURCE LANDS TO URBAN PARKS)

For general planning purposes, the definition of open space is "any parcel or area of land or water that is essentially unimproved and devoted to an open space use for the purposes of (1) the preservation of natural resources, (2) the managed production of resources, (3) outdoor recreation, or (4) public health and safety."[1] See Figure 2 for a visual description of the environmental Open Space Continuum from the region's mountains to the coast.

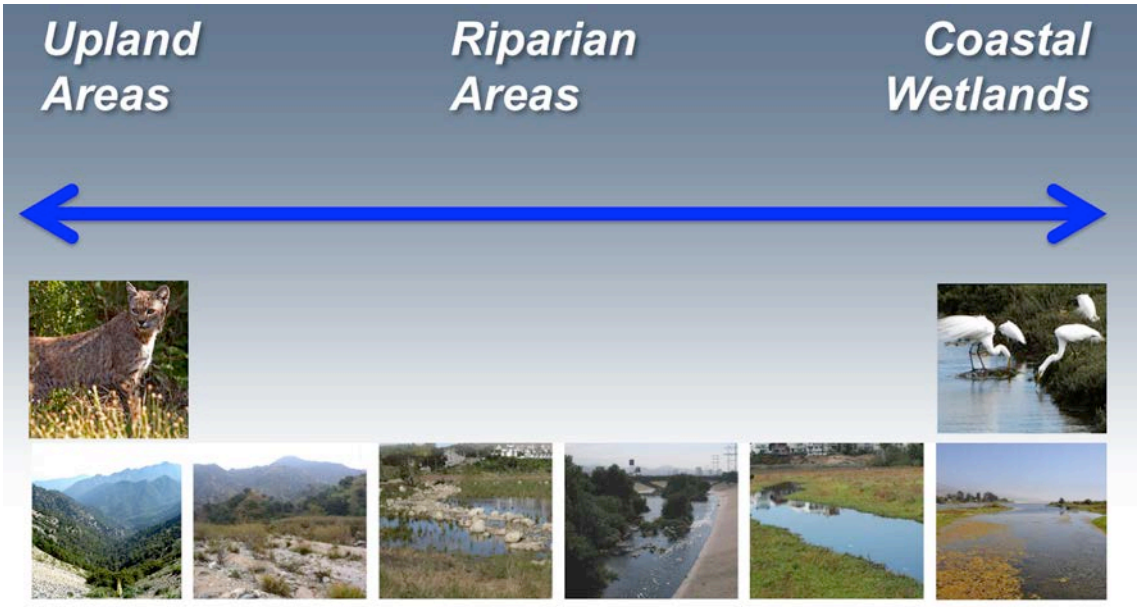

Figure 2. The Open Space Continuum – From Uplands to the Coast

From a planning perspective, open space conservation is typically addressed through state-required open space and conservation elements of General Plans. As a practical matter, the definition of open space is defined based on the community values of the individual jurisdiction and is therefore interpreted fairly widely by Los Angeles County and the nearly 84 cities within the GLAC Region. The variations between jurisdictions are generally due to

[1] State of California, Governor's Office of Planning and Research. *State of California General Plan Guidelines*. 2003.

the interpretation of the phrase "essentially undeveloped," a relative term. See Figure 3 below for a visual description of the recreational Open Space Continuum.

Figure 3. The Open Space Continuum – From Regional Lands to Urban Parks

For the foothill cities, open space is differentiated from developed urban parklands and focuses on relatively natural undeveloped lands that have been designated as environmentally and ecologically significant as wildlife habitat areas and corridors, or areas that provide a visual backdrop and amenity. These lands often include substantial hillside areas and canyons and may include rural and agricultural lands. Open space in these instances applies to land that is typically publicly owned, though not always, and in some instances public access may be restricted. Some of these open space areas have developed visitor facilities and hold commercial events, which can in and of themselves cause impacts on these lands and areas.

The definition of open space as used by the State of California for the preparation of General Plans provides a broad framework that includes many public benefits. Some open space benefits include:

- Habitat preservation and opportunities for restoration:
  - Ecosystem diversity and services
  - Wildlife corridor connectivity
  - Endangered species habitat
- Outdoor recreation opportunities:
  - Passive uses
  - Active uses
- Water supply:
  - Surface
  - Groundwater
- Water quality maintenance
- Air quality maintenance
- Historic and cultural resource protection
- Agricultural opportunity
- Forest management
- Scenic quality preservation
- Control of urban sprawl and associated benefits:
  - Community image / rural character
  - Ambient healthful living conditions
  - Reduced greenhouse gas emissions (air quality)
  - Quality of life

On the other hand, for the more urbanized areas of Los Angeles County or cities that are essentially built out and contain little or no undeveloped or undisturbed landscapes, such as Burbank, Gardena, or Compton, the expression of open space contained in their General Plans emphasizes urban lands used for recreation purposes. These lands include neighborhood and community parks and sports fields. Urban open spaces may even include public school facilities, greenways, bikeways, green streets and landscaped medians, open areas occupied by utilities such as flood control channels and utility easements, and private recreational facilities. Alternatively, there are many open space and wilderness parks that are increasing the number of developed visitor facilities, number of commercial events and leasing properties for commercial purposes.

3 OPEN SPACE AND HABITAT

The GLAC Region is approximately 2,000 square miles located in coastal Southern California. The IRWMP project area is one of the most densely populated, highly urbanized, and biologically diverse areas of the United States. It is located within the Californian Floristic Province, which is a biodiversity hotspot. Designated a hotspot in 1996, it shares this distinction with 33 other places in the world.[2] Noted biologist E.O Wilson designated southern California as one of the world's eighteen "hotspots" – the only one in North America – because of the scale of the threat to its biodiversity. Climatically only two percent of the earth's surface has the Mediterranean-type climate found in southern California.

The study area is part of a complex landscape where the geomorphic provinces of the Transverse Ranges and Peninsular Ranges come together. Major topographic features in the region include the San Gabriel Mountains, Santa Monica Mountains, Verdugo Hills, San Jose Hills, Puente-Chino Hills, and Palos Verdes Peninsula. The mountains, hills, and peninsula define the San Fernando and San Gabriel Valleys and other portions of the Los Angeles basin and coastal plain.

The San Jose and Puente-Chino Hills contain relatively low density urban development as compared to the Los Angeles Basin and still retain areas with significant open space. Areas in the southern San Gabriel foothills are also developed at a lower density than the highly urbanized areas in the valleys and coastal plains. These foothills function as the urban/wildland interface and provide wildlife connections to river and stream corridors.

The two largest watersheds of the region are the San Gabriel River Watershed and the Los Angeles River Watershed. The San Gabriel River watershed drains 660 square miles and has its headwaters in the San Gabriel Mountains. The river reaches the Pacific Ocean at Los Alamitos Bay. The Los Angeles River watershed drains 830 square miles of land from the Santa Monica Mountains, the San Gabriel Mountains, and the Los Angeles basin, reaching the Pacific Ocean in Long Beach. These two rivers formed the Los Angeles basin, a large floodplain and alluvial fan. The Rio Hondo River hydrologically connects the Los Angeles River and San Gabriel River watersheds at the Whittier Narrows Reservoir. Other major watersheds in the region include Malibu Creek, Topanga Creek, Ballona Creek (which drain to Santa Monica Bay), and the Dominguez Channel (which drains to San Pedro Bay). Dozens of smaller watersheds drain directly to Santa Monica or San Pedro Bays.

[2] www.calacademy.org/exhibits/California_hotspot/overview.htm

In the mountains and foothills, including many of the coastal watersheds, the streams have seasonal flows and high-quality habitat. Downstream, the river systems have been engineered to protect homes and businesses from flooding and to provide for water conservation. Moreover, the modifications that have been made contribute to water supply and other resource management strategies, so new projects to achieve open space, habitat and recreation goals must be developed in ways that work with those existing facilities and projects, so that the Region does not undermine attainment of other types of IRWMP goals, such as enhancement of locally-produced water supplies that are more sustainable.

In some areas of Los Angeles County, nearly all aquatic habitat areas that was present prior to European settlement has been developed or severely diminished in habitat value. Despite their altered state, these urbanized channels still serve as habitat for wildlife.

The diverse landscape of the study area contains examples from most of the vegetation types and wildlife that are found in Southern California today. From the high peaks of the San Gabriel Mountains to the low coastal plain south of the Puente-Chino Hills, differences in climate, soils, and geology set the stage for a wide array of plant communities. Common plant communities include coastal strands and bluffs, lagoons, coastal sage scrub, chaparral, foothill woodlands, and coniferous forests in the mountains. Chaparral is the dominant native plant community in the study area.

Many of the region's native plant communities have been displaced due to grazing, agriculture, and urban development. Almost all of the native plant communities that remain contain sensitive, rare, or endangered flora and fauna. The GLAC Region is also home to 51 species that hold federal endangered, threatened, candidate for listing, or subject for post delisting monitoring (PDM) status. Table 2 below provides a list of federal endangered and threatened species found in the project area.[3]

[3] http://www.fws.gov/carlsbad/SpeciesStatusList/CFWO_Species_Status_List.htm

Table 2. Federally Listed Species Occurring within the GLAC Region

Scientific Name	Common Name	Federal Status
PLANTS		
Acmispon (Lotus) dendroideus var. *traskiae*	San Clemente Island lotus	Endangered
Arenaria paludicola	marsh sandwort	Endangered
Astragalus brauntonii	Braunton's milk-vetch	Endangered
Astragalus pycnostachyus var. *lanosissimus*	Ventura marsh milk-vetch	Endangered
Astragalus tener var. *titi*	coastal dunes milk-vetch	Endangered
Berberis nevinii	Nevin's barberry	Endangered
Brodiaea filifolia	thread-leaved brodiaea	Threatened
Castilleja grisea	San Clemente Island Indian paintbrush	Endangered
Cercocarpus traskiae	Catalina Island mountain mahogany	Endangered
*Cordylanthus maritimus (*subsp.*maritimus)*	salt marsh bird's beak	Endangered
Chorizanthe parryi var. *Fernandina*	San Fernando Valley spineflower	Candidate
Delphinium variegatum subsp. *kinkiense*	San Clemente Island larkspur	Endangered
Dodecahema (Centrostegia) leptoceras	slender-horned spineflower	Endangered
Dudleya cymosa subsp. *Ovatifolia*	Santa Monica Mountains dudleya	Threatened
Helianthemum greenei	Island rush-rose	Threatened
Lithophragma maximum	San Clemente Island woodland star	Endangered
Malacothamnus clementinus	San Clemente Island bush mallow	Endangered
Navarretia fossalis	spreading navarretia	Threatened
Orcuttia californica	California Orcutt grass	Endangered
Pentachaeta lyonii	Lyon's pentachaeta	Endangered
Phacelia stellaris	Brand's phacelia	Candidate
Rorippa gambellii	Gambel's watercress	Endangered
Sibara filifolia	Santa Cruz Island rock-cress	Endangered
INVERTEBRATES		
Euphilotes battoides allyni	El Segundo blue butterfly	Endangered
Glaucopsyche lygdamus	Palos Verdes blue butterfly	Endangered

Scientific Name	Common Name	Federal Status
palosverdesensis		
Streptocephalus woottoni	Riverside fairy shrimp	Endangered
FISH		
Catostomus santaanae	Santa Ana sucker	Threatened
Gasterosteus aculeatus williamsoni	unarmored threespine stickleback	Endangered
Oncorhynchus mykiss	southern steelhead (So Cal DPS)	Endangered
AMPHIBIANS		
Anaxyrus californicus (Bufo microscaphus c.)	arroyo toad (a. southwestern t.)	Endangered
Rana draytonii	California red-legged frog	Threatened
Rana muscosa	mountain yellow-legged frog (So Cal DPS)	Endangered
REPTILES		
Xantusia riversiana	island night lizard	Threatened
BIRDS		
Amphispiza belli clementeae	San Clemente sage sparrow	Threatened
Brachyramphus marmoratus	marbled murrelet	Threatened
Charadrius alexandrinus nivosus	western snowy plover	Threatened
Coccyzus americanus	yellow-billed cuckoo	Candidate
Empidonax traillii extimus	southwestern willow flycatcher	Endangered
Gymnogyps californianus	California condor	Endangered
Haliaeetus leucocephalus	bald eagle	PDM
Lanius ludovicianus mearnsi	San Clemente loggerhead shrike	Endangered
Pelecanus occidentalis	brown pelican	PDM
Phoebastria albatrus	short-tailed albatross	Endangered
Polioptila californica californica	coastal California gnatcatcher	Threatened
Rallus longirostris levipes	light-footed clapper rail	Endangered
Sternula (Sterna) antillarum browni	California least tern	Endangered
Vireo bellii pusillus	least Bell's vireo	Endangered
MAMMALS		
Dipodomys merriami parvus	San Bernardino kangaroo rat	Endangered
Enhydra lutris nereis	southern sea otter	Threatened
Perognathus longimembris pacificus	Pacific pocket mouse	Endangered
Urocyon littoralis catalinae	Santa Catalina Island fox	Endangered

The region's lagoons and freshwater marshes are especially important to over wintering and migratory songbirds and waterfowl on the Pacific Flyway in addition to providing year round habitat and critical resources for resident species.

Within all five subregions, there are special designated areas called "critical habitat" that protect listed plant and animal species. The United States Fish and Wildlife Service (USFWS) through the Endangered Species Act (ESA) defines critical habitat as "a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery." A critical habitat designation typically has no impact on property or developments that do not involve a Federal agency, such as a private landowner developing a property that involves no Federal funding or permit. However, when such funding or permit is needed, the impacts to critical habitat are considered during the consultation with the USFWS. Each of the five subregions contain areas designated as critical habitat. Table 3 shows the designated critical habitat for each species across the subregions by acreage.

Table 3. Designated Critical Habitat for Federally Listed Species

Critical Habitat Acreage by Subregion					
Species	**Lower San Gabriel and Lower Los Angeles Rivers**	**North Santa Monica Bay**	**South Bay**	**Upper Los Angeles River**	**Upper San Gabriel and Rio Hondo Rivers**
Arroyo toad	0	0	0	1,190.0	0
Brauton's milk-vetch	0	710	510	270	280
California red-legged frog	0	4,950	0	4	0
Coastal California gnatcatcher	9,350	0	5,040	9,920	4.580
Lyon's pentachaeta	0	1,970	0	0	0
Mountain yellow-legged frog	0	0	0	0	3,240
Palos Verdes blue butterfly	0	0	90	0	0

The location of the designated critical habitat is provided in Figure 4.

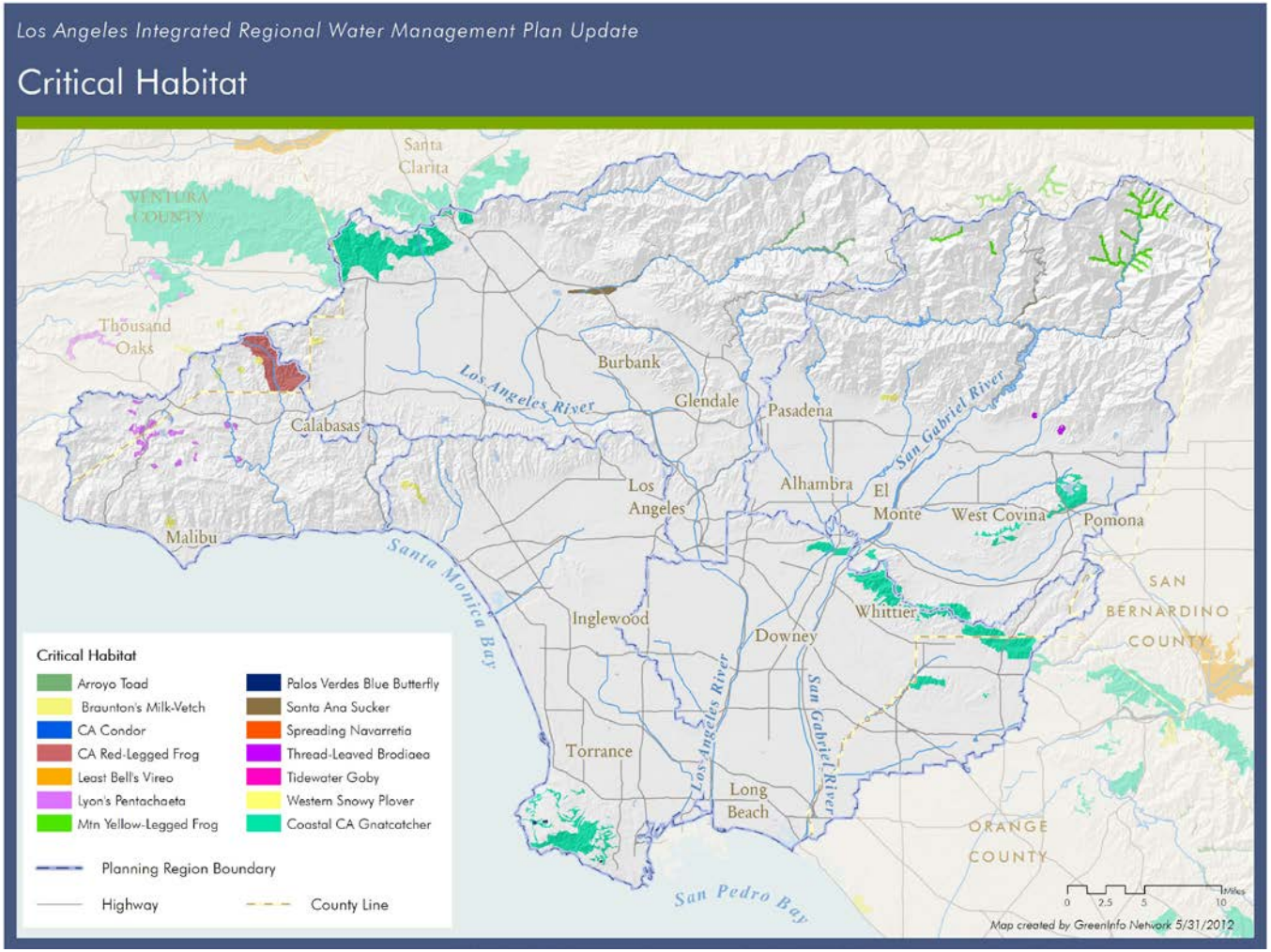

Figure 4. USFWS Designated Critical Habitat Areas

3.1 Regulatory Context

3.1.1 National Environmental Protection Act (NEPA)

NEPA, adopted in 1969 (42 U.S.C. Section 4321 et seq.), establishes a framework for protecting the national environment. "NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment."[4] All projects and activities that involve federal activities or property must comply with NEPA.

3.1.2 California Environmental Quality Act (CEQA)

CEQA, adopted in 1970 (Public Resource Code Section 21000 et seq.), is California's broadest environmental law. It guides local and state agencies in protecting the environment through the issuance of permits and approval of projects. "CEQA applies to all discretionary projects proposed to be conducted or approved by a California public agency, including private projects requiring discretionary government approval."[5] Any proposed project or activity by an individual or state governmental entity that impacts the environment is subject to CEQA regulations.

3.1.3 United States Army Corps of Engineers (USACE)

Regulatory Program

The USACE has regulatory permit authority from Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899. Section 404 gives the USACE jurisdiction over all water of the United States including aquatic habitats, perennial and intermittent streams, ponds, and lakes. The USACE is responsible for the day-to-day administration and permit review and the United States Environmental Protection Agency (EPA) provides program oversight. Any person or public agency proposing to discharge dredged or fill material into waters of the United States is required to obtain a permit. Any work in traditionally navigable waters also requires a permit. "Permit review and issuance follows a sequence process that encourages avoidance of impacts, followed by minimizing

[4] epa.gov/lawsregs/laws/nepa.html
[5] http://dfg.ca.gov/habcon/ceqa/

impacts and, finally, requiring mitigation for unavoidable impacts to the aquatic environment."[6]

Special Area Management Program (SAMP)

Special Area Management Plans (SAMPs) provide a comprehensive review of aquatic resources in an entire watershed rather than the USACE's traditional project-by-project review pursuant to its regulatory program. Potential watershed impacts are analyzed over time in order to identify priority areas for preservation, identify potential restoration areas, determine the least environmentally damaging locations for proposed projects, and establish alternative permitting processes appropriate for the SAMP area.

The goal of a SAMP is to achieve a balance between aquatic resource protection and reasonable economic and infrastructure development. Geographic areas of special sensitivity under intense development pressure are well-suited for this planning process. These comprehensive and complex efforts require the participation of multiple local, state, and federal agencies, as well as public and stakeholder involvement.

Mitigation Banking

The regulatory program provides a preference for the use of mitigation banking to offset unavoidable impacts to jurisdictional areas (33 CFR 332 et seq.). A mitigation bank is created when a government agency, corporation, nonprofit organization, or other entity undertakes providing mitigation for itself or others under a formal agreement with a resource or regulatory agency. Mitigation banks are a form of "third-party" compensatory mitigation, in which the responsibility for compensatory mitigation implementation and success is assumed by the bank operator rather than by the project developer. The bank operator is responsible for the design, construction, monitoring, ecological success, and long-term protection of the bank site (Mitigation Banking Factsheet, US EPA). To offset impacts to aquatic habitats, streams, lakes, and other aquatic sites, mitigation banks must be approved by the USACE. This and other mitigation requirements are discussed in the USACE rule regarding mitigation for the loss of aquatic resources (33 CFR 332 et seq.).

[6] http://www.fws.gov/habitatconservation/cwa.html

3.1.4 United States Fish and Wildlife Services

Endangered Species Act (ESA)

USFWS and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA) administer the ESA. "The ESA provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found."[7] The law requires consultation with federal agencies (e.g. USFWS and/or NOAA) to ensure that actions they authorize, fund, or carry out are not likely to impact the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. ESA prohibits any action that causes a "taking" of any listed species of fish or wildlife.[8]

Habitat Conservation Plans

The ESA, under section 10(a)(1)(B), also outlines a habitat conservation planning process that subsequently allows for USFWS and NOAA to issue incidental take permits for otherwise lawful activities. Projects impacting listed species and/or their habitat that do not have a federal project nexus (i.e. do not partner with a federal agency or use federal funds) are required to go through the 10(a)(1)(B) process and prepare a Habitat Conservation Plan (HCP). The HCP process ensures that a project, when finally approved by the agencies, adequately minimizes and mitigates impacts to listed species to the maximum extent possible. The size and scope of HCPs vary depending on the project proponent (i.e. HCPs can be developed for a single project or can be large-scale and multijurisdictional in nature and cover a variety of project types) (USFWS, 1996).

Conservation Banking

A conservation bank is similar to a mitigation bank. It too is a form of "third-party" compensatory mitigation created when an entity undertakes providing mitigation for itself or others under a formal agreement with a resource or regulatory agency. The conservation bank operator then becomes responsible for the design, construction, monitoring, ecological success, and long-term protection of the bank site. To offset impacts to aquatic habitats, streams, lakes, and other aquatic sites, mitigation banks must be approved by the USACE.

[7] http://www.epa.gov/lawsregs/laws/esa.html
[8] http://www.epa.gov/lawsregs/laws/esa.html

The difference is that the conservation bank is to offset impacts to listed species and their habitat.

3.1.5 Regional Water Quality Control Board (RWQCB)

California's Porter-Cologne Act

Under this Act adopted in 1969, the RWQCB has the authority over California water rights and water quality policy. It has jurisdiction over all of California's aquatic resources. The Act established the nine RWQCBs throughout the State of California to oversee water quality at the local and regional level. Each regional board prepares and updates Basin Plans, issues permits to control pollution and regulate all pollutant or nuisance discharges impacting surface water or groundwater.[9]

Section 401 of the Clean Water Act Certification

If a project requires a Section 404 permit, a Section 401 certification from the RWQCB is also needed. The federal CWA, in Section 401(a)(1), specifies that states must certify that any activity subject to a permit issued by a federal agency meets all state water quality standards:

> *"This program protects all waters in its regulatory scope, but has special responsibility for aquatic habitats, riparian areas, and headwaters because these water bodies have high resource value, are vulnerable to filling, and are not systematically protected by other programs. The Program encourages basin-level analysis and protection, because some functions of aquatic habitats, riparian areas, and headwater streams - including pollutant removal, flood water retention, and habitat connectivity - are expressed at the basin or landscape level"*[10]

Depending on the location of the project or activity, a Section 401 certification is obtained by applying to the applicable RWQCB region in which the project is located. The RWQCB also requires that the project file all other required permits and showing of compliance with NEPA and CEQA.

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[9] http://ceres.ca.gov/aquatic habitats/permitting/
[10] http://www.waterboards.ca.gov/water_issues/programs/cwa401/

National Pollutant Discharge Elimination System (NPDES) Permits

Under the U.S. Environmental Protection Agency, each of the nine RWQCBs has the responsibility of granting CWA NPDES permits for certain point-source discharges. NPDES permits set specific requirements managing the characteristics of the discharged water based on national technology-based effluent limitations and water quality standards. The permits establish the level of performance the permittee or discharger is required to maintain and specify monitoring, inspection, reporting requirements and additional actions necessary to achieve compliance with NPDES regulations. "Point source" is defined as any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container."[11] Each Regional Boards has different waste discharge requirements and other regulatory actions.[12]

Areas of Special Biological Significance (ASBS)

In the mid-1970s, thirty-four areas on the coast of California were designated as areas requiring protection by the State Water Resources Control Board and were called Areas of Special Biological Significance (ASBS). The Public Resources Code states that point source waste and thermal discharges into ASBS are prohibited or limited by special conditions, and nonpoint sources discharging into ASBSs must be controlled to the extent practicable. There is one ASBS, the Mugu Lagoon to Latigo Point ASBS, within the study region.

