     

Total Maximum Daily Load for Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel

Implementation Plan

Draft

Photo courtesy of Jonathan Coffin, Inglewood, CA

Submitted on: November 30, 2009

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Acknowledgments

The Implementation Plan for the Ballona Creek, Ballona Estuary and Sepulveda Channel Bacteria TMDL was developed by the City of Los Angeles, consultants and stakeholders on behalf of the Ballona Creek Jurisdictional Group, excluding the County of Los Angeles.

Many city departments and agencies, non-governmental organizations, and individual stakeholders provided input during workshops and by reviewing draft documents. In addition, the Project Team conducted over a hundred one-to-one and small group meetings, and many field visits with stakeholders to identify potential projects in the Ballona Creek watershed. These contributions were the foundation for measures and selection of the projects that are proposed in this Plan.

Special thanks are due to: Lisa Cahill, Rebecca Drayse, Deborah Weinstein (TreePeople); Jessica Hall (formerly with Ballona Creek Watershed Task Force); Paul Herzog (Ballona Creek Watershed Task Force, Surfrider Foundation); Rex Frankel (Ballona Ecosystem Education Project); Kirsten James, Mark Gold, Susie Santilena (Heal the Bay); Jim Lamm (Ballona Creek Renaissance); Shelley Luce and Sean Bergquist (Santa Monica Bay Restoration Commission); Michael Shull and staff (Department of Recreation and Parks); Larry Smith (formerly with North East Trees); Nancy Steele (Los Angeles and San Gabriel Rivers Watershed Council); and Jonathan Weiss.

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Executive Summary

ES.1 Introduction

The Ballona Creek Bacteria TMDL Implementation Plan (Implementation Plan) defines the approaches that the cities of Los Angeles (lead agency), Culver, Beverly Hills, Inglewood, West Hollywood, Santa Monica, and the California Department of Transportation (Caltrans), (the responsible jurisdictions), will take to comply with the requirements of the *Ballona Creek, Ballona Estuary and Sepulveda Channel Bacteria TMDL* (Bacteria TMDL). The Implementation Plan follows the principles of the Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR) and the Integrated Resources Plan (IRP), and incorporates input from the responsible jurisdictions and stakeholders. The following guidelines were applied in developing this plan:

- ***Integrated Plan***: identify urban runoff management projects that have multiple benefits and treat multiple pollutants. The plan includes pollutant source control and green infrastructure projects that capture stormwater runoff for irrigation, infiltration and other beneficial uses to address multiple impairments in the watershed (bacteria, metals, toxics).

- ***Green Solutions***: wherever possible, implement solutions that are "green," sustainable, and work with the existing natural environment. Green structural solutions include Best Management Practices (BMPs) that effectively reduce the volume of urban runoff and remove pollutants from urban runoff through natural processes.

- ***Stakeholder Collaboration***: identify the best projects and concepts through collaboration with the many active organizations and individual stakeholders in the watershed. In addition to holding several stakeholder workshops, the team worked directly with NGOs and other individual stakeholders to identify specific projects and concepts that they recommend for implementation to assist in complying with TMDL requirements.

- ***Improvements to Existing Programs***: review existing urban runoff programs and identify opportunities to improve current and future water quality plans. All of the responsible jurisdictions have existing programs in place that address water quality within their respective areas. One of the goals of the Implementation Plan is to review these programs and identify areas where existing programs can be enhanced.

The implementation of this plan is subject to the availability of the necessary funding. Currently none of the BMPs and projects identified in this plan are funded, except for the institutional measures. The responsible agencies continue to pursue funding alternatives in partnership with the other agencies in the watershed, including the County of Los Angeles.

ES.2 Regulatory and Permitting Requirements

Ballona Creek is on a regulatory list of impaired waterbodies in the Los Angeles region, referred to as the 303(d) list. The Los Angeles Regional Water Quality Control Board (LARWQCB) biennially prepares the 303(d) list which identifies the impaired waterbody and the specific pollutant(s) for which it is impaired. All waterbodies on the 303(d) list are subject to the development of a Total Maximum Daily Load (TMDL). A TMDL establishes the maximum amount of a pollutant that a waterbody can receive and still meet the applicable water quality standards for that pollutant. Depending on the nature of the pollutant, TMDL implementation may require a cap on pollutant contributions from point sources (e.g., centralized pipe outfall discharges into the creek from wastewater treatment plants), nonpoint sources (e.g., dispersed urban runoff from the storm drainage system), or both.

Adoption of the Bacteria TMDL required an amendment to the regional water quality regulations (Basin Plan). After the LARWQCB adopted the TMDL as a Basin Plan amendment, it was submitted to the State Board and EPA Region 9 for review and approval. The Bacteria TMDL was approved and became effective on April 27, 2007. It requires that the responsible jurisdictions submit a TMDL Implementation Plan to the LARWQCB by October 27, 2009, which describes how the TMDL compliance targets will be achieved.

ES.3 Bacteria TMDL Numeric Limits

The Bacteria TMDL includes numeric limits which are based on the bacteria water quality objectives established in the Basin Plan to protect recreational uses. Numeric targets are established for certain indicator species of bacteria (e.g., fecal coliform). These numeric targets define the levels of bacteria allowable in a single sample and sampling averages (i.e. calculated geometric means) collected over time. The Bacteria TMDL also defines wasteload allocations of bacteria for certain segments of Ballona Creek that prohibit any exceedances of these numeric targets during summer dry weather periods, but do allow exceedances for a specified number of days during winter-dry and wet-weather conditions.

ES.4 Bacteria TMDL Compliance Milestones

The Bacteria TMDL defines milestones for achieving compliance with dry and wet weather bacteria limits:

- By **April 27, 2011** (four years after the effective date of the Bacteria TMDL), the LARWQCB will reconsider this TMDL to ascertain whether re-evaluation of the numeric targets and allowable exceedance days is warranted based on additional technical information.

- By **April 27, 2013** (six years after the effective date of the Bacteria TMDL), achieve compliance with the allowable exceedance days for summer and winter dry weather and 30-day geometric mean limits.

- By **July 15, 2021,** if an Integrated Water Resources Approach is implemented (if the plan is not integrated, then the date is April 27, 2017); achieve compliance with the allowable wet weather exceedance days and rolling 30-day geometric mean targets.

As is documented herein, this Implementation Plan fulfills the requirements of an Integrated Water Resources Approach; therefore the date of final compliance with wet weather TMDL targets is July 15, 2021.

ES.4.1 Additional TMDLs and Watershed Impairments

Two additional TMDLs are effective in the Ballona Creek Watershed:

- *Ballona Creek Metals TMDL* - includes numeric limits and wasteload allocations applicable to urban runoff for copper, lead, selenium and zinc (LARWQCB 2005). The TMDL effective date is January 11, 2006; a TMDL Implementation Plan is due to the LARWQCB January 11, 2010.

- *Ballona Creek Estuary Toxic Pollutants TMDL* - includes numeric targets and wasteload allocations for the following constituents in sediment: cadmium, copper, lead, silver, zinc, and chlordane, DDTs, total PCBs and Total PAHs. The TMDL effective date is January 11, 2006; a TMDL Implementation Plan is due to the LARWQCB January 11, 2011.

The technical analyses for this Implementation Plan were coordinated with the technical analyses required for development of implementation plans for the metals and toxics pollutant TMDLs. This approach supports the development and implementation of an Integrated Water Resource Approach for improving urban runoff quality.

ES.5 Coordinated Monitoring Plan (CMP) Requirements

As required by the Bacteria TMDL, the responsible jurisdictions (including Los Angeles County) submitted the final CMP for the Ballona Creek Watershed to the LARWQCB on January 29, 2009. The CMP will characterize existing water quality based on applicable bacteria water quality objectives assess compliance with the wasteload allocations in the Bacteria TMDL and provide data to support technical re-evaluations of the TMDL targets. The CMP identified eight monitoring sites for TMDL effectiveness monitoring.

ES.6 Responsible Agency Planning Process

The jurisdictions named by the Bacteria TMDL as responsible for meeting the wasteload allocations (except for Los Angeles County) have developed a Memorandum of Understanding (MOU) to prepare one integrated Implementation Plan. Approxi-mately 81 percent of the watershed is under the jurisdiction of the City of Los Angeles. The remainder of the watershed consists of the cities of Beverly Hills, City of West Hollywood, City of Culver City, City of Inglewood, City of Santa Monica, and the County of Los Angeles. Caltrans also has areas within the watershed under its jurisdiction. The City of Los Angeles, as the primary jurisdiction in the watershed, is leading the development of the required TMDL deliverables. The County of Los Angeles is developing its own implementation plan for the portions of Ballona Creek watershed under its jurisdiction.

ES.7 Ballona Creek Watershed Characteristics

The Ballona Creek Watershed is approximately 128 square miles (approximately 82,000 acres) in size (Figure ES-1) and is bounded by the the Santa Monica Mountains to the north and the Baldwin Hills to the south.

Ballona Creek is predominantly channelized and the watershed is highly developed, with the exception of the headwaters in the northern portions of the watershed in the Santa Monica Mountains. North of Hancock Park, a network of underground storm drains direct flows toward the mainstem Ballona Creek channel.The creek then flows through an open channel for less than 10 miles from Los Angeles (South of Hancock Park) through Culver City, reaching the Pacific Ocean at Playa del Rey.

Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, and Benedict Canyon Channel (Figure ES-1). The downstream portions of all of these tributaries are concrete lined channels fed by a network of upstream underground storm drains.

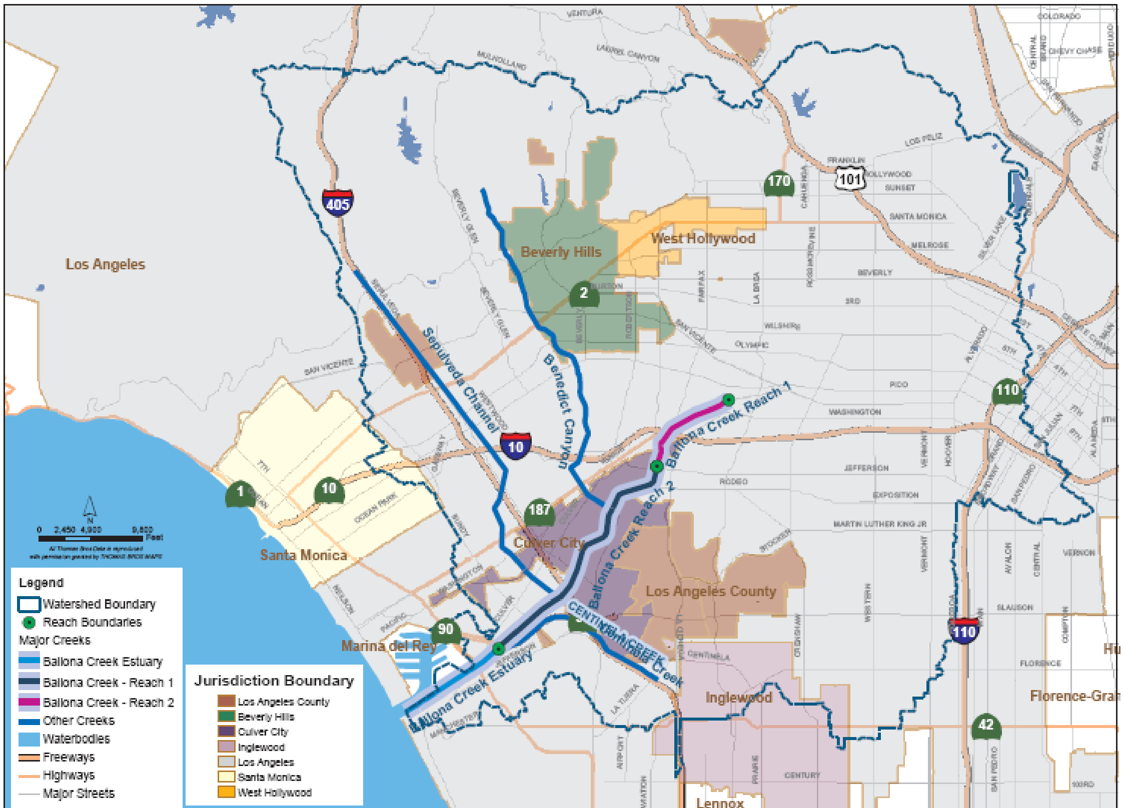

FIGURE ES-1 Ballona Creek Boundary and Jurisdictions

Development of the Bacteria TMDL Implementation Plan required significant data collection to define existing conditions in the watershed and to identify priority locations for potential Best Management Practices (BMPs). The watershed was divided into smaller sub-catchment areas of approximately 40 acres each. These smaller catchment areas allow for a more specific analysis of the drainage patterns at the neighborhood or parcel level. Land use coverages were defined for each catchment area. Overall the watershed is 59 percent residential, 14 percent commercial, 4 percent industrial, 17 percent vacant/open space, 3 percent education and 2 percent transportation. The high degree of urban development has resulted in the Ballona Creek Watershed being covered by approximately 49 percent impervious area consisting of roads, rooftops and other hard surfaces. Additional data compiled to define Ballona Creek Watershed characteristics included topography, hydrology and drainage, land use and impervious areas, soils, depth to groundwater, liquefaction and landslide zones.

Precipitation and Hydrology

The Ballona Creek Watershed receives an average annual rainfall of approximately 15 inches per year over most of the developed portions of the watershed. Rainfall volumes and intensity vary throughout the watershed due, in part, to the varied topography in the Ballona Creek Watershed. The rainfall in the northwest and coastal portions of the watershed is typically higher than in the northeast.

Flows in Ballona Creek are monitored by the County of Los Angeles at a site above Sawtelle Boulevard. Lower instream flows occur in June, July and August during low rainfall periods. The primary source of flows during these months is runoff from activities such as landscape irrigation.

Water Quality

On-going water quality monitoring programs include the City of Los Angeles Status and Trends Monitoring, and the Municipal Separate Storm Sewer System (MS4) monitoring program conducted by the County of Los Angeles. The water quality monitoring results routinely exceed numeric limits for bacteria.

ES.8 Stakeholder-Based Planning

An important step in developing the Implementation Plan included consulting with stakeholders to identify specific BMP implementation opportunities. Identifying these opportunities created the foundation for collaborative implementation of water quality improvement projects. During the development of this Implementation Plan, the responsible jurisdictions conducted community stakeholder workshops, participated in Ballona Creek Watershed Task Force meetings, and held one-on-one discussions with key NGOs. Table ES-1 lists many of the key organizations consulted during the Implementation Plan development process.

City of Los Angeles Watershed Protection Division staff also met on many occasions with stakeholders on an individual basis to obtain information on specific BMP opportunities in the watershed, both active and proposed. In addition, the former Ballona Creek Watershed Coordinator provided substantive input on potential watershed projects. These consultations with stakeholders resulted in identification of numerous structural and institutional BMP opportunities, many of which are consistent with the WQCMPUR.

Table ES-1
Stakeholder Participants in TMDL Implementation Plan Development

Ballona Creek Renaissance
Santa Monica Bay Restoration Commission (SMBRC)
Mar Vista community groups
Mountains Recreation and Conservation Authority
Surfrider Foundation
Heal the Bay
Santa Monica Baykeeper
Private residents
US Army Corps of Engineers
Baldwin Hills Conservancy
Ballona Wetlands (including: Ballona Institute, Friends of Ballona Wetlands, Ballona Wetlands Land Trust)
Los Angeles Regional Water Quality Control Board
Playa Vista
California State Coastal Conservancy

ES.9 TMDL Technical Analysis

This Implementation Plan relies on both structural and institutional (or non-structural) BMPs that, in combination, work together towards achieving compliance with TMDL targets. Where possible, the selection of BMPs emphasizes an Integrated Water Resources Approach that relies first on the implementation of green solutions. The process for selecting appropriate BMPs varied depending on whether the BMP was structural or institutional. Structural BMPs include one of two types:

- *Regional BMPs*: defined as centralized stormwater facilities and are designed to treat urban runoff from a relatively large drainage area (drainage areas ranging from 20 acres to several hundred acres). These BMPs include infiltration facilities, detention basins, subsurface flow (SSF) wetlands (including detention), surface flow (SF) wetlands, treatment facilities, manufactured separation systems (e.g., hydrodynamic separators and trash nets/screens), and channel naturalization (e.g., storm drain daylighting, revegetation, and wetland channel establishment).

- *Distributed BMPs*: defined as stormwater collection devices and landscaping practices dispersed throughout a catchment and serve relatively small drainage areas (typically 10 acres or less). These BMPs include, for example, cisterns, bioretention, vegetated swales, green roofs, porous/permeable pavements, gross solids removal devices (GSRDs), media filters, and catch basin inserts.

ES.10 Identification of Structural BMPs Locations

The Los Angeles County-wide Structural BMP Prioritization Analysis Tool (SBPAT) provided the means for identifying potential BMP locations and types for implementation. SBPAT uses a GIS-based decision tool that relies on four steps for identifying BMP implementation opportunities (Figure ES-2):

SBPAT screens areas based on *need* (i.e., pollutant load generation and downstream impairments), and then identifies *opportunities* (i.e., appropriateness of the area, adjacent storm drains) for BMP implementation. These opportunities are ranked based on factors such as effectiveness, cost, and maintenance requirements. The BMP rankings were used to assist with the selection of the best regional and distributed BMPs for each potential BMP location. The selection process also considered the opportunity to use an Integrated Water Resources Approach or implement BMPs that provide multiple benefits at a potential BMP location.

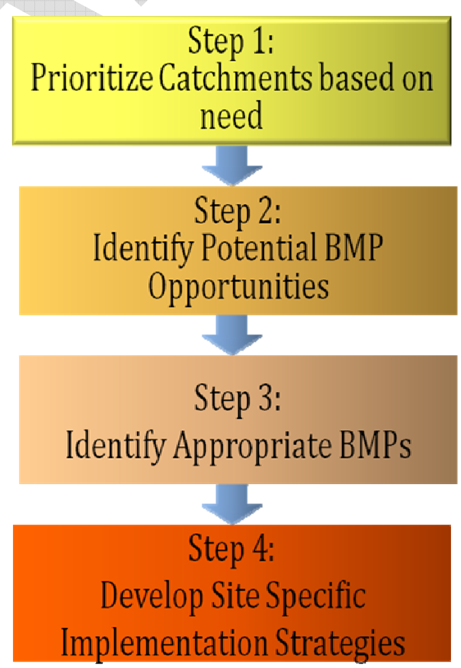

Figure ES-2
Steps for Selection of Structural BMPs

ES.11 Identification of Institutional BMP Programs

Because of the highly developed nature of the Ballona Creek Watershed and limited availability of sites for construction of new urban runoff infrastructure, the responsible jurisdictions will have to rely on an implementation program that includes both structural and institutional elements to achieve compliance. Development of the institutional component of the Bacteria TMDL Implementation Plan relied on information gathered from existing programs adopted to comply with the Santa Monica Bay Bacteria TMDL; information provided by stakeholder; and other regional and national institutional BMP programs.

ES.12 Recommended BMP Implementation

The Implementation Plan relies on a combination of measures designed to decrease migration and transport of bacteria, as well as other pollutants such as metals and organics, by (1) reducing the amount of dry weather and wet weather anthropogenic/urban runoff, (2) providing localized source control to reduce pollutant loads, and (3) incorporating opportunities for beneficial reuse of urban runoff. A phased approach to BMP implementation is recommended. Phase 1 includes the period from 2010 through 2013 and Phase 2 includes the period from 2014 through 2021.

Recommended BMPs include three general categories:

- Low Flow Treatment Facilities for dry-weather compliance;
- Regional and distributed structural BMPs for wet-weather compliance; and
- Institutional BMPs for both wet- and dry-weather compliance.

The recommended BMP implementation approach for each category is summarized below.

ES.12.1 Dry Weather Low Flow Treatment Facilities

The Implementation Plan includes the construction of two low flow diversions and treatment in the watershed, that divert a portion of the runoff from Ballona Creek and Sepulveda Channel for treatment prior to a portion of the flow being discharged back into the respective waterbody. The purpose of these low flow treatment facilities is to significantly reduce bacteria concentrations in Reach 2 and the Ballona Estuary during dry-weather conditions.

ES.12.2 Wet Weather Structural BMPs Implementation

The Implementation Plan includes structural BMPs that would be designed to treat wet weather runoff. Structural BMPs include regional projects serving multiple catchments as well as distributed BMPs that consist of small-scale decentralized, structural BMPs.

New Priority Distributed and Regional BMP Projects - A total of 27 distributed and eight regional BMP sites were selected for the first phase of implementation. Although preliminary concept drawings were developed for these projects, implementation of these projects will be subject to confirmation of engineering feasibility and the water quality treatment approach may be modified. These priority BMPs are geared towards wet-weather compliance and will start in Phase 1 and are expected to be completed during the middle of Phase 2. Figure ES-3 shows the location of the 27 distributed BMP sites and 8 regional BMP sites.

Additional Future Projects – In order to meet the TMDL limits, a number of additional distributed BMPs must be implemented. Table ES-2 provides a list of implementation levels required by land use. As shown, BMPs will need to be installed to treat runoff from an additional 11,200 acres. It should be noted that the 27 distributed BMPs defined in Phase 1 will treat runoff from approximately 500 acres. Therefore, numerous additional projects will need to be implemented. However, note that existing programs, such as SUSMP, are already in place that will result in stormwater related retrofits that will help meet these implementation goals.

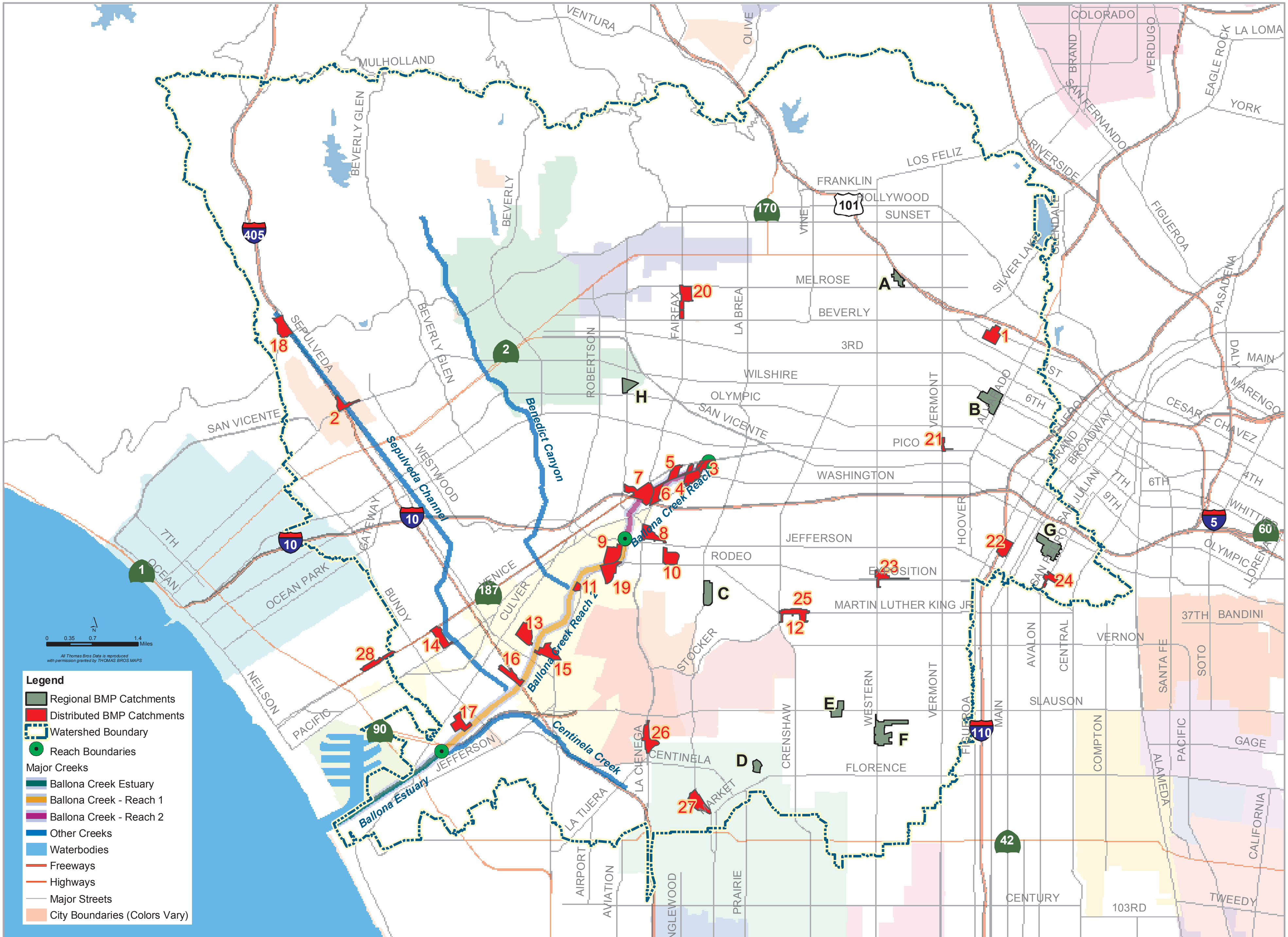

FIGURE ES-3 Ballona Creek Watershed - Priority Distributed and Regional BMP Sites

Table ES-2
Summary of Phase 2 Distributed BMP Implementation Levels

Distributed BMPs	% of Land Use Treated	Acres Treated	% of Watershed
Commercial	17%	1,861	2.3%
Education	4%	108	0.1%
Industrial	6%	214	0.26%
Transportation	27%	453	0.6%
Single Family Residential	19%	5,683	7.0%
Multiple Family Residential	16%	2,919	3.6%
Total Distributed		11,200	13.8%

Additional regional BMPs may also be implemented, but due to the highly developed nature of the watershed, this was not assumed.