3.1.6 California Department of Fish and Wildlife

Streambed Alteration Agreements (Section 1600 of the Fish and Wildlife Code)

The CDFWCDFW Code (Sections 1600-1616) regulates activities that would alter the flow, bed, banks, channel, or associated riparian areas of a river, stream, or lake. The law requires any person, state or local governmental agency, or public utility to notify CDFWCDFW before beginning an activity that will substantially modify a river, stream, or lake. These

[11] http://www.campuserc.org/virtualtour/grounds/drains/Pages/NPDES-Overview.aspx
[12] http://ceres.ca.gov/aquatic habitats/permitting/

activities also must be consistent with any other applicable environmental laws such as Section 404 and 401 of the Clean Water Act and CEQA.[13]

California Endangered Species Act (CESA)

CESA, adopted in 1970, "expresses the state's concern over California's threatened wildlife, defined rare and endangered wildlife," and gave authority to CDFWCDFW to "identify, conserve, protect, restore, and enhance any endangered species or any threatened species and its habitat in California."[14] This Act (Fish and Wildlife Code Section 2050, et seq.) prohibits the "taking" of California listed species unless a permit is obtained from the CDFWCDFW.[15] Many of the endangered and/or threatened species are similar to those listed under the federal ESA.

Natural Communities Conservation Planning (NCCP) Program

In 1991, the Natural Community Conservation Planning (NCCP) Act was added to CESA (Fish and Wildlife Code Section 2800-2840). The State of California is the only state to enact a law that closely complements the habitat conservation planning process of ESA. The NCCP Act encourages the development of multi-species, ecosystem-based plans that provide for the conservation and recovery of both listed and unlisted species within the plan area. The NCCP Act requires a plan to provide for the conservation of covered species, and includes independent scientific input and significant public participation. When applied together, the ESA and NCCP Act bring their complementary strengths to conservation planning to provide greater conservation benefits than either Act alone.

Marine Protected Areas

On December 15, 2010, the California Fish and Game Commission adopted regulations to create a suite of marine protected areas (MPAs) in southern California (Point Conception to the California/Mexico border). This network of 50 MPAs and two special closures (including 13 MPAs and two special closures previously established at the northern Channel Islands) covers approximately 354 square miles of state waters and represents approximately 15 percent of the region. There are four designated MPAs in the study region:

[13] http://ceres.ca.gov/aquatic habitats/permitting/
[14] http://www.energy.ca.gov/glossary/
[15] http://ceres.ca.gov/wetlands/permitting.htm

- Point Dume State Marine Conservation Area
- Point Dume State Marine Reserve
- Point Vicente State Marine Conservation Area
- Abalone Cove State Marine Conservation Area.

All take is prohibited in the Point Dume State Marine Reserve and the Point Vicente State Marine Conservation Area, except for remediation activities associated with the Palos Verdes Shelf Operable Unit of the Montrose Chemical Superfund Site in Point Vicente. Take is restricted in the other State Marine Conservation Areas, although some fishing for pelagic finfish and coastal pelagic species is allowed.

Environmentally Sensitive Habitat Areas

Sensitive ecological areas within the City of Malibu have been modified with additional field studies that either retained or modified the County SEAs. The Malibu Local Coastal Plan and Local Implementation Plan for Coastal Development Permits were adopted on September 13, 2002. ESHA maps are considered as a reference to designate areas that need special study with a site-specific biological resource study. The ESHA maps and other environmental resources may be found at: http://www.malibucity.org/documentcenter/view/4420 (Public Access, Public Beaches, Parklands & Trails (Amended in 2011 http://www.malibucity.org/documentcenter/view/1340), ESHA as of 2001. There have been amendments, if more details are needed.)

3.1.7 County of Los Angeles

Significant Ecological Areas

The concept of a 'significant ecological area' (SEA) is unique to Los Angeles County. Los Angeles County developed the concept in the 1970s in conjunction with adopting the original General Plan for the County.

The Significant Ecological Area (SEA) Program is a component of the Los Angeles County Conservation/Open Space Element in their General Plan. This program is a resource identification tool that indicates the existence of important biological resources. SEAs are not preserves, but are areas where the County deems it important to facilitate a balance between limited development and resource conservation. Limited development activities are reviewed closely in these areas where site design is a key element in conserving fragile

resources such as streams, oak woodlands, and threatened or endangered species and their habitat.

Proposed development is governed by SEA regulations. The regulations, currently under review, do not to preclude development, but to allow limited, controlled development that does not jeopardize the unique biotic diversity within the County. The SEA conditional use permit requires development activities be reviewed by the Significant Ecological Area Technical Advisory Committee (SEATAC). Additional information about regulatory requirements is available on the Los Angeles County website.[16]

[16] http://planning.lacounty.gov/sea/faqs

4 OBJECTIVES AND PLANNING TARGETS FOR HABITAT

The following sections describe the 20-year planning targets that were developed for the habitat section of the OSHARTM through the collaborative process described in Section 1.4. These targets are intended to serve as a quantitative measure of progress towards the overall IRWMP habitat goals, as well as to guide project proponents in effectively incorporating habitat into proposed IRWMP projects.

4.1 Objectives

Natural open space systems provide habitat and recreation opportunities, as well as other important functions related to water supply and water quality. California and the GLAC Region have lost a great amount of its natural systems and for aquatic habitats systems more than any other state (Dahl, 1990).

The objective in this planning process is to help reverse this trend and to have open space, habitat and recreation considered in the planning of water supply and water quality projects. While opportunities for coastal aquatic habitat restoration are limited by extensive development, as well as by geologic and topographic constraints, opportunities to preserve and restore aquatic habitat (i.e. stream corridors and riparian habitat) are numerous. Upland habitat blocks, buffers, and linkages also are in need of preservation and restoration.

The objective is to increase the acreage of aquatic within the region, to provide adequate buffers along aquatic systems, and to create wildlife linkages using riparian corridors and less densely populated hillsides. In addition, the establishment of wildlife linkages, allowing species to migrate northward as conditions change, will help address the effects of climate change.

4.2 Habitat Planning Targets – Aquatic Habitat

4.2.1 Aquatic Habitat

Although southern California is a relatively dry region, the greater Los Angeles area historically contained abundant and diverse aquatic habitat because of its aquatic habitat resources (Rairdan, 1998; Stein et al., 2007; Dark et al., 2011). Much of the original aquatic habitat in the region has been destroyed or converted to other habitat (including concrete-lined rivers), and much of the remaining aquatic habitats have been degraded by poor water quality or other human activities. The goals of the aquatic habitat targets are to protect,

restore (re-establish or rehabilitate), and/or enhance existing aquatic habitat and to create new aquatic habitat in the region.

Terminology

There are many different ways to categorize or define aquatic habitats, including approaches based on various ecological or regulatory perspectives. For this project, rather than use the term "wetland", which might have unintended associations, the term "aquatic habitat" was used to refer to land transitional between terrestrial and aquatic systems where the water table is usually at or near ground surface or the land is covered by shallow water. For purposes of this classification, aquatic habitat must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

For the purposes of this report, many man-made habitats are considered to be aquatic habitat/wetlands while the aquatic habitat regulatory definition considers man-made habitats developed as stormwater Best Management Practices as a separate category. Man-made detention basins, swales, and depressional areas are generally not considered aquatic habitats/wetlands for regulatory purposes even though they may provide ecosystem benefits.

To simplify the presentation of aquatic habitat planning targets, aquatic habitat was categorized into three general categories: (1) tidal aquatic habitat, (2) freshwater and (3) riverine aquatic habitat based on categories defined by the National Wetlands Inventory (NWI). Although incomplete, the NWI is a very important source of information for the present aquatic habitat conditions with the GLAC. Larger, regional areas that function as off-system detention and storage would be considered freshwater aquatic habitat. While it is recognized that rivers and stream beds are not always considered aquatic habitats, for they do provide some aquatic habitat value, and therefore are considered for this study. The definition for each of these categories is as follows:

- *Tidal aquatic habitats* include aquatic habitats that are inundated by tides, either seasonally or year-round. Marine harbors, a man-made habitat, are also considered tidal aquatic habitats. In the NWI mapping system, the three categories included in tidal aquatic habitats are estuarine and marine deepwater, estuarine and marine aquatic habitat, and tidal aquatic habitats.

- *Freshwater aquatic habitats* include aquatic habitats such as depressional marshes, lakes, and ponds. The NWI category "freshwater aquatic habitats" include freshwater emergent aquatic habitat, freshwater forested/shrub aquatic habitat, freshwater ponds and lakes, and also considers man-made habitats such as flood control basins and ponds which may include areas of freshwater aquatic habitats. It is an important distinction that although spreading grounds and some stormwater Best Management Practices, such as detention basins, swales, and depressional areas, also provide ecosystem benefits, they belong under a separate category and should not be subject to the same protection criteria. This category includes vegetated streams as well.
- *Riverine aquatic habitats* include the streambed and associated riparian areas, including upper and lower riverine habitats. Man-made habitats considered riverine aquatic habitats include concrete-lined channels and soft-bottomed channels. Note that "riparian" is sometimes used to mean riverine aquatic habitats. Because of its common usage, the terms are used interchangeably here. However, strictly speaking, riparian refers to the vegetated habitat adjacent to streams, rivers, lakes, reservoirs and other inland aquatic systems.

Because many existing freshwater aquatic habitats in the GLAC region would be considered vegetated streams which are similar to riverine aquatic habitats, targets for these two aquatic habitats are combined.

Three distinct types of aquatic habitat targets were also developed.

1. Protection of existing aquatic habitat
2. Enhancement of existing aquatic habitat
3. Restoration or creation of aquatic habitat

These activities could occur on public or private lands and include some of the following activities:

- *Protection* entails acquiring existing aquatic habitat not previously protected from destruction or degradation or otherwise adding protection measures to prevent an existing aquatic habitat from destruction or degradation.
- In *enhancement*, management actions are taken to improve the functions or values of an existing aquatic habitat. Enhancement actions could include improving the timing or amount of water source to an aquatic habitat, planting native aquatic habitat plants, controlling invasive species, and so forth.

Improving the quality of water entering an aquatic habitat alone would generally not be considered enhancement.

- *Restoration and creation* involve activities of either restoring or creating aquatic habitat in an area that does not currently contain aquatic habitat. The distinction is that if the activity occurs in an area that once contained that type of aquatic habitat it is considered to be restoration or re-establishment, whereas creation occurs in an upland area, converting it to aquatic habitat. In both restoration and creation, the focus should be on reintroducing the physical processes and geomorphic form necessary to support a self-sustaining aquatic habitat ecosystem.

Methodology

Protection, enhancement, and restoration/creation targets were calculated for each aquatic habitat type (tidal, freshwater/riverine). Figure 5 summarizes the general approach to calculating aquatic habitat targets, with more details about the methodology in Exhibit A, Aquatic Habitat Methodologies.

For each category, the percentage used to establish numeric targets was chosen after discussion with the Habitat and Open Space Plan Ad Hoc Subcommittee. The goal was to develop a numeric target that balanced the benefits of protecting, enhancing or restoring aquatic habitats against the practical constraints of undertaking these projects. The general philosophy used to develop these targets was to establish targets that were challenging, yet reasonably attainable.

The restoration/creation habitat targets are based on the area of wetlands lost in each subregion. The current (1986) and historical (1870) extent of wetlands in the Region (derived from Rairdan, 1998) is shown in Figure 6. While the total acreage of historical wetlands was used to establish targets, the locations of historical wetlands are shown merely for informational purposes, and are not intended to mandate where restoration/creation targets should be achieved.

Because the Rairdan data does not cover the NSMB region, the National Wetlands Inventory (NWI) was used to supplement. Maps showing wetlands for the remainder of this report display Rairdan data where it exists and NWI wetland data where no Rairdan data exists.

More detail about wetland data sources and aquatic habitat target development is provided in Exhibit A), shown in Figure 7.

Protection Target	=	Privately held existing habitat	x	20%		
Enhancement Target	=	Existing habitat	x	25%		
Restoration/Creation Target	=	[Lost habitat	x	10%]	+	[Converted habitat	x	10%]

Figure 5. Summary of Approach to Calculating Aquatic Habitat Targets

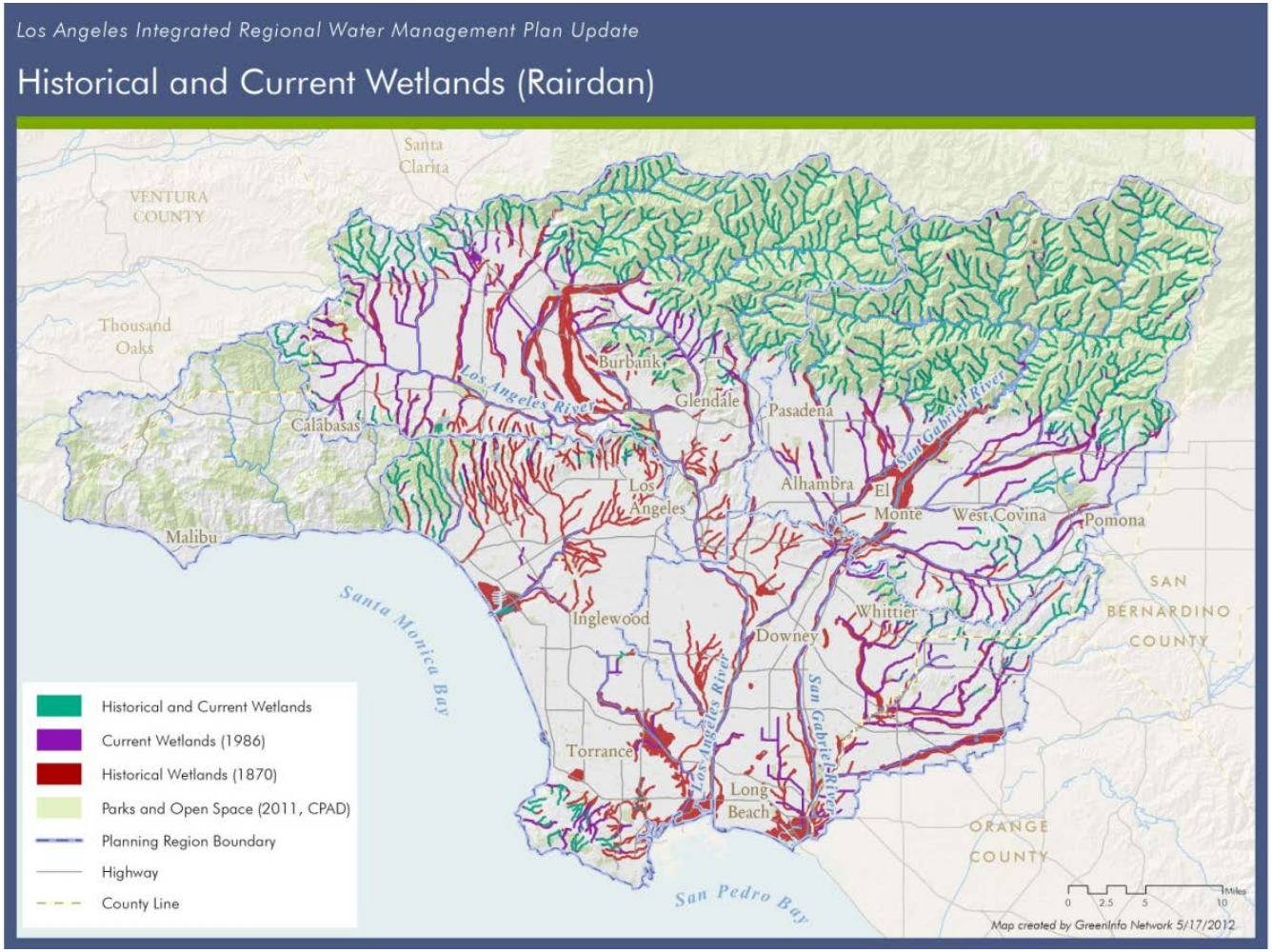

Figure 6. Historical and Current Wetlands (Rairdan) (GLAC Region, except NSMB Subregion)

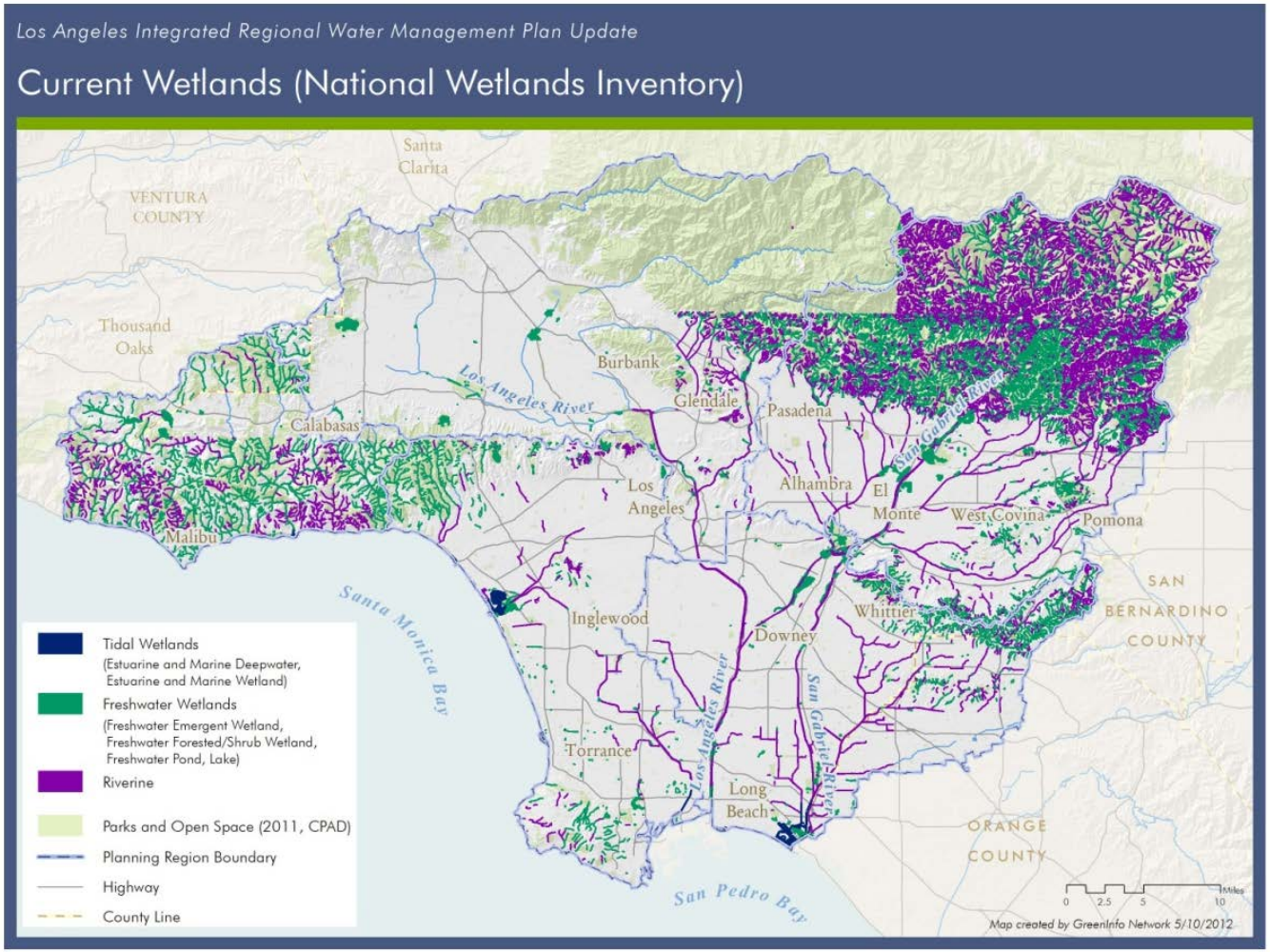

Figure 7. Current Wetlands (NWI) (GLAC Region)

Aquatic Habitat Targets

Table 4 below provides a breakdown of the aquatic habitat targets.

Table 4. Aquatic Habitat Targets (Acres)

GLAC Target	Tidal Aquatic habitat	Freshwater/Riparian Aquatic habitat	Total
Protection or Preservation	200	1,800	**2,000**
Enhancement	300	5,700	**6,000**
Restoration or Creation	760	3,300	**4,000**
TOTAL AQUATIC HABITAT BENEFITS			**12,000**

4.3 Habitat Planning Targets – Uplands

Urbanization of the Greater Los Angeles County area has caused the loss of aquatic habitat and upland communities and the fragmentation of the remaining habitat blocks. The disruption of animal movement by habitat fragmentation presents problems for the region's wildlife ranging from direct mortality on roadways to the genetic isolation of fragmented populations. Protection of water-dependent or aquatic habitat resources depends not only on managing the systems themselves, but also providing buffers to these systems and linkages through the landscape. Therefore, the provision of upland buffers and habitat linkages is important to maintaining habitat diversity.

An abundance of scientific research published since the 1970s documents the value of establishing, maintaining, and enhancing vegetated buffers along aquatic habitats. Aquatic habitat buffers provide important benefits including water quality improvement, streambank stabilization, flood control, wildlife habitat, and groundwater recharge (USDA, 2003; Castelle et al., 1992; EOR, 2001; Wenger, 2000; Correll, 1996). Aquatic habitat buffers also provide significant social and economic benefits by improving aesthetics and increasing property values (Lovell and Sullivan, 2005; Qui et al., 2006). The effects of habitat fragmentation and mitigation by identifying and protecting areas that wildlife use for movement (i.e. the protection of wildlife linkages or wildlife corridors) has been identified more recently (Beier and Noss, 1998; Bennett, 1999; Haddad et al., 2003; Eggers et al., 2009; Gilbert-Norton, 2010).

An aquatic habitat buffer is the vegetated transition zone between an upland area and the aquatic ecosystem, and depending on the definition, the buffer may include portions of both riparian and upland zones. This unique position in the landscape enables buffers to mitigate certain impacts of upland land use on adjacent aquatic habitats. In the absence of aquatic habitat buffers, these impacts are typically magnified and become more damaging.

Aquatic habitat buffers can vary in size based on factors such as adjacent land use, land ownership, topography, aquatic habitat area, and ecological functions. Generally speaking, buffers that are wider, longer, and more densely vegetated with herbaceous, shrub, and tree layers will provide more benefits than buffers that are narrower, shorter, and sparsely vegetated with only herbaceous species. Likewise, wildlife corridors can vary in size. Generally, however, they are larger or wider than buffer zones and provide essential life-support functions for the wildlife using the area.

Ridgelines, canyons, riparian areas, cliffs, swaths of forest or grassland, and other landscape or vegetation features can serve as wildlife linkages. Animals may also move across a relatively broad area rather than through a well-defined corridor, a type of wildlife linkage known as a diffuse movement area. Wildlife linkages are most effective when they connect (or are located within) relatively large and unfragmented areas referred to as habitat blocks (also called wildland blocks).

Areas adjacent to active stream channels can serve as buffers or corridors depending on their design. They can protect the stream and provide lateral connectivity between the streams and adjacent floodplains and uplands, as well as longitudinal connectivity up and down stream. It is the goal of this plan to provide for the acquisition and/or restoration of these vitally important components of the landscape.

Recommendations on buffer width are provided in Table 5 (Center for Watershed Protection, 2005). Recommendations regarding a minimum width of 1,000 feet for wildlife linkages (corridors) are based on Principles of Wildlife Corridor Design (Bond, 2003). However, it is realized that achieving this recommended width may not be possible and pinch-points and breaks in a linkage may occur.

Table 5. Recommended Habitat Buffers

Function	Special Features	Recommended Minimum Width (feet)
Sediment reduction	Steep slopes (5-15%) and/or functionally valuable aquatic habitat	100
	Shallow slopes (<5%) or low quality aquatic habitat	50
	Slopes over 15%	Consider buffer width additions with each 1% increase of slope (e.g., 10 feet for each 1% of slope greater than 15%)
Phosphorus reduction	Steep slope	100
	Shallow slope	50
Nitrogen (nitrate) reduction	Focus on shallow groundwater flow	100
Biological contaminant and pesticide reduction	N/A	50
Wildlife habitat and corridor protection	Unthreatened species	100
	Rare, threatened, and endangered species	200-300
	Maintenance of species diversity	50 in rural area 100 in urban area
Flood control	N/A	Variable, depending on elevation of flood waters and potential damages

Methodology

For purposes of this plan, the targets for upland habitat acquisition and/or restoration were developed using the following definitions of upland areas:

- *Buffers and Buffer Zones* are 50- to 300-foot wide areas adjoining aquatic habitat, channel, or upland linkage or wildlife corridor that is in a natural or

semi-natural state. For aquatic habitat and riparian systems, a buffer is to provide a variety of other functions including maintaining or improving water quality by trapping and removing various non-point source pollutants from both overland and shallow subsurface flows, providing erosion control and water temperature control, reducing flood peaks, and serving as groundwater recharge points and habitat. Buffer zones occur in a variety of forms, including herbaceous or grassy areas, grassed waterways, or forested riparian buffer strips. They also may provide for limited passive recreation.

- *Wildlife Linkages or corridors* are wide areas of native vegetation that connect, or have the potential to connect, two or more large patches of habitat on a landscape or regional scale through which a species will likely move over time. The move may be multi-generational; therefore, a linkage should provide both wildlife connectivity and biological diversity. A Wildlife Linkage should be a minimum of 1,000 feet in width, vegetated with native vegetation, and have little or no human intrusion. The goal is to ensure north-south and east-west linkages to mitigate for climate change.

Because of the largely linear nature of buffers and linkages and the major difference being their width, these two areas were combined for the development of the upland target. The target is based on the acquisition and/or restoration of these two features. For the development of upland linkage and corridor targets, regional linkages that have been previously identified or potential linkages between identified habitat blocks (i.e., the County's Significant Ecological Areas and habitat designated as critical by the U.S. Fish and Wildlife Service) were proposed.

Figure 8 shows the general location of the identified linkages along streams as red arrows and identified and potential upland linkages with black arrows.[17] The red arrows also locate areas where buffers are needed.

[17] Figure adapted from http://criticalhabitat.fws.gov/crithab

Figure 8. Habitat Linkages

For reference, these linkages are shown with critical habitat and land ownership in Figure 9 and Figure 10)

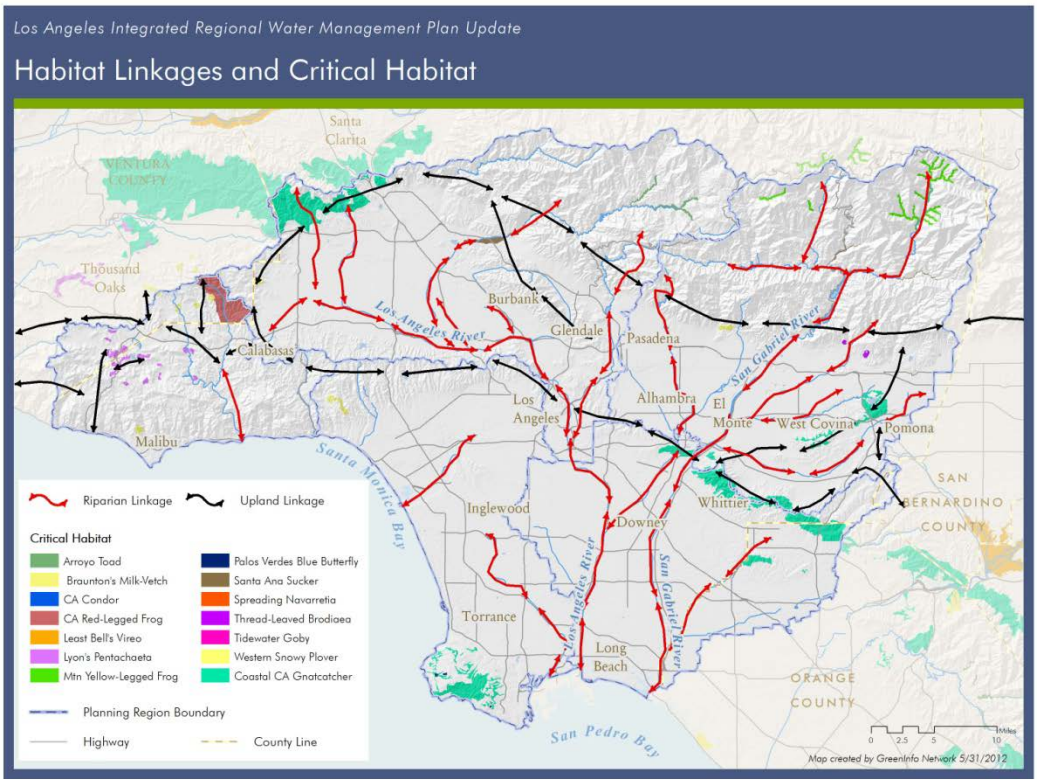

Figure 9. Habitat Linkages with USFWS Designated Critical Habitat Areas (May 2012)

Figure 10. Habitat Linkages with Land Ownership

Upland Targets

For the purpose of developing the upland targets, polygons were created by buffering along the continuous length of the drainages and upland areas with a width of 1,000 feet. Acreage associated with these polygons was then determined. This information is provided in Table 6 below.

Table 6. Measurement of Potential Linkage Areas within the GLAC Region

Linear Feet	Acres
1,585,000	**36,000**

It should be noted that 1,000 feet is a minimum width for a linkage and some of the targeted lands are within open space or public ownership. While it is recognized that this may not provide for an accurate measurement of habitat needs, it is a starting point for providing protection to the region's aquatic habitat systems.

The provision of acquisition and/or restoration of these targets include the provision of buffer zones.

5 OPEN SPACE AND RECREATION

The over 9,000,000 people who live within the GLAC Region have access to more than 2,000 park and open space land parcels that offer a variety of public outdoor recreation opportunities. These lands, totaling approximately 101,000 acres, are owned and managed by a myriad of agencies and organizations. In addition, there are almost 300,000 acres of public multiple-use lands of the Angeles National Forest and the 2,249 school district sites that may also have playgrounds and other outdoor recreation amenities.

5.1 Recreation Overview

Recreation occurring in open space areas, whether it is passive or active or a combination of the two, improves physical health, mental health, social function, and youth development and provides environmental and economic benefits to people and communities.

The physical health benefits of open space projects that provide for outdoor recreation are well documented and include:

- Making the individual less prone to obesity
- Improving cardiovascular condition
- Diminishing the risk of chronic diseases
- Boosting the immune system
- Increasing life expectancy

The mental health benefits of outdoor recreation include:

- Alleviating depression
- Increasing positive moods by reducing stress and anxiety
- Increasing productivity
- Improving quality of life through elevated self-esteem, personal and spiritual growth, and overall life satisfaction

While more and more people are migrating to cities, the desire to still feel connected to the natural environment remains strong. From a sociological perspective, when people are connected to nature, it contributes to feeling less isolated and less focused on them. As a result, they may become more eager to form connections with their neighbors. A greater

sense of community and social ties emerge, as do increases in generosity, volunteerism, trust, and civic-mindedness. Loneliness, aggression, and crime may consequently decrease.

Recreational activities that include physical activity also help the aging population lead independent and satisfied lives, helping them remain mobile, flexible, and able to maintain their cognitive abilities.

Recreation assists in overall youth development. Recreation activities help develop decision-making skills, cooperative behaviors, positive relationships and empowerment. Young people explore strategies for resolving conflicts while recreating and playing. They learn to act fairly, plan proactively, and develop a moral code of behavior. This play also helps enhance their cognitive and motor skills. Individuals with more highly developed motor skills tend to be more active, popular, calm, resourceful, attentive and cooperative.

The open space resources of the GLAC Region provide exceptional learning opportunities for students. Case studies of educational facilities that adopted environment-based education as the central focus of their academic programs showed: 1) improvement in reading and mathematics scores; 2) better performance in science and social studies; 3) declines in classroom discipline problems; and 4) high level learning opportunities equalized among students.

Conserving resource lands is an investment in future economic development. Community image is enhanced. Businesses frequently relocate where their top talent wants to live, and that is most often in places of natural beauty. New homebuyers value trails and natural areas above any other amenity. When resource land is protected, the adjacent land often increases in value, with homes selling at a faster rate and for 10 to 20 percent return more than comparable homes without access to parks and open areas.

The California Legislature has summarized the need for parks and open space areas that provide outdoor recreation benefits, as presented in the box below:

Summary on the Need for Parks and Open Space Areas

The California Legislature has nicely summarized the need for parks and open space areas that provide outdoor recreation benefits by declaring:

- The demand for parks, beaches, recreation areas and recreational facilities, and historical resources preservation projects in California is far greater than what is presently available, with the number of people who cannot be accommodated at the area of their choice or any comparable area increasing rapidly. Further, the development of parks, beaches, recreation areas and recreational facilities, and historical resources preservation projects has not proceeded rapidly enough to provide for their full utilization by the public.
- The demand for parks, beaches, recreation areas and recreational facilities, and historical resources preservation projects in the urban areas of our state is even greater since over 90 percent of the present population of California reside in urban areas; there continues to be a serious deficiency in open space and recreation areas in the metropolitan areas of the state; less urban land is available, costs are escalating, and competition for land is increasing.
- There is a high concentration of urban social problems in California's major metropolitan areas which can be partially alleviated by increased recreational opportunities.
- California's coast provides a great variety of recreational opportunities not found at inland sites; it is heavily used because the state's major urban areas lie, and 85 percent of the state's population lives, within 30 miles of the Pacific Ocean; a shortage of facilities for almost every popular coastal recreational activity exists; and there will be a continuing high demand for popular coastal activities such as fishing, swimming, sightseeing, general beach use, camping, and day use. Funding for the acquisition of a number of key coastal sites is critical at this time, particularly in metropolitan areas where both the demand for and the deficiency of recreational facilities is greatest. Development pressures in urbanized areas threaten to preclude public acquisition of these key remaining undeveloped coastal parcels unless these sites are acquired in the near future.
- Increasing and often conflicting pressures on limited coastal land and water areas, escalating costs for coastal land, and growing coastal recreational demand require, as soon as possible, funding for, and the acquisition of, land and water areas needed to meet demands for coastal recreational opportunities.
- Cities, counties, and districts must exercise constant vigilance to see that the parks, beaches, recreation areas and recreational facilities, and historical resources they now have are not lost to other uses; they should acquire additional lands as such lands become available; they should take steps to improve the facilities they now have.

Source: CA Public Resource Code 5096.143

The parks and open spaces of the GLAC Region are well used, operating at capacity, and in some cases the recreation demand simply outstrips the supply.

The landscape character of these recreation lands ranges from highly structured parks and recreation sites within urban areas, to regional parks that may offer a combination of developed active and undeveloped passive recreation use, to relatively natural habitat areas and wildlands that contain trail-related recreation with minimal development.

Figure 11 illustrates the following for the GLAC Region:

- Existing developed urban park and recreation areas
- School sites
- Open space areas available for passive recreation
- Existing greenways and those subject to sea-level rise
- Planned greenway concepts
- Existing and planned County trail routes

Trail routes are illustrated on Figure 11 and were identified in the draft Los Angeles County 2035 General Plan. [18] Most of the identified urban greenways include multiple-use trails that also serve transportation functions. Most of these are inter-city proposals, and thus could be considered regionally significant. In addition, many of the 84 cities within the GLAC Region, such as the cities of Malibu, Monrovia, and Pasadena, have proposed or adopted local trail plans for recreation and transportation access within their jurisdictions. In many cases, these trails tie into and complement the county-wide trail network. As an ongoing process, once adopted, some or all of these local trail routes should be added to the IRWMP data base. Those trail routes that branch from the regional trail system and create loop opportunities for recreation, or local trails that directly connect urban areas with the regional trail system should be specifically identified and included in the regional recreation targets.

[18] Due to the map scale, not all layers are visible in all locations of this map.

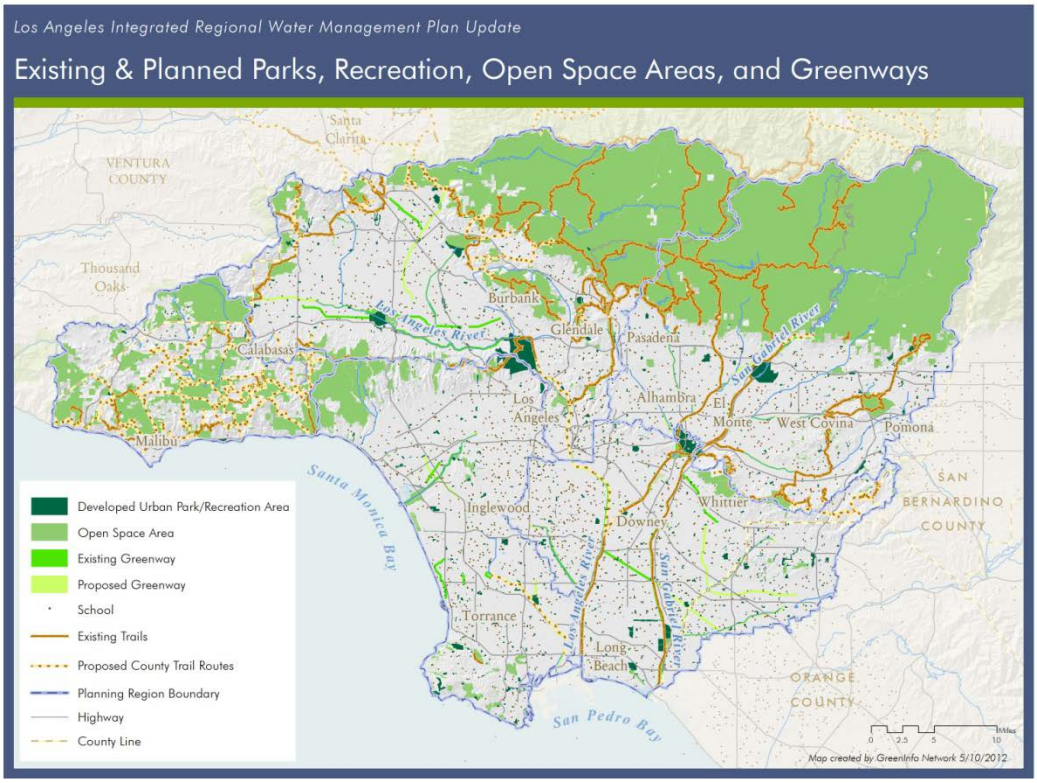

Figure 11. Existing and Planned Parks, Recreation Areas, Open Spaces Areas, and Greenways

Exhibit D lists individual parcels, by subregion, which are accessible to the public for outdoor recreation and environmental education purposes and categorizes them by developed park and recreation areas, passive recreation areas (including National Forest Lands), greenways, and other public lands such as historic sites, cemeteries, botanic gardens, and other similar spaces. While such inventories of existing local and regional park lands exist, there is no complementary information for land areas at school sites used for outdoor recreation and environmental education.

Table 7 summarizes the existing acreages of these available recreation lands. Also provided are existing (2010) and projected (2035) populations.

Table 7. Existing Recreation Lands

Developed Urban Park and Recreation Area (acres)	Passive Recreation Area			Greenway (acres)	Other / Misc (acres)	Existing <u>Population</u> Projected Population
	Riparian / Upland / Aquatic habitat (acres)	Beach / Estuary (acres)	National Forest (acres)			
19,000	124,000	1,800	298,000	3,200	2,300	<u>9,630,000</u> 10,990,000

(1) Existing populations based on 2010 census data. Population projections based on SCAG data indicating that for cities within the GLAC area an average population increase of 5.9% between 2008 and 2020, or approximately 5% when scaled from 2010, then 8.7% between 2020 and 2035 could be anticipated.

5.1.1 Types of Recreation Areas

A wide range of outdoor recreational and environmental educational opportunities exist. No two park or recreation areas are the same. There is no simple system to classify the variability of development that exists. The following describes the major types of recreational open space areas found in the GLAC Region. Targets were established for each of these three recreation types.

Developed Urban Park Areas: Developed lands consist of neighborhood parks, community parks, and sports complexes that are generally less than 20 acres in size and offer active recreation activities such as playground equipment or sports fields, as well as passive recreation. Most secondary or primary schools or institutions of higher learning are designed as a park-like setting. Many have playgrounds and athletic fields associated with them and are open to the public after hours. School grounds typically provide opportunities for active recreation, such as playgrounds and sports fields, but are sometimes not included in park and recreation inventories.

Passive Recreation Areas:

- Habitat Areas or Wildlands: The majority of these resource lands are managed by cities, the County, special districts, and joint powers authorities for their natural qualities. Developed facilities generally are limited and focus on safe public access (staging areas, trails, limited visitor support facilities, wildlife sanctuaries, nature centers, and natural areas) for outdoor passive recreation and environmental

education. In some cases open space recreation lands may be a component of a city-wide or regional park, a golf course, or greenway.

- Angeles National Forest: The mission of the United States Department of Agriculture, Forest Service, the agency that administers the Angeles National Forest, is to achieve quality land management under the sustainable multiple-use management concept to meet the diverse needs of people. To the millions of Los Angeles-area residents within the GLAC Region and to visitors from all over the world, the Angeles National Forest provides a variety of outdoor recreation opportunities.

Greenways: These are linear areas that are generally located around rivers and creeks but sometimes along countywide trail routes, major utility corridors (such as transmission lines), or abandoned rail routes to provide for a wide variety of trail-related recreation. Greenways, while they can provide habitat linkages, also can provide for active and passive recreation serving many of the same functions as neighborhood and community parks, depending on how they are developed.

These linear recreation lands would typically connect a series of urban park and recreation areas. They also may connect natural landscape components, including aquatic habitat, riparian, and upland associations. Countywide trail routes could also be considered in this category as they may connect major parks or open space areas such as the Santa Monica Mountains with the San Gabriel Mountains. Greenways provide opportunities for passive recreation. There are no specific park standards related to greenways, as these are generally opportunities afforded by the landscape setting.

5.1.2 Open Space, Park, and Recreation Agencies

There are over 140 agencies that provide public outdoor recreation and environmental education opportunities within the region, not including schools. These include federal, state, regional, county, city park departments, special recreation and park districts, open space districts, joint power authorities, water agencies, and land conservation organizations.

Regional Agencies

A list of federal, state, private, and special districts and associations that provide regional recreation within the region is found in Table 8.

Table 8. Federal, State, County, Special District, and Private Organizations Providing Public Recreation Opportunities within the Region

Federal Agencies
United States Army Corps of Engineers
United States Bureau of Land Management
United States Coast Guard
United States Forest Service
United States National Park Service
State Agencies
California Department of Fish and Wildlife
California Department of Parks and Recreation
California State Coastal Conservancy
California State Lands Commission
Santa Monica Mountains Conservancy
University of California
Counties
Los Angeles
Orange
Ventura
Special Districts
Conejo Open Space Conservation Agency
Conejo Recreation and Park District
Hawthorne School District
Kinneloa Irrigation District
Las Virgenes Municipal Water District
Los Angeles County Flood Control District
Metropolitan Transportation Authority
Metropolitan Water District of Southern California
Miraleste Recreation and Park District
Mountains Recreation and Conservation Authority
Native Habitat Preservation Authority
Puente Hills Habitat Authority
Rancho Simi Open Space Conservation Agency
Rancho Simi Recreation and Park District
Ridgecrest Ranchos Recreation and Park District

Rose Hills Memorial Park Association
Rossmore Community Services District
San Dimas-La Verne Recreational Facilities Authority
San Gabriel County Water District
San Gabriel River Water Committee
Watershed Conservation Authority
Westfield Recreation and Park District
Wilmington Public Cemetery District
Other
El Monte Cemetery Association
Fond Land Preservation Foundation
Glendora Community Conservancy
Huntington Library and Botanical Gardens
Mountains Restoration Trust
Palos Verdes Peninsula Land Conservancy
Pasadena Cemetery Association
Roosevelt Memorial Park Association
San Gabriel Cemetery Association
Sierra Madre Cemetery Association
Trust for Public Land
Amerige Heights Community Association

Municipal Park and Recreation Departments / Districts

A list of municipal agencies that provide neighborhood and community parks within the region is found in Table 9.

Table 9. Cities Providing Public Recreation Opportunities within the Region

Cities			
Agoura Hills	Cypress	Lawndale	Rolling Hills
Alhambra	Diamond Bar	Lomita	Rosemead
Anaheim	Downey	Long Beach	San Dimas
Arcadia	Duarte	Los Alamitos	San Fernando
Artesia	El Monte	Los Angeles	San Gabriel
Azusa	El Segundo	Lynwood	San Marino
Baldwin Park	Fullerton	Malibu	Santa Fe Springs
Bell Gardens	Gardena	Manhattan Beach	Santa Monica
Bell	Glendale	Maywood	Seal Beach
Bellflower	Hawaiian Gardens	Monrovia	Sierra Madre
Beverly Hills	Hawthorne	Montebello	Signal Hill
Brea	Hermosa Beach	Monterey Park	South El Monte
Buena Park	Huntington Park	Norwalk	South Gate
Burbank	Inglewood	Palos Verdes Estates	South Pasadena
Calabasas	Irwindale	Paramount	Temple City
Carson	La Canada Flintridge	Pasadena	Thousand Oaks
Cerritos	La Habra Heights	Pico Rivera	Torrance
Chino Hills	La Habra	Placentia	Walnut
Claremont	La Mirada	Pomona	West Covina
Commerce	La Palma	Rancho Palos Verdes	West Hollywood
Compton	La Puente	Redondo Beach	Westlake Village
Covina	La Verne	Rolling Hills Estates	Whittier
Culver City	Lakewood		

6 OBJECTIVES AND PLANNING TARGETS FOR RECREATION

The following sections describe the 20-year planning targets that were developed for the recreation section of the OSHARTM through the collaborative process described in Section 1.4. These targets are intended to serve as a quantitative measure of progress towards the overall IRWMP recreation goals, as well as to guide project proponents in effectively incorporating recreation into proposed IRWMP projects.

6.1 Objectives

General recreation objectives are to:

- ***Developed urban parks:*** Assist in providing developed urban park areas that are accessible to underserved populations (and DAC communities) based on average of 4 acres per 1,000 population.
- ***Passive recreation:*** Create or assure the preservation of 6 acres of open space lands per 1,000 population that are available for passive recreation. These lands may incorporate: all or a portion of greenways; county, state, or national parks; US Forest Service lands; regional trails routes; and/or dedicated open space areas or any jurisdiction.
- ***Greenways:*** Enhance existing and planned greenways as shown in Table 9 and regional trails within open space areas with outdoor recreation and environmental educational opportunities.

6.2 Methodology

The methodology used for calculating recreation targets and establishing priority areas is described in detail in Exhibit C.

6.3 Developed Urban Park Targets

Recreation services may be addressed in the mandatory Conservation and Open Space element of a General Plan, in a discretionary Parks and Recreation element of a General Plan, or through a Parks Master Plan that may be referenced in the General Plan or as a stand-alone policy. On average, most municipalities within the entire GLAC Region use a standard of 4 acres of parkland per 1,000 population for providing neighborhood and community parks that offer both active and passive recreation opportunities. The Los

Angeles County General Plan reflects this goal. Often these standards are complemented with a proximity goal of a park being within a ¼ to ½ mile radius of all residents. Not meeting one or both of these standards is often the definition of "underserved communities" from a parkland provision perspective.

For the purposes of this work, targets were based on acres of additional urban parkland required to meet the standard of 4 acres of parkland per 1,000 population, using projected population for 2035. Targets are shown in Table 10.

Table 10. Developed Urban Park Targets

Existing Open Space Lands Available for Recreation (1) (acres)	Existing Population Projected Population(2)	Total Area Required to Meet Goal (3) (acres)	Targets (4) (acres)
18,800	9,630,000 10,990,000	38,500 43,900	19,700 25,100

(1) See Exhibit C.
(2) Existing populations based on 2010 census data. Population projections based on SCAG data indicating that for cities within the GLAC area an average population increase of 5.9% between 2008 and 2020, or approximately 5% when scaled from 2010, then 8.7% between 2020 and 2035 could be anticipated.
(3) 4 acres of parkland per 1,000 population.
(4) Additional open space lands required to meet goal.

A number of additional factors need to be considered during the process to implement these targets. For neighborhood or community parks that provide active and/or passive recreation, the order of priority should be as follows:

- High Priority: projects within urban areas with less than 1 acre of available park and recreation area per 1,000 population.
- Moderate Priority: projects within urban areas with between 1 to 3.9 acres of available park and recreation area per 1,000 population.
- Low Priority: projects within urban areas with greater than 4 acres of available park and recreation area per 1,000 population.

Figure 12 shows the distribution of these urban park priority areas throughout the region. This figure is not intended to show proposed locations for future parks, rather it is intended to provide information that could help guide the implementation of targets.

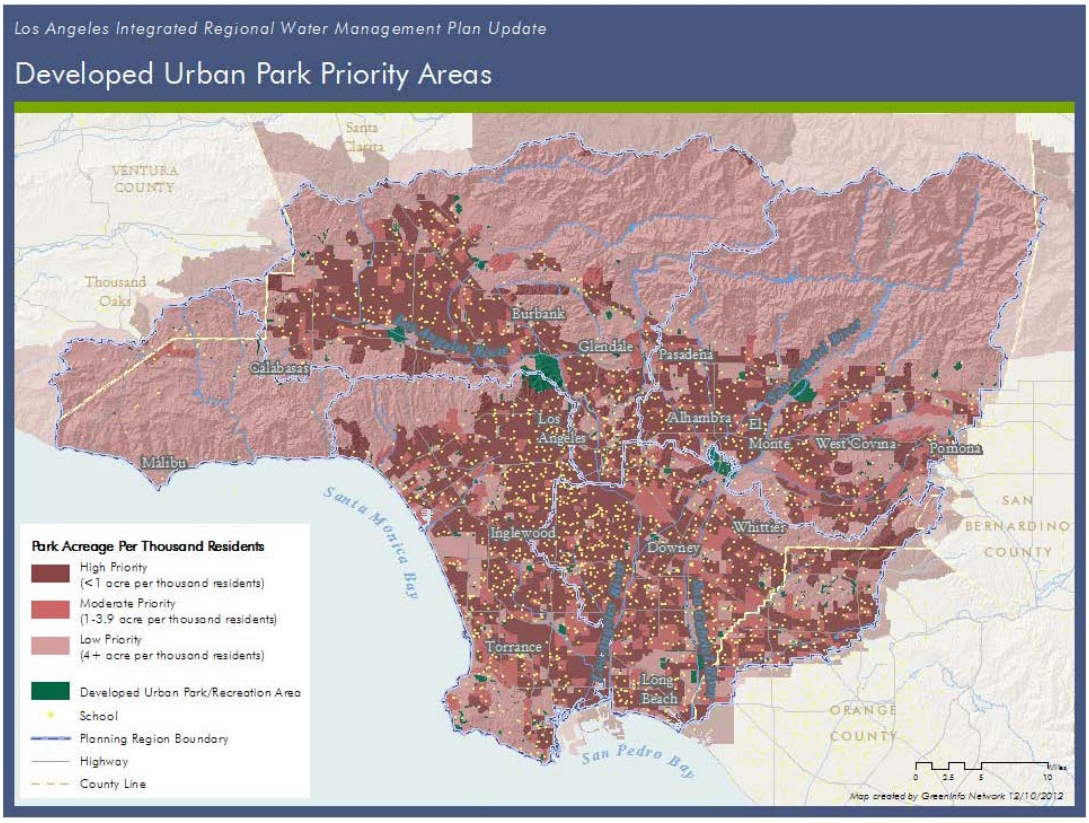

Figure 12. Developed Urban Park Priority Areas

6.4 Passive Recreation Targets

Most cities do not have standards for open space lands that afford passive recreation opportunities. The Los Angeles County General Plan cites a standard ratio of 6 acres per 1,000 people for regional parks and open space lands that would principally offer passive outdoor recreation and environmental education opportunities. These standards accommodate the needs of a regional population and therefore should only be evaluated on a regional basis not limited by al boundaries.