ES.12.3 Institutional BMPs

A critical component of institutional BMP implementation is the establishment of a programmatic structure that creates consistency in urban runoff management, encourages application of green solutions, provides adequate legal authority, and includes appropriate levels of coordination, planning, and collaboration. The Implementation Plan includes a number of institutional BMPs directed at improving programmatic issues.

Recommended institutional BMPs include:

- *Education and Outreach* - Education and outreach programs for residents and businesses on water quality impacts from controllable sources of bacteria include brochures, posters, Websites, event attendance, utility bill inserts, and surveys. Education and outreach programs require a change in consumer behavior to be effective.

- *Pet Waste Disposal-* A BMP for pet waste disposal includes both educational outreach and enforcement to make residents and pet owners clean up after their pets. Options to control pet waste include park signage, receptacles for pet waste, designated dog parks, strict ordinances to regulate pet waste clean-up, and educational materials at pet stores, animal shelters, veterinary offices, and other sites frequented by pet owners.

- *Restaurant Inspection and Trash Management* - Uncontained restaurant and grocery store wastes can be a significant bacteria source in urban runoff, especially during wet weather. An expanded education and outreach program would increase restaurant and store operator awareness of this potential bacteria source and provide solutions to trash management concerns.

- *Individual Car Washing* - This BMP targets car owners that wash their own cars. This activity increases dry weather urban runoff and mobilizes bacteria present on impervious surfaces. To reduce bacteria loads, educational outreach could be increased to encourage car owners to minimize washing activities that increase runoff to storm drains.

- *Street Sweeping* - Street sweeping removes sediment, debris, and other pollutants from road and parking lot surfaces. The effectiveness of sweeping programs can vary widely. Accordingly, urban runoff management programs would benefit from a careful evaluation of the existing program to determine how to cost-effectively increase efficiency of pollutant removal from surfaces.

- *Catch Basin Cleaning-* Catch basin cleaning can maintain higher pollutant removal rates and reduce remobilization of pollutants entrained in the sediments such as bacteria. However, increasing the cleaning frequency to more than quarterly appears to provide little additional benefit. Catch basin cleaning is an important institutional BMP, but the bacteria load reduction benefits of increased frequency of catch basin cleaning should be evaluated.

- *Downspout Retrofits* - This BMP redirects runoff from roofs to pervious areas, resulting in reduced flow to storm drains. Implementation options include redirecting downspouts to lawns, gardens or swales, or installing a rain barrel or cistern to collect roof runoff for later use. Downspout retrofit can be an effective institutional BMP for commercial, industrial, and public buildings as well.

Institutional BMP Implementation

Phase 1 Institutional BMPs. Implementation of institutional BMPs will generally follow a typical project cycle including planning, preparation of a detailed BMP specific BMP action plan, development of a pilot program, leading into the subsequent implementation phases. Each of these project phases is expected to take approximately one year. Where feasible, the pilot programs will be prioritized to target the higher priority catchments. A detailed institutional BMP action plan will be developed for each program and will focus on what each specific agency is currently doing, how resources could be shifted to target high priority catchments initially, and what can be done to enhance activities that will be implemented by each jurisdiction within the first three years following approval of this plan, enabling these strategies to be fully in effect by the first interim compliance milestone of 2013.

Phase 2 Institutional BMPs. Under Phase 2, as the institutional BMPs become better defined through the iterative, adaptive approach, specific, quantifiable performance measures will be identified and included in the respective program implementation plans. In addition, as water quality monitoring results are obtained from the CMP, institutional BMPs can be honed to target specific locations where high bacterial contributions are found, and the implementation plan for the affected programs modified accordingly.

Instream Solutions

Several unique projects may be feasible along Ballona Creek. These include various stakeholder identified "stream daylighting" projects which are intended to restore portions of Ballona Creek and major tributaries into 'natural' stream channels. These projects will be evaluated opportunistically and their implementation schedule is to be determined.

The Ballona Creek Wetlands present another unique opportunity to achieve multi-objective watershed project. Several agencies have initiated a project to enhance habitat and public access at the 600-acre property along both sides of Ballona Creek Estuary.

ES.13 Quantification of Water Quality Benefits

A water quality model was used to estimate the baseline (2005) average runoff volume and bacteria loadings from all land uses in the watershed. Bacteria load reductions associated with the implementation of the regional and distributed structural BMPs and institutional BMP source controls were estimated for the entire watershed.

ES.13.1 Compliance with Wet Weather TMDL Limits

Wet weather Waste Load Allocation (WLA) for bacteria is based on bacteriological water quality objectives for marine and fresh water to protect the contact and non-contact recreation uses and an allowable number of exceedance days. The WLA, when translated into an annual loading limit, is estimated to be 33 x 10^{12} MPN. This limit is predicted to be met.

Table ES-3 shows the predicted load reduction from each BMP type, which is the combination of the structural and institutional BMPs proposed for implementation within the Ballona Creek watershed by 2021. The table presents the average, low and high ranges of load reduction. In order to compare this load reduction to the annual loading limit, factoring in high flow suspension and the allowable exceedance days per year, as well as the predicted in-stream decay, Table ES-4 summarizes the resulting expected pollutant loading by 2021 of 30 x 10^{12} MPN. This data is also presented as the range of average, low, and high in-stream loading based on the range of expected pollutant removal from the proposed BMPs. As shown, the in-stream loading in 2021 for both the high and average of the range are below the annual limit of 33 x 10^{12} MPN.

There are several unavoidable sources of uncertainty in the pollutant load reduction estimates for structural and institutional BMPs due to data limitations, unknown future conditions, simplifying assumptions, and site-specific factors.

Table ES-3
Predicted Bacteria Load Reductions (2021)

BMP Type		Acres Treated	% of Watershed	Load Reduction (10^{12} MPN/Yr)	
				Average	Est. Range
Regional BMPs					
Centinela Park		736	0.90%	88	16 - 210
La Cienega Park		374	0.46%	65	1 - 192
Harvard Recreation Center		235	0.29%	15.2	0.4 - 53
Rancho Cienega Sports Center		162	0.20%	12	0.5 - 39
MacArthur Park		135	0.17%	22	1 - 71
Los Angeles Unified School District Site		99	0.12%	9	0.2 - 32
Lemon Grove Recreation Center		63	0.08%	4	0.1 - 14
Van Ness Recreation Center		36	0.04%	4	0.1 - 14
Total Regional BMP Load Reduction		**1,840**	**2.3%**	**219**	**20 - 625**
Distributed BMPs					
Commercial	17%	1,861	2.3%	793	19 – 2660
Green Streets	15.4%	1,691	2.08%	678	17 – 2295
SUSMP Redevelopment	1.6%	170	0.21%	115	3 – 365
Industrial	6%	214	0.26%	4	1 - 8
Green Streets	1.9%	74	0.09%	1.4	0.3 – 3
SUSMP Redevelopment	3.7%	140	0.17%	2.2	0.5 – 5
Transportation	27%	453	0.6%	3.4	1 – 6
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%	3	1 – 5
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%	1	0.2 – 1
Education	4%	108	0.1%	39	1 - 124
LAUSD and UCLA	3.6%	92	0.11%	33	1 - 108
Private Schools Redevelopment	0.6%	16	0.02%	6	0.1 - 16
SFR	19%	5,683	7.0%	409	66 - 1038
Green Streets	10.1%	3,077	3.78%	222	33 – 585
Downspout Disconnect	8.6%	2,607	3.20%	186	33 - 452
MFR	16%	2,919	3.6%	141	27 - 338
Green Streets	11.4%	2,039	2.5%	96	17 – 237
SUSMP Redevelopment	4.9%	880	1.1%	45	10 – 101
Total Distributed BMP Load Reduction		**11,238**	**13.8%**	**1,389**	**116 - 4173**
Institutional BMPs					
Pet Waste Pick Up Education and Outreach		52,682	65%	827	100 - 1760
Enhanced Street Sweeping		15,278	19%	21	11 – 1073
Total Institutional BMP Load Reduction		**67,960**	**83%**	**848**	**111 - 2833**
TOTALS		**81,038**	**100%**	**2,456**	**247 - 7632**

Table ES-4
Estimated In-Stream Loading at 2021

	Average	Low	High
Baseline Fecal Coliform Load (10^{12} MPN/yr)	1922	1922	1922
Implementation Plan Load Reduction at 2021 (10^{12} MPN/yr)	-451	-44	-1387
Estimated Runoff Load at 2021 (10^{12} MPN/yr)	1472	1879	535
Load Reduction due to In-Stream Attenuation and Decay (10^{12} MPN/yr)	-1458	-1458	-1458
In-Stream Loading at 2021 (10^{12} MPN/yr)	14	421	0

ES.13.2 Compliance with Dry Weather TMDL

Recommended management of dry weather in Ballona Creek involves a few key facilities and source control programs in addition to wet-weather BMPs that provide some treatment of dry weather flow. Generally, these additional management strategies involve source control to reduce over irrigation and other urban sources of dry weather runoff, and the two proposed low flow diversion and treatment in Ballona Creek and Sepulveda Channel.

ES.14 Implementation Plan Schedule and Milestones

Table ES-5 summarizes the preliminary schedule and milestones for institutional BMPs, structural BMPs including regional and distributed, and low flow diversion and treatment projects for achieving compliance with TMDL limits in the Ballona Creek Watershed. The schedule identifies Phase 1 including years 2010-2013 and Phase 2 including years 2014-2021. For each category of BMP, the schedule shows the proposed initiation and duration of: 1) Planning/Piloting activities, 2) Design and Permitting, 3) Construction, and 4) Ongoing Implementation/O&M. It is assumed that the responsible jurisdictions will continue to act collaboratively and continue to coordinate on scheduling the implementation activities. Caltrans, however has reserved the right to proceed independently to address the TMDL goals depending on the specific costs and implementation measures identified during the implementation process

Table ES-5 Ballona Crek Bacteria TMDL Implementation Schedule and Milestones

(Wet/Dry)	Objective	Type of BMP	Implementation Option Category/Site	Phase 1				Dry-Weather Compliance	Phase 2								Wet-Weather Compliance
				2010	2011	2012	2013		2014	2015	2016	2017	2018	2019	2020	2021	
Dry	**Divert Dry-Weather Flow and Treat**	**Low Flow Treatment**	Divert, Clean, and Return														
Wet and Dry	**Reduce or Eliminate Source of Bacteria**	**Institutional / Non-Structural**	Education & Outreach														
			Program Development														
			Planning & Coordination														
			Direct Source Control														
	Treat Wet-Weather Discharges	**Structural**	Priority Projects														
			Additional Future Projects														
	In-Stream Solutions	**Stream Restoration**	Wetlands Restorations/ Daylightings														
	Special Studies	**Water Quality Monitoring**	TMDL Effectiveness Monitoring														

- Planning/Piloting
- Design/Permitting
- Construction
- Ongoing Implementation/ O&M

ES.15 Implementation Plan Cost Estimates

The recommended BMPs proposed for the Implementation Plan were analyzed to develop planning level cost estimates including capital and annual operation and maintenance costs. The basis for developing the cost estimates for the structural BMPs was the Water Environment Research Federation (WERF) Whole Life Cycle cost spreadsheets. The Whole Life Cycle costing approach was applied to five selected distributed BMP sites and four selected regional BMP sites. Based on these results, average "per acre" costs were calculated and applied to estimate the overall costs of the structural BMP program applied across the Ballona Creek watershed. Costs estimates for the Distributed BMPs, Regional BMP, Low Flow Diversions and Institutional BMPs are presented in Table ES-6.

Table ES-6
Draft TMDL Implementation Plan Costs for Ballona Creek Watershed[1]

Ballona Creek Watershed BMPs	Treated Acres [2]	Capital Cost per Treated Acre	Total Capital Cost	O&M Costs per acre	Annual O&M
Structural BMPs					
Distributed BMPs	*10,100[3]*	$68,000	$686,800,000	*$2,800*	$18,180,000
Regional BMPs	*1,840*	$22,500	$41,400,000	*$600*	$1,100,000
Low Flow Diversion-1 (NOTF)			$10,600,000		$1,060,000
Low Flow Diversion-2 (Oval St)			$14,700,000		$1,470,000
Institutional BMPs					
Enhanced Street Sweeping			$840,000		$600,000
Downspout Disconnection			$88,400,000		$0
Enhance Pet Waste Pickup and Education Program			$2,000,000		$200,000
Subtotal			**$840,000,000**		**$22,600,000**
Program Management, Engineering, Administration, and Monitoring (20% of capital cost)[4]			$170,000,000		$4,500,000
Program Contingency (30%)			$250,000,000		$6,800,000
Total Cost			**$1,260,000,000**		**$34,000,000**

[1] Selected BMPs will address multiple pollutants including bacteria, metals and toxicity.
[2] Treated Acres based on draft Implementation Plan selected scenario assuming distributed BMP deployment as required to meet Bacteria TMDL load reduction target and 8 Regional BMP facilities. See Table 5-7 in Section 5.
[3] Excludes the acres that will be retrofit through the SUSMP program, as these costs would not be the responsibility of the responsible jurisdictions. As such, the treated acres shown here differ from the total acres shown in Table ES-2.
[4]The responsible agencies will require additional resources in order to manage the BMPs implementation described in this Implementation Plan. The costs associated with this include administration, engineering, and ongoing monitoring of the program. The costs are estimated to be 20% of the total capital costs, or $160,000,000 through 2021. This cost would include increased staff for oversight of the design and implementation of the structural BMPs as well as implementation of the institutional BMPs (reviewing and enhancing existing policies, etc, as listed in Appendix G).

ES.16 Funding Availability

Currently, except for the institutional measures, none of the projects and BMPs identified in this Implementation Plan are funded. The City of Los Angeles continues to pursue funding alternatives in partnership with the various agencies in the watershed, including the County of Los Angeles.

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Section 1
Introduction

The Ballona Creek Bacteria TMDL Implementation Plan (Implementation Plan) defines the approaches that the City of Los Angeles (lead agency), City of Culver City, City of Beverly Hills, City of Inglewood, City of West Hollywood, City of Santa Monica, and the California Department of Transportation (Caltrans), (the responsible jurisdictions), will take to comply with the requirements of the *Ballona Creek, Ballona Estuary and Sepulveda Channel Bacteria TMDL* (Bacteria TMDL).

1.1 Guiding Principles

A guiding plan in the development of this Implementation Plan is the City of Los Angeles Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR). Although the WQCMPUR is a strategic plan for the City of Los Angeles, its guidelines and directions apply to the entire watershed and were developed in concurrence with all watershed stakeholders, including the responsible jurisdictions. The WQCMPUR has three strategies (City of Los Angeles, 2009):

1) Water Quality Management Initiative for project identification;

2) Citywide Coordination Initiative to develop ordinances and collaborative approaches within and among agencies; and

3) Outreach Initiative for source control.

This TMDL Implementation Plan addresses these three initiatives. Further, the WQCMPUR included an Action Plan (Table ES-3 of the WQCMPUR executive summary). The Action Plan identifies high priority items including the development of multiple TMDL Implementation Plans and watershed specific Water Quality Management Plans, which are currently in development.

Following the principles of the WQCMPUR and IRP, this Implementation Plan incorporated input from the responsible jurisdictions and stakeholders. This plan uses the following guiding principles:

- ***Watershed Wide Approach***: characterize the watershed as a whole and identify and select projects independently of jurisdictional boundaries in order to develop the most beneficial plan for the watershed.

- ***Integrated Plan***: identify urban runoff management projects that have multiple benefits and treat multiple pollutants.

- ***Green Solutions***: wherever possible, implement solutions that are “green,” sustainable, and work with the existing natural environment.

- ***Build on Existing Programs***: review existing urban runoff programs and identify opportunities to improve current water quality programs.

- ***Stakeholder Involvement***: identify the best projects and concepts through collaboration with the many active organizations and individual stakeholders in the watershed.

- ***Adaptive Management***: develop a plan that embraces the need to refine itself based on the information gathered over time through the implementation of both successful and unsuccessful programs and projects.

1.2 Regulatory and Permitting Requirements

1.2.1 Background

The Clean Water Act of 1972 (CWA) provides the basis for the protection of all inland surface waters, estuaries, and coastal waters. The federal Environmental Protection Agency (EPA) is responsible for administering the CWA and developing regulations, but may delegate its authority to the State.

The State of California (State) implements the CWA by establishing water quality protection laws and regulations and issuing discharge permits through State regulatory agencies. At its own discretion, the State has established requirements in many instances that are more stringent than federal requirements for CWA implementation.

California‘s primary statute governing water quality is the Porter-Cologne Water Quality Control Act of 1970 (Porter-Cologne Act). The Porter-Cologne Act grants the California State Water Resources Control Board (State Board) and nine California Regional Water Quality Control Boards broad powers to protect water quality, and it is the primary vehicle for the administration of California’s regulations under the federally delegated responsibilities of the CWA. The governing Regional Board for the Los Angeles area watersheds is the Los Angeles Regional Water Quality Control Board (LARWQCB).

Biennially, the LARWQCB prepares a list of impaired waterbodies in the region, referred to as the 303(d) list (as a reference to the applicable CWA section). The 303(d) list outlines the impaired waterbody and the specific pollutant(s) for which it is impaired. All waterbodies on the 303(d) list are subject to the development of a TMDL. A TMDL establishes the maximum amount of a pollutant that a waterbody can receive and still meet the applicable water quality standard for that pollutant. Depending on the nature of the pollutant, TMDL implementation may require a cap on pollutant contributions from point sources (wasteload allocation), nonpoint sources (load allocation), or both.

The development of TMDLs affecting waters in the Los Angeles area watersheds is the responsibility of the LARWQCB. Adoption of a TMDL requires an amendment to the regional water quality regulations (Basin Plan) and is subject to a substantial public review process. After the LARWQCB adopts the TMDL as a Basin Plan amendment, it is submitted to the State Board for approval. If approved by the State

Board, the TMDL is submitted to EPA Region 9 for final review and federal approval. The TMDL does not take effect until the EPA has issued its formal approval.

Once a TMDL becomes effective, the schedule for TMDL implementation by each named responsible jurisdiction becomes active. TMDL-specific implementation requirements vary, but typically include preparation of a Coordinated Monitoring Plan (CMP) for the affected watershed, and development of an Implementation Plan detailing how responsible jurisdictions plan to achieve compliance with the TMDL requirements. This Implementation Plan is written in response to requirements contained in the Bacteria TMDL.

1.2.2 Bacteria TMDL Development History

To address Bacteria TMDL development requirements, the LARWQCB published for public review draft technical documents, including a proposed Basin Plan Amendment, Tentative Resolution, California Environmental Quality Act (CEQA) Checklist and Determination, and Staff Report on April 4, 2006. Following opportunity for public comment, the LARWQCB adopted the TMDL on June 8, 2006 (Appendix A). State Board and State Office of Administrative Law approvals occurred on November 15, 2006 and February 20, 2007, respectively. EPA Region 9 approved the TMDL on March 26, 2007 and the TMDL became effective one month later on April 27, 2007.

1.2.3 Bacteria TMDL Numeric Limits

Table 1-1 summarizes the TMDL numeric limits which are based on the bacteria water quality objectives established in the Basin Plan to protect recreational uses. Tables 1-2 and 1-3 summarize the beneficial uses, exceedance days and wasteload allocations applicable to the Ballona Creek Watershed. These requirements are part of the Amendment to the Basin Plan.

Table 1-1
Bacteria TMDL Numeric Targets Applicable to Recreational Uses (REC) in the Ballona Creek Watershed

Indicator	Freshwater (MPN/100 mL)						Marine Waters (MPN/100 mL)	
	REC-1		LREC-1		REC-2		REC-1	
	GM	SSM	GM	SSM	GM	SSM	GM	SSM
Total Coliform							1,000	10,000 <u>or</u> 1,000 if of fecal-to-total ratio exceeds 0.1
Fecal Coliform	200	400	200		2,000	4,000	200	400
Enterococcus	126	235	126	576			35	104
E. coli	126	235	126	576				

Source: Attachment A to Resolution No. 06-011. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the *TMDL for Ballona Creek Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel*. Adopted by the California Regional Water Quality Control Board, Los Angeles Region on June 8, 2006.

Notes: GM – geometric mean; SSM – single sample maximum. REC-1 – water contact recreation; LREC-1- limited water contact recreation; REC-2 – non-contact water recreation

Table 1-2
Dry and Wet Weather Final Allowable Exceedance Days by Reach

<table>
<tr><th>Time Period</th><th>Ballona Estuary, Ballona Creek Reach 2, and Sepulveda Channel*</th><th>Ballona Creek Reach 1**</th></tr>
<tr><td rowspan="2">Summer Dry-Weather
(Apr 1- Oct 31)</td><td>Single Sample Bacteria Water Quality Objective.:
• 0 exceedance days</td><td rowspan="6">Single Sample Bacteria Water Quality Objective:
• No more than 10% of Single Sample Objective

Rolling 30-Day Geometric Mean Bacteria Water Quality Objective:
• 0 exceedance days</td></tr>
<tr><td>Rolling 30-Day Geometric Mean Bacteria Water Quality Objective:
• 0 exceedance days</td></tr>
<tr><td rowspan="2">Winter Dry-Weather
(Nov 1-Mar 31)</td><td>Single Sample Bacteria Water Quality Objective.
• 3 exceedance days</td></tr>
<tr><td>Rolling 30-Day Geometric Mean Bacteria Water Quality Objective:
• 0 exceedance days</td></tr>
<tr><td rowspan="2">Wet-Weather
(days with >=0.1 inch of rain +3 days following the rain event)</td><td>Single Sample Bacteria Water Quality Objective.
• 17*** exceedance days</td></tr>
<tr><td>Rolling 30-Day Geometric Mean Bacteria Water Quality Objective:
• 0 exceedance days</td></tr>
</table>

Source: Attachment A to Resolution No. 06-011. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the *TMDL for Ballona Creek Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel*. Adopted by the California Regional Water Quality Control Board, Los Angeles Region on June 8, 2006.