For the purposes of this work, targets were based on acres of open space required to meet the standard of 6 acres of open space per 1,000 population, using projected population for 2035. Targets are shown in Table 11.

Table 11. Passive Recreation Targets for Existing Populations

GLAC Region	Existing Open Space Lands Available for Recreation (1) (acres)	Existing Population / Projected Population(2)	Total Area Required to Meet Standard (3) (acres)	Targets (4) (acres)
Excluding Angeles National Forest Lands	13,000	**9,630,000** **10,990,000**	58,000 65,926	45,000 53,000
Including Angeles National Forest Lands	27,000	**9,630,000** **10,990,000**	58,000 66,000	30,000 38,000

(1) This number assumes that approximately 5% of the total open space land acreage is accessible and developed for recreation access and/or outdoor recreation purposes. This would include staging areas, trailhead enhancements, trails, and associated visitor serving facilities for recreation and outdoor education.

(2) Existing populations based on 2010 census data. Population projections based on SCAG data indicating that for cities within the GLAC area an average population increase of 5.9% between 2008 and 2020, or approximately 5% when scaled from 2010, then 8.7% between 2020 and 2035 could be anticipated.

(3) Based on 6 acres / 1000 population. Open Space is a regional amenity and is not defined by sub-region.

(4) Additional open space lands required to meet standard.

Distance and time to get to these recreation resources is used as a determinant of need. These open space lands could be portions of the regional park system, open space preserves, state parks, or U.S. Forest Service lands and could include lands surrounding planned County trail routes.

One key to the usability of open space for outdoor recreation is accessibility. Studies of use in open space areas have shown that approximately 90% of visitors arrive by automobile while approximately 10% come by alternative transport modes (walking, bicycling, jogging or on horseback) (USC Sustainable Cities Program and the National Park Service).

Accessibility, in terms of distance and time it takes to access a regional open space area directly relates to its level of use. Living closer to an open space recreation opportunity means that opportunity to enjoy its benefits is more likely to be used. Proximity to an open

space area starting at about 1 mile up to a distance of about 10 miles is fairly proportional to a decrease in visitor frequency. Visitation reaches its lowest levels at approximately 22 miles where travel becomes problematic for most recreationists. This limiting distance pattern is reflected in Los Angeles County's service areas for Community Regional Parks (20 miles) and Regional Parks (25 miles).

For resource recreation areas that provide passive recreation or environmental education opportunities, the order of priority should be as follows:

- High Priority: projects more than a 3 miles from an existing open space area or greenway or projects that help complete the County trail system
- Moderate Priority: projects between 1 and 3 miles from an existing open space area or greenway
- Low Priority: projects from between 0 and 1 mile from an existing open space area or greenway

Lands within the County trail system should also be considered as a high priority. This system provides for passive recreation opportunities for both near-to-home recreation and for visitors to southern California from throughout the world. An important justification, from a recreation perspective, for additional open space land acquisition and conservation that will serve the recreation interests of both residents within the GLAC Region and visitors from outside the region is tied to the planned Los Angeles County regional trail system. Completion of this system will require significant land and/or easement acquisition; therefore, the County trail system is also identified as high priority.

There also are other opportunities to accommodate local and area-wide recreation demand for resource lands. These opportunities are found in undeveloped but privately held parcels that, if in public ownership, would provide a direct link between the region's urban populations to existing regional resource lands, including those within the Santa Monica Mountains, the Angeles National Forest, and other regional-serving open space areas such as the Puente or San Jose Hills. No priority is proposed for these resource areas.

Figure 13 illustrates the areas with highest need for passive recreation opportunities. This figure is not intended to show proposed locations for future parks, rather it is intended to provide information that could help guide the implementation of targets.

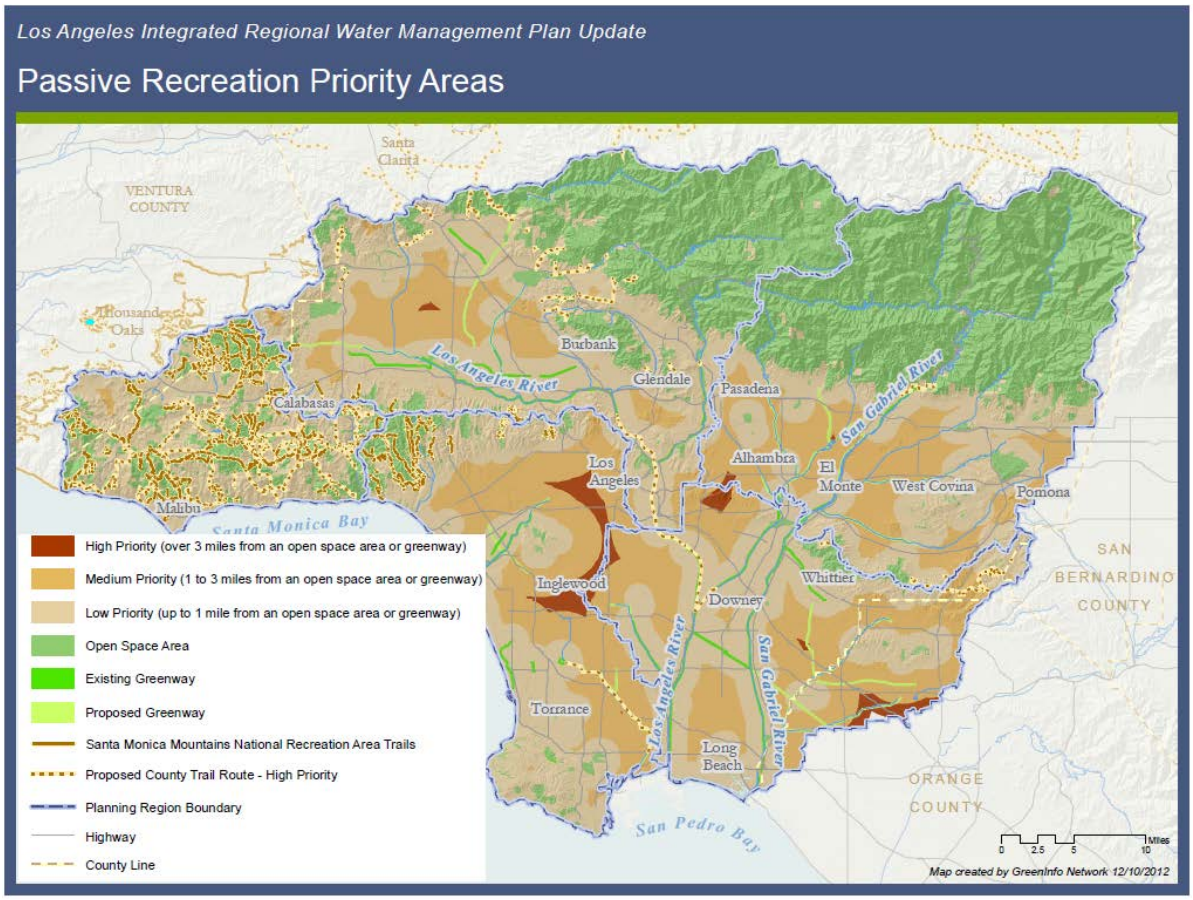

Figure 13. Passive Recreation Priority Areas

6.5 Greenway Targets

There are no specific park standards related to Greenways, as these are generally opportunistic based on a linear landscape setting typically along creeks, major transportation corridors, or utility corridors. Development of a new greenway could contribute to meeting the active and passive recreation target. To serve as a developed urban park, active recreation amenities could be included as part of the greenway design. Because additional acreage of greenway is included in the recreation targets, the greenway targets were not set as additional acreage, but rather as a goal to enhance existing or proposed greenway designs so to incorporate active recreation amenities.

Existing and proposed greenways are shown above in Figure 13 and a detailed list is provided in Exhibit D.

7 OPEN SPACE AND ECOSYSTEM SERVICES

The benefits of open space lands within the region, whether in public or private ownership, are numerous. Evaluation of habitat and recreation benefits only as they are related to water management practices results in an isolated perspective that does not nearly demonstrate the full integration of societal benefits attributable to open space. Additionally, the physical benefits of open space are complemented with economic benefits that open space provides to those who live near open space lands and to entire communities. There are numerous models and studies that have demonstrated the economic values of open space preservation. The justification for the preservation and maintenance of open space lands therefore cannot be solely related to any single benefit but should be viewed as the cumulative effect of many benefits, the management of water resources being only one of them.

Ecosystem services provide one approach for framing the values and benefits of open space. Ecosystem services are the benefits people obtain from ecosystems. The Millennium Ecosystems Assessment (2005) has presented a scheme for classifying ecosystem services using four general categories:

- *Provisioning services* such as food, water, timber, and fiber
- *Regulating services* that affect climate, floods, disease, wastes, and water quality
- *Cultural services* that provide recreational, aesthetic, and spiritual benefits
- *Supporting services* such as soil formation, photosynthesis, and nutrient cycling

Aquatic habitats provide services in all four categories, as is shown in Table 12 (Vymazal, 2011). Aquatic habitat ecosystems reduce flood damage to human communities, sequester carbon, and reduce pollutants in runoff entering streams (Brauman et al., 2007). Aquatic habitats support consumptive uses such as hunting and fishing as well as non-consumptive uses such as bird watching. Zedler and Kersher (2008) consider four of the many functions performed by aquatic habitats to have global significance and value as ecosystem services: biodiversity support, water quality improvement, flood abatement, and carbon management.

Table 12. Examples of Services Provided by Aquatic habitats, Organized According to the Millennium Ecosystem Assessment Framework.

Provisioning Services	
Food	Production of fish, wild game, fruits, grains
Fresh water	Storage and retention of water for domestic, industrial and agricultural use
Fiber and fuel	Production of logs, fuel-wood, peat, fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic materials	Genes for resistance to plant pathogens, ornamental species, and so on
Regulating Services	
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climate processes
Water regulation (hydrological flows)	Groundwater recharge/discharge; flow attenuation
Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Natural hazard regulation	Food control; storm protection
Pollination	Habitat for pollination
Cultural Services	
Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religion values to aspects of aquatic habitat ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of aquatic habitat ecosystems
Educational	Opportunities for formal and informal education and training
Supporting Services	
Soil formation	Sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients

Upland habitats also provide a wide range of ecosystem services. As with aquatic habitats, uplands provide biodiversity support and support consumptive uses such as hunting as well as non-consumptive uses such as recreation and education.

The following sections discuss some of the ecosystem services provided by open space lands.

7.1 Providing Fresh Water

The GLAC Region is diverse in its hydrology and geology. As shown in Figure 14, the general flow of water is from north to south; however, geologic conditions can force flows in an east-west direction and in some areas allow for aquifer recharge. When overlaying existing and future open space projects and programs with the Region's hydrologic and geologic characteristics, some generalized conclusions can be made. For the purposes of the GLAC IRWMP planning process, these conclusions focus on the facts that open space projects, if appropriately designed and sited, have the ability to influence groundwater levels, improve surface water quality, and improve flood management by either attenuating storm flows or by being developed where unmet drainage needs exist, possibly removing the need altogether.

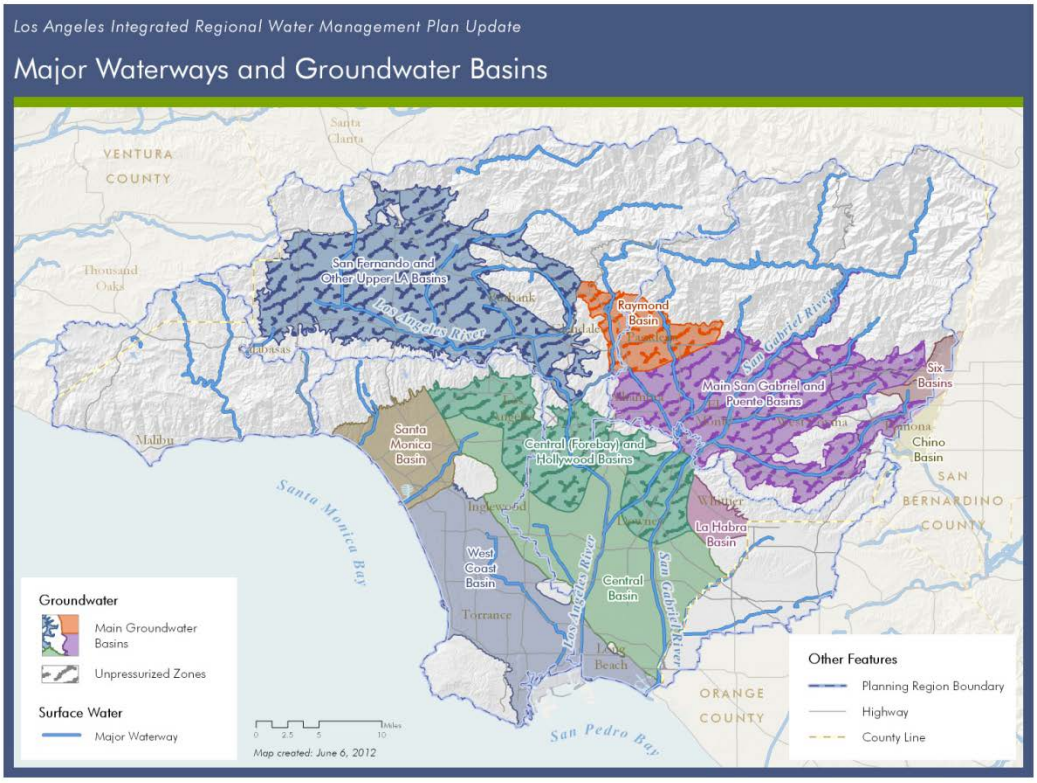

Figure 14. Major Waterways and Groundwater Basins (GLAC Region)

Infiltration and Potential Groundwater Recharge: Preserving or enhancing infiltration for potential groundwater recharge improves water supply reliability and overall water quality. When open space projects are treated as multiple-use, best management practices (BMP) can be incorporated to achieve multiple water management objectives.

Quantifying the water supply benefit that could be achieved by a proposed project will be a necessary component of project prioritization and meeting water supply targets. To assist planners in this effort, a spreadsheet tool was developed that provides an estimate of annual average infiltration potential of projects using regional climatic data and a generalized hydraulic model. A background for this tool is presented in Exhibit E, and the spreadsheet will be made available to planners via the GLAC IRWMP website.

While this tool can provide a rough estimate for planners, it should be understood that it is for planning purposes only. To ensure that the estimated water supply and water quality benefits are realized, professional design assistance should be employed.

Water Conservation: Designing open space projects with water conservation practices, such as appropriate plant palettes, efficient irrigation design, and use of recycled water, can help reduce demands on the region's potable water supplies. Water conservation practices should apply to all designed landscapes within the GLAC Region. For any developed park or outdoor recreation area, demands on water supply are directly affected by planting and irrigation design practices. New parks could be expected to use BMPs to minimize water demand. Additionally, all developed park and recreation areas, like any capital improvement, have a life cycle. Therefore, there remains great opportunity with many older sites that, with rehabilitation and BMPs, further reduction in demands on water supply is possible.

7.2 Improving Water Quality

Natural habitats can improve water quality by capturing and removing pollutants, including nutrients and pathogens. Aquatic habitats are particularly renowned for improving water quality. Some pollutants, particularly metals and many organic compounds are removed when the suspended particles to which they are adsorbed settle out in aquatic habitats. Some pollutants are transformed by processes occurring within aquatic habitats, such as denitrification for the removal of excess nitrogen. Other pollutants, including bacteria, are deactivated by solar radiation while being retained in aquatic habitats. The water quality improvement services of natural aquatic habitats are often exploited when aquatic habitats are constructed specifically to treat wastewater (including stormwater)

In addition to water quality improvement by natural habitats, designed habitats can also improve water quality. Requiring BMPs to capture wet and dry weather flows from on-site and potentially off-site improves stormwater management and helps to keep pollutants out of receiving water bodies. This would be applicable to both stormwater and irrigation water runoff. BMPs could include use of rain gardens, constructed aquatic habitats, water quality swales, and/or stormwater retention/detention basins to enhance capture rates, filter and improve water quality and, when appropriately sited, enhance groundwater levels. It should be noted that designing BMPs to provide habitat value requires careful consideration, and more work needs to be done similar to the technical report "Habitat Value of Constructed and Natural Wetlands Used to Treat Urban Runoff" (Sutula and Stein, 2003) to guide BMP designers in the development of BMPs for habitat enhancement.

These BMPs will contribute to meeting water quality targets for the region. Water quality targets are expressed as an overall capacity (volume) of these systems throughout the region. This capacity is based on systems designed to capture the ¾-inch storm. While additional

volume could be provided and may achieve additional water quality benefits, only the volume needed to capture the ¾-inch storm can be counted towards water quality targets. The spreadsheet tool described in Section 7.1 (with additional background provided in Exhibit E) also has the capacity to estimate potential to contribute to water quality targets for a proposed BMP. As stated above, this tool is to be used for planning purposes only, and a design professional should be employed to ensure the estimated benefits are achieved.

Also important to note is the consequences to water quality should open spaces be lost to development. While building codes require some level of treatment of the increased pollution generated due to the development, developers are not required to treat existing pollution from tributary areas. When open spaces are maintained with a multiple benefit approach, they not only generate less pollution than developed lands, but are capable of improving water quality from off-site. Thus, increased development on previously open space lands leads to an overall degradation in water quality.

7.3 Flood Risk Reduction

Managing storm events by retaining significant volumes of rainfall before it becomes runoff can assist in reducing demands on the storm drain network. As well, developing open space projects that are able to flood, and potentially placing them in areas that are repeatedly inundated, has the potential to reduce the GLAC Region's overall risk to flooding.

7.4 Preserving Biodiversity

Open space projects provide a wide variety of ecological benefits, including the conservation benefits of providing habitat to native species and the protection and enhancement of biodiversity.

Virtually all developed urban park and recreation areas include some form of green space. Depending on the percentage of vegetated area, vegetative species present, overstory canopy, cover density, and forage opportunity, each of these areas could enhance urban wildlife habitat values and species diversity. The larger the urban park, recreation area, or golf course, the greater the opportunity for hosting a variety of resident species.

The most obvious habitat conservation benefits of open space projects accrue to aquatic and upland habitats and species. Although the Los Angeles area today, especially its urban areas, seems largely devoid of aquatic ecosystems, historically the region supported an abundance of diverse aquatic habitats (Rairdan, 1998; Stein et al., 2007; Dark et al.; 2011). From an

ecological perspective, riparian areas are critically important in the semi-arid and arid southwest United States, where they provide rare, mesic habitat corridors and contribute disproportionately to regional biodiversity (Knopf et al., 1988). For example, although riparian habitats comprise only one percent of the land area of the Santa Monica Mountains, they are the primary habitat for nearly 20 percent of the native plant flora (Rundel and Sturmer, 1998). Management of these vital habitats is especially critical because 95-97 percent of the original riparian habitat in southern California has been lost (Faber et al., 1989).

The conservation value of aquatic ecosystems has increased as the region developed and aquatic habitats were lost and/or degraded. Habitat modification, weedy exotic species introductions, stream channel modification, and heavy recreational use all appear to lead to sharp reductions in plant species diversity (Rundel and Sturmer, 1998). These ecosystems provide habitat for a large number of sensitive species including the southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), arroyo toad (*Bufo californicus*), California red-legged frog (*Rana draytonii*), and western pond turtle (*Emys [Actinemys] marmorata*) among others (Abell, 1989; Jennings and Hayes, 1994; Thomson et al., 2012).

Besides the obvious effects of habitat destruction and modification, aquatic ecosystems in the region have been influenced by many anthropogenic factors. Hydromodification through changes in the impervious surface of watersheds (Hawley and Bledsoe, 2011) or stream bank alteration can have significant ecological effects (White and Greer, 2006), often called the "urban stream syndrome" (Walsh et al., 2005). Altered stream flow can influence many taxa, including fish, macroinvertebrates, and amphibians (Poff and Zimmerman, 2010). Changes in water quality can also have negative effects on aquatic communities (Paul and Meyer, 2001).

7.5 Providing Carbon Management

Aquatic habitats are particularly important in carbon management because they can sequester significant amounts of carbon (Chmura et al., 2003; Bridgham et al., 2006). This is particularly true in saltwater aquatic habitats, whose high productivity results in some of the highest carbon sequestration rates of all habitats. Moreover, salt marshes do not emit methane, which is emitted at relatively high rates by some freshwater aquatic habitats. Because methane is a potent greenhouse gas, the greenhouse gas mitigation potential for salt marshes is generally higher than for freshwater aquatic habitats. Nonetheless, riparian forests sequester substantial amounts of carbon in their aboveground biomass.

7.6 Providing Aesthetic and Cultural Values

Aquatic habitats provide a variety of aesthetic and cultural values. Aquatic habitats are important tourism destinations because of their aesthetic values and high biodiversity (Millenium Ecosystem Assessment, 2005b). The many unique plants and animals, including a disproportionate number of endangered species, make aquatic habitats valued places for viewing birds and other wildlife and plants. Aquatic habitats are also popular for a number of recreational activities, including fishing and boating, although in GLAC these activities are largely restricted to estuaries and lakes or reservoirs. Aquatic habitats provide opportunities for education and scientific research. Aquatic habitats provide aesthetic values to people who appreciate natural features. This value is particularly important in urbanized settings such as much of GLAC, where aquatic habitats provide views and open space that provide a relief from urban environments. Similarly, aquatic habitats provide spiritual and inspirational services, where personal feelings and well-being can be supported (Millenium Ecosystem Assessment, 2005b).

Many of these same services are provided by non-aquatic habitats. Transitional and upland habitats provide many recreational activities, including hiking and biking. Transitional and upland habitats also provide important aesthetic values and spiritual and inspirational services. Many people value the “sense of place” associated with recognized features of their environment, including aspects of the ecosystem (Millenium Ecosystem Assessment, 2005a).

As discussed earlier, open space includes a continuum from natural habitats valued largely for habitat to man-made habitats valued largely for recreation. The aesthetic and cultural services vary similarly along a continuum, spiritual/inspirational and aesthetic services predominating at the natural end of the continuum, and recreational services predominating at the other.

8 POTENTIAL SURFACE WATER AND GROUNDWATER RESOURCES MANAGEMENT BENEFITS OF OPEN SPACE PROJECTS

As described above, the benefits of open space, habitat and recreation are many and include ecosystem and cultural services such as biodiversity and public health, yet these are difficult to accurately quantify. A method was developed for quantifying water quantity and water quality benefits for individual projects; however, applying this to the entire region without specific proposed projects presents obvious challenges. Regardless, estimating and quantifying these benefits on a regional scale have been attempted in recently completed and currently ongoing studies. The methodology is described in detail in Exhibit F, and the results are presented below.

8.1 Stormwater Infiltration and Potential Groundwater Recharge Benefits

Results from the methodology described in Exhibit F show that there is a potential to recharge 47,000 AF/yr throughout the GLAC Region if the target habitat and recreation lands in areas with high recharge potential are developed and/or enhanced with BMPs (Table 13). Figures 15 and 16 show recreation and habitat targets with potential recharge benefits.