Notes:

*Exceedance days for Ballona Estuary based on REC-1 marine water numeric targets; for Ballona Creek Reach 2 based on LREC-1 freshwater numeric targets; and for Sepulveda Channel, based on fresh water REC-1 numeric targets

**Exceedance frequency for Ballona Creek Reach 1 based on freshwater REC-2 numeric targets

***In Reach 2, the greater of the allowable exceedance days under the reference system approach or high flow suspension shall apply. The ‘reference system/anti-degradation approach’ means that on the basis of historical exceedance levels at existing monitoring locations, including a local reference beach within Santa Monica Bay, a certain number of daily exceedances of the single sample bacteria objectives are permitted. The allowable number of exceedance days is set such that (1) bacteriological water quality at any site is at least as good as at a designated reference site within the watershed and (2) there is no degradation of existing bacteriological water quality. This approach recognizes that there are natural sources of bacteria that may cause or contribute to exceedances of the single sample objectives and that it is not the intent of the LARWQCB to require treatment or diversion of natural coastal creeks or to require treatment of natural sources of bacteria from undeveloped areas.

Table 1-3
Dry and Wet Weather TMDL Wasteload Allocations Applicable for Tributaries to Impaired Reaches

<table>
<tr><th>Tributary</th><th>Point of Application</th><th>Applicable Recreational Use</th><th>Wasteload Allocation
(No. of exceedance days)</th></tr>
<tr><td>Ballona Creek Reach 1</td><td>At confluence with Reach 2</td><td>LREC-1 Freshwater</td><td rowspan="2">For single sample objectives:
• 0 summer dry weather,
• 3 winter dry weather
• 17* winter wet weather

For geometric mean objectives:
• 0 for all periods</td></tr>
<tr><td>Benedict Canyon Channel</td><td>At confluence with Reach 2</td><td>LREC-1 Freshwater</td></tr>
<tr><td>Ballona Creek Reach 2</td><td>At confluence with Ballona Estuary</td><td>REC-1 Marine water</td><td rowspan="2">For single sample objectives:
• 0 summer dry weather,
• 3 winter dry weather
• 17 winter wet weather

For geometric mean objectives:
• 0 for all periods</td></tr>
<tr><td>Centinela Creek</td><td>At confluence with Ballona Estuary</td><td>REC-1 Marine water</td></tr>
<tr><td>Del Rey Lagoon</td><td>At confluence with Ballona Estuary</td><td>REC-1 Marine water</td><td>NA</td></tr>
</table>

Source: Attachment A to Resolution No. 06-011. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the *TMDL for Ballona Creek Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel.* Adopted by the California Regional Water Quality Control Board, Los Angeles Region on June 8, 2006.

Notes:

*At the confluence with Reach 2, the greater of the allowable exceedance days under the reference system approach or high flow suspension shall apply (see definition of reference system approach in notes to Table 1-2.

- Summer Dry-weather = April 1 to October 31, Winter Dry-weather = November1-March 31, Wet-Weather = days with >= 0.1 inch of rain plus the 3 days following the rain event.
- Sepulveda Channel was not assigned a wasteload allocation at its confluence with Reach 2, since the TMDL requires that the more stringent REC-1 objectives are met in this waterbody, which should lead to the attainment of the less stringent LREC-1 objectives of the downstream reach.
- No. of exceedance days based on a daily sampling schedule

1.2.4 Additional TMDLs and Watershed Impairments

Water quality concerns in the Ballona Creek Watershed extend beyond elevated bacteria concentrations. These concerns have resulted in the adoption of the additional TMDLs and 303(d) listed impairments.

Adopted TMDLs

Two additional TMDLs are effective in the Ballona Creek Watershed:

- *Ballona Creek Metals TMDL* - includes numeric limits and wasteload allocations applicable to urban runoff for copper, lead, selenium and zinc (LARWQCB 2005). The TMDL effective date is January 11, 2006; a TMDL Implementation Plan is due to the LARWQCB January 11, 2010.

- *Ballona Creek Estuary Toxic Pollutants TMDL* - includes numeric targets and wasteload allocations for the following constituents in sediment: cadmium, copper, lead, silver, zinc, chlordane, DDT, total PCBs and Total PAHs (LARWQCB 2005). The TMDL effective date is January 11, 2006; a TMDL Implementation Plan is due to the LARWQCB January 11, 2011.

Many of the technical analyses for this Bacteria TMDL Implementation Plan were coordinated with the technical analyses required for development of implementation plans for the metals and toxic pollutants TMDLs. This approach supports the development and implementation of an Integrated Water Resource Approach (IWRA) for improving urban runoff quality.

303(d) List of Impaired Waters

Pollutants that are listed on the 303(d) list of impaired waters typically require that TMDLs be developed and implemented. The EPA-approved 303(d) list for California was most recently updated in 2006. Within the Ballona Creek Watershed, the 2006 303(d) list identifies the following additional impairments:

- Ballona Creek is listed for cadmium (sediment) and silver (sediment) with a proposed TMDL completion date of 2005. The draft 2008 303(d) list recommends that the silver listing for sediment be removed from the 303(d) list[1]. In addition, the draft list indicates that a "USEPA-approved TMDL has made a finding of non-impairment…" for cadmium (sediment)[2].
- Ballona Creek is listed for cyanide with a proposed TMDL completion date of 2019.
- The Ballona Creek Estuary is listed for Shellfish Harvesting Advisory with a proposed TMDL completion date of 2006.
- Ballona Creek Wetlands is listed for Exotic Vegetation, Habitat Alterations, Hydromodification, and reduced tidal flushing with a proposed TMDL completion date of 2019.
- Sepulveda Canyon is listed for ammonia with a proposed TMDL completion date of 2019.

In anticipation of the promulgation of TMDL requirements for these waterbodies in the near future, the Implementation Plan recommends, where possible, Best Management Practices (BMPs) that have the potential to address multiple pollutants.

[1]http://www.waterboards.ca.gov/losangeles/water_issues/programs/303d/2008/ComprehensiveReport/table_of_contents.shtml, last visited on 9/18/09.

[2]http://www.waterboards.ca.gov/losangeles/water_issues/programs/303d/2008/Revised%20303(d)/Revised_Appendix_F_08July09.pdf, last visited on 9/18/09.

1.2.5 Coordinated Monitoring Plan (CMP) Requirements

As required by the Bacteria TMDL, the responsible jurisdictions (including Los Angeles County) submitted a CMP for the Ballona Creek Watershed to the LARWQCB on January 29, 2009. The CMP has three objectives:

1. Characterize existing water quality based on applicable bacteria water quality objectives;

2. Assess compliance with the wasteload allocations in the Bacteria TMDL and;

3. Provide data to support re-evaluations that will be made when the Bacteria TMDL is scheduled for reconsideration on April 27, 2011, four years after the effective date of the Bacteria TMDL.

The requirements of the Bacteria TMDL CMP Plan include:

- *Ambient Monitoring* - Ambient monitoring of water quality conditions will begin six months after LARWQCB's formal approval of the CMP, and conclude at the first compliance deadline in each impaired reach and confluences of each tributary. As stated in the Bacteria TMDL, on-going monitoring efforts by the City and County of Los Angeles within the Ballona Creek Watershed may fulfill the ambient monitoring requirement; however, all responsible jurisdictions are ultimately accountable for ensuring that these monitoring requirements are met. Prior to the first compliance deadline, weekly ambient monitoring will be conducted at the CMP-specified effectiveness monitoring locations.

- *TMDL Effectiveness Monitoring* - The TMDL effectiveness monitoring program will be conducted to assess attaining allowable bacteria exceedances for Ballona Creek, Ballona Estuary, Sepulveda Channel, and the wasteload allocations for the tributaries. As stated in the Bacteria TMDL:

  If the number of exceedance days is greater than the allowable number of exceedance days in the REC-1 and LREC-1 waters, and/or the frequency of exceedance is greater than 10 percent in the REC-2 waters, the responsible jurisdictions and/or responsible agencies shall be considered not attaining the TMDLs and/or assigned allocations. Responsible jurisdictions or agencies will be considered attaining TMDLs and/or assigned allocations based upon the results of an investigation that at a minimum shows single sample events meet bacteria water quality objectives through daily sampling results at the existing monitoring location.

The CMP identified eight monitoring sites for TMDL effectiveness monitoring (Figure 1-1 and Table 1-4). Ambient monitoring under the CMP began in June 2009. For the summer and winter dry weather periods, accelerated sampling will be conducted as a result of single-sample exceedances. Locations monitored weekly will be subject to accelerated monitoring, at 48 hours after the initial bacterial exceedance and, if the 48-

hour sample exceeds, sampling also will occur at 96 hours following the initial bacterial exceedance. All location-required indicator bacteria, not just the exceeding indicator, will be analyzed during accelerated testing.

Table 1-4
TMDL Effectiveness Monitoring

Station ID	BCB-1	BCB-2	BCB-3	BCB-4	BCB-5	BCB-6	BCB-7	BCB-8
Station Name	Washington	Duquesne	Benedict Canyon	Culver	Inglewood	Centinela	Lincoln	Pacific
Location	Washington Blvd. (at Creek)	Duquesne Ave. (at Creek)	Duquesne Ave (at confluence)	Culver Blvd. (at Sepulveda Channel)	Inglewood Blvd. (at Creek)	South of Centinela Ave. (McConnell Ave. at Creek)	South of Centinela Ave. (at Conf- luence)	Pacific Ave. (at creek)
Historical ID & Agency	N/A	N/A	TS09 (LACDPW) Duquesne (S&T)	TS08 (LAC DPW) Culver (S&T)	Inglewood (S&T)	N/A	N/A	Pacific (S&T)
Creek Section	Reach 1	Reach 2 (upper; at creek)	Reach 2 (conf- luence)	Sepulveda Channel	Reach 2 (lower; at creek)	Estuary (upper; at creek)	Estuary (conf- luence)	Estuary (lower; at creek)
Sampling Frequency	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly

1.2.6 Bacteria TMDL Compliance Requirements

The Bacteria TMDL defines milestones for achieving compliance with dry and wet weather bacteria limits:

- By **April 27, 2013** (six years after the effective date of the TMDL), achieve compliance with the allowable exceedance days for summer and winter dry weather and 30-day geometric mean limits (Table 1-2).
- By **July 15, 2021** (if an IWRA is implemented), achieve compliance with the allowable exceedance days and rolling 30-day geometric mean targets during wet weather (Table 1-2 and 1-3) (if the plan does not apply an IWRA, then the compliance date is April 27, 2017).

  The Bacteria TMDL states:

  > "In order to clearly justify an extended implementation schedule beyond 10 years and up to 14 years from the effective date of the TMDL, the responsible agencies are required to submit additional quantifiable analyses as described below to demonstrate (1) the proposed plans will meet the final WLAs [wasteload allocations] and (2) the proposed implementation actions will achieve multiple water quality benefits and other public goals. The types of approaches proposed coupled with quantifiable estimates of the integrated water resources benefits of the proposed structural and non-structural BMPs

> included in the Implementation Plan would provide the obligatory demonstration that an integrated water resources approach is being pursued. This demonstration shall include numeric estimates of the benefits, including but not limited to reductions in other pollutants, groundwater recharged, acres of multi-use projects and water (e.g. urban runoff) beneficially reused." (LARWQCB, 2006)

Based on the guiding principles that were followed throughout the development of this Implementation Plan is consistent with the requirements of an IWRA; therefore the date of final compliance with wet weather TMDL targets is July 15, 2021. Section 5 provides the necessary quantification elements.

- By **April 27, 2011** (four years after the effective date of the TMDL), the LARWQCB shall reconsider this TMDL to:

  (1) Re-assess the allowable winter dry weather and wet weather exceedance days based on a re-evaluation of the selected reference watershed, and consideration of other reference watersheds that may better represent reaches of Ballona Creek and Estuary;

  (2) Consider if the allowable winter dry weather and wet weather exceedance days should be adjusted annually dependent on the rainfall conditions and an evaluation of natural variability in exceedance levels in the reference system(s);

  (3) Re-evaluate the reference year used in the calculation of allowable exceedance days;

  (4) Re-evaluate whether there is a need for further clarification or revision of the geometric mean implementation provision;

  (5) Consider natural source exclusion for bacteria loading from Del Rey Lagoon based on results of the source identification study;

  (6) Re-assess wasteload allocations for Benedict Canyon Channel, Sepulveda Channel, and Centinela Creek based on results of the required compliance monitoring, and/or any voluntary beneficial use investigations.

1.3 Compliance Components

Adaptive Management

The elements described above related to the re-evaluation of the TMDL are in line with the adaptive management approach of the Implementation Plan. Adaptive management recognizes that there is considerable uncertainty associated with the development of the indicator bacteria numeric TMDL limits and the allowable exceedance days.

Adaptive management, or in this case, "adaptive implementation" is an iterative process whereby the responsible jurisdictions will commit to implementing an initial suite of priority BMPs both structural and institutional, meanwhile continuing water quality sampling under the CMP to quantify progress towards meeting the numeric limits. Refinements or improvements to BMPs or the analytical tools such as water quality models will also be undertaken after initiation of the Implementation Plan. Under the adaptive management process, the responsible jurisdictions, in coordination with the LARWQCB, would identify and implement improved BMPs and apply the refined analytical tools using current water quality monitoring data. The process would involve future periodic revisions to the Implementation Plan. The adaptive management approach can enable implementation of new BMPs with reduced uncertainty of their performance, and potentially improved cost-effectiveness. Adaptive management only addresses uncertainty regarding the efficacy of BMPs and the water quality monitoring data used to characterize the impacted waterbodies.

Phased Compliance

Based on the compliance requirements, there are two phases of implementation in the Implementation Plan (see Section 5 for implementation details):

Phase 1 (2010 – 2013) – This phase coincides with the first compliance milestone (April 27, 2013), which is for summer and winter dry weather flows. This phase emphasizes institutional and distributed structural BMPs, and possibly some regional BMPs, that can be expeditiously implemented and monitored for effectiveness. Institutional BMPs include revision and development of policies, ordinances, and guidelines throughout the watershed for urban development and redevelopment that promote pollution prevention, low impact development (LID), rainwater reuse, coordination of activities watershed-wide, as well as expansion of outreach programs. Distributed structural BMPs include the installation of decentralized, small-scale, local storage and reuse, infiltration or bioretention projects along public right-of-ways or at public facilities. Regional BMPs also reduce the volume of runoff that reaches the receiving waters, or treats and discharges it, but they typically manage the runoff from a larger tributary area and typically have a larger footprint than distributed BMPs. Priority distributed and regional BMPs are planned projects for targeting high priority catchments.

Phase 2 (2013 – 2021) – This phase coincides with the second milestone, which is for wet weather flow, and incorporates the adaptive management concept previously described. This phase will consider the need for further implementation of additional regional structural BMPs, low flow diversions (LFDs) and other end-of-pipe solutions, such as diversion of wet weather runoff to the wastewater treatment system or the construction of runoff treatment plants. These are generally single-purpose facilities that offer little benefit beyond pollution reduction and represent a less holistic approach to runoff management. For this reason, the need to pursue these options is generally deferred until the effectiveness of a concerted effort to implement institutional and distributed structural solutions can be evaluated.

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Section 2
Watershed Background

This section provides an overview of physical conditions (e.g., land use, topography and soils types), hydrologic conditions (e.g., precipitation, flow, and storm drain connectivity), and historic water quality in the Ballona Creek Watershed.

2.1 Ballona Creek Watershed

The Ballona Creek Watershed is approximately 128 square miles (approximately 82,000 acres) in size (Figure 2-1). Located on the coastal plain of the Los Angeles basin, it is bounded by the the Santa Monica Mountains to the north and the Baldwin Hills to the south. Draining to Santa Monica Bay, the watershed collects runoff from the southern part of the Santa Monica Mountains (south of Mulholland Drive) and the western part of the City of Los Angeles. Approximately 80 percent of the watershed is under the jurisdiction of the City of Los Angeles. The remainder of the watershed consists of the cities of Beverly Hills, West Hollywood, Culver, Inglewood, Santa Monica, and the County of Los Angeles. Caltrans also has areas within the watershed under its jurisdiction.

The Basin Plan describes three main sections of Ballona Creek (Figure 2-1); Reach 1, the uppermost section; Reach 2, the middle portion; and the Estuary, the lower section that flows into the Pacific Ocean. Ballona Creek is predominantly channelized and with the exception of the headwaters within the northern portion of the watershed in the Santa Monica Mountains, the watershed is highly developed.

2.2 Watershed Characteristics

2.2.1 Topography

Figure 2-2 illustrates the topography of the Ballona Creek Watershed. The northern area in the Santa Monica Mountains has the highest elevations. The Baldwin Hills area in the southern part of the watershed is also elevated. The topography of the watershed is an important factor in understanding rainfall variation, subwatershed and catchment development, landslide potential, and potential BMP siting.

2.2.2 Hydrologic Connectivity and Storm Drain Network

Hydrologic connectivity refers to the physical connections between a river or channel and its tributaries, between surface water and groundwater, and between wetlands and waterbodies. The Basin Plan defines three sections of the creek based on hydrologic units (Figure 2-3):

- *Ballona Creek, Reach 1* – Reach 1 begins at the point where the creek emerges from the underground network of drains at Cochran Avenue in the City of Los Angeles and extends about 2 miles to where it ends at National Boulevard in Culver City. This Reach is characterized by vertical concrete walls.

- *Ballona Creek to Estuary, Reach 2* - The longest segment of the creek (approximately 4 miles). This reach begins at the lower end of Reach 1 (National Boulevard) and ends at Centinela Avenue, where the Ballona Creek Estuary begins.

- *Ballona Creek Estuary* - The estuary reach, which is 3.5 miles in length, begins at Centinela Avenue and ends at the Pacific Ocean. Its lower portion flows parallel to the main channel of Marina del Rey Harbor.

Except for the estuarine section of the creek, which is composed of grouted rip-rap sloped sides and an earthen bottom, Ballona Creek is entirely lined in concrete and extends into a complex underground network of storm drains, which extend north beyond Beverly Hills and West Hollywood into the Hollywood Hills.

Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, and Benedict Canyon Channel (see Figure 2-1). The downstream portions of all of these tributaries are concrete lined channels also fed by a network of upstream underground storm drains. Benedict Canyon discharges into Ballona Creek in Reach 2 at Madison Avenue. Downstream of the Benedict Canyon confluence, Sepulveda Canyon Channel also discharges into Ballona Creek Reach 2. Centinela Creek drains directly to Ballona Creek Estuary just below its boundary with Reach 2.

Storm drainage throughout most of Ballona Creek Watershed is provided through a vast network of underground pipelines (Figure 2-3). The upper watershed drains the Los Angeles neighborhoods of Hollywood Hills, Silver Lake, Hollywood, South Park, mid-Wilshire, Koreatown, Crenshaw, Lemmert Park, Jefferson Park, the northeast drainage of the Baldwin Hills, and the cities of West Hollywood and Beverly Hills.

BMPs were sited based on their location relative to storm drains and storm drain size. For example, the potential benefits to be obtained from a regional BMP depend on the location of storm drains. In addition, understanding the drainage area of a storm drain network is critical to BMP sizing considerations.

2.2.3 City-Defined Catchment Areas

In order to effectively develop a TMDL implementation plan for the watershed, the watershed was divided into smaller sub-catchment areas. Existing Geographical Information Systems (GIS) data developed by the the City and County of Los Angeles divided the watershed into catchments of approximately 40 acres each (Figure 2-4). These smaller catchment areas allow for a more detailed analysis of the drainage patterns at the neighborhood or parcel level. The catchments are delineated by topography and the drainage patterns within each area.

2.2.4 Land Use and Impervious Area

Watershed land use, and its relationship to imperviousness, was used to estimate runoff generated at the catchment, watershed, or subwatershed level.

Land Use

The Ballona Creek Watershed encompasses approximately 82,000 acres. Figure 2-5 illustrates the land use distribution in the watershed (LACDPW, 2005). For this illustration, related land use classes were combined into larger categories based on the nature of the land use and how land use data are used in selected watershed modeling tools (Section 4). For example, "residential" land use represents a combination of high-density single-family residential, low-density single-family residential, multi-family residential, and mixed residential. These residential land use classes were aggregated into two categories: single family and multi-family. The Implementation Plan analysis incorporated seven major land use categories. These categories and their relative land use coverage include:

- Multi-family Residentail 22%
- Single-family Residential 37%
- Vacant/Open Space 17%
- Commercial 14%
- Education 3%
- Transportation 2%
- Industrial 5%

Impervious Areas

Imperviousness is a measure of the fraction of the total area covered in impervious surfaces, such as roads, rooftops, sidewalks, patios, parking areas, and highly compacted soil. Rainfall and dry weather water sources (e.g., irrigation, car washing, etc.) that fall on pervious surfaces have the best opportunity to infiltrate into the ground and reduce the total amount of runoff generated from an area. The degree to which infiltration is expected to occur in pervious areas is related to soil types and associated infiltration rates (Section 2.2.5).

The Los Angeles County Department of Public Works (LACDPW) Hydrology Manual assigns an imperviousness factor to a number of land use types (LACDPW, 2006) (Table 2-1). Higher numbers indicate greater imperviousness. With a potential range of 0 to 1, the weighted average imperviousness factor for the entire Ballona Creek Watershed is estimated to be 0.49.

2.2.5 Soil Types

Soil types are an integral factor in determining how much runoff can infiltrate into the ground. This is an important component in evaluating the feasibility of siting an infiltration BMP, along with depth to groundwater, and geotechnical considerations. Figure 2-6 identifies the primary soil types and presents their geographic distribution in the watershed (LACDPW Hydrology GIS Database). Note that soil type is only one factor in identifying ideal sites for infiltration BMPs. Other factors, such as depth to groundwater and geotechnical issues, are also important.

Table 2-1
Land Use in Ballona Creek Watershed with Associated Imperviousness Factor

Land Use	Imperviousness Factor[1]	Acres[2]	Percent Cover
Vacant	0.01	11,198	13.7%
Golf Courses	0.03	1,092	1.3%
Under Construction	0.15	367	0.5%
Low Density Single Family / Rural Residential	0.21	2,688	3.3%
High Density Single Family	0.42	27,039	33.1%
Agriculture / Orchards / Horse Ranch	0.47	21	0.0%
Education	0.47	2,518	3.1%
Natural Resources Extraction	0.47	870	1.1%
Multiple Family Residential / Trailer parks	0.55	11,219	13.7%
Mixed Residential	0.59	7,404	9.1%
Military	0.65	21	0.0%
Heavy Industrial	0.66	32	0.0%
Open Space / Recreation	0.74	1,640	2.0%
Mixed Urban	0.89	184	0.2%
Commercial / Industrial	0.91	74	0.1%
General Office	0.91	1,324	1.6%
Institutional	0.91	1,739	2.1%
Light Industrial	0.91	2,369	2.9%
Maintenance Yards Communications Facilities	0.91	178	0.2%
Other Commercial	0.91	435	0.5%
Other Facilities	0.91	139	0.2%
Regular / Mixed Transportation	0.91	1,673	2.0%
Retail / Commercial	0.97	6,874	8.4%
Floodways and Structures	1.00	216	0.3%
Receiving / Marina Waters	1.00	326	0.4%
Weighted Average	0.49	NA	NA
Total	NA	81,644	100%

[1] *Source: LA County Hydrology Manual, Appendix D. http://dpw.lacounty.gov/wrd/publication/engineering/2006_Hydrology_Manual/Appendix-D.pdf*
[2] *Source: Southern California Association of Governments (SCAG) Land Use Data (2005), http://www.scag.ca.gov/*

2.2.6 Parcel Ownership Data

Figure 2-7 illustrates parcel ownership in the Ballona Creek Watershed. One important consideration for BMP project selection includes determining whether a potential BMP site is publicly or privately owned. It is assumed that implementation can occur in a more timely, less costly manner on publicly owned parcels. These publicly owned sites are primarily considered for regional BMPs. However, BMPs on privately owned parcels are included in the Implementation Plan, assuming a selection of both distributed and institutional BMPs will be implemented.

2.2.7 Groundwater Depth

Depth to groundwater is important when selecting infiltration BMPs, since high groundwater conditions will prohibit infiltration. Figure 2-8 illustrates the depth to groundwater (less than or greater than 30 feet below ground surface) throughout the Ballona Creek Watershed. The northern portion of the watershed and the area adjacent to the downstream portion of Ballona Creek contain groundwater that is less than 30 feet below the surface of the ground. The remainder of the area has a groundwater depth of greater than 30 feet.

2.2.8 Liquefaction and Landslide Zones

Liquefaction refers to the behavior of soils (e.g. loose sand) that, under conditions such as an earthquake, shift from a solid state to a liquefied state with a consistency similar to that of a heavy liquid. This occurs in saturated soils where the water pressure increases with the earthquake event and changes the behavior of the soil. Soil liquefaction can cause tremendous damage during earthquakes. Liquefaction zone areas in the watershed are located along the mainstem of Ballona Creek (Figure 2-9). Liquefaction potential may preclude siting of typical structural infiltration BMPs in these areas.

Landslides occur when a slope’s stability changes from stable to unstable, causing the ground to move. Landslides can be caused by many natural factors, including earthquakes, increased groundwater pressure, heavy rains, and human factors, including the use of heavy machinery, blasting, and earthwork. Areas susceptible to landslides in the watershed are primarily in the north and the Baldwin Hills area (Figure 2-9).

2.3 Hydrology

The following two sections present a summary of precipitation and flow in the Ballona Creek Watershed.

2.3.1 Rainfall Data Summaries

The Ballona Creek Watershed climate can be characterized as Mediterranean with average annual rainfall of approximately 15 inches per year over most of the developed portions of the watershed. Table 2-2 summarizes rainfall data from 1998 to 2008 from Los Angeles County Gauge 634C in the Santa Monica area (monthly totals, max/min rainfall data, and yearly summaries).

Rainfall volumes and intensity vary throughout the watershed due, in part, to the varied topography in the Ballona Creek Watershed. Figure 2-10 provides a plot of 85th percentile, 24-hour rainfall isohyets (i.e., lines of equal rainfall depth) throughout the watershed (based on Los Angeles County data). The isohyets represent the depth of rainfall for the 85th percentile design frequency over a 24-hour period. Figure 2-11 illustrates the distribution of rainfall in the area, showing that the rainfall in the northwest and coastal portions of the watershed is higher than in the northeast.

2.3.2 Flow Data

Flow in Ballona Creek is monitored by the County of Los Angeles at a site above Sawtelle Boulevard at meter F38CB (Figure 2-12). Tables 2-3 and 2-4 present flow data from 1998 to 2008 for dry and wet weather, respectively. The tables also provide monthly mean stream flows by year, as well as summary data each year. The summary data include the mean flow, maximum flow, and minimum flow, and a count of the number of days flow is above or below 40 cfs—the definition for the distinction between dry and wet weather flows contained in the Ballona Creek metals TMDL (LARWQCB 2006). While this flow distinction is not directly linked to demonstrating Bacteria TMDL compliance, it is still a relevant consideration for the Implementation Plan given the need to manage multiple pollutants.

Lower instream flows occur in June, July and August during low rainfall periods (Tables 2-3 and 2-4). Generally, the primary source of flows during these months is likely runoff from activities such as landscape irrigation. During the period from December 16, 1999 to April 1, 2008, the County recorded 3,471 flow and rainfall measurements. Observations included:

- Rainfall occurred on 316 days. On these days:
  - Instream flow exceeded 40 cfs on 229 days, resulting in a classification of the flow as a wet weather flow.
  - Instream flow was less than 40 cfs on 87 days, resulting in a classification of the flow as a dry weather flow.
- Overall, flow exceeded 40 cfs on 975 days. On these days:
  - No rainfall occurred on 746 days even though, by definition, they would be considered wet weather days.
  - Rainfall did occur on 229 of the days.

2.4 Water Quality

Water quality monitoring has been conducted for many years in the Ballona Creek Watershed. The primary monitoring programs include the City of Los Angeles Status and Trends Monitoring, and the Municipal Separate Storm Sewer System (MS4) monitoring program conducted by the County of Los Angeles. These programs are discussed below.

In additional to these monitoring programs, as a part of the TMDL, the responsible jurisdictions submitted a final draft of the CMP to the Regional Board on January 29, 2009 (Section 1). This plan is currently being implemented.

The City of Los Angeles conducts status and trends water quality monitoring in Ballona Creek for bacteria (total coliform, *Escherichia coli* (*E. coli*) and enterococcus) at several locations. Figure 2-13 and Appendix B provide summaries of these data for the period 2001 to 2008. Similarly, the County of Los Angeles conducts MS4 monitoring for bacteria (total coliform, fecal coliform, and enterococcus) at several locations. Appendix B presents data from this monitoring program for the period 1998 to 2006. For each monitoring program, the Appendix B data summary includes the number of samples collected, the number of exceedances for each site, and (where applicable) the numeric TMDL target for each constituent. Following the tables, sample results plots are provided for each monitoring station and each constituent.

The bacteria water quality results routinely exceed single sample maximum numeric limits. In all but one case where geometric means could be calculated, the geometric mean numeric limits were exceeded.

Table 2-2
Precipitation Summary (inches) based on Daily Precipitation Records in the Santa Monica Area, November 1998 to May 2008, Los Angeles County Gauge 634C

Year From	Year To	Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year Total
1998	1999	Monthly Total		1.09	0.64	1.00	0.82	1.99	1.74		0.37				7.65
		Mean		*0.36*	*0.21*	*0.25*	*0.21*	*0.33*	*0.44*		*0.12*				
		Max Day		*0.86*	*0.45*	*0.38*	*0.58*	*1.15*	*0.82*		*0.28*				
		Min Day		*0.06*	*0.05*	*0.12*	*0.04*	*0.02*	*0.13*		*0.02*				
		# Rain Days		*3*	*3*	*4*	*4*	*6*	*4*		*3*				*27*
1999	2000	Monthly Total				1.41	5.48	2.13	1.47	0.05				0.02	10.56
		Mean				*0.20*	*0.55*	*0.36*	*0.74*	*0.05*				*0.02*	
		Max Day				*0.69*	*1.65*	*1.27*	*1.02*	*0.05*				*0.02*	
		Min Day				*0.02*	*0.10*	*0.01*	*0.45*	*0.05*				*0.02*	
		# Rain Days				*7*	*10*	*6*	*2*	*1*				*1*	*27*
2000	2001	Monthly Total	0.01		0.02	6.05	7.29	1.66	0.73						15.76
		Mean	*0.01*		*0.02*	*0.76*	*0.52*	*0.55*	*0.37*						
		Max Day	*0.01*		*0.02*	*3.25*	*2.03*	*0.80*	*0.40*						
		Min Day	*0.01*		*0.02*	*0.01*	*0.02*	*0.10*	*0.33*						
		# Rain Days	*1*		*1*	*8*	*14*	*3*	*2*						*29*
2001	2002	Monthly Total	0.09	2.00	0.95	0.40	0.30	0.32	0.05						4.11
		Mean	*0.05*	*0.40*	*0.16*	*0.13*	*0.30*	*0.08*	*0.05*						
		Max Day	*0.07*	*0.91*	*0.30*	*0.25*	*0.30*	*0.17*	*0.05*						
		Min Day	*0.02*	*0.03*	*0.02*	*0.03*	*0.30*	*0.01*	*0.05*						
		# Rain Days	*2*	*5*	*6*	*3*	*1*	*4*	*1*						*22*
2002	2003	Monthly Total		2.04	2.44		4.49	2.52	1.31	1.54	0.04	0.06			14.44
		Mean		*0.41*	*0.35*		*0.75*	*0.84*	*0.17*	*0.39*	*0.02*	*0.03*			
		Max Day		*1.53*	*1.00*		*3.08*	*2.00*	*0.46*	*1.15*	*0.03*	*0.05*			
		Min Day		*0.01*	*0.03*		*0.05*	*0.07*	*0.01*	*0.03*	*0.01*	*0.01*			
		# Rain Days		*5*	*7*		*6*	*3*	*5*	*4*	*2*	*2*			*34*
2003	2004	Monthly Total	0.04	1.29	0.91	1.04	4.20	0.84	0.01					0.01	8.34
		Mean	*0.02*	*0.26*	*0.13*	*0.09*	*0.47*	*0.21*	*0.01*					*0.01*	
		Max Day	*0.03*	*0.95*	*0.57*	*0.42*	*2.50*	*0.79*	*0.01*					*0.01*	
		Min Day	*0.01*	*0.02*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*					*0.01*	
		# Rain Days	*2*	*5*	*7*	*5*	*9*	*4*	*1*					*1*	*34*
2004	2005	Monthly Total	3.13	0.50	6.03	8.50	11.68	1.56	0.87	0.15				0.20	32.62
		Mean	*0.52*	*0.13*	*0.67*	*0.85*	*1.06*	*0.20*	*0.44*	*0.05*				*0.20*	

Table 2-2
Precipitation Summary (inches) based on Daily Precipitation Records in the Santa Monica Area, November 1998 to May 2008, Los Angeles County Gauge 634C

Year		Statistic	Month												Year Total
From	To		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
		Max Day	*1.26*	*0.30*	*2.25*	*1.87*	*3.88*	*1.10*	*0.85*	*0.09*				*0.20*	
		Min Day	*0.05*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.02*	*0.01*				*0.20*	
		# Rain Days	*6*	*4*	*9*	*10*	*11*	*8*	*2*	*3*				*1*	*54*
2005	2006	Monthly Total	1.16	0.38	1.50	2.40	1.30	2.54	2.05	0.68	0.01				12.02
		Mean	*0.39*	*0.19*	*0.38*	*0.60*	*0.33*	*0.32*	*0.26*	*0.68*	*0.01*				
		Max Day	*0.57*	*0.32*	*1.18*	*1.38*	*0.67*	*0.92*	*1.10*	*0.68*	*0.01*				
		Min Day	*0.03*	*0.06*	*0.01*	*0.12*	*0.10*	*0.01*	*0.01*	*0.68*	*0.01*				
		# Rain Days	*3*	*2*	*4*	*4*	*4*	*8*	*8*	*1*	*1*				*35*
2006	2007	Monthly Total	0.01	0.13	0.51	0.53	0.67	0.02	0.44			0.01		0.95	3.27
		Mean	*0.01*	*0.13*	*0.17*	*0.08*	*0.13*	*0.01*	*0.22*			*0.01*		*0.95*	
		Max Day	*0.01*	*0.13*	*0.30*	*0.36*	*0.23*	*0.01*	*0.36*			*0.01*		*0.95*	
		Min Day	*0.01*	*0.13*	*0.09*	*0.01*	*0.04*	*0.01*	*0.08*			*0.01*		*0.01*	
		# Rain Days	*1*	*1*	*3*	*7*	*5*	*2*	*2*			*1*		*1*	*23*
2007	2008	Monthly Total	1.12	0.61	1.98	4.39	1.58		0.05	0.06					9.79
		Mean	*0.56*	*0.31*	*0.28*	*0.40*	*0.40*		*0.05*	*0.06*					
		Max Day	*1.11*	*0.60*	*1.08*	*1.03*	*0.77*		*0.05*	*0.06*					
		Min Day	*0.01*	*0.01*	*0.01*	*0.02*	*0.01*		*0.05*	*0.06*					
		# Rain Days	*2*	*2*	*7*	*11*	*4*		*1*	*1*					*28*
Average by month of each parameter for the total period from Nov 1998 to May 2008 (based on daily precipitation):															
Average Monthly Total			0.62	0.80	1.50	2.57	3.78	1.36	0.87	0.28	0.05	0.01	0	0.13	11.96
Average of each Mean			0.17	0.22	0.24	0.34	0.47	0.29	0.27	0.14	0.02	0.00	0	0.13	
Average Max Day			0.34	0.56	0.72	0.96	1.57	0.82	0.51	0.23	0.04	0.01	0	0.13	
Average Min Day			0.02	0.03	0.03	0.04	0.07	0.03	0.11	0.09	0.00	0.00	0	0.03	
Average # rain of days			1.9	2.7	4.7	5.9	6.8	4.4	2.8	1.1	0.7	0.3	0	0.4	31.7

Notes:
"Monthly Total" is the sum of all rainfall that month
“Mean" is the average of each daily rain event by month, for days that it rained
"Max Day" is the maximum rainfall observed for the days that had rain that month
"Min Day" is the minimum rainfall observed for the days that had rain that month
"# of Rain Days" is a count of the total number of days that it rained that month
"Average by month of each parameter for the total period from Nov 1998 to May 2008 (based on daily precipitation)" is the average by month over the entire period based on daily rainfall. The averages include zeros for months that had no rainfall
Source: Los Angeles County Gauge 634C, Santa Monica area

Table 2-3
Monthly Mean Dry Stream Flow (cfs) (Less than 40 cfs)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998										28.1	15.2	17.3	
1999	17.9	13.2	13.4	17.3	27.5	18.9	16.9	16.3	14.6	15.0	20.0	19.8	17.6
2000	17.9	26.5	23.8	25.9	35.4	22.3	14.9	18.5	25.1	25.5	16.1	26.7	23.2
2001	19.1	15.7	26.2	25.4	21.3	25.8	21.8	25.2	18.1	25.7	23.2	27.9	22.9
2002	13.6	25.8	16.7	19.0	24.0	23.0	12.5	17.9	24.1	22.7	25.9	26.8	21.0
2003	25.8	28.9	34.7	18.6	16.8	18.9	18.7	28.4	15.8	13.3	12.6	15.0	20.6
2004	26.3	18.0	22.9	17.4	22.8	25.9	23.6	24.0	20.6	19.0	18.1	28.9	22.3
2005	14.4	39.9		37.5	34.7	39.7	38.5	37.8	35.3	34.9	33.6		34.6
2006	32.5			38.0	36.9	38.6	27.5	27.7	32.4	27.0	37.2	29.3	32.7
2007	34.7	30.9	30.9	31.7	31.3	30.2	29.9	30.0	30.2	26.7	34.1	33.5	31.2
2008	36.3	36.8											
Summary													
Mean	23.9	26.2	24.1	25.6	27.9	27.0	22.7	25.1	24.0	23.8	23.6	25.0	25.1
Minimum	10	10	10	8	8	12	8	9	10	8	9	11	8
Maximum	39	40	40	40	40	40	40	39	40	39	40	39	40

Number of Days Flow is below 40 cfs:

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998										28	28	29	
1999	27	26	28	24	17	28	31	31	29	31	29	30	331
2000	27	19	26	27	9	30	31	30	28	10	30	17	284
2001	28	16	27	25	26	26	23	15	5	30	9	25	255
2002	18	26	29	29	30	22	23	30	29	31	22	16	305
2003	28	17	27	25	26	30	27	21	23	30	28	27	309
2004	25	21	29	25	31	30	31	31	30	25	28	11	317
2005	30	1	=	2	25	2	4	6	13	25	21		129
2006	1			6	10	8	19	31	23	27	14	27	166
2007	25	13	22	22	26	30	31	25	28	29	24	24	299
2008	4	12											

Based on Average Daily Flow, Los Angeles County Dept of Public Works, Meter:F38CB http://dpw.lacounty.gov/wrd/report/0607/runoff/discharge.cfm, Site: Above Sawtelle Blvd.

Table 2-4
Monthly Mean Wet Stream Flow (cfs) (Greater than 40 cfs)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998										43	624	194	
1999	421	206	522	421	49	352			95		382	392	315
2000	421	718	566	646	78			74	93	128		57	309
2001	336	774	335	302	48	47	64	63	85	42	126	192	201
2002	507	172	151	59	77	62	53	41	43		371	267	164
2003	332	550	1132	195	251		43	43	55	399	243	416	333
2004	47	879	449	49						845	128	542	420
2005	497	651	138	129	60	56	51	50	53	296	74	96	179
2006	539	192	164	169	115	46	55		51	42	59	249	153
2007	482	148	48	106	49			46	595	487	143	346	245
2008	67	208	102	80									
Summary													
Mean	365	450	361	215	91	113	53	53	134	285	239	275	258
Minimum	40	40	40	40	40	40	40	40	40	40	40	40	40
Maximum	4,390	3,370	4,060	1,590	1,080	571	86	100	919	1,810	2,020	5,230	5,230
Number of Days Flow Exceeds 40 cfs:													
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ANNUAL**
1998										3	2	2	
1999	4	2	3	6	14	2			1		1	1	34
2000	4	10	5	3	22			1	2	21		14	82
2001	3	12	4	5	5	4	8	16	25	1	21	6	110
2002	13	2	2	1	1	8	8	1	1		8	15	60
2003	3	11	4	5	5		4	10	7	1	2	4	56
2004	6	8	2	5						6	2	20	49
2005	1	27	31	28	6	28	27	25	17	6	9	31	236
2006	30	28	31	24	21	22	12		7	4	16	4	199
2007	6	15	9	8	5			6	2	2	6	7	66
2008	27	17	31	1									
Average	10	13	12	9	10	13	12	10	8	6	7	10	99

Based on Daily Flow from Los Angeles County Dept of Public Works, Meter: F38CB; http://dpw.lacounty.gov/wrd/report/0607/runoff/discharge.cfm, Site: Above Sawtelle Blvd.