Table 13. Infiltration and Potential Groundwater Recharge Benefits from Open Space Projects

Potential Groundwater Recharge Capacity (AF/yr)		
Habitat	**Recreation**	**Total**
6,000	41,000	47,000

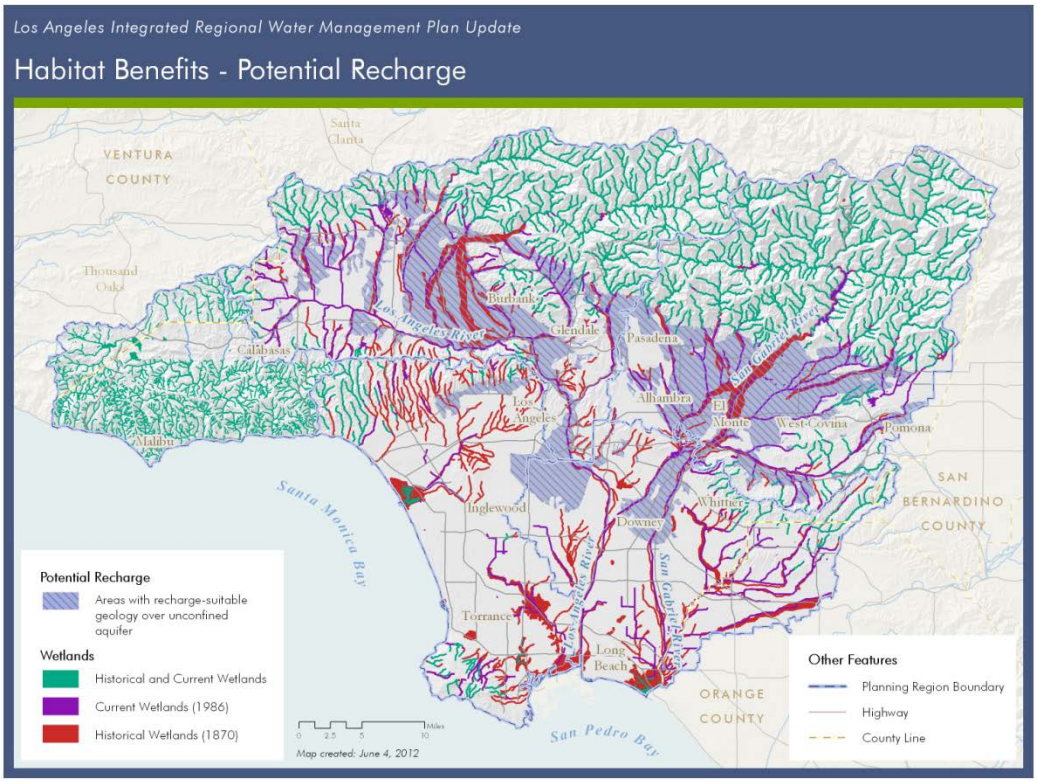

Figure 15. Habitat Targets and Potential Recharge Benefits (GLAC Region)

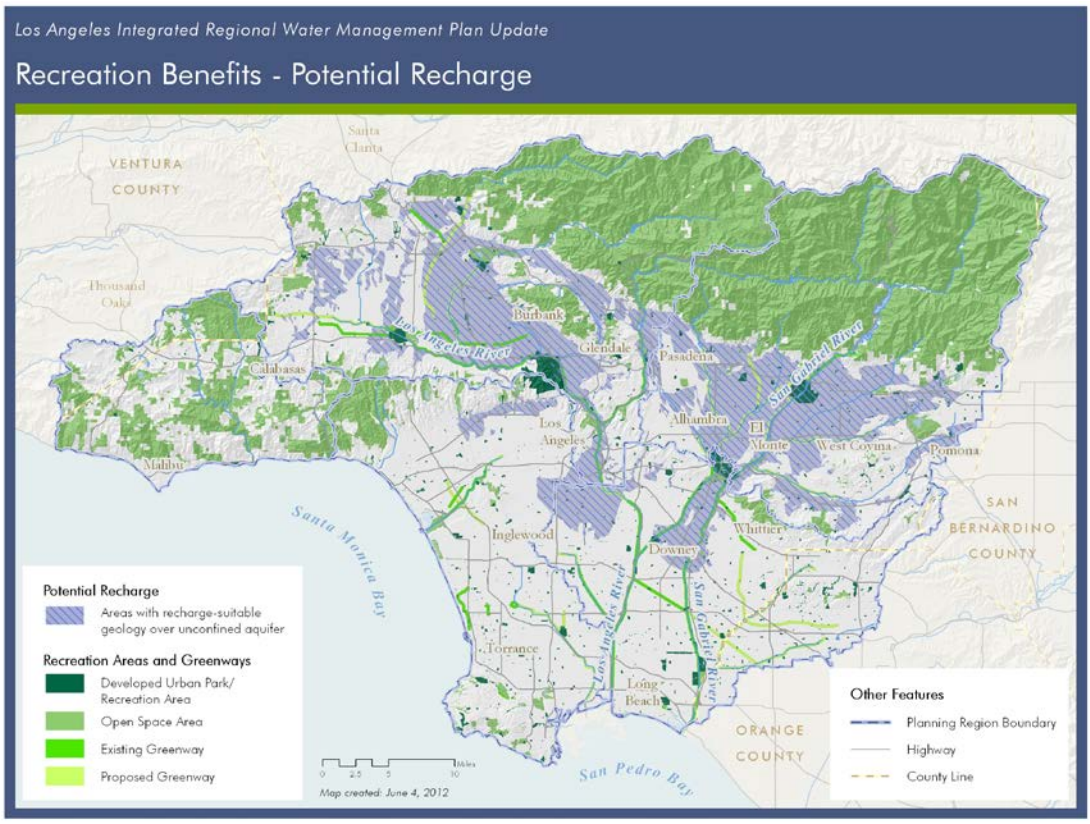

Figure 16. Recreations Targets and Potential Recharge Benefits (GLAC Region)

8.2 Stormwater Quality

Results show that there is a potential to create 21,000 AF of storage for water quality purposes, out of a target of 57,000 AF of storage throughout the GLAC Region if the target habitat and recreation lands are developed and/or enhanced with BMPs (Table 14).

Table 14. Potential Stormwater Quality Benefits from Open Space Projects

Potential Capture Capacity (AF/yr)		
Habitat	**Recreation**	**Total**
3,600	17,000	21,000

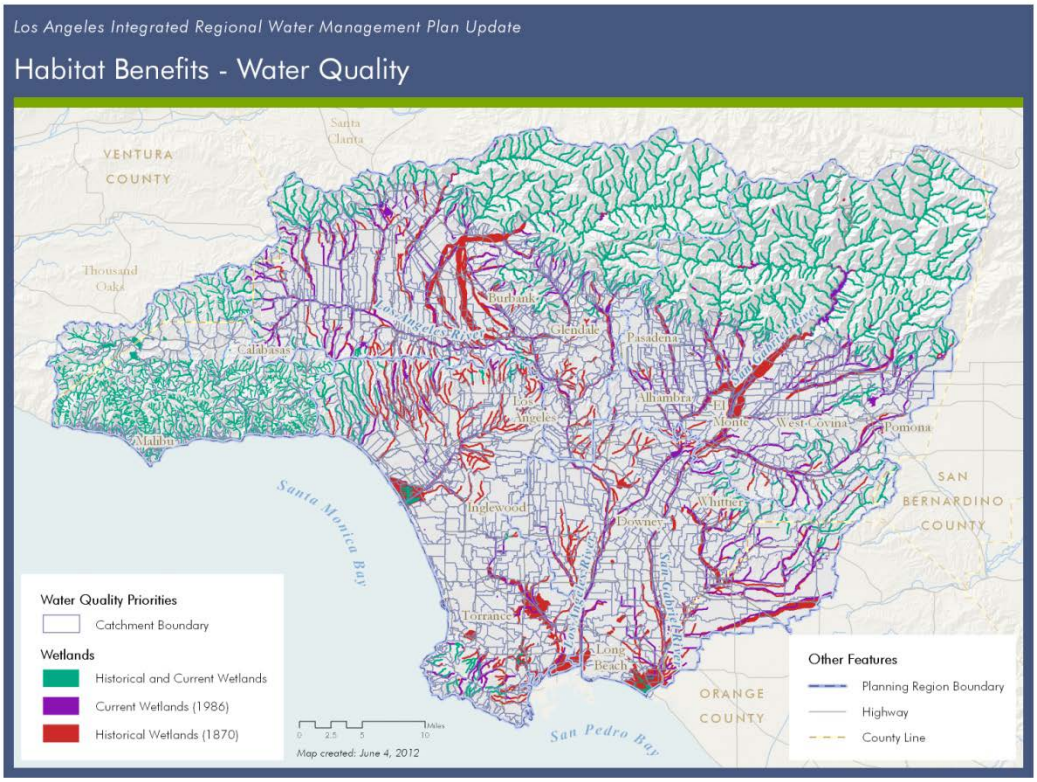

Figure 17. Habitat Targets and Stormwater Quality Benefits (GLAC Region)

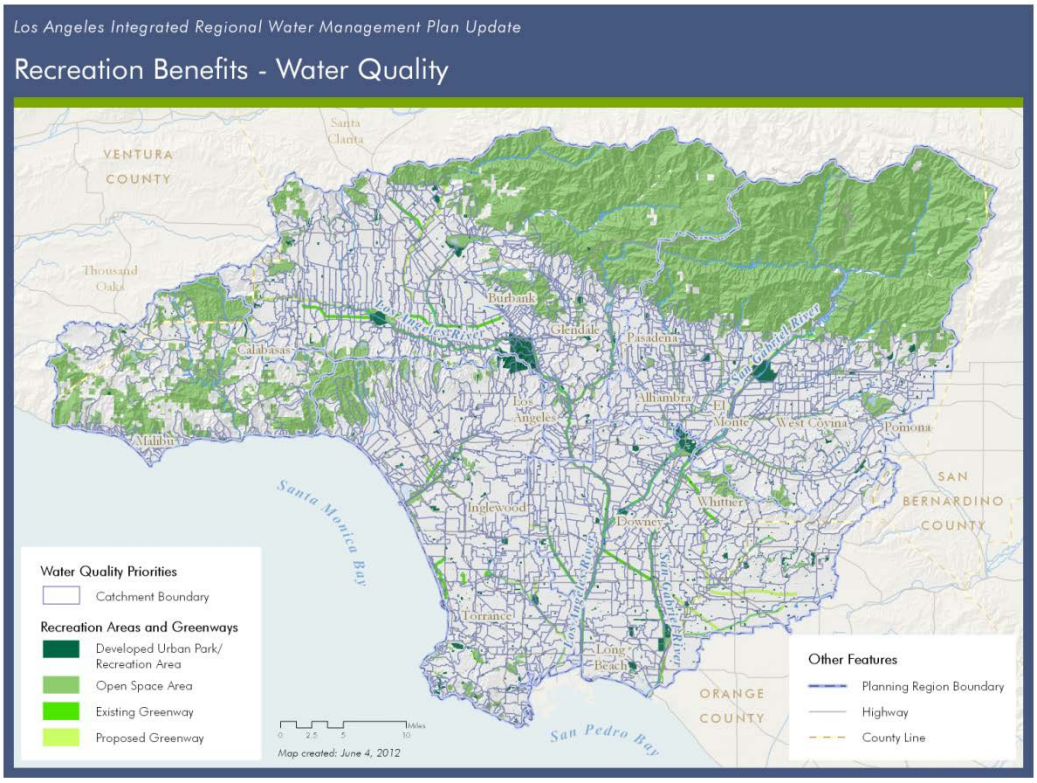

Figure 18. Recreation Targets and Stormwater Quality Benefits (GLAC Region)

9 POTENTIAL CLIMATE BENEFITS OF OPEN SPACE PROJECTS

9.1 Projected Impacts of Climate Change

The effects of climate change are wide-reaching and must be incorporated into long-term planning efforts. According to California Climate Change Center's 2006 Summary Report on California's Changing Climate (Luers et al., 2006) temperatures are expected to rise substantially over the next century. Scientific models, based on the level of greenhouse gas (GHG) emissions, project three different climatic scenarios for California. Under the lower GHG emission scenario, temperature is anticipated to rise between 3 and 5.5°F. The medium GHG emission scenario anticipates a rise in temperature between 5.5 and 8°F. The high GHG emission scenario predicts that temperature may rise between 8 and 10.5°F (Luers et al., 2006).

Unlike temperature projections, there is less of a consensus on the effects that climate change will have on the amount of precipitation in California. Some models predict that there will be little change in the total annual precipitation, while others do not show any consistent trend over the next century. The Mediterranean seasonal precipitation pattern, with most precipitation falling during the winter months and from north pacific storms, is expected to continue. However, some models predict wetter winters while others project a 10 to 20 percent decrease in precipitation (Luers et al., 2006). One of the many anticipated effects of climate change is that more precipitation will fall as rain rather than snow. This could lead to a drastic reduction in the annual snow pack (70 to 90 percent), which will pose challenges for water resource managers, winter recreational activities, and the environment.

Another effect of climate change is increased oceanic temperatures and sea level rise. The California Department of Boating and Waterways commissioned an analysis on the economic costs to sea-level rise to California beach communities. The report, released in September 2011, cites various studies projecting the amount California sea-levels may rise. These studies predict that mean sea level in California could rise between 3 feet and 6 feet by 2100 (King et al., 2011). While a rise in sea level of more than 6 feet could mean the inundation of coastal infrastructure and facilities, the most significant coastal damages will most likely occur from extreme storms and episodic events, which are projected to occur more frequently under a changing climate. Coastal erosion is also projected to accelerate in the coming century and will threaten ecosystem services, including shoreline storm buffering capacities and recreational opportunities (King et al., 2011).

Climate change will also have dramatic effects on species and their habitats over the next century. Already, research has linked climate change with observed changes in species behaviors and species habitat (Parmesan, 2006). For example, the migration cycles of migratory songbirds are shifting as birds begin to migrate north earlier in the year. The change in migration cycle has resulted in a decoupling between the birds arrival date at their breeding ground and the availability of food they need for successful reproduction (the birds are arriving prior to the emergence of their food supply) (USFWS 2010).

The latitudinal and elevational ranges of species will shift as the climate warms (Tingley et al., 2009). Species (both plant and animal) are expected to move to higher elevational gradients as lower elevations become too warm or dry to be habitable (Kelly and Goulden, 2008). Warmer temperatures will also increase the risk and size of wildfires, insect outbreaks, pathogens, disease outbreaks, and tree mortality. The IPCC's Fourth Assessment Report estimates that approximately 20 to 30 percent of the world's plant and animal species will have an increased risk for extinction (IPCC, 2007).

In aquatic ecosystems, increased water temperatures will negatively impact cold and cool-water fish. Rising sea levels will also inundate critical coastal habitats that serve as nurseries for fish populations as well as other wildlife (USFWS, 2010).

Overall climate change is likely to cause abrupt ecosystem changes and species extinctions (Beliard et al., 2012). It will reduce our natural systems' ability to provide valuable ecosystem services—including reducing the availability of clean water—and impact our local and regional economy.

A benefit of greenways with multi-use bicycle paths is that they will be used for transportation purposes and will incrementally slow the pace of global warming. Nationally, the development of trails is seen as one avenue to reduce the nation's obesity epidemic, its dependency on oil, and its contribution to global warming. Fewer autos on the regional highway network means less carbon emissions that are driving global warming. Expanding use of bicycles further reduces emissions and, though marginal, increases the time available for society to respond to major climatic changes.

Within the region, the direct impact of climate change on physical recreation resources is principally related to the potential effects of sea level rise. It could be argued that the greatest open space resource of the GLAC Region is the Pacific Ocean, its public beaches, estuaries, and the public parks and trails along the shoreline. The economic benefits of these fabled southern California resources are significant. The impacts of sea level rise may be nothing short of cataclysmic to some of these beach and coastal estuary resources. These at-

risk lands account for approximately 1,600 acres of Developed Urban Parks and Recreation Areas or Open Space Resource Areas. Although climate change adaptation techniques such as managed retreat have already been adopted at some southern California locations, the ability to clear urbanized lands to accommodate sea level rise is challenging at best, if simply not feasible economically. The ability to manage inland flooding from sea level rise is likely possible with multiple-use design solutions that incorporate levees, sea walls, or other engineered containment facilities with public access to trails and linear habitat corridors. These facilities may be designed to include provisions for particular recreation features such as the coastal trail or retention of piers, but other recreation resources will only be replaced with the acquisition of sufficient existing upland areas that are essentially now fully developed.

9.2 Recommended Criteria and Planning Strategies to Address Climate Change

9.2.1 Climate Change Adaptation

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (USFWS 2010, 14). Climate change adaptation seeks to reduce or ameliorate the effects of climate change that may occur.

Historically, California's Mediterranean climate has been known for its naturally variable temperatures and periodically recurring droughts. As a result, many species and ecosystems developed mechanisms to adapt to naturally occurring variations in temperature and water availability. However, with the accelerated warming trends predicted by climate change scientists, there is a high-level of uncertainty as to whether species and ecosystems will be able to adapt adequately enough to survive.

There are a number of adaptation strategies that could be adopted to conserve biodiversity and targeted species. Conservation planning, especially in the design of nature reserves, can be undertaken with a view towards future climate change (Bernazzani et al., 2012). This could include establishing reserves with high diversity of microhabitats (to accommodate on-site shifting of species distributions in response to climate change) to adopting a flexible-boundary approach, perhaps in conjunction with buffers or conservation zoning around a reserve.

The principal adaptation approach being used by the USFWS is the application of landscape-scale approach to conservation. Landscape-scale conservation includes the strategic conservation of terrestrial, freshwater, and marine habitats within sustainable landscapes. With the conservation of strategic habitat areas, it is also equally important to restore linkages and corridors between large habitat areas to facilitate the movement of fish and wildlife species responding to climate change. The fundamental goal of the USFWS program is to conserve target populations of species, or suites of species, and the ecological functions that sustain them (USFWS, 2010).

Although landscape-scale conservation planning, including strategic placement of reserves and corridors, is an essential element of climate change adaptation, in many cases species will not be able to migrate fast enough to keep up with climate change. A more active adaptation strategy is "assisted migration" (or assisted colonization) where target species are actively moved to a new location outside of their current distribution to anticipate the loss of suitable habitat where they currently occur (Vitt et al., 2010). Although there is some evidence of limited success with assisted migration, this strategy is controversial because of the many conservation issues it creates.

One of the most serious threats to coastal communities, both ecological and human, is sea level rise (Herberger et al., 2011). To improve the GLAC Region's understanding of the threat of climate change, a multi-sectoral, multi-jurisdictional assessment of shoreline vulnerability and risk is needed. This assessment of the shoreline and estuarine areas would be conducted on a subregion basis. Local community and stakeholder interest and capacity for participation, the diversity of shoreline features, and presence of regionally significant infrastructure and resources would be considered.

The vulnerability and risk of asset categories would include, but not be limited to: river estuaries, community land use including parks and recreation resources, shoreline protection, and stormwater and wastewater infrastructure. To address assessment frames, a social vulnerability analysis, a broad socio-economic analysis using FEMA's HAZUS methodology, and an analysis of environmental and economic costs due to potential disruption and loss of services could be completed. The goal would be to identify regional and local adaptation strategies to improve resilience features that address the vulnerabilities present. The assessment should also consider the social inequities likely to be reinforced or increased with future climate change (Shonkoff et al., 2011).

Because of the uncertainties associated with predicting future climate change, it is critical that adaptive management strategies be built into long-term planning initiatives. The US Department of Interior defines adaptive management as:

> *A decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contribution to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent and end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.* (US DOI, 2009)

Implementation of effective adaptive management strategies provides resource managers, recreation planners, and site planners with a mechanism to address the uncertainties of our changing climate.

9.2.2 Climate Change Mitigation

Climate change mitigation refers to reducing GHG concentrations by either reducing the source of GHG emissions or increasing GHG sinks. Mitigation measures include carbon storage and sequestration, fossil fuel and material substitution, food production, and providing additional local recreation areas and green travel routes to encourage walking and cycling.[19] Reducing the production of greenhouse gases will result in immediate improvements to the regional environment while contributing to better health and economic efficiencies in households and businesses.[20]

The most obvious mitigation measure is to reduce GHG emissions by reducing fossil fuel combustion, since that is the largest source of GHGs. Alternative energy sources and energy conservation are often mentioned as obvious means of reducing fossil fuel consumption.

[19] http://www.opengreenspace.com/
[20] http://ccir.ciesin.columbia.edu/nyc/ccir-ny_q4a.html

More fuel-efficient transportation, including bicycling and walking, can contribute to that goal. There are important opportunities to encourage these activities in GLAC.

One important class of GHG mitigation strategies is geoengineering. Geoengineering encompasses a wide range of activities, from reducing the level of solar radiation by introducing chemicals or objects in the atmosphere or into space, to sequestering carbon by industrial activities, enhancing ocean productivity, or enhancing carbon sequestration in natural habitats by reforestation (Scheilnhuber, 2011). Many of these activities are extremely controversial, partially because of doubts about their effectiveness and partially because of concerns about potentially large unintended and undesirable consequences.

Besides strategies to reduce fossil fuel consumption, there are a number of climate mitigation strategies that would be implemented in GLAC. One of the most effective would be carbon sequestration by natural habitats. Aquatic habitats can be excellent habitats for carbon sequestration, especially coastal aquatic habitats (Chmura et al., 2003; Vymazal, 2011), so the GLAC aquatic habitats could be managed to maximize carbon sequestration whenever feasible; this would include both aquatic habitat protection, which would preserve existing carbon stores, and aquatic habitat creation, which could increase carbon sequestration. The organization Restore America's Estuaries has done work developing standards and estimating climate benefits for aquatic habitat enhancement/creation through their Verified Carbon Standard Program.[21]

[21] https://www.estuaries.org/climate-change.html

10 INTEGRATING HABITAT AND RECREATION TARGETS

As discussed earlier, open space encompasses a continuum of uses from natural resource lands to urban parks. Although habitat and recreation targets were calculated separately using different methodological approaches, in fact they are related. However, they are not additive.

A particular project may be useful for both habitat and recreation, in which case the uses would be completely complementary, or on the other extreme it could be useful for one or the other only (i.e., exclusive). Projects that focus on habitat or recreation, even to the exclusion of the other use, are valuable, but of course it is ideal if a project can accommodate both uses.

The total Open Space target for the region will be some combination of the habitat targets and the recreation targets. If habitat and recreation were exclusive, then the total Open Space target would be the sum of the habitat and recreation targets.

While it is recognized there is a potential that at least some of the habitat and recreation targets may overlap because of the open space continuum, for the purpose of this plan, the total Open Space target is the sum of the habitat and recreation target values. No analysis has been done to determine if the total target number can be reduced because of the continuum. The total Open Space target is shown along with all targets described earlier in this document in Table 15.

Table 15. Summary of Target Tables – Aquatic habitats, Uplands, and Recreation

Type	Target (acre)
Aquatic Habitat Protection or Preservation (Tidal Aquatic Habitat, Freshwater/Riverine Aquatic Habitat)	2,000
Aquatic Habitat Enhancement (Tidal Aquatic habitat, Freshwater/Riverine Aquatic Habitat)	6,000
Targets for Aquatic Habitat Restoration or Creation (Tidal Aquatic Habitat, Freshwater/Riverine Aquatic Habitat)	4,000
Upland Habitat (Buffers and Linkages)	36,000
Developed Urban Parks	19,700-25,100
Passive Recreation	30,000-53,000
Total Open Space Target	**115,700-144,100**

11 IMPLEMENTATION OF THE OPEN SPACE, HABITAT AND RECREATION OBJECTIVES

The IRWMP serves as a blueprint that guides a regional approach to developing, protecting, and preserving water resources within the GLAC region. The blueprint seeks to integrate targets, methodologies, and criteria for assessing water resource projects. One goal of this integration is to generate well-designed water resource projects that meet multiple water resource management needs and objectives, including the provision of open space, habitat and recreation. Another goal is to optimize successful grant-funding opportunities within the state's IRWMP program.

11.1 Opportunities and Challenges

Opportunities

The benefits of considering habitat and open space in the IRWMP are numerous. Investing in the preservation, enhancement, and restoration/creation of open space features creates a vision for a more connected region, protecting biodiversity from the uncertain effects of climate change, and maintaining the region's recreational opportunities. The wildlife buffers, linkages, corridors and ample recreation opportunities recommended by the plan will help ensure that people, plants, and animals can move across the landscape to adapt to warming temperatures. It also will allow people to understand the connection between open space and improved environmental management.

The protection, enhancement, and restoration/creation of aquatic habitats systems and their associated buffer zones throughout the region will protect valuable watershed functions. These activities will provide not only critical habitat to species as they move across the landscape, but will also help preserve water quality and quantity. In coastal areas, the preservation, enhancement, and/or restoration/creation of tidal aquatic habitats will help mitigate the effects of rising sea levels.

The IRWMP serves as a broad planning framework that can serve the Region's agencies, and other stakeholders as they work together. The establishment of regional goals and objectives allows these entities to build upon each other's visions and projects. In addition, the process for Plan updates provides a means for goals and objectives to be measured and adjusted as progress is made.

In addition to meeting the goals and objectives of the state's IRWMP program, targets developed in the OSHARTM were developed in a manner that is consistent with current regulatory standards of other state and federal permitting agencies. This was done to ensure efficient use of project funds by agencies competing for grant funding.

Challenges

There are many challenges in developing and implementing the goals, objectives, and targets of the OSHARTM. Some issues that must be further explored and analyzed to inform future iterations of open space, habitat and recreation planning include the following:

- **This analysis was insufficiently tailored to the local and Subregional level.** This plan developed targets and evaluation criteria for the region. In the future, each subregion may choose to develop their own strategy for setting targets, and for contributing to meeting the targets. Subregions may choose to use the methodologies presented in this report, or they may choose to develop different methods that meets the specific needs of their region. Subregional implementation will require planning agencies and city planning departments within each region to evaluate or interpret the targets compared to land use to determine opportunities and constraints in their local areas, subregions, and then throughout the region.
- **There is currently insufficient research on evaluating and assigning value to ecosystem services.** Evaluation of ecosystem services is a relatively new area of study that has yet to achieve consensus on assessment methodologies. As research in this area advances, the OSHARTM will be able to more precisely assess the benefits of open space.
- **Inequitable access to existing open space resources for outdoor recreation and environmental education purposes needs to be addressed.** Access is chiefly dependent on proximity and transportation factors that are outside the scope of the IRWMP. While there may be ways of transporting people to open space, there are limited opportunities to bring open space to people within many urban areas of the GLAC Region. The urban areas are essentially built out and the opportunities for land acquisitions and redevelopment and/or restoration are considered to be limited. The cost of land also may be considered too prohibitive if the justification for acquisition is only related to recreation values. Multipurpose projects may aid in addressing this issue to some extent.