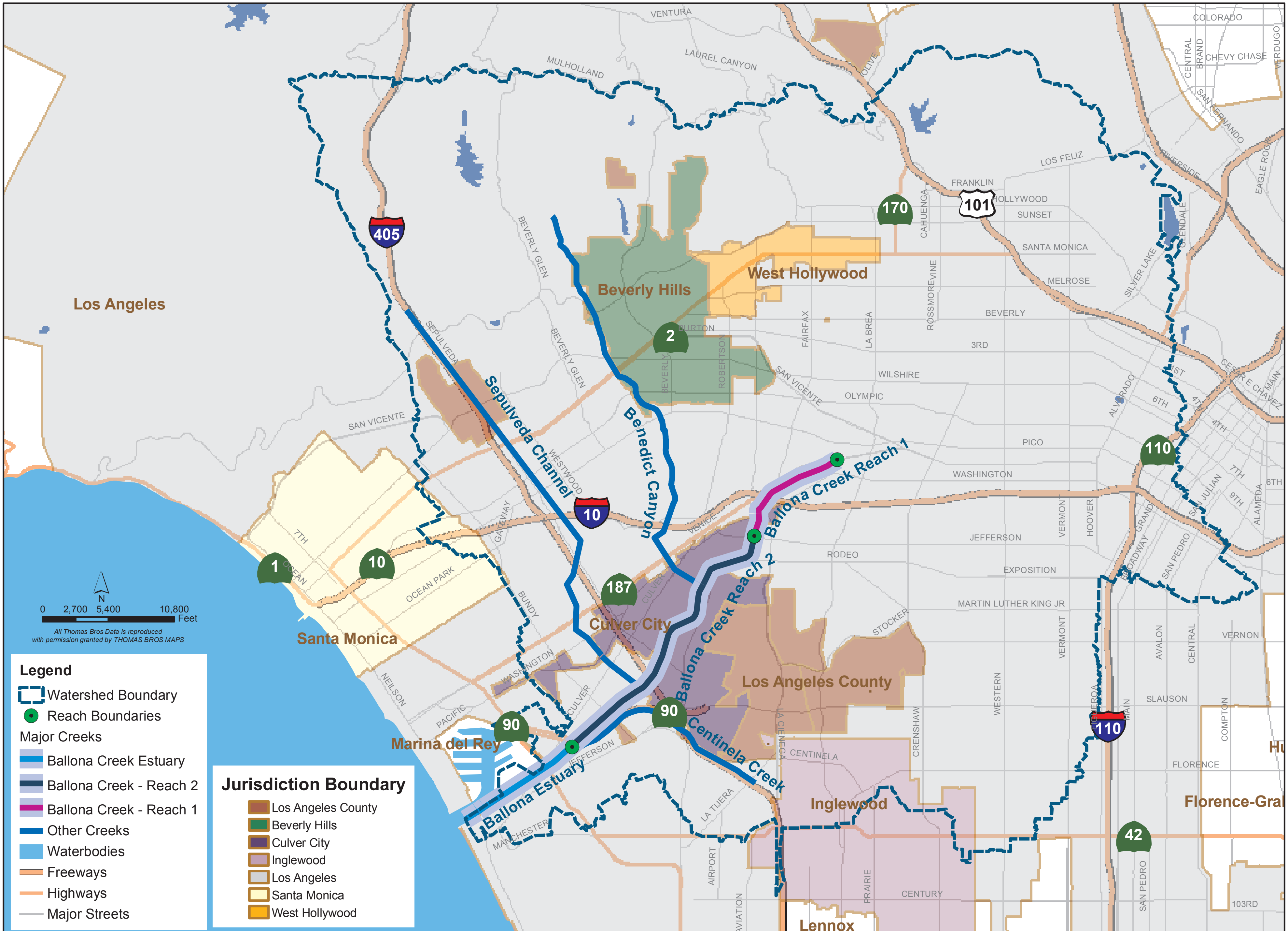

Figure 2-1 Ballona Creek Boundary and Jurisdictions

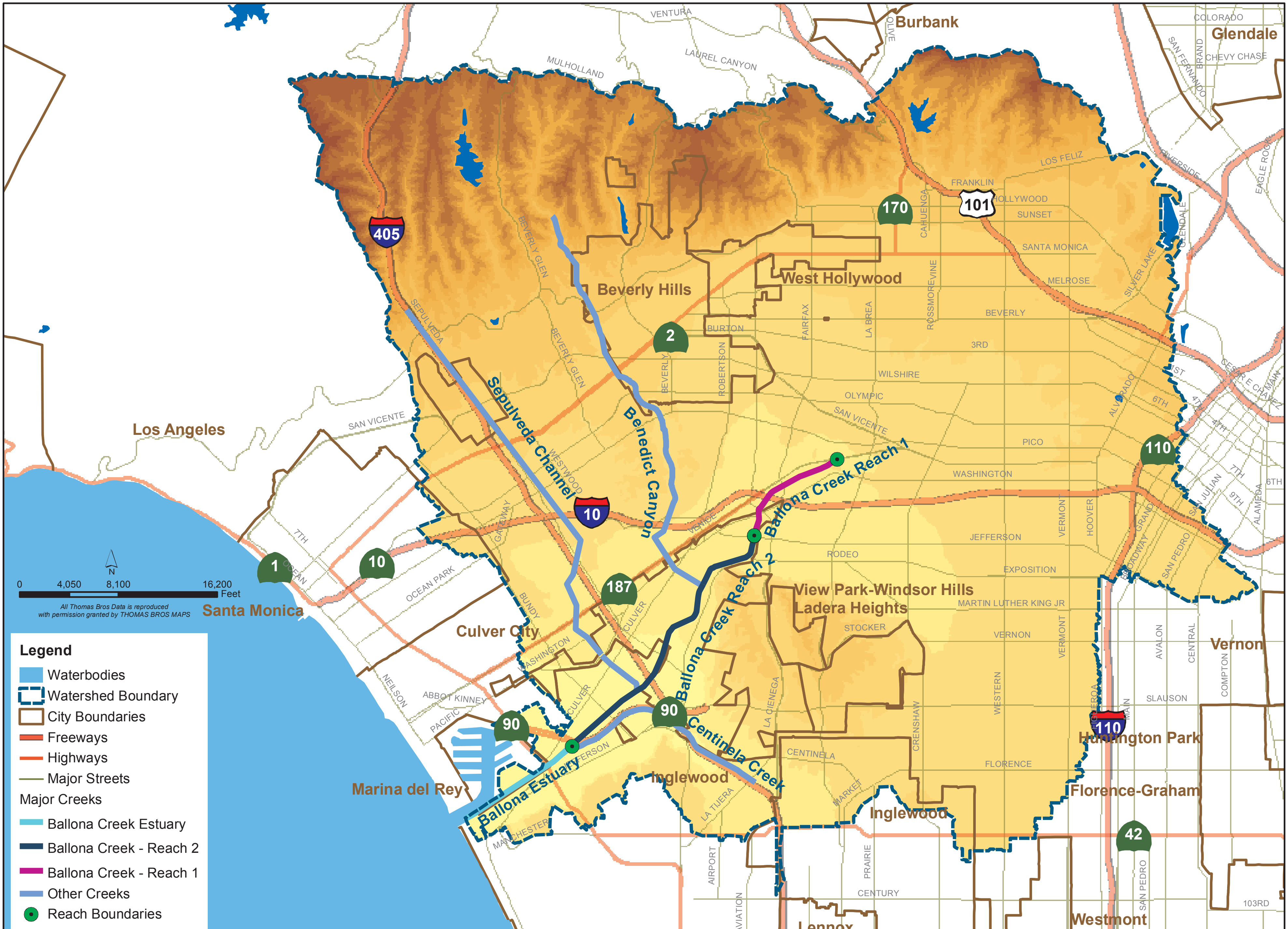

Figure 2-2 Ballona Creek Watershed - Topography

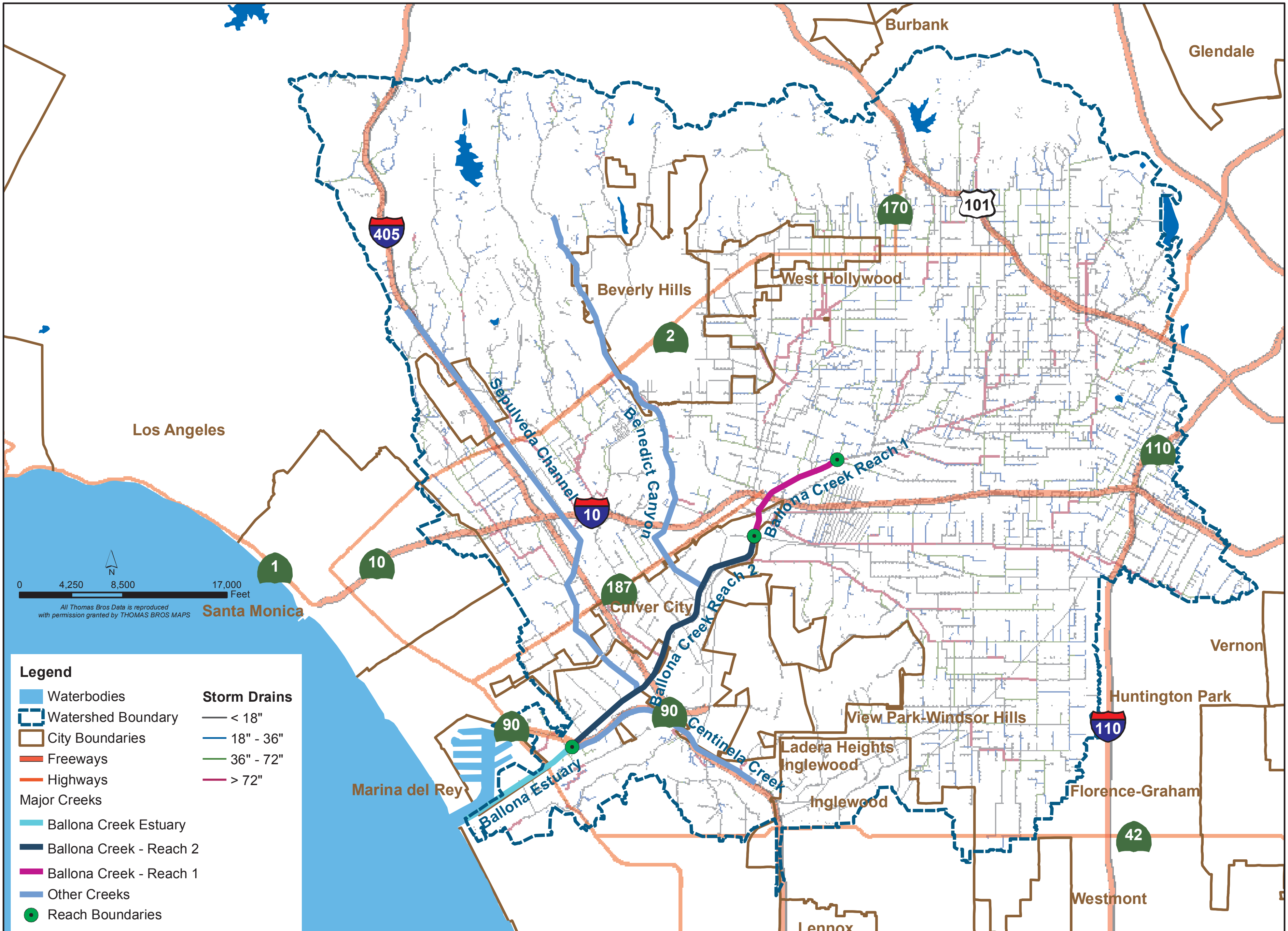

Figure 2-3 Ballona Creek Watershed - Storm Drains

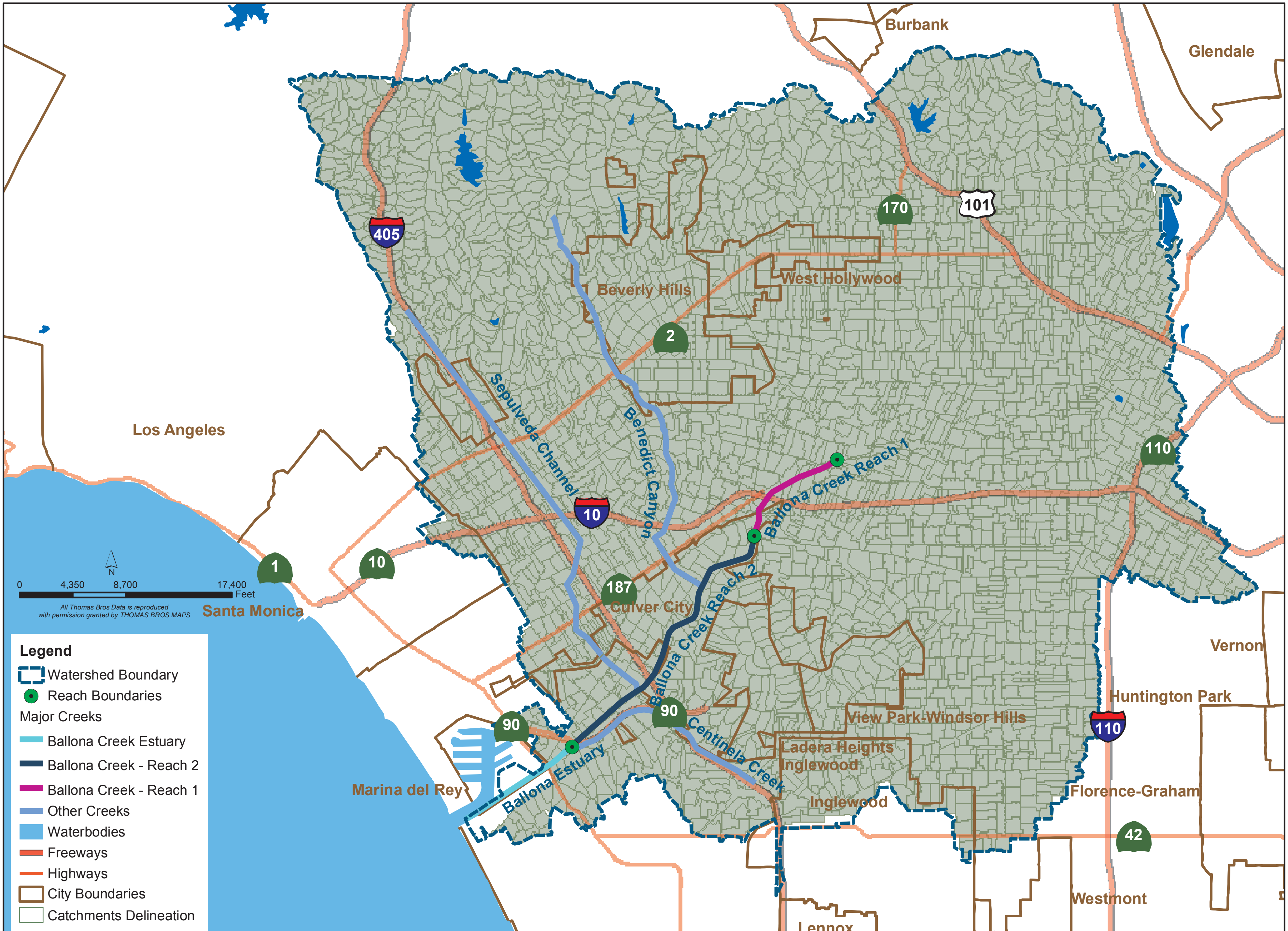

Figure 2-4 Ballona Creek Watershed Catchments

Figure 2-5 Ballona Creek Watershed - Land Use

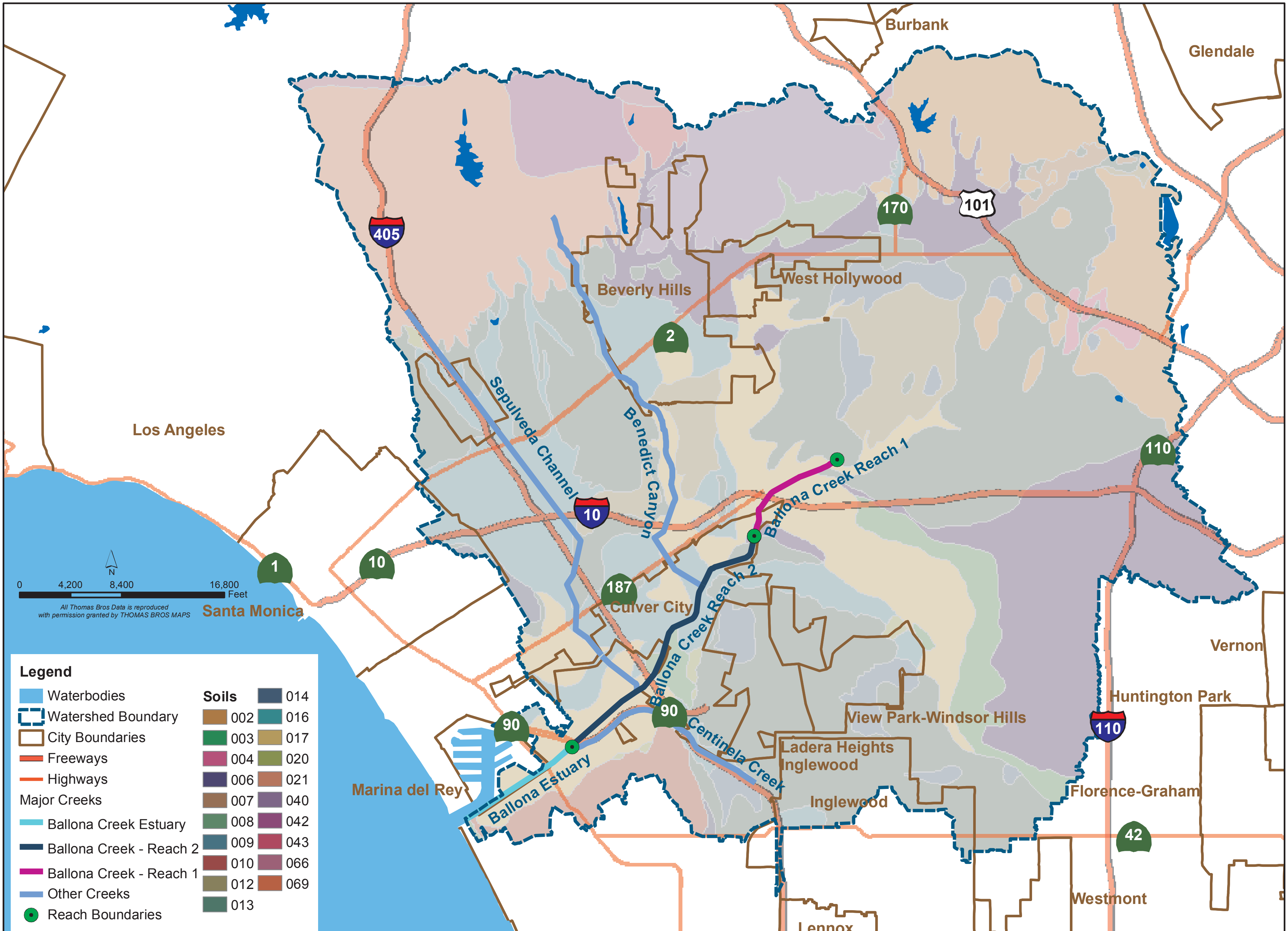

Figure 2-6 Ballona Creek Watershed - Soils

Figure 2-7 Ballona Creek Watershed - Parcels

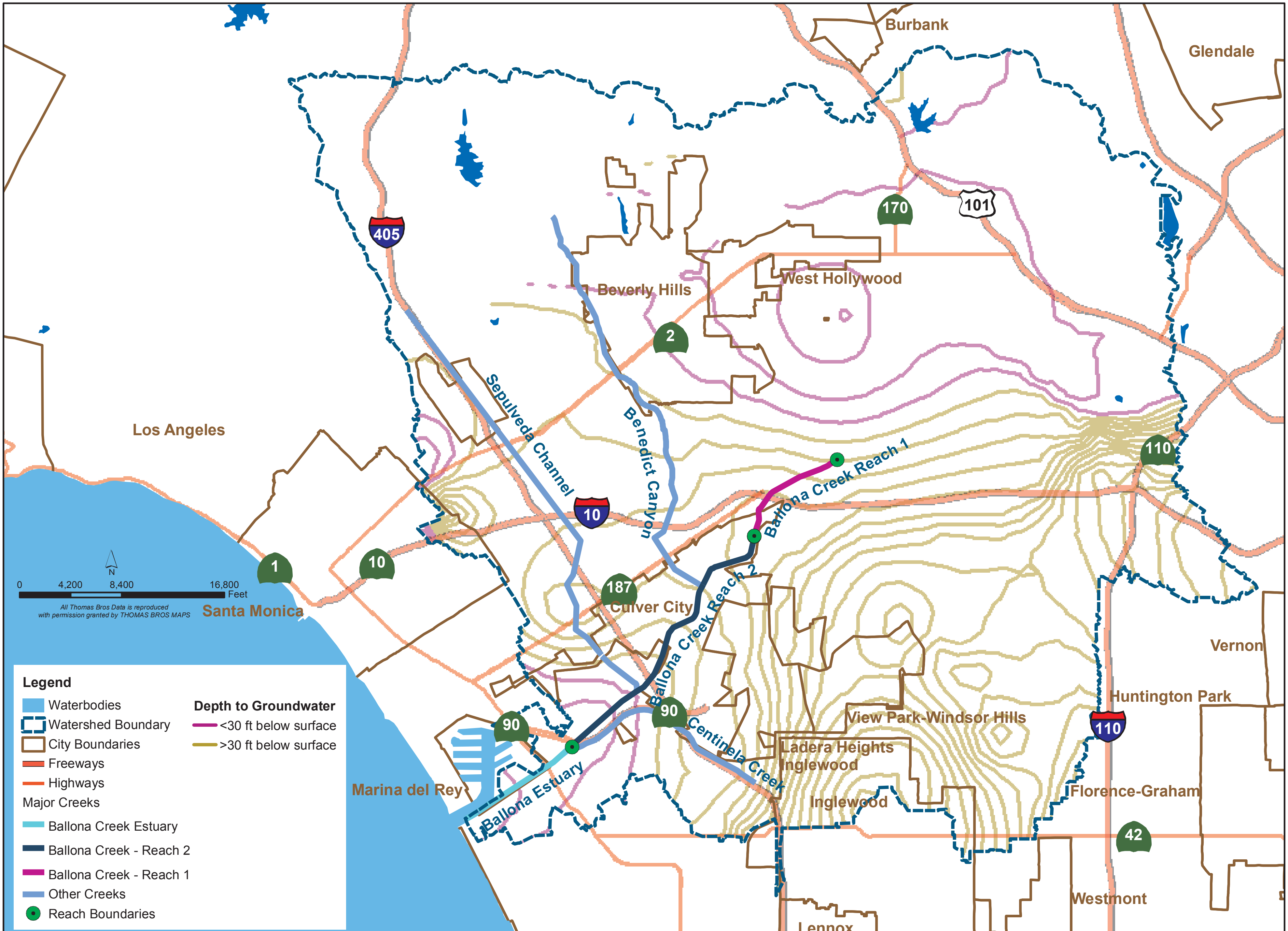

Figure 2-8 Ballona Creek Watershed - Depth to GroundWater

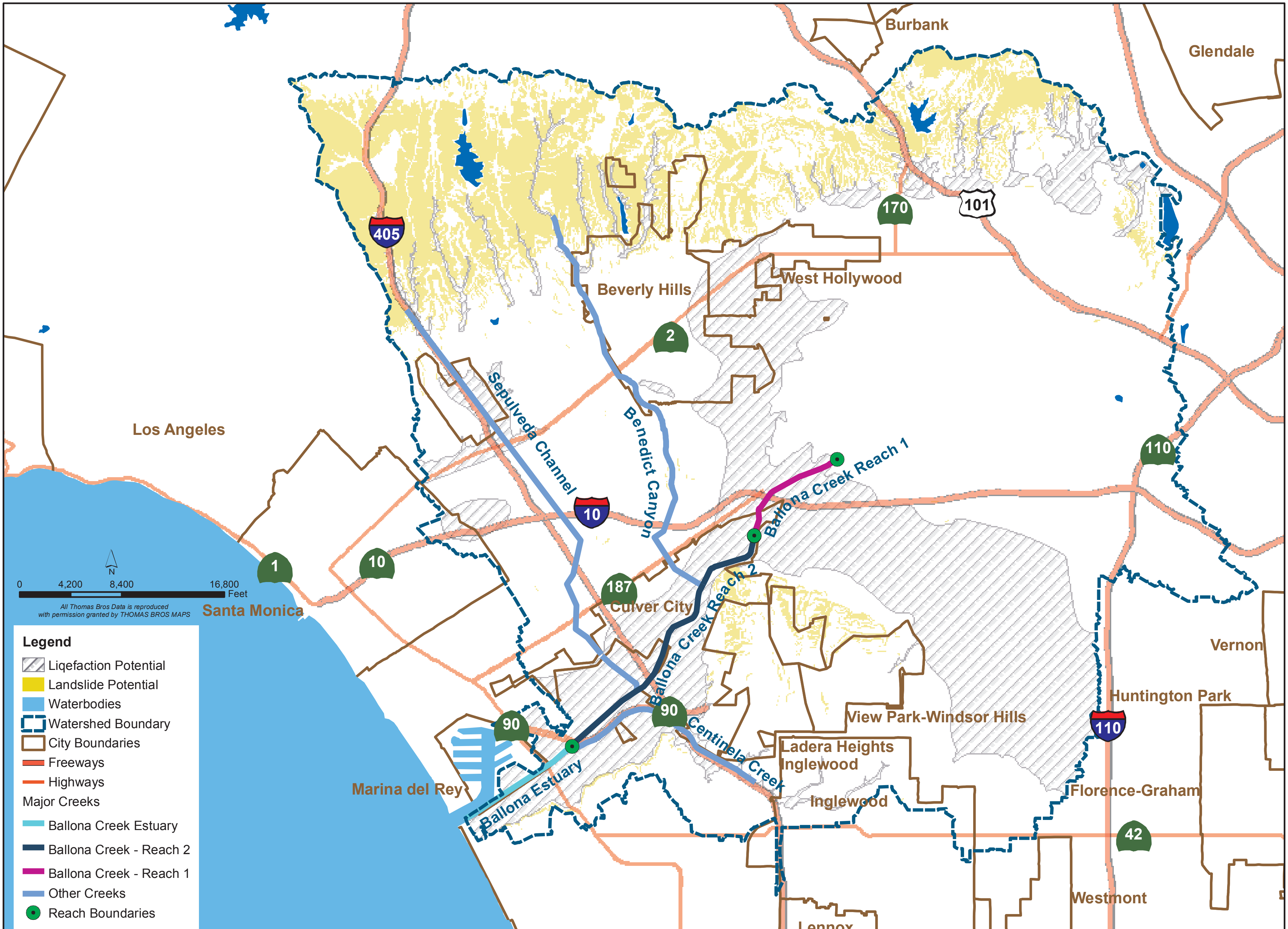

Figure 2-9 Ballona Creek Watershed - Areas of Landslide and Liquefaction Potential

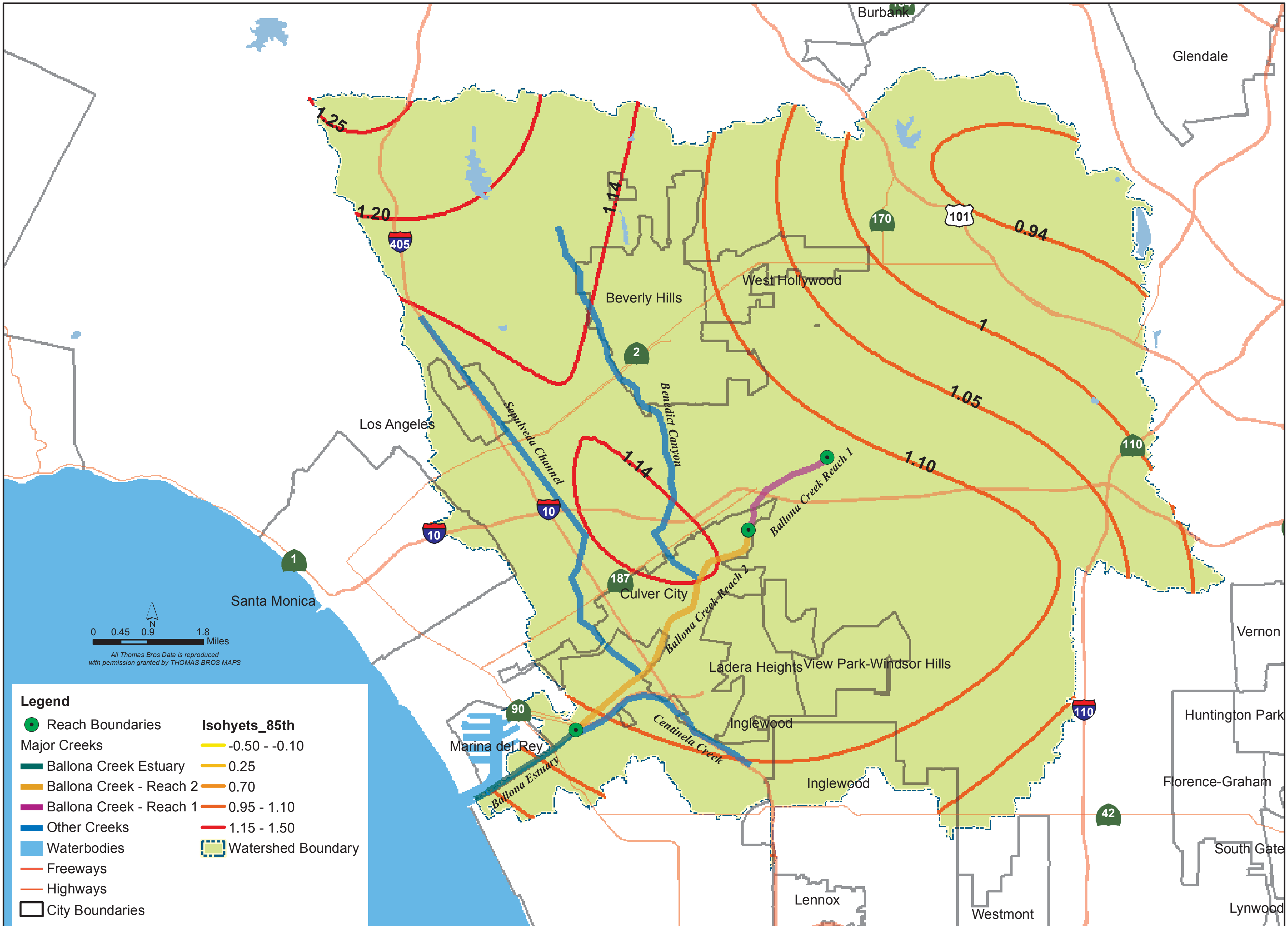

Figure 2-10 Ballona Creek Watershed - Rainfall (85th-percentile 24-hour rainfall depths)