- **The high level of urbanization and land values within the GLAC Region presents a significant challenge in implementing open space conservation and the targets developed in this TM.** Open space conservation is needed for the region to protect its biodiversity and help mitigate the effects of climate change. By implementing environmental solutions that address water resource management needs such as flood attenuation and water quality improvement, society will receive multiple benefits. It is recognized that these solutions tend to be more complex than "traditional" engineered approaches and should be encouraged.
- **There is a concern that project proponents may fail to consult property owners, including public agency landowners, prior to developing project concepts and adding these projects into the IRWMP project database.** The project addresses this criticism by providing a framework for partnering and collaboration throughout the GLAC region.
- **Oftentimes the development of open space decreases local government revenue by taking properties "off the tax rolls", while increasing costs through increased enforcement/oversight for recreational users and/or requiring funds for natural resource management and maintenance.** Such funding is typically not readily available. New resource management tools need to be assessed to address this issue. For example, public agency mitigation or conservation banking could not only provide compensatory mitigation for important public infrastructure projects, but also protect/restore habitat and provide adequate funding for the long-term management.
- **The acquisition of open space or creation/enhancement/restoration of habitat adjacent to existing neighborhoods may place an increased burden on local government services including the potential of fire, flood hazards, and police and rescue services.** These environmental activities also may negate the benefits of existing infrastructure, impact water rights, and/or significantly alter long-established operations and maintenance procedures. If any of these are identified as an issue during the project review process, they should be addressed at that time.

Strategies to Work with Agencies to Ensure Consistency with the IRWMP

The development of the IRWMP has served as a mechanism for discussions between agencies and other stakeholders regarding ways to increase integrated water resource management planning within the GLAC Region. Some of these discussions led to the

identification of issues and needs that must be further explored. This exploration should take place during future revisions of this IRWMP. This IRWMP Update should serve as a catalyst for further evaluation of regional issues and the means to resolve those issues through a collaborative process. Case studies on the Santa Barbara County and the Santa Ana Watershed approach may be useful in further refining a collaborative process.

Stakeholder and agency partnerships have been created during the development of the IRWMP. By establishing these relationships, these entities can effectively coordinate planning with each other, exchange innovative ideas and methods, and increase coordination to undertake studies and projects. Agencies and non-governmental organizations might even collaborate to work on issues of common interest and identify consensus on broad goals, as exemplified by the working arrangement between the Los Angeles Department of Water and Power and TreePeople. By partnering, both the individual strengths of each organization, and the benefits from implemented projects, will expand.

Given the large number of agencies with jurisdiction in the GLAC Region, there are a broad range of interests and issues. Many of the interests and issues extend beyond water resource management. Ongoing planning between agencies should increase opportunities to focus on common themes to protect water supply and water quality as well as to address other environmental issues and to provide more parks and open space. Through ongoing planning, agencies can work together to plan and develop multi-purpose projects and programs that fulfill their mandates and meet larger regional needs while also helping to enhance water supplies and improve water supply reliability (GLAC IRWMP Acceptance Process Application, April 28 2009).

11.2 Gaps in Knowledge

The revised IRWMP is based on the best available science to date. However, information updates (i.e., research, science, and public policies) are needed and these updates must be disseminated. Obtaining, assessing, and disseminating high-quality data often is difficult. Without an agreement as to the basic information, it can be difficult to determine accurate baselines, make projections, and set targets in implementing water-related projects (Bliss and Bowe, 2011). The effectiveness of the knowledge itself may pose another gap because it often takes several years of implementation, practice, and monitoring to determine an outcome.

While regional inventories of park and recreation lands exist, the complementary information for outdoor areas at school sites used for outdoor recreation and environmental

education throughout the entire region does not. Many elementary, middle, and high schools in the urban areas of Los Angeles County are not park-like; instead, they have minimal recreational amenities and contain asphalt rather than vegetated surfaces. Information that should be inventoried includes: condition of outdoor recreation / physical education areas, accessibility to neighborhood areas (open or closed to public use after school hours), and existence of joint use agreements with public recreation providers.

Trail routes illustrated on the recreation and open space target maps are proposed regional trails as identified in the draft Los Angeles General Plan 2035, as well greenways identified by stakeholders during the outreach efforts for the development of the OSHARTM. Many of the 84 cities within the GLAC region, such as the Cities of Malibu, Monrovia, and Pasadena, as well as other agencies and joint power authorities that provide outdoor recreation opportunities have adopted or proposed local trail plans that complement the county-wide trail network. As an ongoing process, once adopted, these trail routes may be added, as appropriate, to the IRWMP database. Those trail routes that create loops stemming from the regional trail system, connect regional trail routes within lands that are outside of existing public lands, or directly connect urban areas with the regional trail system should be specifically identified.

Inventories are also needed to characterize and evaluate the region's wildlands. Besides potential buffer and identified linkage areas, additional habitat core areas may be identified.

Standardized statistics about the use, appeal, and value of the open spaces of the GLAC Region, and the passive recreation that take places in them, do not exist. The GLAC Region hosts industries, climate, and landscapes that are known locally, statewide, nationally, and internationally. However, the open spaces of the region are not all the same. Beaches, river greenways, and a variety of mountain settings offer a myriad of open space opportunities. Added to that variety, there is a great disparity in the way the different agencies that own or manage open space areas maintain statistics about visitors and use within those resources. Conducting a comprehensive open space inventory and use analysis that employs a standardized approach applied evenly over the region, and that identifies the economic value of open space to the region would greatly benefit the OSHARTM because of the sensitivity of the metrics applied to open space.

11.3 Recommendations

The IRWMP is a living document. It is not intended to be filed away on a shelf, but rather to serve as the catalyst for solutions that can be implemented throughout the GLAC

subregions. The OSHARTM is also intended to be reviewed regularly and updated as new information, technologies, and data become available. The following recommendations for the OSHARTM will assist in:

- Incorporating new open space data and information in the IRWMP
- Identifying and prioritizing important habitat and recreation needs
- Refining targets, methodologies and project evaluation
- Fostering regional partnerships.

It is recommended that stakeholders conduct an inventory of planned or existing projects within the GLAC region that meet the intent of the IRWMP. The information sources currently available are disjointed and in many different formats, including specific plans, periodicals, newsletters, and occasionally contained within usable GIS databases.

While in the process of finalizing the updated Significant Ecological Area Program, Los Angeles County could amend it to identify linkages and give them the same priority as protection of large habitat blocks.

The aquatic habitat targets are based on data about historical and current extent of aquatic habitats and ownership of parcels with aquatic habitats. The best available data were used for calculating the targets, but additional work could be done to improve all of these databases. Recommendations include:

- **Aquatic habitat loss**. Rairdan (1998) was used to determine the loss of aquatic habitats in the region. Rairdan's historical aquatic habitat analysis has been supplanted by historical ecology studies in two sections of GLAC (Stein et al., 2007 for the San Gabriel River and Dark et al. 2011 for the Ballona Creek watershed). The recent historical ecology studies use more modern, detailed methods than Rairdan used, but their limited geographic scope precluded their use for establishing GLAC targets. The creation/restoration targets would be improved if a historical ecology study was completed for the entire GLAC region.
- **Current aquatic habitat extent**. The National Wetlands Inventory (NWI) was used to indicate the current extent of aquatic habitats in GLAC. Unfortunately, the current NWI maps do not cover the entire GLAC region. The protection

and enhancement targets would be improved if there were NWI maps for the entire region. Moreover, the NWI mapping should be done at a level that includes as many local aquatic habitat types as possible, including small ephemeral aquatic habitats and streams.

- **Ownership**. Aquatic habitat ownership was determined using the California Protected Area Database (CPAD). However, not all publicly owned lands are included in the CPAD. It would be possible to develop a more accurate estimate of private ownership by searching ownership on a parcel-by-parcel basis; however, an effort such as this was beyond the scope of this project. The protection targets could be refined by determining ownership using a parcel-by-parcel analysis.

The habitat targets could be improved by considering ecosystem services as well as aquatic habitat extent. It was originally planned to incorporate ecosystem services more thoroughly into the targets. However, there is no readily applicable method for quantifying ecosystem services at present, and there is an almost complete lack of information on the ecosystem services being provided by existing aquatic habitats. The importance of assessing ecosystem services has only recently been recognized, and this is an area of active research. The development of methods to assess ecosystem services should be monitored and applied to GLAC aquatic habitats when a suitable method has been developed. A detailed understanding of the ecosystem services provided by existing aquatic habitats is critical for developing improved aquatic habitat targets.

As an ongoing process, once adopted, some or all of these local trail routes should be added to the IRWMP data base. Those trail routes that branch from the regional trail system and create loop opportunities for recreation, or local trails that directly connect urban areas with the regional trail system should be specifically identified and included in the regional recreation targets.

And finally, essential to any truly integrated effort, as part of the IRWMP, the GLAC Region should develop and publicize its strategic focus and willingness to invest in feasible, multi-beneficial, collaboratively developed projects.

This report was released for public review, and comments received identified further areas of continued work that would build upon this work. These include the following:

- Present historical aquatic habitats with overlays of development, and especially port development and flood channel development, to provide a more clear assessment of where potential aquatic habitat restoration would be most feasible.

- Goals for aquatic habitat protection do not include the definition for the mechanism by which the aquatic habitat would be protected. While acquisition of privately held aquatic habitat areas is one potential method, this could be infeasible. Future work will include establishing specific strategies for protection of aquatic habitats that will include alternatives to acquisition.
- Targets for protection and enhancement of existing aquatic habitats could be refined based on the quality of the existing habitat. It would not make sense to select concrete lined flood control channels for the protection target, as they provide minimal habitat value. Future work should rank existing aquatic habitat areas by their habitat value and use that information to inform guide protection and enhancement targets.
- Future work should be done to describe the specific needs and constraints throughout the region. Once the needs and constraints were adequately assessed, projects could be evaluated taking this into consideration.
- Improve the Water Source/Supply & Hydroperiod section of the scoring sheets to take into account more complex mechanisms of hydromodification, such as impacts of increased impervious cover.
- Incorporate OSHARTM targets into the General Plans generated by the Governor's Office of Planning and Research.
- Refine list of linkages to reflect the constraints. For instance, channels that undergo regular maintenance or rivers where it would not be feasible to provide a 1,000-foot buffer should be removed from this list.
- Develop a methodology for counting projects that serve both recreation and habitat goals towards the targets.
- Coastal Sediment is a major climate change issue. The California Coastal Sediment Workgroup just issued a draft Beach Sediment Report. Further work on Open Space targets should include a review of this report and incorporate relevant findings.
- Develop a more accurate assessment of usable park land in large open spaces within the region to more accurately assess how well passive recreation standards are met and refine targets.
- Critical habitat areas should be updated with each update of the plan, as they are continuously being revised.

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Exhibit A

Aquatic Habitat Target Methodology

This exhibit provides a more detailed description of how the aquatic habitat targets were determined.

To the extent possible, all aquatic habitat targets were calculated in a transparent manner using quantitative data sources. Inevitably, there are limitations in the data used to calculate these targets; some of these limitations are described below. Two specific examples where future work could dramatically improve the data sources are (1) the historical extent of aquatic habitats, and (2) the National Wetland Inventory of current aquatic habitat extent. As better data become available, the habitat targets could easily be updated to reflect these data by applying the methods described here.

Databases used

Three main databases were used as the foundation for calculating aquatic habitat targets. These databases are described in the following sections.

California Protected Area Database

The California Protected Area Database (CPAD) is a mostly parcel-based data set that tracks all known parks and open space lands in the state. Land ownership categories in the CPAD include city, county, state, federal, special district, and non-profit. We used CPAD Release 1.7, from September 2011). More detailed metadata about the CPAD is available at http://www.calands.org/data.php.

CPAD may not accurately reflect private ownership. For example, CPAD does not include the majority of lands owned by agencies such as the Los Angeles County Flood Control District for the primary purpose of flood control. It would be possible to obtain a more accurate estimate of private ownership by searching ownership on a parcel-by-parcel basis; however, an effort such as this was beyond the scope of this project. To the extent that the CPAD database includes public lands, the targets for protection will be too high.

National Wetlands Inventory

Current aquatic habitat extent was determined using the National Wetlands Inventory (NWI), September 2011 release, from the USFWS. Metadata for the NWI database are available at http://www.fws.gov/aquatic habitats/Data/metadata.html. The NWI

database reports aquatic habitat extent in acres. Although the NWI database represents the best data for aquatic habitat extent in the region, it has definite limitations. NWI data are not precise; detailed mapping would require on-the-ground mapping using a Global Positioning System (GPS). Not all aquatic habitats are included in normal NWI mapping. NWI maps include aquatic habitats that can be identified by experienced photointerpreters from aerial photographs, but may not include some ephemeral aquatic habitats or other habitats that are not visually distinct from non-aquatic habitats. Some of the areas in the GLAC region have been mapped using an enhanced NWI methodology. Ideally, the enhanced NWI methodology would be applied for all areas in the region, but these data were not available when the present targets were calculated.

NWI categorizes aquatic habitats according to the Cowardin aquatic habitats classification scheme. The classification scheme is shown in Figure 1. Note that NWI uses two high-level classifications that include marine and estuarine habitats: Estuarine and Marine Deepwater, and Estuarine and Marine Aquatic habitat. For tidal aquatic habitats, we included all estuarine habitats, both subtidal and intertidal, which cut across both of the high-level classifications. There may be some aquatic habitat types included in estuarine habitats that would not typically be considered tidal aquatic habitats, but these would be very minor in this region.

Rairdan (1998)

The calculation of aquatic habitat losses requires a data source with consistent data for current and historical aquatic habitat extent for the region. There are no available data for the entire region, but Rairdan (1998) presented data for all subregions except North Santa Monica Bay (NSMB). For the other four regions, losses were calculated using data layers provided by Rairdan (U.S. Army Corps of Engineers, Sacramento, CA). The historical extent was based on maps and other sources from circa 1870; current extent was in 1986. To calculate loss, the two layers for each subregion were overlaid to show the difference between the current extent and historical extent. This allowed the identification of areas that historically supported aquatic habitats but no longer do, areas that historically supported aquatic habitats and still do, and areas that did not historically support aquatic habitats but currently do.

Rairdan's riverine data are presented as miles instead of acres. Arguably, miles better represent the extent of linear features such as rivers and streams, especially because the lateral extent of these systems can vary considerably from year to year and can be difficult to discern from maps. However, in order to maintain consistency with NWI data, riverine extent was converted to acres. To make this conversion, a current aquatic habitat extent from the Rairdan data (presented in miles) and the NWI data (presented in

acres) was compared. The ratio of miles to acres between these two data sources was as a conversion factor Rairdan's historical data.

Although Rairdan's data provide a valuable resource for calculating habitat targets, there are limitations in the data. Rairdan could only include data for aquatic habitats that were reliably mapped. Vernal pools, for example, are important in the region but not well mapped. Rairdan (1998) indicated general locations of notable vernal pool complexes but could not provide quantitative estimates of their extent.

Perhaps more importantly, Rairdan completed his analysis nearly 15 years ago and more modern, detailed historical ecology analyses can be completed today. There have been some recent historical ecology studies done in the region (e.g., Stein et al. 2007 for the San Gabriel River watershed; Dark et al. 2011 for the Ballona Creek watershed). Although these provide much more detailed information for their particular study areas, that level of detail is not available for the entire region, or even an entire subregion, and so they cannot be used to establish targets.

There are also more detailed data available for the current extent of aquatic habitats (i.e., the most recent NWI maps). However, the current NWI maps were not used in the estimate of aquatic habitat losses because the methods used to generate these maps differed from the methods used by Rairdan. For consistency, we used Rairdan's data for both historical and current (1986) aquatic habitat extent.

The use of Rairdan's data for establishing habitat targets needs to be viewed in the context of its use. The calculation of habitat targets does not require detailed information about the extent and location of historical and current aquatic habitats, just a reasonable estimate of the loss of different aquatic habitat types. Rairdan's data provide a reasonable estimate of loss, as well as being the only estimate currently available for most of the region. If future studies provide more detailed estimates of loss for the entire region, the targets can be adjusted appropriately. Additionally, it should be noted that while the total acreage of historical aquatic habitats was used to establish targets, the locations of historical aquatic habitats are shown merely for informational purposes, and are not intended to mandate where restoration/creation targets should be achieved.

Protection

The target for protection of existing aquatic habitat was calculated as 20 percent of the privately held aquatic habitats.

The target is based on privately held aquatic habitats because it was assumed that aquatic habitats already in public or non-profit ownership are protected from destruction or degradation. This might not always be the case, but there is no database available to categorize the level of protection for each aquatic habitat in the region. We used the CPAD to determine ownership.

Current aquatic habitat extent was determined using the National Wetlands Inventory (NWI).

To calculate the extent of existing aquatic habitats in private ownership, the NWI and CPAD data layers were intersected in each of the five subregions. Any lands not in CPAD (that is, not city, county, state, federal, special district, or non-profit) were assumed to be private. Thus, the basis for the calculation of protection targets is acres of each aquatic habitat type in private ownership.

Enhancement

The target for the enhancement of existing aquatic habitat was calculated as 25 percent of the existing aquatic habitat area.

The enhancement target was based on the current extent of existing aquatic habitats in each region. Current extent, in acres, was provided by the NWI database. For the enhancement targets, we did not consider ownership since enhancement could be appropriate in privately or publicly owned aquatic habitats. In addition, actual enhancement projects would only focus on degraded aquatic habitats, but there is no regional database that characterizes the condition of all the aquatic habitats in the region. It is believed, however, that many aquatic habitats are moderately to severely degraded in the region, so there is no doubt much more than 25 percent of the existing aquatic habitats could benefit from enhancement projects. Because the NWI database includes a large acreage of "lakes," many if not all of which are man-made, we did not include lakes when calculating the enhancement target.

Adjustments to the aquatic habitat extent data had to be made for USGRH and ULAR subregions because the NWI mapping did not cover the entire subregions. (Note: these adjustments were not made for the Protection targets because the adjustments were based on Angeles National Forest land, which is publically owned.)

For the USGRH subregion, 172,405 acres (96% of the Angeles National Forest area in the subregion) was mapped and 6,408 acres (4%) was not mapped. All of the subregion that was not mapped was in the mountains of the Angeles National Forest. The extent of aquatic habitats missed in the unmapped area was estimated by calculating the

fraction of the mapped area that was covered by aquatic habitats. There were 3,398 acres of freshwater aquatic habitats in the mapped area, indicating approximately 126 acres in the unmapped area. The 126 acres was added to the freshwater aquatic habitat extent in the subregion to get an adjusted total extent of freshwater aquatic habitats. There were 2,940 acres of riverine aquatic habitats in the mapped area, indicating approximately 109 acres in the unmapped area. The 109 acres was added to the riverine aquatic habitat extent in the subregion to get an adjusted total extent of freshwater aquatic habitats.

The adjustment for the ULAR subregion followed the same procedure, with the complication that not all of the unmapped area was mountains in the Angeles National Forest. Although we could apply the same procedure for the Angeles National Forest area, there were additional "flatlands" for which aquatic habitat extent could not be estimated. Comparing the ULAR and USGRH maps, it is apparent that the vast majority of the aquatic habitats are in the mountainous regions, but there are some aquatic habitats of both types (freshwater and riverine) in the flatlands. In addition, there are some mountainous areas (e.g., the hills north of Burbank and hills around the western and southern borders of the subregion) that are not part of the Angeles National Forest. Thus, our calculation of additional aquatic habitats underestimates the true extent of aquatic habitats in the unmapped area of the subregion. To account for this underestimate, we added 20% to the calculation based on the Angeles National Forest unmapped area. Finally, we applied the fraction of mapped area covered by aquatic habitats from the USGRH subregion because it was based on a much larger mapped area (172,405 acres compared to 8,883 acres). This procedure resulted in estimates of an additional 2,628 acres of freshwater aquatic habitat and 2,274 acres of riverine aquatic habitat for the ULAR.

Restoration or Creation

The goal of aquatic habitat restoration or creation in the region is to increase the extent of functioning aquatic habitats to partially compensate for the losses that have occurred in the past. Thus, the restoration/creation targets are based on the extent of aquatic habitat losses. Two kinds of losses are considered: (1) aquatic habitats that were destroyed and replaced by non-aquatic habitat, and (2) aquatic habitats that were converted from natural aquatic habitat to man-made aquatic habitat, such as a flood control basin or a concrete lined channel. The target for the restoration or creation of aquatic habitat was calculated as 10 percent of lost aquatic habitat plus 10 percent of converted habitats. Creation would occur in historical aquatic habitat areas that have been destroyed, while restoration would occur in the converted aquatic habitat areas.

The loss of aquatic habitats was calculated using data from Rairdan (1998). Figures 6 and 7 of the main report show the historical and current extent of aquatic habitats for the entire region except NSMB where historical information is not available. Several regional trends are apparent. Some of the greatest losses occurred in the Upper Los Angeles River and Upper San Gabriel and Rio Hondo Rivers subregions, where extensive dry washes have been eliminated. There were also substantial losses of tidal aquatic habitats in the Lower San Gabriel and Los Angeles Rivers and the South Santa Monica Bay subregions. The South Bay subregion also lost a large area of depressional marsh/ephemeral lake. Note that there is no image for the North Santa Monica Bay subregion as the data for comparing historical to current extent are not available. A discussion on how the analyses and targets were set for this subregion can be found later in this section.

We used Rairdan's data to calculate the extent of natural aquatic habitats converted to man-made aquatic habitats. For tidal marsh, the converted aquatic habitat calculation was based on the current extent of harbors and marinas. For freshwater aquatic habitats, the converted aquatic habitat calculation was based on the current extent of flood control basins and spreading grounds. Two man-made aquatic habitat types, constructed lake/pond and reservoir/recreational lake, were not included in the calculation of converted freshwater aquatic habitats because they likely represent the construction of new aquatic habitat types rather than a conversion of natural aquatic habitats. For riverine aquatic habitats, the converted aquatic habitat calculation was based on concrete-lined channels and soft-bottom channels.

Although the aquatic habitat restoration/creation targets were generally calculated as 10 percent of the lost aquatic habitat plus 10 percent of converted habitats, there are a few exceptions. On principle, the acreage was adjusted to include known large restoration projects in the late stages of planning since setting a target below current plans for the subregion did not seem useful. For example, in the South Bay, the calculated tidal marsh target was 389 acres. However, the Ballona Aquatic habitats restoration will be approximately 400 acres (the actual acreage of the project is not yet determined), so the South Bay target was set at 400 acres. The Lower San Gabriel and Los Angeles Rivers tidal aquatic habitat target was calculated as 332 acres. A restoration project is being planned for the Los Cerritos aquatic habitat, which may match the size of the subregion's restoration target acreage. However, at this time, the project's plans are still in the early stages and there is not enough information available to quantify the project's full extent. Due to this uncertainty, the subregion's target was not adjusted to include the project.

As noted previously, Rairdan's data did not cover the NSMB subregion, so a different approach was used to calculate aquatic habitat restoration/creation targets. We describe the approaches below:

- For **tidal marsh,** the target was set at 25 acres based on the planned Malibu Lagoon restoration and other possible lagoon restoration projects, including the tidal aquatic habitat at Topanga.

- For **freshwater aquatic habitats**, a quantitative analysis is difficult because there are no data on the loss of freshwater aquatic habitats in the subregion. The NWI data indicate there currently are 1,152 acres of freshwater aquatic habitats in the subregion (excluding lakes). Although there have been no studies of impacts to freshwater aquatic habitats in the region, Lilien (2001) conducted a comprehensive analysis of impacts to riverine aquatic habitats in Malibu Creek watershed. It is reasonable to assume the same proportional loss of riverine and freshwater aquatic habitats since they are mainly impacted by the same types of activities; freshwater aquatic habitats may be slightly more likely to be impacted because they are flat areas and not located in the active stream channel, but they are not channelized, which was the dominant impact to riverine aquatic habitats. If we assume the loss of freshwater aquatic habitats has been equivalent to riverine aquatic habitats, with the riverine losses determined as described below based on Lilien (2001), then we assume a loss of 25% of the original freshwater aquatic habitats. Thus, we estimate there was originally 1,536 acres of freshwater aquatic habitats, with a loss of 384 acres. Therefore, the freshwater aquatic habitat restoration/creation target was calculated as 10% of 384 acres, or 38 acres. We did not adjust this estimate for converted habitats because Lilien included these conversions in his analysis.