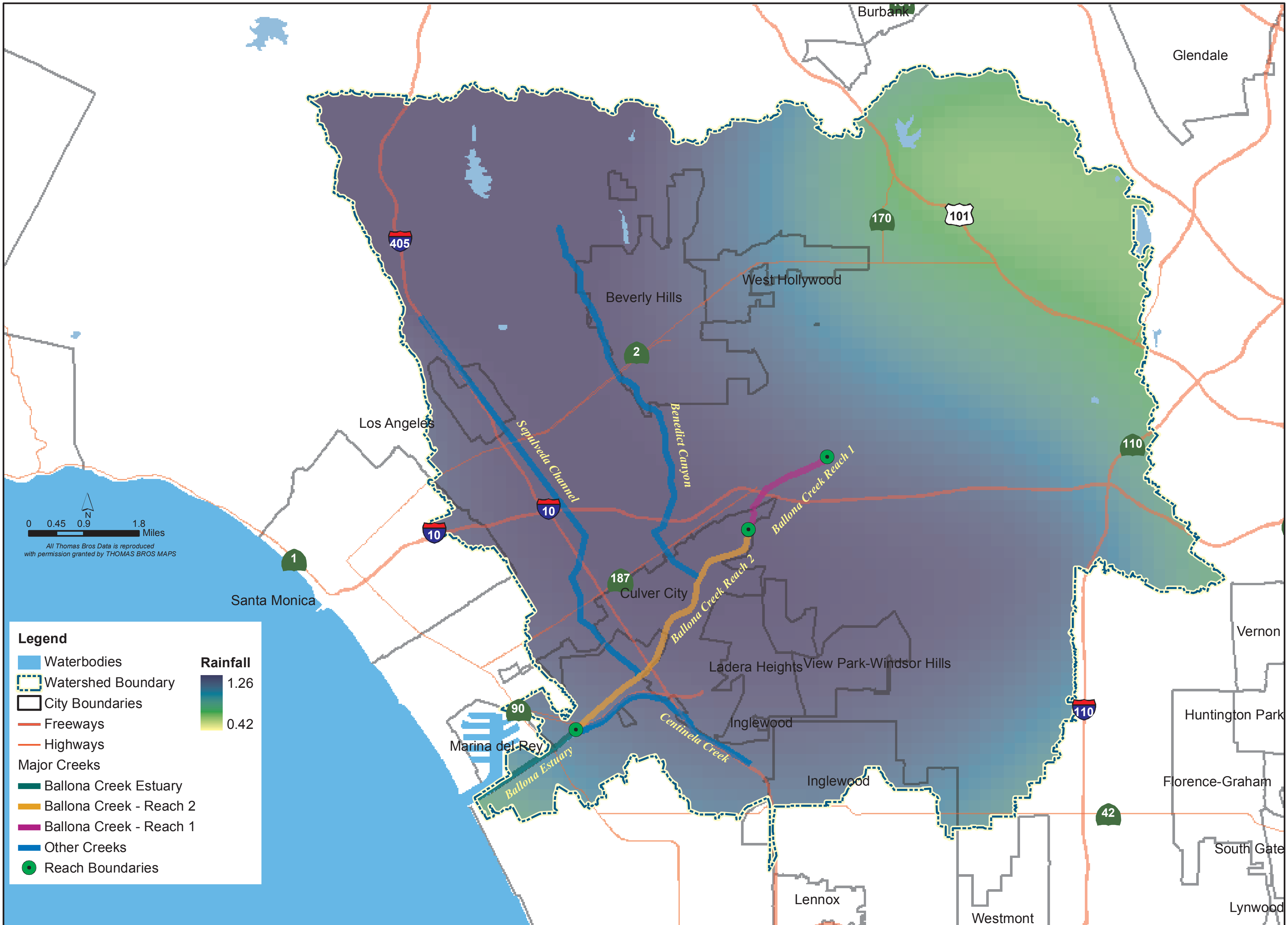

Figure 2-11 Ballona Creek Watershed - Rainfall (85th-percentile 24-hour rainfall depths)

Figure 2-12
Average Flow at Ballona Creek above Above Sawtelle Boulevard
October 1998 to March 2008

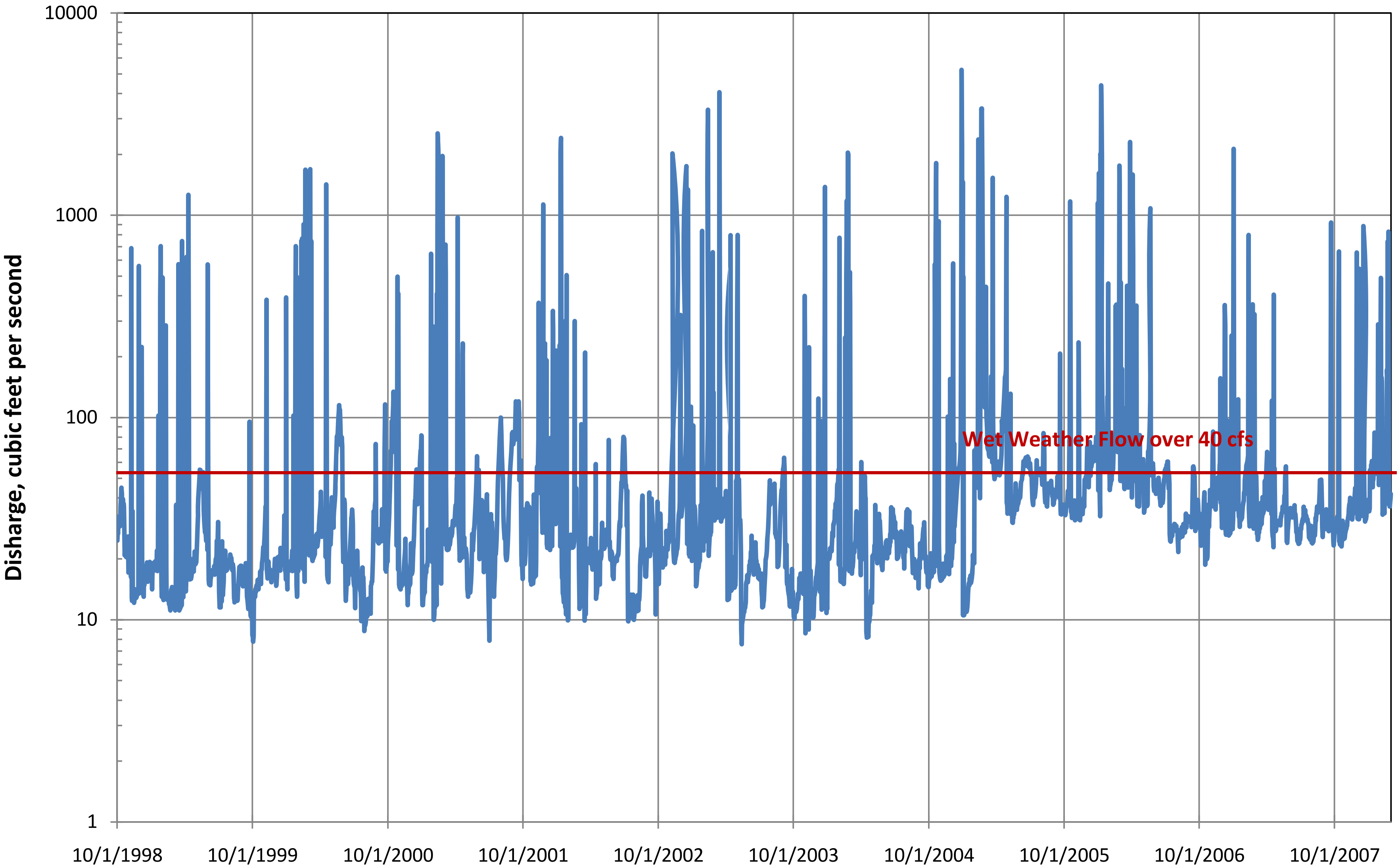

Figure 2-13 Ballona Creek Watershed - Monitoring Locations

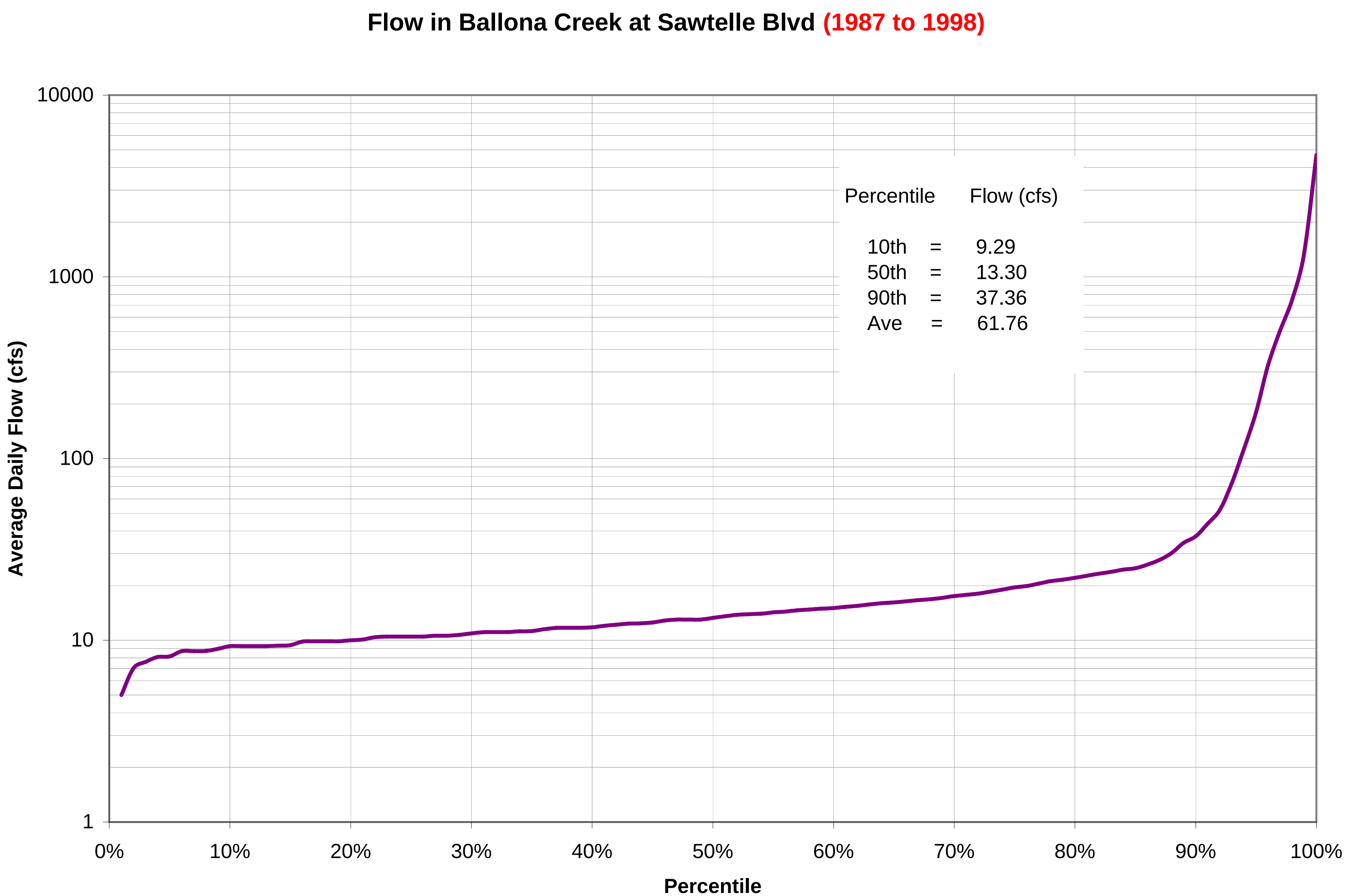

Figure 2-14
Flow In Ballona Creek at Sawtelle Blvd (1987 to 1998)

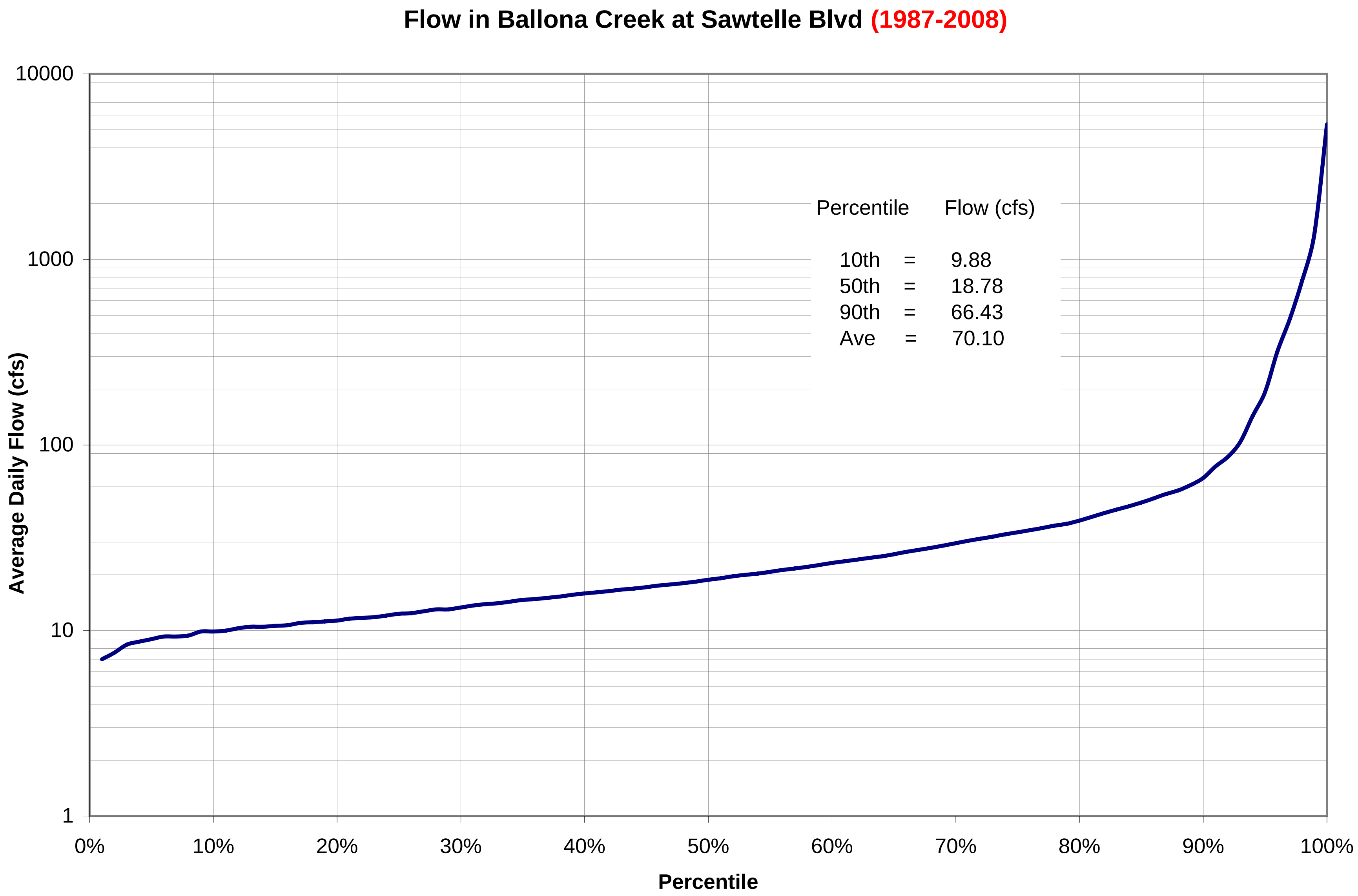

Figure 2-15
Flow In Ballona Creek at Sawtelle Blvd (1987 to 2008)

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Section 3
Stakeholder-Based Planning

One of the guiding principles of this Implementation Plan is to improve upon existing programs. Accordingly, an important step in developing the Implementation Plan included consulting with stakeholders on BMP implementation opportunities. Identifying these opportunities creates the foundation for collaborative implementation of water quality improvement projects. This section summarizes the processes used to coordinate with stakeholders, ongoing watershed planning activities, and specific BMP opportunities identified by stakeholders.

3.1 Coordination with Stakeholders

During the development of this Implementation Plan, the responsible jurisdictions conducted community stakeholder workshops, participated in Ballona Creek Watershed Task Force meetings, and held one-on-one discussions with key Non-Governmental Organizations (NGOs).

Workshops

Two stakeholder workshops were held as follows:

- *Workshop 1*: Watershed Characterization, City of Culver Council Chambers, November 6, 2008

- *Workshop 2*: Best Management Practices Strategies, City of Los Angeles Hyperion Treatment Facility, March 3, 2009

Appendix C provides the agenda and presentation for each workshop. Each workshop was well attended and included open discussions. Workshop 2 provided an opportunity for stakeholders to break up into smaller groups and discuss opportunities for structural and institutional BMP implementation based on their local knowledge of the watershed. A third workshop is planned in conjunction with the development of implementation plans for other upcoming TMDLs.

Ballona Creek Watershed Task Force

The Ballona Creek Watershed Task Force prepared the Ballona Creek Watershed Management Plan (BCWMP) in 2004. The BCWMP includes many projects and programs with opportunities for collaboration with the TMDL Implementation Plan.

Several responsible jurisdictions, including the City of Los Angeles, several City Council Districts, County of Los Angeles, and Culver City are regular participants of the Ballona Creek Watershed Task Force, which meets every other month. Other participants include the following:

- Ballona Creek Renaissance
- Santa Monica Bay Restoration Commission (SMBRC)
- Mar Vista community groups
- Mountains Recreation and Conservation Authority
- Surfrider Foundation
- Heal the Bay
- Santa Monica Baykeeper
- Private residents
- US Army Corps of Engineers
- Baldwin Hills Conservancy
- Ballona Wetlands (including: Ballona Institute, Friends of Ballona Wetlands, Ballona Wetlands Land Trust)
- Los Angeles Regional Water Quality Control Board
- Playa Vista
- California State Coastal Conservancy

BMP Opportunities Developed with Stakeholders

City of Los Angeles Watershed Protection Division staff met on many occasions with stakeholders on an individual basis to obtain information on specific BMP opportunities in the watershed, both active and proposed. Consultations with stakeholders were held over a period of ten months.

Stakeholder meetings were also held with specific watershed organizations, including the SMBRC, Ballona Ecosystem Education Project, Ballona Creek Watershed Task Force, and the Ballona Renaissance. In addition, the former Ballona Creek Watershed Coordinator provided substantive input on potential watershed projects based on previous work performed as the watershed coordinator. Some of the projects discussed are described in the following documents: B*allona Creek Watershed Management Plan 2004, Santa Monica Bay Restoration Plan 2008, and the Green Solution Project 2008.* Meetings included field inspections of potential BMP sites, and discussion regarding projects and programs needed to address Ballona Creek water quality. The following sections describe some of the key structural and institutional BMPs recommended during these consultations.

3.2 Structural BMPs

Potential BMP opportunities identified by watershed stakeholders are located throughout the watershed (Figure 3-1 northwest quadrant; Figure 3-2 southwest quadrant; Figure 3-3 northeast quadrant; Figure 3-4 southeast quadrant). Table D-1 in Appendix D provides additional information regarding each of the potential BMP sites identified in these figures. Some BMP projects[1] investigated with stakeholders and potential collaboration partners include:

- *Mar Vista (Oval Street)* –curbcuts, bioswales, and subsurface infiltration swales, serving a drainage area of approximately 150 acres. The Mar Vista Community Council has been identified as the potential collaboration partner for this project.
- *Ballona Creek Street Ends from Cochran Avenue to Hauser Boulevard* –bioswales and native tree planting at several streets that end at Ballona Creek, serving a drainage area of approximately 25 acres. The Ballona Creek Watershed Task Force would be the potential collaboration partner for this project.
- *Occidental Boulevard* –utilize the wide parkway medians by installing vegetated swales, curbcuts, and porous pavement, serving a drainage area that ranges between approximately 31 and 83 acres, depending upon the length of the area of implementation. The Ballona Creek Watershed Task Force would be the potential collaboration partner.
- *Venice Blvd. New Preschool* – bioretention in parkways with underdrains along Venice Boulevard, serving a drainage area of approximately 22 acres.
- *Exposition Boulevard Rail Line*—upon coordination with MTA and other responsible parties, this project proposes implementation of stormwater BMPs within the open space along the rail line. This project would include bioswales, permeable pavements, and native tree planting. This project is located in the area of moderately-high to high pollutant loading. Potential partners include MTA, Ballona Creek Watershed Task Force, Ballona Ecosystem Education Project, and others.

3.3 Institutional BMPs

Stakeholders also provided information on institutional BMP projects. Based on their experience in the region, stakeholders identified barriers that have delayed many proposed BMPs and programmatic issues that are recommended for resolution. The following sections summarize these findings. Many of these issues were included in the *Santa Monica Bay Restoration Plan Check-up; Implementation Progress Update 1995 – 2008*, SMBRC, 2008.

3.3.1 Program-Specific

Program-specific institutional BMPs are activities that require implementation of structural BMPs or the establishment of new programs. Three key areas recommended for consideration include:

- *Residential Downspout Disconnection Program* – Stakeholders identified the need for a downspout disconnection program as a priority in the watershed. A grant-

[1] Note: At this time, the following projects represent concepts. No technical planning efforts have been implemented; accordingly engineering and cost feasibility analyses have not yet occurred.

funded pilot program is currently on hold due to State financial issues. This pilot program includes participation by up to 600 residential and commercial property owners and would reduce urban runoff entering Ballona Creek by more than one million cubic feet per year.

- *Education & Outreach Program* – A number of existing educational programs are ongoing in the watershed, including development and implementation of the Environmental Learning Center at the Hyperion Treatment Plant. However, funding varies substantially from year to year. Accordingly, there is a need for a long-term, stable funding source.

- *Downtown Parking Lot Conversion* – Implementing stormwater infiltration BMPs in the highly impervious spaces of the City of Los Angeles downtown area, a portion of which is in the Ballona Creek Watershed, is a challenge due to space constraints. A potential solution is the conversion of downtown asphalt parking lots into permeable pavement designed to retain stormwater runoff onsite in lieu of conveying the runoff to the storm drain system.

3.3.2 Collaborations

A number of stakeholder recommendations in this area are consistent with the second strategy of the WQCMPUR (City of Los Angeles 2008), as discussed in Section 1. These recommendations include the need for greatly improved coordination, collaboration, and planning by all city agencies. Similar recommendations provided by stakeholders included:

- *Inter-Agency Coordination* – Urban runoff management is correctly recognized as an inter-agency responsibility and as such, there is a need for improved coordination in planning and approval processes. Examples include working with development agencies (such as Los Angeles Community Redevelopment Agency) or departments tasked with water management (such as the Los Angeles Department of Water and Power (LADWP)) to consider urban runoff management needs when developing projects for implementation.

- *General Plan Updates* – All cities have an approved General Plan that guides all development activities. An important tool for improving water quality can include reviewing these plans to ensure that urban runoff management elements are incorporated into the planning process.

- *Inter-Agency Task Force* – Stakeholders recommended the establishment of a task force that includes appropriate representation, including decision-makers associated with responsible city or agency departments, NGOs, and SMBRC. The primary purpose of this task force would be to coordinate the review and revision or adoption of new policies and ordinances in a consistent manner throughout the watershed. Other functions could include facilitation of BMP implementation and coordination of similar programs across jurisdictions.

- *Watershed Management Support* – NGOs have completed several key studies in the watershed that contain recommendations for improved urban runoff management, such as the Ballona Creek Watershed Management Plan, Green Solutions Project, and Santa Monica Bay Restoration Plan. It is recommended that the responsible jurisdictions work with the NGOs to plan and implement many of the projects already identified, or potentially fund elements that would help support NGO management efforts.

3.3.3 Regulations and Enforcement

Stakeholders have identified the need for responsible jurisdictions to have sufficient authority and programmatic structure to move urban runoff management activities in a common direction towards synergy rather than conflict. Similar to the issues described in the previous section, many of the identified needs in this area are key elements already identified in the WQCMPUR (City of Los Angeles, 2009). Specific issues highlighted by stakeholders include:

- *Ordinances* – Adopt or revise ordinances that promote urban runoff management such as a stream protection ordinance that limits development adjacent to waterbodies (note that the City of Los Angeles is currently working on developing such an ordinance).

- *Policy* – Develop policies or revise current policies such as beneficial reuse of stormwater, green building, permeable pavement, possible use of Quimby Act fees to buy vacant properties for BMP use, and purchase of properties along stream alignments when available.

- *Incentive and Rebate Programs* – Establish incentive/rebate programs to encourage improved urban runoff management. Examples of incentive/rebate programs include (a) programs to encourage retention of urban runoff on individual parcels through activities such as installation of rain barrels and/or creation of rain gardens; and (b) conversion of lawns to drought tolerant gardens with low water use, or installation of smart irrigation to reduce dry weather runoff.

- *Standard Urban Stormwater Mitigation Plan (SUSMP) Enhancement* – Enhance the current NPDES Permit SUSMP requirements to include LID principles (e.g., increase permeable surfaces, maintain pre-development hydrology).

- *Enforcement* – Evaluate enforcement authority to increase penalties for over-consumption of water. Coordinating ongoing LADWP conservation efforts with the need to reduce dry weather runoff sources would help meet TMDL compliance requirements.

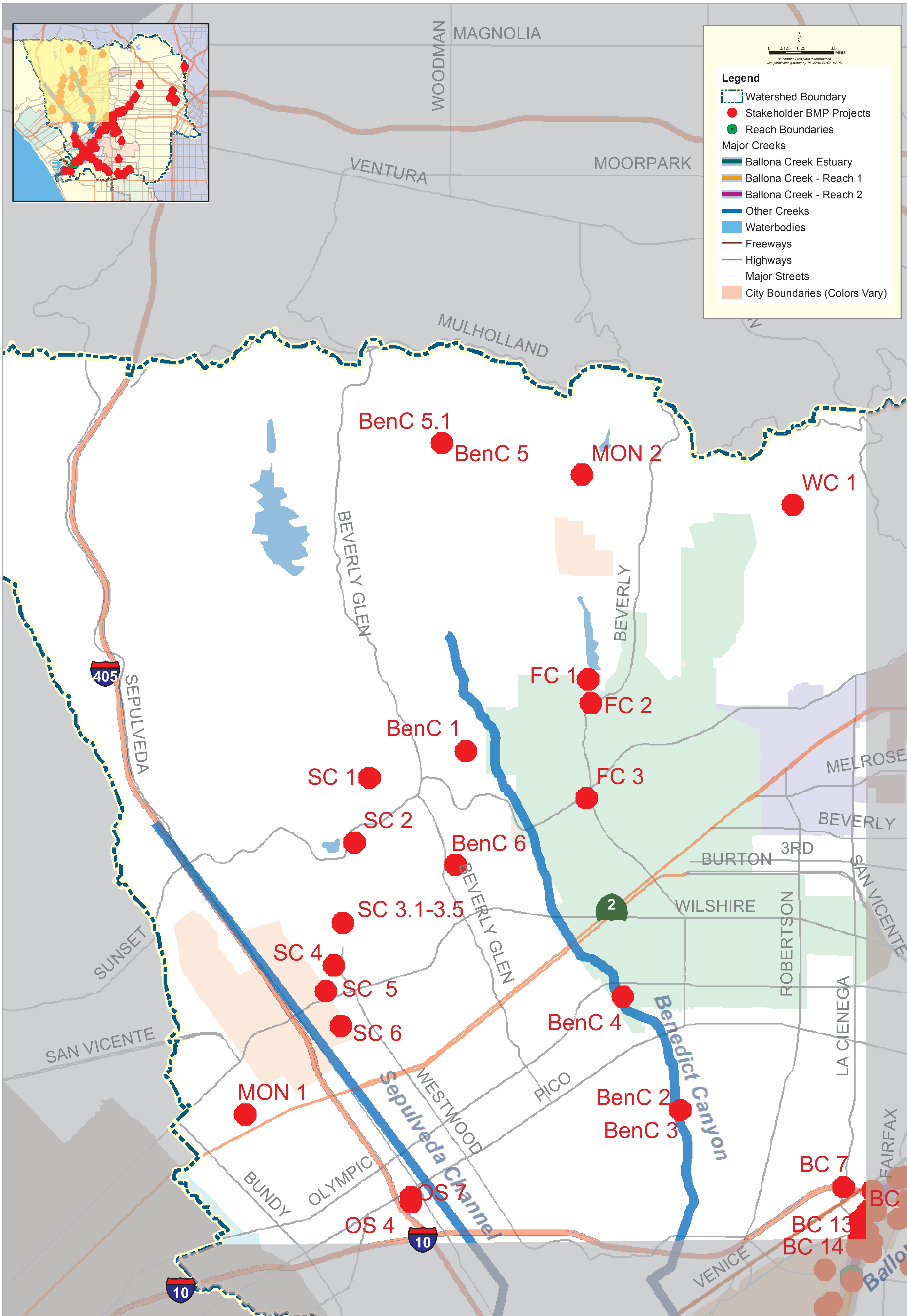

Figure 3-1 Stakeholder Identified BMP Opportunities (NW Quadrant)

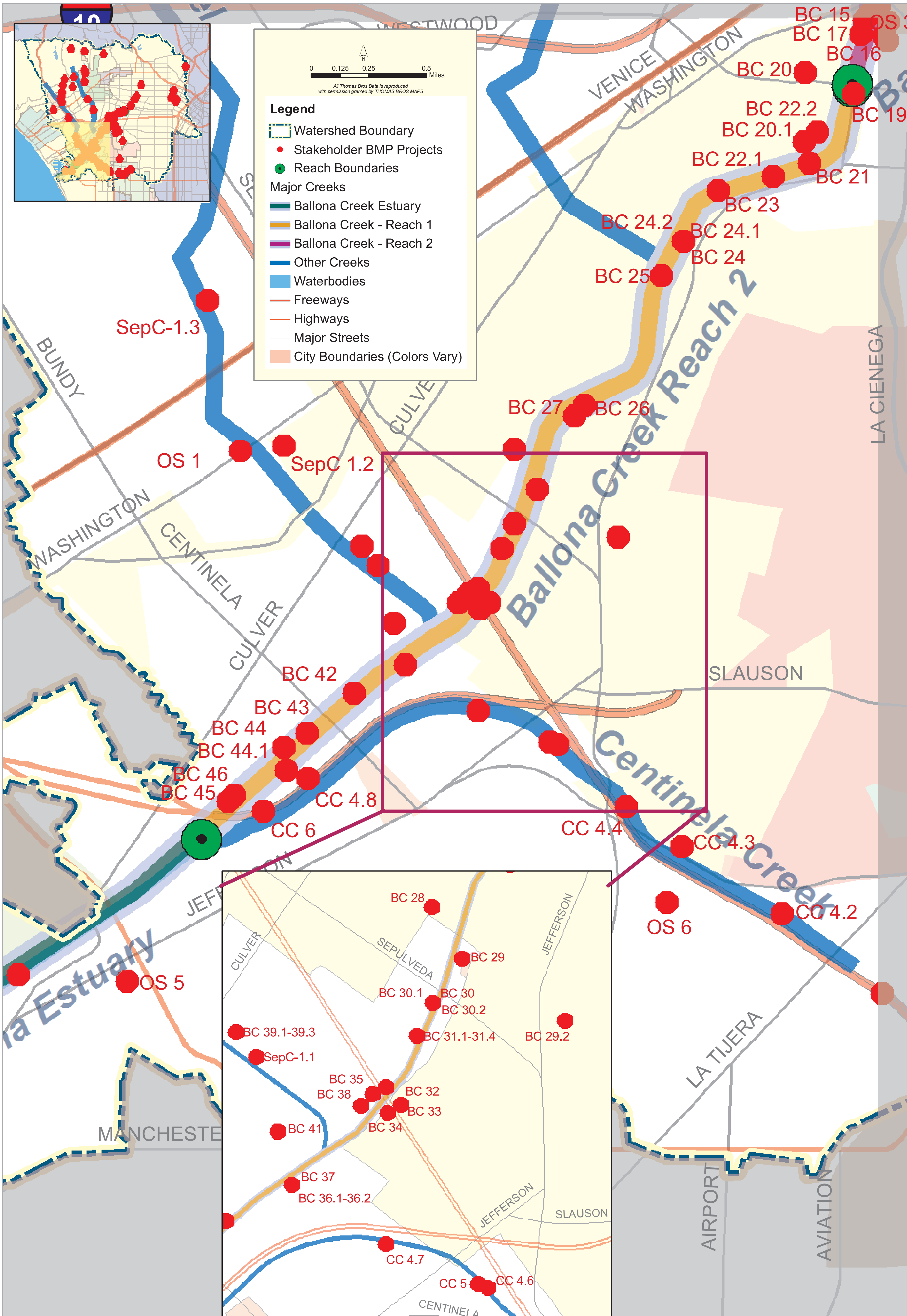

Figure 3-2 Stakeholder Identified BMP Opportunities (SW Quadrant)

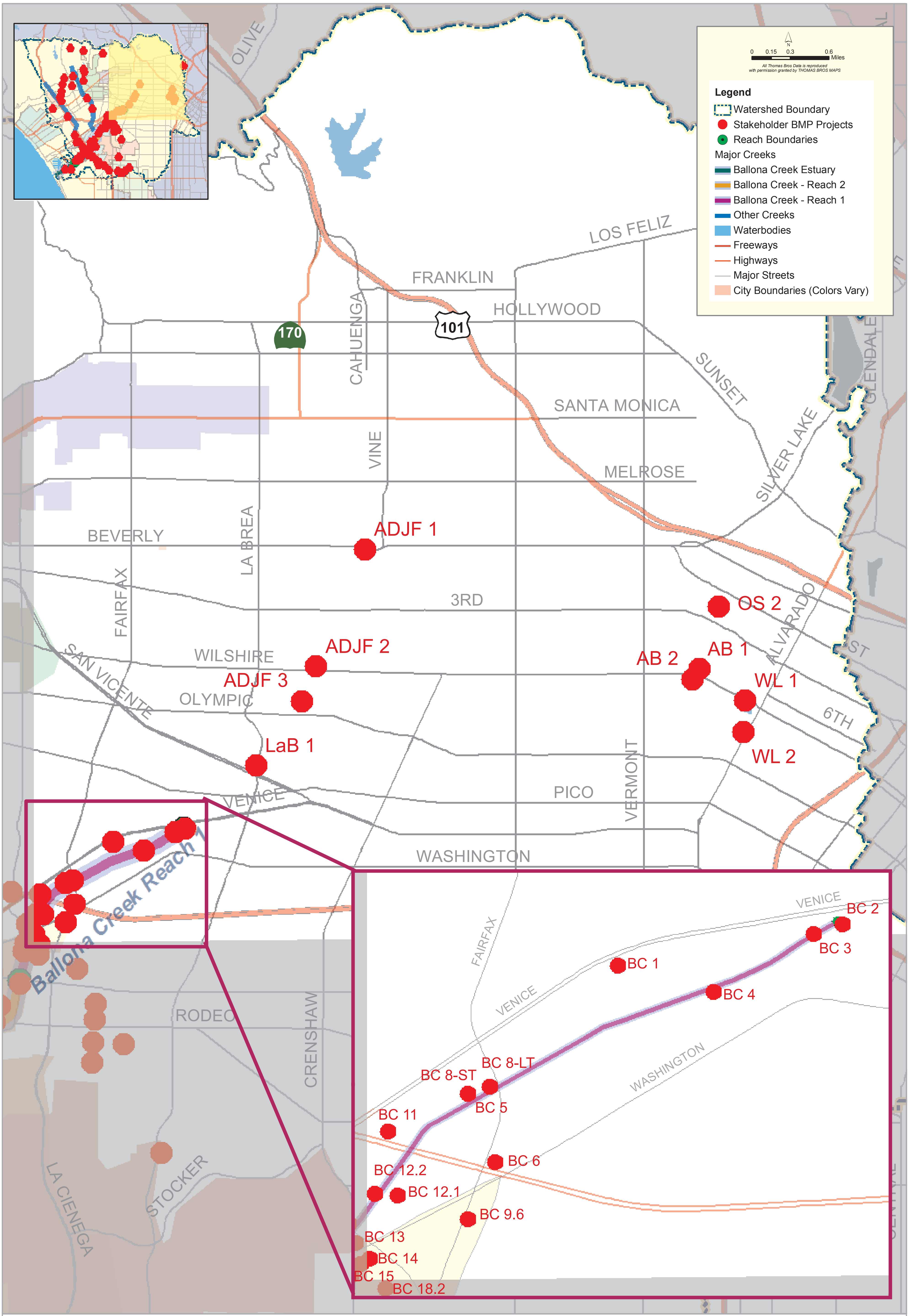

Figure 3-3 Stakeholder Identified BMP Opportunities (NE Quadrant)

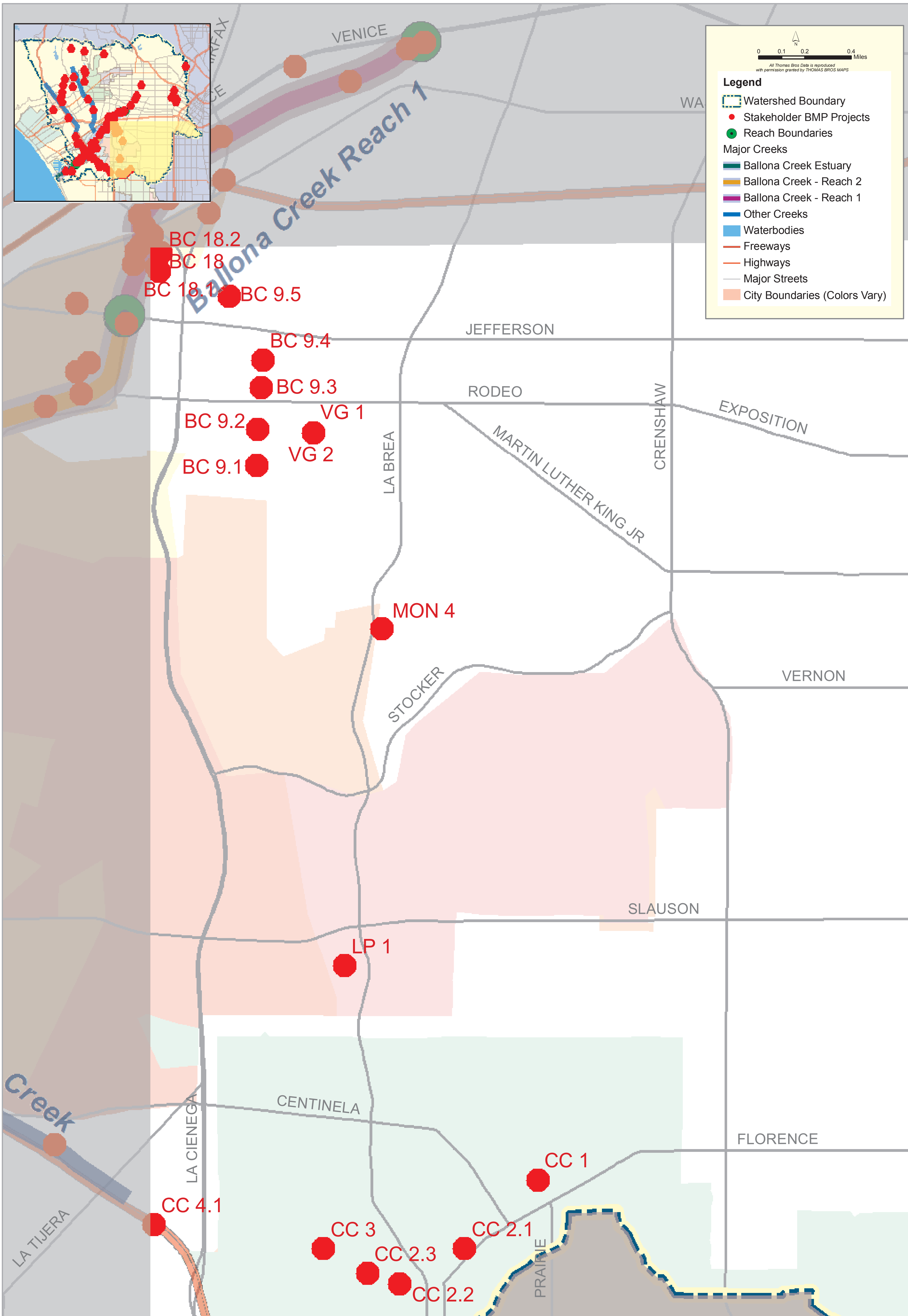

Figure 3-4 Stakeholder Identified BMP Opportunities (SE Quadrant)

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Section 4
Technical Analysis

This Implementation Plan relies on both structural and institutional BMPs that, in combination, work together towards achieving compliance with TMDL targets. Where possible, the selection of BMPs emphasizes an integrated water resources approach that relies first on the implementation of green solutions. The process for selecting appropriate BMPs varied depending on whether the BMP was structural or institutional, and both of these processes will be outlined in this section. In addition, structural BMPs include one of two types:

- *Regional BMPs* - Defined as centralized stormwater facilities, typically placed near the outlet of a catchment (a drainage area of approximately 40 acres) or subwatershed (a group of catchments with a common outlet) that are designed to treat urban runoff from a relatively large drainage area (drainage areas ranging from 20 acres to several hundred acres). These BMPs include, for example, infiltration facilities, detention basins, subsurface flow (SSF) wetlands (including detention), surface flow (SF) wetlands, treatment facilities, manufactured separation systems (e.g., hydrodynamic separators and trash nets/screens), and channel naturalization (e.g., storm drain daylighting, revegetation, and wetland channel establishment).

- *Distributed BMPs* - Defined as stormwater collection devices and landscaping practices dispersed throughout a catchment that serve relatively small drainage areas (typically 10 acres or less). These BMPs include, for example, cisterns, bioretention, vegetated swales, green roofs, porous/permeable pavements, gross solids removal devices, media filters, and catch basin inserts.

Sections 4.1 through 4.2 describe the methods used to identify structural BMP opportunities throughout the watershed, and the method utilized to select the best BMP projects for implementation. Section 4.3 summarizes institutional BMP opportunities and the selection process for BMP implementation.

4.1 Structural BMP Selection Methodology

The Los Angeles County-wide Structural BMP Prioritization Analysis Tool (SBPAT)[1] provided the means for identifying potential BMP locations and types for implementation. SBPAT screens areas based on *need* (i.e., pollutant load generation and downstream impairments), and then identifies *opportunities* (i.e., appropriateness of the area, adjacent storm drains) for BMP implementation. SBPAT uses a GIS-based decision tool that relies on four steps for identifying BMP implementation opportunities (Figure 4-1):

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1 Developed by Geosyntec Consultants for the County of Los Angeles Department of Public Works, Heal the Bay, and the City of Los Angeles Bureau of Sanitation

1. ***Catchment Prioritization*** - Prioritize catchments based on water quality management need (e.g., pollutant-loading, receiving water issues) (Section 4.1.1).

2. ***Identification of Structural BMP Opportunities*** - Identify potential BMP opportunities within high priority catchments based on factors such as parcel size, land use, and ownership (Section 4.1.2).

3. ***Structural BMP Prioritization*** - Identify appropriate BMPs based on factors such as cost, maintenance, and effectiveness for the pollutants of concern (Section 4.1.3).

4. ***Site-Specific BMP Evaluation*** - Develop site-specific implementation strategies based on desktop analyses and field investigations (Section 4.2).

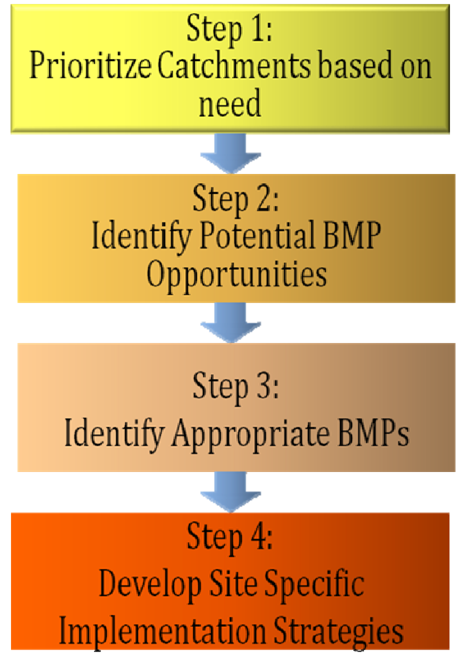

Figure 4-1
Steps for Selection of Structural BMPs

The following sections summarize the implementation of these analysis steps in the Ballona Creek Watershed. A more detailed explanation of the methodology can be found in Appendix E or in the SBPAT Guidance Manual (Geosyntec, 2006).

4.1.1 Catchment Prioritization

Overview

This step identifies the catchments within the entire Ballona Creek Watershed that have the potential to generate the highest pollutant load during wet weather events. This analysis relies on Event Mean Concentration (EMC) data applicable to different land uses.

To evaluate potential pollutant loadings based on land use, SBPAT modeled specific constituents. In some cases, these constituents were the same as the TMDL listing. In other cases, a surrogate constituent was used. For example, the Bacteria TMDL includes compliance targets for the following bacteria indicators: fecal coliform, total coliform, enterococcus, and *E. coli.* Of these constituents, SBPAT only models fecal coliform because sufficient EMC and BMP effectiveness data have been developed for this bacterial indicator. However, fecal coliform modeling may serves as a surrogate for the other bacterial indicators because:

- Total coliform, *E. coli*, and enterococcus concentrations are generally correlated with fecal coliform concentrations; thus, it is reasonable to assume that locations identified as priorities for fecal coliform mitigation are also priority locations for the other bacterial indicators; and

- The mechanism for bacterial removal in potential BMPs is expected to be the same regardless of the type of bacterial indicator.