- For **riverine aquatic habitats**, there was little quantitative information on which to base the target, particularly because riverine aquatic habitats are so extensive in the subregion. The most detailed study of impacts to riverine aquatic habitats is the region is Lilien (2001), which provides a comprehensive assessment of impacts to riverine habitats in the Malibu Creek watershed. Lilien documented over 200 projects undertaken in the Malibu Creek watershed that impacted 54 km of riparian habitat, approximately 50% of the total length of the catchment's major tributaries. Many of the documented impacts did not destroy the affected habitat, however, since they included activities such as vegetation clearing. However, 14 channelization projects accounted for over 13 km of impacts. Other substantial impacts were caused by recreation facilities including golf course, lakes, and reservoirs, transportation projects, bank stabilization projects, and residential and

commercial development. The substantial impacts documented by Lilien comprised 26.3 km of impacts, or approximately 25% of the major tributaries in the watershed. As Lilien notes, this is likely an underestimate because of limitations in the data he had available for his analysis. According to the NWI database, there are currently 590 acres of riverine habitat in the North Santa Monica Bay subregion. If we assume that habitat impacts for the Malibu Creek watershed are representative of the entire subregion, then the existing riverine habitat is 75% of the original riverine habitat in the subregion. The assumption that 25% of all existing habitat was lost may be high, since there is more development in the Malibu Creek watershed than in most other areas in the subregion. On the other hand, Lilien identifies a number of reasons why his analysis underestimates impacts, including the fact that early impacts were not documented and he only recorded impacts along the main tributaries, whereas most of the impacts have occurred along the smaller tributaries. The impact to smaller tributaries likely overwhelms the other factors, but we have no quantitative estimate of their extent. Thus, 25% seems like the best estimate we have at the moment. Therefore, we estimate that there were originally 787 acres of riverine habitat, and 197 acres have been lost. The target we set at 10% of 197 acres, or 20 acres. We did not adjust this estimate for converted habitats because Lilien included these conversions in his analysis.

Figure 1. Classification scheme used in the National Wetlands Inventory.

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

System: M - Marine

Subsystem: 1 - Subtidal; 2 - Intertidal

Class	Subclass
RB – Rock Bottom	1 Bedrock 2 Rubble
UB – Unconsolidated Bottom	1 Cobble-Gravel 2 Sand 3 Mud
AB – Aquatic Bed	1 Algal 3 Rooted Vascular
RF – Reef	1 Coral 3 Worm
AB – Aquatic Bed	1 Algal 3 Rooted Vascular
RF – Reef	1 Coral 3 Worm
RS – Rocky Shore	1 Bedrock 2 Rubble
US – Unconsolidated Shore	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

System: E - Estuarine

Subsystem: 1 - Subtidal; 2 - Intertidal

Class	Subclass
RB – Rock Bottom	1 Bedrock 2 Rubble
UB – Unconsolidated Bottom	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB – Aquatic Bed	1 Algal 3 Rooted Vascular 4 Floating Vascular
RF – Reef	2 Mollusk 3 Worm
AB – Aquatic Bed	1 Algal 3 Rooted Vascular 4 Floating Vascular
RF – Reef	2 Mollusk 3 Worm
SB – Streambed	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic
RS – Rocky Shore	1 Bedrock 2 Rubble
US – Unconsolidated Shore	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
EM – Emergent	1 Persistent 2 Non-persistent 5 *Phragmites australis*
SS – Scrub-Shrub	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen
FO – Forested	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

System: R - Riverine

Subsystem: 1 - Tidal; 2 – Lower Perennial; 3 – Upper Perennial; 4* - Intermittent; 5* – Unknown Perennial

Class	Subclass
RB** – Rock Bottom	1 Bedrock 2 Rubble
UB – Unconsolidated Bottom	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
SB** – Streambed	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated
AB – Aquatic Bed	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular
RS – Rocky Shore	1 Bedrock 2 Rubble
US – Unconsolidated Shore	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
EM – Emergent	2 Nonpersistent

* **Intermittent** is limited to the **Streambed** Class;
Unknown Perennial is limited to **Unconsolidated Bottom** Class code **R5UB** only
** **Rock Bottom** is not permitted for the **Lower Perennial** Subsystem;
Streambed is limited to **Tidal** and **Intermittent** Subsystems

Table 1. Values used for the calculation of aquatic habitat targets for the North Santa Monica Bay Subregion.

Target for Protection or Preservation:	Current Extent of Privately Held Areas	Calculated Target			Target	Basis
Tidal Wetland (acres)	2	0			0	20% of privately held habitat, NWI and GPAD data
Freshwater Wetland (acres)	840	168			168	20% of privately held habitat
Riverine (acres)	262	52			52	20% of privately held habitat.
Targets for Enhancement	Current Extent	Calculated Target			Target	Basis
Tidal Wetland (acres)	38	9			9	25% of existing habitat, NWI data
Freshwater Wetland (acres)	1152	288			288	25% of existing freshwater wetlands minus lakes, NWI data
Riparian (riverine)(acres)	590	147			147	25% of existing riverine habitat.
Targets for Restoration or Creation	Loss	Calculated Target	Previously Converted Wetland	Calculated Target based on Converted Wetland	Target	Basis
Tidal Wetland (acres)	0	0			25	General target is 10% of lost tidal marsh, but in the absence of this information the target is based on the planned Malibu Lagoon restoration and other possible lagoon restoration projects
Freshwater Wetland (acres)	384	38	0	0	38	General target is 10% of depressional wetland and ephemeral lake and pond (data do not include historical extent of vernal pools), but in the absence of that information, using an estimate of 384 acres of freshwater wetland habitat lost based on Lilien (2001)'s estimate of riverine wetland loss.
Depressional marsh	NA	NA			NA	
Ephemeral lake/pond	NA	NA			NA	
Riparian (riverine)(acres)	197	20	0	0	20	General target is 10% of lost braided, upper and lower riverine and dry wash, but in the absence of that information, using an estimate of 190 acre of riverine habitat lost based on Lilien (2001).
Braided lower riverine (acres)	NA	NA			NA	
Lower riverine (acres)	NA	NA			NA	
Upper riverine (acres)	NA	NA			NA	
Dry wash (acres)	NA	NA			NA	

Table 2. Values used for the calculation of aquatic habitat targets for the Upper Los Angeles River Subregion.

Target for Protection or Preservation:	Current Extent of Privately Held Areas	Calculated Target			Target	Basis
Tidal Wetland (acres)	0	0			0	20% of privately held habitat
Freshwater Wetland (acres)	569	114			114	20% of privately held habitat
Riverine (acres)	342	68			68	20% of privately held habitat.
Targets for Enhancement	Current Extent	Calculated Target			Target	Basis
Tidal Wetland (acres)	0	0			0	25% of existing habitat, NWI data
Freshwater Wetland (acres)	3262	816			816	25% of existing freshwater wetlands minus lakes, NWI data adjusted to account for the area not mapped
Riparian (riverine)(acres)	2815	704			704	General target is 25% of existing riverine habitat adjusted to account for the area not mapped
Targets for Restoration or Creation	Loss	Calculated Target	Previously Converted Wetland	Calculated Target based on Converted Wetland	Target	Basis
Tidal Wetland (acres)	0	0	0	0	0	10% of lost tidal marsh
Freshwater Wetland (acres)	15	1	2440	244	245	10% of depressional wetland and ephemeral lake and pond. Note the this does not include historical extent of vernal pools. Plus 10% of previously converted wetland.
Depressional marsh	15	1			1	
Ephemeral lake/pond	0	0			0	
Riparian (riverine)(acres)	7507	751	833	83	834	10% of lost braided, upper and lower riverine and dry wash, plus 10% of previously converted wetland. Used conversion factor to convert from miles to acres for riverine habitats.
Braided lower riverine (acres)	50	5			5	
Lower riverine (acres)	505	50			50	
Upper riverine (acres)	303	30			30	
Dry wash (acres)	6650	665			665	

Table 3. Values used for the calculation of aquatic habitat targets for the Upper San Gabriel and Rio Hondo Subregion.

Target for Protection or Preservation:	Current Extent of Privately Held Areas	Calculated Target			Target	Basis
Tidal Wetland (acres)	0	0			0	20% of privately held habitat
Freshwater Wetland (acres)	2121	424			424	20% of privately held habitat
Riverine (acres)	1376	275			275	20% of privately held habitat.
Targets for Enhancement	Current Extent	Calculated Target			Target	Basis
Tidal Wetland (acres)	0	0			0	25% of existing habitat, NWI data
Freshwater Wetland (acres)	4981	1245			1245	25% of existing freshwater wetlands minus lakes, NWI data adjusted to account for the Angeles National Forest area not mapped
Riparian (riverine)(acres)	4716	1179			1179	25% of existing riverine habitat, NWI data adjusted to account for the Angeles National Forest area not mapped
Targets for Restoration or Creation	Loss	Calculated Target	Previously Converted Wetland	Calculated Target based on Converted Wetland	Target	Basis
Tidal Wetland (acres)	0	0	0	0	0	10% of lost tidal marsh
Freshwater Wetland (acres)	17	2	2002	200	202	10% of depressional wetland and ephemeral lake and pond. Note the this does not include historical extent of vernal pools. Plus 10% of previously converted wetland.
Depressional marsh	0	0			0	
Ephemeral lake/pond	17	2			2	
Riparian (riverine)(acres)	8080	808	757	76	884	10% of lost braided, upper and lower riverine and dry wash. Plus 10% of previously converted wetland. Used conversion factor to convert from miles to acres.
Braided lower riverine (acres)	3	0			0	
Lower riverine (acres)	414	41			41	
Upper riverine (acres)	139	14			14	
Dry wash (acres)	7525	752			752	

Table 4. Values used for the calculation of aquatic habitat targets for the Lower San Gabriel and Los Angeles River Subregion.

Target for Protection or Preservation:	Current Extent of Privately Held Areas	Calculated Target			Target	Basis
Tidal Wetland (acres)	557	111			111	20% of privately held habitat, NWI and GPAD data
Freshwater Wetland (acres)	1200	240			240	20% of privately held habitat, NWI and GPAD data
Riverine (acres)	1686	337			337	20% of privately held habitat, NWI and GPAD data
Targets for Enhancement	Current Extent	Calculated Target			Target	Basis
Tidal Wetland (acres)	659	165			165	25% of existing habitat, NWI data
Freshwater Wetland (acres)	1711	428			428	25% of existing freshwater wetlands minus lakes, NWI data
Riparian (riverine)(acres)	1901	475			475	25% of existing riverine habitat, NWI data
Targets for Restoration or Creation	Loss	Calculated Target based on Loss	Previously Converted Wetland	Calculated Target based on Converted Wetland	Target	Basis
Tidal Wetland (acres)	2885	289	439	44	332	10% of lost tidal habitat. Plus 10% of previously converted wetland. (Note: Los Cerritos restoration may be about this area.)
Freshwater Wetland (acres)	357	36	2524	252	288	10% of depressional wetland and ephemeral lake and pond. Note the this does not include historical extent of vernal pools. Plus 10% of previously converted wetland.
Depressional marsh	0	0			0	
Ephemeral lake/pond	357	36			36	
Riparian (riverine)(acres)	2576	258	730	73	331	10% of lost braided, upper and lower riverine and dry wash. Plus 10% of previously converted wetland. Used conversion factor to change miles to acres for riverine habitats.
Braided lower riverine (acres)	156	16			16	
Lower riverine (acres)	638	64			64	
Upper riverine (acres)	80	8			8	
Dry wash (acres)	1703	170			170	

Table 5. Values used for the calculation of aquatic habitat targets for the South Santa Monica Bay Subregion.

Preservation:	Privately Held Areas	Target			Target	Basis
Tidal Wetland (acres)	491	98			98	20% of privately held habitat
Freshwater Wetland (acres)	309	62			62	20% of privately held habitat
Riverine (acres)	322	64			64	20% of privately held habitat.
Targets for Enhancement	Current Extent	Calculated Target			Target	Basis
Tidal Wetland (acres)	634	158			158	25% of existing habitat, NWI data
Freshwater Wetland (acres)	1057	264			264	25% of existing freshwater wetlands minus lakes, NWI data
Riparian (riverine)(acres)	575	144			144	25% of existing riverine habitat.
Targets for Restoration or Creation	Loss	Calculated Target	Previously Converted Wetland	Calculated Target based on Converted Wetland	Target	Basis
Tidal Wetland (acres)	3285	328	610	61	400	Target based on Ballona Wetlands restoration plan (approximately 400 ac). 10% of depressional wetland and ephemeral lake and pond. Note the this does not include historical extent of vernal pools. Plus 10% of previously converted wetland.
Freshwater Wetland (acres)	2813	281	0	0	281	
Depressional marsh	1243	124			124	
Ephemeral lake/pond	1571	157			157	
Riparian (riverine)(acres)	1175	118	288	29	146	10% of lost braided, upper and lower riverine and dry wash. Plus 10% of previously converted wetland. Used conversion factor to convert from miles to acres for riverine habitats and dry wash.
Braided lower riverine (acres)	0	0			0	
Lower riverine (acres)	448	45			45	
Upper riverine (acres)	409	41			41	
Dry wash (acres)	318	32			32	

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Exhibit B

Upland Habitat Target Methodology

For purposes of this plan, the targets for upland habitat acquisition and/or restoration were created for the following characteristics:

- *Buffers and Buffer Zones* are 50- to 300-foot wide areas adjoining a wetland, channel, or upland linkage or wildlife corridor that is in a natural or semi-natural state. For wetland and riparian systems, a buffer is to provide a variety of other functions including to maintain or improve water quality by trapping and removing various non-point source pollutants from both overland and shallow subsurface flows, to provide erosion control and water temperature control, to reduce flood peaks, and to serve as groundwater recharge points and habitat. Buffer zones occur in a variety of forms, including herbaceous or grassy areas, grassed waterways, or forested riparian buffer strips. They also may provide for limited passive recreation.

- *Wildlife Corridors or Linkages* are wide areas of native vegetation that connect or have the potential to connect two or more large patches of habitat on a landscape or regional scale through which a species will likely move over time. The move may be multi-generational; therefore, a linkage should provide both wildlife connectivity and biological diversity. A Wildlife Linkage should ideally be a minimum of 1,000 feet in width (but may be less), be vegetated with native vegetation, and have little or no human intrusion. The goal is to ensure north-south and east-west linkages to mitigate for climate change and genetic isolation.

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Exhibit C

Recreation Targets and Priorities Methodology

Existing Recreation Areas

An evaluation of the existing recreational areas in the GLAC region relied on the California Protected Area Database (GreenInfo Network) also known as CPAD which is an inventory of all protected park and open space lands in California.

Each public park and open space lands within the GLAC region that appeared in the database was categorized using the following categories:

- **Developed Urban Parks:** Developed lands consist of neighborhood parks, community parks, and sports complexes (including public lands)
- **Open Space:** Generally any parcel that is essentially unimproved and devoted to an open space use for the purposes of the preservation of natural resources and provides passive outdoor recreation opportunities. These parcels may include developed parking/staging areas and include trail systems and minor visitor amenity features within them. There are two types of open space areas identified as there is a relationship between these and IRWMP targets for habitat.
  - **Beach / Estuary:** Low lying habitat areas of the GLAC region
  - **Riparian/Upland /Wetland:** All other open space areas including riparian and upland habitats.
  - **US Forest Service:** Lands owned by the United States that provide open space and passive recreation opportunities, among other functions.
  - **Greenway:** Linear open spaces established along a corridor, such as a river, and that provide habitat, recreation, or alternative transportation benefits. While greenways could serve as developed urban park depending on their design, it was assumed for this analysis that greenways provided only passive recreation opportunities.

Generally if the name of the unit included the term “Open Space” or “Resource Parkland” it was categorized as open space. Many regional parks were evaluated using internet based photo and map imagery to estimate a percentage of “developed urban” vs. “open space lands” contained within that unit. That unit was then prorated appropriately

The data set is created at the parcel level (whenever possible), meaning many parks are represented by many polygons. Parks that cross major jurisdictional lines are also split into multiple pieces. Therefore, there may be more than one data entry for an individual park or open space area.

Targets

Targets were established by comparing the existing recreation areas in the GLAC Region to the following standards:

- Developed Urban Parks: 4 acres per 1,000 population;
- Passive Recreation: 6 acres of passive recreation area per 1,000 population.

The target was set as the additional acreage required to meet the standards.

Methodology

- Developed Urban Parks: Areas of need were developed using census tracts. Each tract was evaluated according to the following standards:
    - High Priority: projects within urban areas with less than 1 acre of available park and recreation area per 1,000 population.
    - Moderate Priority: projects within urban areas with between 1 to 3.9 acres of available park and recreation area per 1,000 population.
    - Low Priority: projects within urban areas with greater than 4 acres of available park and recreation area per 1,000 population.
- Passive Recreation Areas: Areas of need were evaluated according to the following standards:
    - High Priority: projects more than a 3 miles from an existing open space area or greenway or projects that help complete the County trail system
    - Moderate Priority: projects between 1 and 3 miles from an existing open space area or greenway
    - Low Priority: projects from between 0 and 1 mile from an existing open space area or greenway

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Exhibit D

Existing and Proposed Greenways, Parkways, and Bikeways

	Linear Urban Greenways / Parkways / Bikeways	Projects (existing or proposed)	Source
1	**Los Angeles River**	partially existing	Los Angeles County Departments of Public Works, Parks and Recreation, and Regional Planning, Los Angeles River Master Plan. 1996. http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
2	**Arroyo Seco**	existing	
3	**Bell Creek Greenway**	proposed	http://acmela.org/images/Bell_Creek_Greenway_Project_Trust_for_Public_Land_Presentation_Sept_22_of_2009.pdf
4	**Tujunga Wash**	proposed	http://www.lamountains.com/parks.asp?parkid=671 http://ladpw.org/apps/news/pdf/2380_2618.pdf
6	**Burbank Western Channel**	proposed	http://www.ci.burbank.ca.us/index.aspx?page=900
8	**San Gabriel River**	partially existing	Moore Iacofano Goltsman, Inc. for the County of Los Angeles Department of Public Works. *A Common Thread Rediscovered- San Gabriel River Corridor Master Plan.* June, 2006. http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
9	**Compton Creek Regional Garden Park**	partially existing	Freedman, Zack D. for the Santa Monica Mountains Conservancy. *Grounds for Renewal: The Revitalization of Compton Creek.* 2003
10	**Rio Hondo (Emerald Necklace)**	partially existing	Amigo de los Rios. Moore Iacofano Goltsman, Inc. for the County of Los Angeles Department of Public Works. *A Common Thread Rediscovered- San Gabriel River Corridor Master Plan.* June, 2006.
11	**Santa Anita Wash**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005
12	**Eaton Wash**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005
13	**Rubio Wash**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005
14	**Alhambra Wash**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005
15	**Coyote Creek**	partially existing	Trails4All. *Coyote Creek Trail Master Plan.* April. 2008 . Moore Iacofano Goltsman, Inc. for the County of Los Angeles Department of Public Works. *A Common Thread Rediscovered- San Gabriel River Corridor Master Plan.* June, 2006. http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
16	**Carbon Creek**	existing	Trails4All. *Coyote Creek Trail Master Plan.* April 2008
17	**Brea Creek**	existing	Trails4All. *Coyote Creek Trail Master Plan.* April 2008
19	**La Canada Verde Creek**	existing	Trails4All. *Coyote Creek Trail Master Plan.* April 2008
20	**Fullerton Creek**	existing	Trails4All. *Coyote Creek Trail Master Plan.* April. 2008 .
21	**Whittier Greenway Trail**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N

	Linear Urban Greenways / Parkways / Bikeways	Projects (existing or proposed)	Source
22	**Walnut Creek**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005
23	**San Jose Wash**	proposed	Amigos de los Rios. Emerald Necklace Green Infrastructure - Los Angeles County. 2005Moore Iacofano Goltsman, Inc. for the County of Los Angeles Department of Public Works. *A Common Thread Rediscovered- San Gabriel River Corridor Master Plan.* June, 2006. http://www.ice.ucdavis.edu/nrpi/project.asp?ProjectPK=08915
25	**Ballona Creek**	partially existing	Restoration Design Group for the Bay Restoration Foundation and the California Coastal Conservancy. *Ballona Creek Greenway Projects.* January, 2011 http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
26	**Sepulveda Channel**	proposed	Restoration Design Group for the Bay Restoration Foundation and the California Coastal Conservancy. *Ballona Creek Greenway Projects.* January, 2011
27	**Arroyo la Cienaga**	proposed	Restoration Design Group for the Bay Restoration Foundation and the California Coastal Conservancy. *Ballona Creek Greenway Projects*. January, 2011
28	**Dominguez Channel**	proposed	County of Los Angeles Department of Public Works. *Dominguez Watershed Management Master Plan*. April, 2004.
29	**Long Beach Greenbelt**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
30	**Santa Monica Beach and South Bay Bike Path**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
31	**Shoreline Pedestrian Bikeway**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
32	**Duarte Bike Trail**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
33	**Metro Orange Line Bike Path**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
34	**Chandler Bikeway**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N
35	**Malibu Civic Center Linear Park**	partially existing	City of Malibu Parks and Recreation Master Plan 2013 and Department of Public Works Capital Improvement Projects.
36	**Mission City Bike Trail**	existing	http://www.traillink.com/trailsearch.aspx?tn=&st=CA&ct=Los+Angeles&sp=N

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Exhibit E

Benefits Evaluation Tool

This section presents a methodology for evaluating a BMP project on the basis of its ability to contribute to water quality and groundwater recharge targets. This methodology was incorporated into an easy to use spreadsheet tool which will be made available on the IRWMP website. It applies to infiltration BMPs which capture stormwater in a storage basin and allow it to infiltrate into the ground over time, and flow through BMPs which filter and treat stormwater and then release it to a receiving water body. Some BMPs may not fit into these categories and would require individualized modeling in order to quantify their water quality and groundwater recharge benefits.

Water Quality

Because the water quality targets are presented as capacity of BMPs the water quality benefit is simply the volume of the proposed BMP (footprint multiplied by depth). However, because these targets are based on BMPs designed to treat the ¾-inch storm, only volumes less than or equal to the volume that would be produced by a ¾-inch storm can be counted towards meeting water quality targets. This volume is a function of the area draining to the BMP and its tendency to shed water. For preliminary design purposes, the tendency to shed water can be determined from the percent impervious cover of the area tributary to the BMP.

If the proposed BMP site can support a larger volume, this will have additional water quality benefits, but these benefits cannot count toward the proposed targets. There is the potential however for these additional water quality benefits to be used to garner additional funds for the proposed project. Additionally, this extra volume could contribute to water supply targets.

Groundwater Recharge

Water supply benefits are usually estimated using complex hydraulic time step models, which require technical expertise, time, and resources to develop and evaluate. To create a tool that could be used by planners to screen projects, a spreadsheet was developed that uses SWWM model runs for a generic watershed and local precipitation data that allows the user to input basic information regarding the proposed project to get a reasonable estimate of average annual volume infiltrated.

Without supporting evidence to the contrary, only BMPs in “High Recharge Potential Areas” as should be considered as having the potential to augment groundwater supplies. While projects in areas with low recharge potential may not help meet water supply targets, the percent of annual runoff captured has implications for water quality improvement, even if the infiltrated or treated water does not reach groundwater aquifers.

Evaluation Tool Technical Background

Stormwater BMPs can be conceptualized as having a storage volume and a treatment rate, in various proportions. Both are important in the long-term performance of the BMP under a range of actual storm patterns, depths, and inter-event times. Long-term performance is measured by the operation of a BMP over the course of multiple years, and provides a more complete metric than the performance of a BMP during a single event, which does not take into account antecedent conditions, including multiple storms arriving in short timeframes. A BMP that draws down (infiltrates) more quickly would be expected to capture a greater fraction of overall runoff (i.e. long-term runoff) than an identically sized BMP that draws down more slowly. This is because storage is made available more quickly, so subsequent storms are more likely to be captured by the BMP. In contrast a BMP with a longer drawdown time (infiltrates slowly) would stay mostly full, after initial filling, throughout periods of sequential storms. The volume in the BMP that draws down more quickly is more "valuable" in terms of long term performance than the volume in the one that draws down more slowly.

An evaluation of the relationships between BMP design parameters and expected long term capture efficiency has been conducted to assist in planning and assessment of various alternative projects. Relationships have been developed through a simplified continuous simulation analysis of precipitation, runoff, and routing, that relate BMP design volume and storage recovery rate (i.e., drawdown time) to an estimated long term level of performance.

Modeling Methodology

The USEPA Stormwater Management Model Version 5.0 (SWMM5.0) was used to simulate the long term average capture efficiency for a range of general BMP design configurations over several decades. SWMM was selected for this analysis as it is a relatively simple, open source, continuous simulation model that has well-demonstrated capability for simulation of rainfall-runoff processes in urban environments and simulating transient storage mechanisms in BMPs. A relatively simple representation of BMPs was used to develop the general relationships that conceptualized all BMPs as having a storage volume and a treatment or drawdown rate. While this representation does not account for the nuances of BMP designs, it is appropriate for planning level assessment. Assumed SWMM input parameters are provided in Table 1. Sensitivity analyses demonstrated that the only inputs with significant sensitivity within typical input ranges were the precipitation and ET inputs and the BMP configurations. These were selected to be representative of several locations in Los Angeles County. Results are interpreted to allow scaling across the various rainfall regimes of the County.

SWMM Parameters	Units	Values
Period of Simulation	years	10/01/1948 to 10/01/2008 (except Lechuza Patrol Station, through 1997)
Wet time step	seconds	900
Wet/dry time step	seconds	900
Dry time step	seconds	14,400
Precipitation	inches	Hourly precipitation data from: COOP 045114 – Los Angeles Airport COOP 044867 – Lechuza Patrol Station COOP 047762 – San Fernando 3 COOP 041194 – Burbank Airport See Table 2 for statistics
Impervious Manning's n		0.012
Hypothetical drainage area	acres	50 (not significantly sensitive to results)
Shape		Rectangular, 500 ft flow path length; representing typical overland flow to reach a channelized or piped conveyance (not significantly sensitive parameter).
Impervious fraction modeled		100%
Slope	ft/ft	0.05
Evaporation	inches	Monthly Normal ET from CIMIS ET Zones Map × 60% Crop Coefficient LAX and Lechuza: Zone 4 Burbank Airport: Zone 6 San Fernando 3: Zone 9 See Table 3 for monthly normal ETo
Depression storage, impervious	inches	0.05, based on Table 5-14 in SWMM manual (James and James, 2000)
Runoff coefficient used to convert precipitation depth to design volume	unitless	0.95 (approximately consistent with modeled runoff in SWMM)
Design capture storm depth (85th percentile, 24-hour depth) calculated from Irvine Gage	inches	Varied over continuous range from 0.025 to 5 inches
BMP Storage Volume	cu-ft	Calculated based on design storm and tributary area. V = depth × runoff coeff × area × conversion factors Example: V (cu-ft) = 1.0 inches × 0.95 × 50 ac × 43,560 sq-ft × (1 ft/12 inches) = 172,400 cu-ft

SWMM Parameters	Units	Values
Drawdown Time	hours	Varied over continuous range from 0.1 hour to 2,400 hours
BMP Discharge	cfs	Calculated based on design volume and drawdown time. Q (cfs) = V(cu-ft) / Drawdown time (s) Example: 172,400 cu-ft / (48 hr × 3600 s/hr) = 0.997 cfs
Period of Simulation	years	10/01/1948 to 10/01/2008 (except Lechuza Patrol Station, through 1997)
Wet time step	seconds	900
Wet/dry time step	seconds	900
Dry time step	seconds	14,400
Precipitation	inches	Hourly precipitation data from: COOP 045114 – Los Angeles Airport COOP 044867 – Lechuza Patrol Station COOP 047762 – San Fernando 3 COOP 041194 – Burbank Airport See Table 2 for statistics
Impervious Manning's n		0.012
Hypothetical drainage area	acres	50 (not significantly sensitive to results)
Shape		Rectangular, 500 ft flow path length; representing typical overland flow to reach a channelized or piped conveyance (not significantly sensitive parameter).
Impervious fraction modeled		100%
Slope	ft/ft	0.05
Evaporation	inches	Monthly Normal ET from CIMIS ET Zones Map × 60% Crop Coefficient LAX and Lechuza: Zone 4 Burbank Airport: Zone 6 San Fernando 3: Zone 9 See Table 3 for monthly normal ETo
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SWMM Parameters	Units	Values
(85th percentile, 24-hour depth) calculated from Irvine Gage		
BMP Storage Volume	cu-ft	Calculated based on design storm and tributary area. V = depth × runoff coeff × area × conversion factors Example: V (cu-ft) = 1.0 inches × 0.95 × 50 ac × 43,560 sq-ft × (1 ft/12 inches) = 172,400 cu-ft
Drawdown Time	hours	Varied over continuous range from 0.1 hour to 2,400 hours
BMP Discharge	cfs	Calculated based on design volume and drawdown time. Q (cfs) = V(cu-ft) / Drawdown time (s) Example: 172,400 cu-ft / (48 hr × 3600 s/hr) = 0.997 cfs

Rainfall Statistics, Modeled Gages							
Station ID	Name	Data Temporal Resolution	Data Depth Resolution (in.)	Modeled POR	Missing & Accumulated Fraction of Record (not simulated)	Calculated Avg. Annual Rainfall (in.)	Calculated 85th, 24-hr (Events > 0.1", MIT 6 hrs)
41194	BURBANK WB AP	Hourly	0.01	WY 1949-2008	6%	13.67	1.35
44867	LECHUZA PTRL ST FC352B	Hourly	0.01	WY 1949-1997	5%	19.17	1.70
45114	LOS ANGELES WSO AP	Hourly	0.01	WY 1949-2008	1%	12.16	1.02
47762	SAN FERNANDO PH 3	Hourly	0.01	WY 1949-2008	8%	16.70	1.43

Monthly Normal ETo													
CIMIS ET Zone	Reference ET												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Normal
Zone 4	1.86	2.24	3.41	4.50	5.27	5.7	5.89	5.58	4.50	3.41	2.40	1.86	46.6
Zone 6	1.86	2.24	3.41	4.80	5.58	6.3	6.51	6.2	4.80	3.72	2.40	1.86	49.7
Zone 9	2.17	2.80	4.03	5.10	5.89	6.6	7.44	6.82	5.70	4.03	2.70	1.86	55.1

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Exhibit F

Estimating Regional Water Supply and Water Quality Benefits Methodology

The following two sections present the methodology employed to estimate the water supply and water quality benefits that could be achieved through meeting the habitat and recreation targets presented in the main section of this report. The assumption is that with a multi-benefit approach, creation or enhancement of habitat and recreation areas would incorporate stormwater best management practices (BMPs) which have the potential to both recharge aquifers and improvement stormwater quality.

While it is straightforward to estimate infiltration or pollution removal potential for a given BMP in a particular site, determining this capacity over a region with no specific BMPs planned requires a taking a generalized approach based on the overarching characteristics of the region, BMP performance data studies, and best professional judgment.

The benefits for water supply and water quality are calculated in similar, but distinct methods, because water supply targets are rate based (acre-ft per year), and water quality targets are volume based (acre-ft). Therefore water supply benefits are estimated by determining the annual average stormwater volume entering the BMP multiplied by an efficiency factor, while water quality benefits are estimated by multiplying a design storm over the contributing area. It should be noted that many projects will have both water supply and water quality benefits.

Water Supply

Only open space areas with high potential for aquifer recharge were considered to contribute to aquifer recharge. For an area to be considered a high recharge potential area, two general qualities must be met:

1. The open space locations are situated above unconfined aquifers. Though groundwater recharge may also serve to support plant life and river flow, this analysis specifically looks at benefits of groundwater recharge to water supply;

2. The open space areas are situated above geologic sedimentary deposits most conducive to percolating infiltrated water to the aquifer. Recent studies, such as the one being undertaken by the Water Replenishment District of Southern California (in progress) indicate that these include the following:

- Younger Quaternary from the Holocene age made up of medium grained material (sand),
- Younger Quaternary from the Holocene age made up of coarse grained material (gravel),

- Younger Quaternary from the Holocene age made up of very coarse grained material (boulders),
- Older Quaternary from the Pleistocene age made up of course grained material (gravel), or
- Older Quaternary from the Pleistocene age made up of very course grained material (boulders).

The areas where these two criteria are met are considered "Areas of High Recharge Potential". There are shown in Figures 15 and 16 of main report.

Habitat

The estimation of potential benefits of habitat projects is applied to the creation and enhancement targets for freshwater wetlands and riverine wetlands (HCTfw, HETfw, HCTrw, and HETrw) which occur within the Areas of High Recharge Potential. The entirety of these areas will not be suitable for infiltration BMPs. Therefore, the target habitat area is multiplied by the estimated percent of the area that will be suitable for an infiltration BMP (SAh) (Green Solutions, 2008). This returns a reduced area where infiltration and potential recharge may occur.

$$Total\ Treatment\ Area = (HCTfw + HETft + HCTrw + HETrw) * SAh$$

Treatment BMPs have capacities to treat certain tributary areas that are a function of their size the character of their tributary areas. One study evaluated BMPs in recreation and habitat areas and presented generalized ratios for tributary area to treatment area for BMPs in these settings. The ratio for habitat areas (TARh) can be applied to the total treatment area, to give an estimate of contributing area (Green Solutions, 2008). The tributary area is capped at either the total treatment area multiplied by the TARh, or the tributary area to the site, whichever is less.

The total annual average volume of water the tributary area contributes is calculated multiplying the tributary area by the average annual precipitation in the subregion (Pavg) where the project is located.

Finally, two factors are applied to this value. The first factor is the guideline for the percent capture (C) of the annual average precipitation for *flow based* stormwater best BMPs (which is consistent with the current Los Angeles County MS4 permit, Orange County Technical Guidance, the CASQA BMP Handbook, and even the Newhall Ranch Specific Plan, among many other MS4 permits across the state) and the second is an expected efficiency for these systems in habitat areas (Eh). When the average precipitation is input in feet per year, the output from this method is in acre feet per year.

Recreation

The method for estimating potential recharge from recreation lands is similar when applied to recreation and greenway creation and enhancement targets (RCTrg, RETrg). Different factors are used for recreation lands as opposed to habitat lands for the estimated percent recreation area that will be suitable for an infiltration BMP (SAr) and the estimated treatment area ratio for recreation (TARr), and the expected efficiency of these systems in recreation areas (Er).

The factors used and their sources are as follows:

Variables Used For Estimation of Stormwater Infiltration and Potential Recharge				
	Item	**Habitat**	**Recreation**	**Source**
HCTfw, HCTrw, HETfw, HCTrw	Habitat Creation and Enhancement Targets for Freshwater Wetlands and Riverine Wetlands	various	N/A	OSHARTM
RCTrg, RETrg	Recreation Creation and Enhancement Targets for Recreation and Greenways	N/A	various	OSHARTM
C	Percent Capture of Annual Average Precipitation for flow-based stormwater BMPs	75%		Stormwater Guidelines
Eh, Erg	Expected Capture Efficiencies for flow-based stormwater BMPs	0.25	0.25	Estimates
SAh, SAr	Estimated % Suitable Area for Habitat and Recreation	45%	50%	Green Solutions
TARh, TARr	Estimated Treatment Area Ratio for Habitat and Recreation	45	30	Green Solutions
Pavg	Annual Average Precipitation (in feet)	Subregionally specific		N/A

Stormwater Quality

The benefits of open space projects to stormwater quality can be estimated in a manner similar to estimating water supply benefits, using generalized factors for the region.

Habitat

The estimation of potential benefits of habitat projects is applied to the creation and enhancement targets for freshwater wetlands and riverine wetlands (HCTfw, HETfw, HCTrw, and HETrw). While water supply benefits were attributed only to open space projects within High Recharge Potential Areas, water quality benefits are counted for all open space areas.

The entirety of these areas will not be suitable for water quality BMPs. Therefore, the target habitat area is multiplied by the estimated percent of the area that will be suitable for a BMP (SAh) (Green Solutions, 2008). This returns a reduced area where water quality capacity may exist.

$$Total\ Treatment\ Area = (HCTfw + HETft + HCTrw + HETrw) * SAh$$

As described in the methodology for calculating infiltration benefits, a tributary area to treatment area ratio for habitat areas (TARh) is applied to determine the area that can be treated by the total treatment area (Green Solutions, 2008). This tributary area is capped at either the total treatment area multiplied by the TARh, or the actual tributary area to the site, whichever is less.

The total capacity is calculated multiplying the tributary area by the selected design storm event (D). When the design storm event is input in feet, the output from this method is in acre feet.

Recreation

The method for estimating water quality capacity from recreation lands is similar when applied to recreation and greenway creation and enhancement targets (RCTrg, RETrg). Different factors are used for recreation lands as opposed to habitat lands for the estimated percent recreation area that will be suitable for an infiltration BMP (SAr) and the estimated treatment area ratio for recreation (TARr).

The values used in the above equations are as follows:

Variables Used For Estimation of Stormwater Quality Capture Volumes				
	Item	**Habitat**	**Recreation**	**Source**
HCTfw, HCTrw, HETfw, HCTrw	Habitat Creation and Enhancement Targets for Freshwater Wetlands and Riverine Wetlands	various	N/A	OSHARTM
RCTrg, RETrg	Recreation Creation and Enhancement Targets for Recreation and Greenways	N/A	various	OSHARTM
D	Design Storm for Volume Based BMPs (in feet)	0.0625 ft (0.75“)		LID Manuals, MS4
SAh, SAr	Estimated % Suitable Area for Habitat and Recreation	45%	50%	Green Solutions
TARh, TARr	Estimated Treatment Area Ratio for Habitat and Recreation	45	30	Green Solutions

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Exhibit G

Glossary

401 Certification: Requirement of Section 401 of the federal Clean Water Act (CWA) that provides States must certify that any activity subject to a permit issued by a federal agency meets all state water quality standards.

404 Permit: Requirement of Section 404 of the CWA requires the US Army Corps of Engineers to have issued a permit before dredged or fill material are discharged into waters of the United States, including adjacent wetlands.

Adaptive Management: The development of a management strategy that anticipates likely challenges associated with mitigation projects and provides for the implementation of actions to address those challenges, as well as unforeseen changes to those projects. It requires consideration of the risk, uncertainty, and dynamic nature of mitigation projects and guides modification of those projects to optimize performance.

Biodiversity: The number and variety of different organisms in the ecological complex in which they naturally occur (i.e., within a given species, ecosystem, biome, or the planet). It is a measure of the health of an ecosystem

Biodiversity Hotspot: A biogeographic region with a significant reservoir of biodiversity that is under threat from humans.

Biotic Structure: Describes the way organisms interact within an ecosystem.

Buffer Zones: An area adjoining a wetland, channel, or upland linkage or wildlife corridor that is in a natural or semi-natural state and not dedicated to anthropogenic uses that would severely detract from its ability to contain contaminants, discourage visitation into the habitat area by people and non-native predators, and/or protect the habitat area from stress and disturbance. For wetland and riparian systems, a buffer is to maintain or improve water quality by trapping and removing various non-point source pollutants from both overland and shallow subsurface flows, provide erosion control, provide water temperature control, reduce flood peaks, serve as groundwater recharge points, etc. Buffer zones occur in a variety of forms, including herbaceous or grassy buffers, grassed waterways, or forested riparian buffer strips.

California Floristic Province: A floristic province with a Mediterranean climate located on the Pacific Coast of North America with a distinctive flora that bears similarities to floras found in other regions experiencing hot, dry summers and cool, wet winters. One of the biodiversity hotspots in the world as defined by Conservation International due to an unusually high

concentration of endemic plants (approximately 3,400 of the 8,000 species found in the province) and to having lost over 70 percent of its native vegetation.

Climate Change: Climate change refers to the buildup of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns on a global scale. The effects include changes in rainfall patterns, sea level rise, potential droughts, habitat loss, and heat stress.

Channel or Drainage: An open conduit either naturally or artificially created which periodically or continuously contains moving water or which forms a connecting link between two bodies of standing water.

Community Park: Land with full public access intended to provide recreation opportunities beyond those supplied by neighborhood parks. Community parks are larger in scale than neighborhood parks but smaller than regional parks.

Condition: The relative ability of a resource to support and maintain a community of organisms having a species composition, diversity, and functional organization comparable to those in the region.

Connectivity: The state of being functionally linked by movement of organisms (i.e., to feed, move, reproduce, rest, winter, etc.), materials, or energy.

Conservation: The use, protection, and improvement of natural resources according to principles that will ensure their highest economic or social benefits.

Conservation Easement: An easement restricting a landowner to land uses that are compatible with long-term conservation and environmental values.

Critical Habitat: A specific geographic area(s) designated by the US Fish and Wildlife Service that contains features essential for the conservation of a threatened or endangered species and may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery

Dredge & Fill Material: "Dredge" is material that is excavated or dredged from waters of the United States. "Fill material" means any material used for the primary purpose of replacing an aquatic area with dry land or changing the bottom elevation of a water body. The term "fill material" does not include any pollutant discharged into the water primarily to dispose of waste, as that activity is regulated under section 402 of the CWA.

Ecological: Relating to the interrelationships of organisms and their environment.

Ecosystem: The interacting synergism of all living organisms in a particular environment; every plant, insect, aquatic animal, bird, or land species that forms a complex web of interdependency.

Ecosystem Services: Ecosystem services provide one approach for framing the values and benefits of open space. The Millennium Ecosystems Assessment (2005) has presented a scheme for classifying ecosystem services using four general categories: provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

Environmental Education: Focuses on environmental "literacy" and on using the environment to engage students in their education through "real-world" learning experiences, with the goals of helping them achieve an understanding of and appreciation for the environment, caring for the total environment, understanding how humans interact with and are dependent on natural ecosystems, and developing critical-thinking skills to resolve environmental issues.

Ephemeral Stream: An ephemeral stream has flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream; runoff from rainfall is the primary source of water for stream flow.

Establishment: The manipulation of the physical, chemical, or biological characteristics present to develop an resource that did not previously exist at a site. Establishment results in a gain in resource area and functions.

Estuarine: Tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.

Floristic Resource Value: An assessment of the richness or diversity of native plant community, a measure of habitat integrity.

Freshwater Wetlands: Non-saline lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. NWI categories considered freshwater wetlands include freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond and lake.

Functional capacity: The degree to which a resource area performs a specific function.

Functions: The physical, chemical, and biological processes that occur in ecosystems.

Impact: Adverse effect.

Geomorphic Provinces: Naturally defined geologic regions that display a distinct landscape or landform.

Greenway: A linear area maintained as open space in order to conserve natural and cultural resources and to provide recreational opportunities, aesthetic and design benefits, and linkages. More specifically, a coordinated system of open space that links existing facilities using streets, railroad rights-of-way, utility easements, and natural features such as stream corridors and drainage channels.

Ground Water Management: The planned and coordinated management of a groundwater basin or portion of a groundwater basin with a goal of long-term sustainability of the resource.

Groundwater: Water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated.

Habitat Connectivity: The degree to which the landscape facilitates animal movement and other ecological flows.

Habitat Conservation: A land management practice that seeks to conserve, protect and restore habitat areas for native plants and animals, especially conservation reliant species, and prevent their extinction, fragmentation of their habitat, or reduction in range.

Habitat Conservation (Plans): A plan prepared under Section 10(a)(1)(B) of the federal Endangered Species Act to provide for the lawful take of a listed wildlife species by conserving the ecosystems upon which the listed species depend, ultimately contributing to their recovery.

Habitat Enhancement: The manipulation of the physical, chemical, or biological characteristics of a community or ecosystem to heighten, intensify, or improve a specific resource function(s). Enhancement results in the gain of the selected resource function(s), but may also lead to a decline in others.

Headwater: The upper watershed area where streams generally begin; typically consists of 1st- and 2nd-order streams.

Hydrological: The distribution and cycle of surface and underground water.

Hydrology: A science related to the occurrence and distribution of natural water on the earth including the annual volume and the monthly timing of runoff.

Intermittent Stream: A stream that has flowing water only during certain times of the year, when groundwater provides water for stream flow. During dry periods, flowing water may not be present. Runoff from rainfall is a supplemental source of water for stream flow.

Lacustrine System: Wetlands and deepwater habitats that are situated in a topographic depression or a dammed river channel.

Landscape Linkage: Large, regional connections between habitat blocks ("core areas") meant to facilitate animal movement and other essential flows between different sections of a landscape (taken from Soulé and Terborgh 1999). These linkages are not necessarily constricted, but are essential to maintain connectivity function in the ecoregion.

Mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of natural resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization measures for a project has been achieved.

Mitigation Banking: Created when a government agency, corporation, nonprofit organization, or other entity undertakes providing mitigation for itself or others under a formal agreement with a resource or regulatory agency. Mitigation banks are a form of "third-party" compensatory mitigation, in which the responsibility for compensatory mitigation implementation and success is assumed by the bank operator rather than by the project developer. The bank operator is responsible for the design, construction, monitoring, ecological success, and long-term protection of the bank site.

Multiple Use Area: A land management area where several environmental, recreational, economic, historical, cultural and/or social values are located in the same geographic area in a compatible and sustainable manner.

Multiple-Use (Multi-Use) Trail: A trail that permits more than one user group at a time (e.g., horse, hiker, mountain bicyclist, etc.).

National Trails System: A network of trails (National Scenic, Historic, or Recreation) throughout the country authorized by the National Trails System Act (16 U.S.C. 1241-51).

Neighborhood Park: City- or County-owned land intended to serve the recreation needs of people living or working within one-half mile radius of the park.

Open Space: Any parcel or area of land or water that is essentially unimproved and devoted to an open space use for the purposes of (1) the preservation of natural resources, (2) the managed production of resources, (3) outdoor recreation, or (4) public health and safety.

Outdoor Recreation: Leisure activities involving the enjoyment and use of natural resources primarily outside of structures.

Palustrine System: A nontidal wetland dominated by trees, shrubs, persistent emergents, emergent mosses or lichens.

Park: Any area that is predominately open space with natural vegetation and landscaping used principally for active or passive recreation.

Perennial Stream/Pond/Lake: A river, stream or lake that has continuous surface flows in parts of its bed all year round during years of normal rainfall.

Perennial Yield: The maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition.

Point-Source Discharge: Any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container

Pollution (of water): The alteration of the physical, chemical, or biological properties of water by the introduction of any substance into water that adversely affects any beneficial use of water.

Preservation: The removal of a threat to, or preventing the decline of, a resource by an action in or near those resources. The term includes activities commonly associated with the protection and maintenance of resources through the implementation of appropriate legal and physical mechanisms such as acquisition, placement of a deed restriction or conservation easement, etc. Preservation does not result in a gain of resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to the former resource or community. Re-establishment results in rebuilding a former resource and results in a gain in that type of resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded natural resource. Rehabilitation results in a gain in resource function, but does not result in a gain in area.

Recreation: The refreshment of body and mind through forms of play, amusement, or relaxation; usually considered any type of conscious enjoyment that occurs during leisure time.

Recreation, Active: A type of recreation or activity that requires the use of organized play areas including, but not limited to, softball, baseball, football and soccer fields, tennis and basketball courts, and various forms of children's play equipment.

Recreation, Passive: Type of recreation or activity that does not require the use of organized play areas.

Regional Park: A park typically 150 to 500 acres in size focusing on activities and natural features not included in most other types of parks and often based on a specific scenic or recreational opportunity.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded resource. Restoration is divided into two categories: re-establishment and rehabilitation.

Riparian: Lands adjacent to streams, rivers, lakes, and estuarine-marine shorelines. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality.

Riparian (Riverine) Wetlands: The wetlands associated with rivers and streams, including upper and lower riverine habitats and dry washes.

Riverine Systems: All waters, wetlands, and other plant communities living within a river or stream, including the adjacent wetland and riparian areas along their banks. Man-made habitats considered part of a riverine system include concrete-lined channels and soft-bottomed channels.

Riverine Wetland: Riverine wetlands include wetlands and deepwater habitats contained within a channel, except those areas dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.

School District Lands: Properties owned by public school districts and used for environmental, recreational, and administrative purposes.

Stakeholder: Individuals or groups who can affect or be affected by an organization's activities; or individuals or groups with an interest or "stake" in what happens as a result of any decision or action. Stakeholders do not necessarily use the products or receive the services of a program.

Storm Water Quantity: Storm water (runoff) – Water which is originated during a precipitation event which may collect and concentrate diffused pollutants and carry them to water courses causing degradation. Runoff in the urban environment, both storm-generated and dry weather flows, has been shown to be a significant source of pollutants to the surface waters of the nation. In California, the authority to regulate urban and storm water runoff under the NPDES system has been delegated by EPA to the State Water Resources Control Board and the nine Regional Water Quality Control Boards. See Volume 2, Chapter 19 Urban Runoff Management RMS.

Streambed Alteration Agreement - Section 1600: Regulates activities that would alter the flow, bed, banks, channel, or associated riparian areas of a river, stream, or lake. The law

requires any person, state, local governmental agency or public utility to notify CDFG before beginning an activity that will substantially modify a river, stream, or lake. These activities also must be consistent with any other applicable environmental laws such as Section 404 and 401 of the Clean Water Act and CEQA.

Surface Water: As defined under the California Surface Water Treatment Rule, CCR, Title 22, Section 64651.83, means “all water open to the atmosphere and subject to surface runoff..." and hence would include all lakes, rivers, streams and other water bodies. Surface water thus includes all groundwater sources that are deemed to be under the influence of surface water (i.e., springs, shallow wells, wells close to rivers), which must comply with the same level of treatment as surface water.

Tidal Wetlands: Wetland habitats that are inundated by tides, either seasonally or year-round. Marine harbors, a man-made habitat, are also considered tidal wetlands. In the National Wetland Inventory (NWI) mapping system, the three categories included in tidal wetlands are estuarine and marine deepwater, estuarine and marine wetland, and tidal wetlands.

Transverse Ranges: An east-west trending series of steep mountain ranges and valleys. The east west structure of the Transverse Ranges is oblique to the normal northwest trend of coastal California, hence the name "Transverse." The province extends offshore to include San Miguel, Santa Rosa, and Santa Cruz islands. Its eastern extension, the San Bernardino Mountains, has been displaced to the south along the San Andreas Fault.

Uplands: An area of the terrestrial environment that does not have direct interaction with surface waters.

Water Quality: Description of the chemical, physical, and biological characteristics of water, usually in regard to its suitability for a particular purpose or use.

Water Quality Standards: A law or regulation that consists of the beneficial designated use or uses of a water body or a segment of a water body and the water quality criteria that is necessary to protect the use or uses of that particular water body. Water quality standards also contain an anti-degradation policy. The water quality standard serves a twofold purpose: (a) it establishes the water quality goals for a specific water body and (b) it is the basis for establishing water quality-based treatment controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Clean Water Act, as amended by the Water Quality Act of 1987.

Watershed: A land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

Watershed Approach: An analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs.

Wetlands: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wildlife Linkages: A wide area of native vegetation that connects or has the potential to connect two or more large patches of habitat on a landscape or regional scale through which a species will likely move over time. The move may be multi-generational; therefore, a linkage should provide both wildlife connectivity and biological diversity. A Wildlife Linkage should be a minimum of 1,000 feet in width, be vegetated with native vegetation, and have little or no human intrusion.