While this Implementation Plan is being submitted to meet the requirements of the Bacteria TMDL, the other pollutants of concern (discussed in Section 1) were considered when prioritizing catchments and selecting BMPs. Since one of the guiding principles of this Implementation Plan is that it be integrated, and since selecting BMPs that address multiple pollutants follows this principle, this catchment prioritization step also considered specific metals (copper, lead and zinc) and Total Suspended Solids (TSS) (which served as a surrogate for toxicity).

Catchment-Specific Catchment Prioritization Index (CPI)

SBPAT calculated a CPI for each of the 2,819 catchments in the Ballona Creek Watershed based on the potential for each catchment to contribute pollutant loads for any modeled pollutant of concern. The CPI assigned to each catchment ranges from 1 to 5, with 5 representing the highest priority. For a more detailed explanation of the CPI calculation, see Step 1 of the SBPAT Guidance Manual (Geosyntec, 2006). Following is a brief summary of the key elements of this step.

First, pollutant-specific CPI scores were calculated for each catchment as the product of area-weighted pollutant EMCs, area-weighted 85th-percentile precipitation depths (see Figure 2-10 – rainfall isohyet figure in Section 2), and area-weighted volumetric runoff coefficients (based on land use from Southern California Association of Governments [SCAG] and land use runoff coefficients reported by Ackerman & Schiff, 2003; Table 4-1 below).

Table 4-1
Runoff Coefficient based on Land Use

Land Use	Runoff Coefficient[(1)]
Commercial/Educational	0.61
Industrial/Transportation/Other Urban	0.64
Open	0.06
Residential	0.39

[(1)]Source: Ackerman, D. and K. Schiff. Modeling Storm Water Mass Emissions to the Southern California Bight. J. of Environmental Engineering. April 2003. pp. 308-317.
Notes: "Other urban" category, which includes "mixed industrial/commercial" and "under construction" SCAG land use categories, represents <1% of total County area

Second, the pollutant CPI scores for each catchment were then normalized by the maximum observed score for each pollutant and weighted by pollutant group based on the relative importance assigned to each pollutant group. Table 4-2 summarizes the consensus-based pollutant group weights (as determined by the participants in the development of SBPAT).

Table 4-2
Pollutant Group Weights for Normalized Pollutant CPI Calculation

Pollutant	Weight
Trash	0
Nutrients (Nitrate)	0
Bacteria (Fecal Coliform)	10
Total Metals (Total Copper, Total Lead, Total Zinc) (5 points each)	15
Total Suspended Solids (representing sediment)	5

Third, the adjusted fecal coliform and metals pollutant CPI scores for each catchment were multiplied by 3 to weight them higher because they represent constituents for which a TMDL has already been adopted. This adjustment resulted in a preliminary CPI score. Final CPI scores were obtained by normalizing the preliminary CPI scores to a maximum possible score of 5.

Catchment Prioritization

A CPI analysis was completed for each of the analyzed pollutants (fecal coliform, copper, lead, zinc, TSS). The prioritization results for each pollutant (1–lowest priority to 5-highest priority) are illustrated in the following Figures 4-2 through 4-6:

- Fecal Coliform (Figure 4-2)
- Copper (Figure 4-3)
- Lead (Figure 4-4)
- Zinc (Figure 4-5)
- TSS (Figure 4-6)

An integrated catchment prioritization map was developed which represents the weighted average of all of the analyzed pollutants (Figure 4-7). This integrated map provides a final catchment-specific prioritization that is multi-pollutant based.

A “nodal” catchment prioritization index, or NCPI, was used to group hydrologically linked high-priority catchments with “downstream” catchments that may be utilized for potential regional BMP implementation. Using the downstream catchment attribute, catchments tributary to each network node were identified and an area-weighted average CPI score for that node was computed. After rounding to the nearest integer, each catchment was assigned the NCPI value of its associated outlet node. This is illustrated in Figure 4-8, which provides the final NCPI results.

Catchments with high NCPI scores are characterized as having an upstream tributary area that contains a relatively large proportion of high priority catchments. A comparison of the spatial distribution of NCPI scores (Figure 4-8) with CPI scores shows general agreement regarding the classification of priority catchments. High priority NCPI catchments are typically down-gradient of, or are themselves, high priority catchments as determined by the CPI score (see Figure 4-7).

Prioritization Results

Based on the analysis described above, Table 4-3 summarizes the distribution of CPI scores and Nodal CPI scores. The catchments with the highest scores were carried forward to that next step, SBPAT Step 2. The method for determining the number of distributed and regional opportunity sites that corresponds to each score is described in the following Section 4.1.2.

Table 4-3
Number of Catchments Compared to Potential Opportunities (by ranking)

Score	Distributed Sites		Regional Sites	
	Total # of Catchments	# of Distributed Opportunities	Total # of Catchments	# of Regional Opportunities
5	131	18	80	161
4	353	48	240	49
3	1,109	128	1,276	0
2	1,198	577	1,213	0
1	28	1578	10	0
0	NA	470	NA	2,609
Total	2,819	2,819	2,819	2,819

4.1.2 Identification of Structural BMP Opportunity Sites

Step 2 of the methodology focuses on locating potential BMP opportunities within the high priority catchments identified in Step 1. Priority catchments identified in Step 1 were screened to determine the best opportunities to implement regional and distributed structural BMPs, based on screening factors such as parcel size, land use, and ownership. In addition, proximity to storm drains was an important factor for regional BMP opportunities. A more detailed explanation of the process for identifying BMP opportunities is included in Step 2 of the SBPAT Guidance Manual (Geosyntec, 2006).

Based on the selected screening factors, regional and distributed structural BMP opportunity scores were calculated for each catchment in the Ballona Creek Watershed. These structural BMP opportunity scores served as the basis for prioritizing the catchments for BMP implementation by ranking them on a scale from 1 to 5, with 5 representing the best opportunity for implementation. Table 4-3 summarizes the number of opportunity catchments by BMP type and rank.

For the regional BMPs, the NCPI rankings were coupled with the Regional BMP Opportunity Score rankings (Table 4-3) to identify the best catchments for BMP implementation, i.e., scores of 3, 4 or 5 for both the NCPI ranking and BMP

Opportunity Score. This analysis identified a total of 87 priority catchments (Figure 4-9).

For the distributed BMPs, the CPI rankings were coupled with the Distributed BMP Opportunity Score rankings (Table 4-3) to identify the best catchments for BMP implementation, i.e., scores of 3, 4 or 5 for both the CPI ranking and BMP Opportunity Score. This analysis identified a total of 189 priority catchments (Figure 4-10).

The high priority regional and distributed BMP catchments selected (per the above method) were carried forward to the Step 3 level of analysis.

4.1.3 Structural BMP Prioritization

SPBAT Step 3 uses four general screening categories to determine which types of structural BMPs may be most appropriate for each of the priority catchments identified in Step 2. These categories include:

- Effectiveness
- Cost
- Ease of implementation
- Other environmental factors

The output from implementing this step is a series of catchment-specific comparison tables that apply user-defined weights to a variety of BMP evaluation criteria. This calculates relative scores for each distributed and regional BMP type. The result is a ranking of potential BMPs for each site. The following sections describe the types of BMPs considered for implementation under this step. Appendix F provides the relative BMP scores calculated for each catchment.

4.1.3.1 Regional BMPs

- *Infiltration Systems* - Volume-based BMPs similar to stormwater retention systems but are constructed with a highly permeable base specifically designed to infiltrate captured runoff. Because it is usually not practical to infiltrate runoff at the same rate that it is captured, these facilities usually include both storage and drainage components. Pretreatment BMPs such as swales, filter strips, and sediment forebays/basins/manholes that minimize sediment loading to the infiltration facility are recommended to increase longevity and reduce maintenance costs.

- *Detention Basins* (also known as dry ponds and detention ponds) – Detention systems are BMPs designed to collect and store runoff for gradual release. Basins should have outlets designed to detain the storm runoff for 36 to 48 hours to allow sediment particles and associated pollutants to settle and be removed. These facilities may also be used to provide hydromodification and/or flood control by modifying the outlet control structure design and including additional detention storage.

- *SSF Wetlands with Detention* –Engineered, below-ground treatment wetlands that include many of the natural treatment processes of surface flow constructed wetlands as well as the filtration mechanisms of media filters. Water flows through a granular matrix, which typically supports the growth of emergent wetland vegetation on the surface. The matrix provides a significant surface area for the filtration of particulate bound constituents and the growth of bacterial biofilms that metabolize and degrade many pollutants including nutrients, bacteria, dissolved metals, and organic compounds. Due to the low treatment flow rates, an equalization basin is typically needed to handle peak flows and provide near constant discharge to the facility.

- *Constructed Wetlands/Wetponds – A naturalis*tic retention system BMP that includes a permanent or seasonal pool of water. Aquascape facilities, such as artificial lakes, are a special form of wetpond that can incorporate innovative design elements to allow them to function as a stormwater treatment facility in addition to an aesthetic water feature. The main pollutant removal mechanism is sedimentation. Other pollutant reduction processes include dilution and biological processes such as microbially-mediated transformations and plant uptake and storage.

- *Treatment Diversion* – Urban runoff may be diverted from the storm drain system to a conventional wastewater treatment facility. Additionally, there are proprietary, treatment technologies that could possibly provide runoff treatment on a small scale in localized drainage areas before discharging to receiving waters. Small packaged systems are available using traditional treatment methods such as grit removal, primary sedimentation, secondary sedimentation/filtration, and disinfection using chlorine. An equalization basin upstream of the treatment plant would typically be required to smooth the peaks of runoff events.

- *Hydrodynamic Devices* - Flow-based mechanical BMPs that remove pollutants from stormwater by physical separation processes making use of the influent flow stream energy. Removal processes include physical separation of solids and associated pollutants. Hydrodynamic separators are typically installed in-line with storm drains and require regular maintenance of the filtration devices.

- *Channel Naturalization* - Includes projects such as storm drain daylighting, channel revegetation, and wetland channel establishment. Natural pollutant attenuation processes can occur in these types of water systems.

4.1.3.2 Distributed BMPs

- *Cisterns* - Volume-based BMPs that collect and store runoff from storm events for use or disposal after the storm event has ended. Cisterns range in size from rain barrels to underground storage tanks.

- *Bioretention Facilities* - Volume-based BMPs resembling vegetated, landscaped, shallow depressions that provide storage, infiltration, and evapotranspiration. Bioretention areas also remove pollutants by filtering stormwater through plants adapted to the local climate and soil moisture conditions, and an engineered soil mix. In bioretention areas, pore spaces, microbes, and organic material in the engineered soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants, such as dissolved metals and petroleum hydrocarbons, into the soil matrix. Bioretention areas function to reduce runoff volumes by capturing and infiltrating stormwater. However, underdrains can be provided where the underlying soils have low permeability.

- *Vegetated Swales* - Flow-based BMPs resembling open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels; provide the opportunity for volume reduction through infiltration and evapotranspiration; and reduce the flow velocity, in addition to conveying stormwater runoff.

- *Porous/Permeable Pavement* - Area-based BMPs that include a variety of different paving methods that allow infiltration of stormwater, including pavers, porous asphalt, porous concrete, and others. Each is characterized by the ability to rapidly infiltrate water from the surface into subsurface storage for eventual infiltration. Typically designs include an aggregate or sand reservoir below the wearing surface that accumulates water during a storm and draws down by infiltration and evaporation. Impervious surfaces may drain to permeable pavement, thereby further reducing runoff.

- *Green Roofs* - Area-based BMPs that include a variety of roof-top landscaping that promote water retention and attenuation of peak runoff from roofs. Designs range from those consisting of simple layers of aggregate and soil to those including various layers of soil, synthetic retention layers, gravel, and underdrains. Each is characterized by the ability to store a portion of the water from a storm event and evapo-transpire stored water between events. Note that, as shown in Section 5, no green roofs are included in this Implementation Plan through 2021.

- *Gross Solids Removal Devices (GSRDs)* - Flow-based BMPs that include a variety of proprietary BMPs to remove large solids, such as trash and litter, from stormwater by physical separation processes, making use of the energy of the influent flow. Removal processes include physical separation of solids and associated pollutants. GSRDs are characterized by relatively small storage volume compared to treatment flow rate, resulting in minor changes to site hydrology as a result of implementation. Note that, as shown in Section 5, no GSRDs are included in this Implementation Plan through 2021.

- *Media Filters* - Flow-based proprietary and non-proprietary BMPs that remove pollutants from stormwater by media filtration. Removal processes include physical separation (filtration of solids), sorption of some dissolved solids, and limited biological activity. Media filters are characterized by relatively small storage volume compared to filtration flow rate, resulting in minor changes to site hydrology as a result of implementation. Note that, as shown in Section 5, no media filters are included in this Implementation Plan through 2021.

- *Catch Basin Inserts* - Manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media to remove floating oils and grease. There are a multitude of inserts of various shapes and configurations, typically falling into one of three groups: socks, boxes, and trays. Inserts are an easy and inexpensive retrofitting option as drain inlets are already a component of most standard drainage systems. Note that, as shown in Section 5, no catch basin inserts are included in this Implementation Plan through 2021.

4.1.3.3 Green Solution and Multi-Benefit BMPs

The BMP rankings, based on technical analyses specific to each catchment, were used to assist with the selection of the best regional and distributed BMPs for each site (as described in the list above). Also considered was the opportunity to use integrated water resources approach and implement green solution BMPs, or BMPs that provide multiple benefits.

Green solution structural BMPs focus on: (1) reducing the volume of urban runoff (thereby indirectly improving water quality); and (2) removing pollutants from urban runoff through natural processes. Similarly, multi-benefit BMPs can provide ancillary benefits to the watershed, harvesting stormwater for irrigation, infiltration for groundwater recharge, and other beneficial uses such as creating more green open spaces.

Table 4-4 categorizes the regional and distributed BMPs discussed above, taking into account the other benefits that may be obtained through implementation. All BMPs used in this Implementation Plan fall into one of these categories, with most falling into at least two categories.

Table 4-4
Green Solutions and Multiple Benefit BMPs

BMP Type	Benefits		
	Natural Process	Water Reuse Element	Treat Multi-Pollutants
Regional			
Infiltration Facilities	X	X	X
Detention Basins	X		X
SSF Wetlands with Detention	X		X
Constructed Wetlands/ Wetponds	X		X
Treatment Facilities			X
Hydrodynamic Devices			X
Channel Naturalization	X		X
Distributed/ BMPs			
Cisterns	X	X	X
Bioretention Facilities	X		X
Vegetated Swales	X		X
Green Roofs	X		X
Porous/Permeable Pavement	X	X	X
Gross Solids Removal Devices (GSRDs)			X
Media Filters	X		X
Catch Basin Inserts			X

4.2 Proposed Structural BMPs

4.2.1 Regional BMP Opportunities

The fourth step in the SBPAT methodology is a site-specific screening step. Planning and siting of potential regional structural BMPs is particularly challenging because of the highly developed conditions in the watershed. Because the majority of structural BMPs will need to be retrofit into developed areas of the watershed, the structural

BMP analyses required significant preliminary data collection and field inspections in order to screen, prioritize, and select sites. This section summarizes the methods and results of the process used to (1) identify potential structural regional BMP sites in the watershed, and (2) conduct field inspections to further evaluate the sites. This activity is applied only to those sites that have met all potential criteria up to this point in the analysis process. Three technical steps were followed to further evaluate the 87 regional priority catchments for suitability for regional BMP implementation, as described here.

GIS –Level Screening

This activity relied on GIS to screen sites using a series of "constraints" layers such as landslide zones, poor soil infiltration zones, and environmentally sensitive zones. Based on this analysis, a number of catchments were eliminated from the original list of 87 catchments. Of the remaining potential sites, a representative sample of 30 sites was selected for additional screening (Refer to Appendix E for additional information on this process). The outcome of this step included site-specific maps with the following information:

- Catchment-specific constraints maps (with landslides, slopes, etc.)
- Catchment-specific opportunity maps (with aerial photos, storm drains, parcel ownership, etc.)
- Subwatershed-level drainage/opportunity maps (with drainage patterns)
- Regional opportunity catchment maps (zoomed in maps of the opportunity sites shown in Figure 4-9)

Desktop-Level Screening

This step evaluated individual parcels within each of the 30 selected catchments, and preliminarily selected potential BMP sites. Since, by definition, the regional sites have at least a 50-acre area tributary to the site, the location needs to have sufficient space to construct a BMP and manage the runoff generated from the tributary area. Where opportunities for construction of a regional BMP could not be identified within a catchment, the location was screened out.

In addition to the data provided by SBPAT, this desktop analysis relied on the following tools: Navigate LA, (storm flow, catchment information, boring logs, etc.); ZIMAS (Zoning Information and Map Access System [lot sizes, owner information, planning maps, etc]); Google Earth (aerial and panoramic images); Los Angeles Bureau of Engineering Vault records (as-built drawings of storm drain lines); and information available at www.LAStormdrain.org. Using these sources, the following information was summarized for each site:

- General area description (cross streets, land use, landmarks)

- Drainage area
- Description of potential parcels for BMP Implementation
- Storm drain information
- Subsurface utilities
- Existing BMPs and project proposals
- Neighborhood Council information
- Parks and open space areas
- Utility corridors
- Blacktop areas (school playgrounds)
- Roadways
- Sidewalks and parkway

The outcome of this analysis was the preparation of maps and figures to aid the field investigator when visiting the site to further assess the opportunity to implement a regional BMP at the location.

Based on this desktop analysis, 11 of the 30 potential BMP opportunity sites were eliminated as inappropriate for BMP implementation. The remaining 19 sites were included in the field screening activity. Of these sites, three of them were also identified as opportunities by stakeholders. Appendix F provides the desktop-level screening results.

Field-Level Screening

The final phase in the screening process is a field investigation to evaluate each site as an opportunity for implementing a regional BMP. The purpose of this visit is to: (1) verify previously identified constraints, and (2) identify any additional fatal flaws (e.g., flood control limitations, jurisdictional issues, storm drain proximity, public safety concerns, etc.) or opportunities (e.g., opportunity to implement distributed BMPs in the area). For each site visit, the information generated from the GIS and desktop-level screenings was verified, supplemented, and/or corrected as needed in the field.

Screening Results

Based on the review of the 19 regional BMP sites, eight sites were selected as priority sites for implementation. These eight sites are described in Section 5. Many of the remaining sites could be considered in the future for implementation.

4.2.2 Distributed BMP Opportunities

Opportunities to implement distributed BMPs on a particular catchment vary depending on the existing land use and other factors. However, because distributed BMPs include multiple individual small-footprint facilities requiring much less space, opportunities exist to retrofit distributed BMPs in most catchments. The process involved in identifying the distributed BMP opportunities was the same as the process for the regional sites, except for the types of BMPs considered and the area served. This section summarizes the methods and results of the process used to (1) identify potential structural distributed BMP sites in the watershed, and (2) conduct field inspections to further evaluate the sites. The same three steps applied to the 87 site-specific regional BMP opportunities were also applied to the 189 distributed BMP opportunities: GIS, desktop, and field screenings (see Section 4.2.1 for additional details).

Similar to the process for evaluating regional BMP sites, the evaluation of distributed BMP sites considered the knowledge of Ballona Creek Watershed stakeholders. As discussed in Section 3, stakeholders identified approximately 120 sites for BMP implementation (See Figures 3-1, 3-2, 3-3 and 3-4 and Appendix D). Most of these opportunities are associated with the retrofit of parcels with distributed BMPs. This information was evaluated along with other identified distributed BMP opportunities to establish a priority list for implementation.

GIS –Level Screening

The same factors evaluated for regional BMP sites were evaluated for potential distributed sites using GIS tools. Of the 189 distributed BMP opportunity sites, 70 were selected and carried forward for desktop-level screening.

Desktop–Level Screening

The desktop-level screening involved reviewing the individual parcels within each of the 70 catchments, and preliminarily identifying potential BMP opportunities. Since the distributed sites are identified as having at least 10 acres of tributary area, the sites identified needed sufficient space for the footprint required for a BMP that could manage runoff generated from this tributary area. If sufficient area was not present, the site was screened out. Based on the desktop analysis, all 70 sites were determined to have opportunities for distributed BMP implementation. Therefore, all 70 sites were included in the field-level screening activity.

Field –Level Screening

For each site visit, the investigator carried a packet of information generated from the GIS and desktop-level screenings. This information was supplemented and corrected as needed in the field. The distributed BMP field investigation activities generated numerous field data sheets and photographs for each of the 70 sites. Appendix F includes a summary of this information.

Screening Results

Ultimately, the field investigation phase did not rule out any potential sites for implementing distributed BMPs. This is an expected result given that for any catchment, at least some portion can typically be retrofit with distributed BMPs. Accordingly, the stakeholder sites were combined with the 70 opportunity sites identified by the SBPAT analysis to create a list from which priority sites were selected (Note: some of the stakeholder sites were also identified as opportunity sites).

After review of the potential distributed BMP site list, it was determined that 27 priority distributed sites would be selected for implementation during the first phase of the Implementation Plan. These sites are discussed in Section 5. Several of the 27 sites were also included on the stakeholder provided list. Selecting the stakeholder identified sites provides benefits to the implementation process since in many cases, these sites were identified during previous planning efforts and also it provides a substantial opportunity to collaborate with watershed stakeholders during the implementation process.

4.3 Identification of Institutional BMP Programs

Sections 4.1 and 4.2 identified the method and selection of priority regional and distributed BMPs for implementation throughout the watershed. These structural BMPs will be implemented in combination with institutional BMPs to comply with Bacteria TMDL compliance targets. Because of the highly developed nature of the watershed and limited availability of sites for construction of new urban runoff infrastructure, the responsible jurisdictions will have to rely on an implementation program that includes both structural and institutional elements to achieve compliance. The benefits of incorporating a strong institutional BMP program are numerous, and include:

- ***Potential cost savings*** - While the long-term operating costs for institutional programs may be significant, these BMPs do not require large capital expenditures to construct facilities. Operating costs may be spread out over many years, reducing overall annual program costs.

- ***Areal treatment coverage*** - Many institutional BMPs are implemented through watershed-wide programs, such as BMPs that target the reduction of water use and resulting runoff through better irrigation practices. Unlike a structural BMP facility, the coverage and water quality benefits are not limited to the catchment area served.

- ***Retrofit potential*** - Institutional BMPs may be applied to existing development which counters problems generated by the lack of open space prevalent in a built-out urban environment, as is the case in the Ballona Creek Watershed.

- ***Target specific pollutants*** - Institutional BMPs can target a specific pollutant parameter of concern. For example, BMPs that target increasing pet waste pickup reduce the transport of bacteria to the storm drain.

The following sections describe the approach used to evaluate and select institutional BMPs for implementation in the watershed.

4.3.1 Methodology

Development of the institutional component of the Bacteria TMDL Implementation Plan relied on information gathered from three sources:

- ***Existing institutional BMP program implementation*** – Existing watershed institutional BMP programs, such as those implemented through the MS4 stormwater permit or adopted to implement the Santa Monica Bay Bacteria (SMBB) TMDLs, were evaluated to determine (1) water quality benefits achieved under the existing level of effort, and (2) evaluate how these programs may be enhanced or expanded to achieve additional water quality benefits.

- ***Priority stakeholder institutional BMP programs*** – During development of the Implementation Plan, meetings were held with a number of watershed stakeholders to discuss BMP implementation opportunities (see Section 3 for more information). In particular, stakeholders provided their perspective on effective institutional BMP programs and opportunities for collaboration between government agencies and stakeholder groups in implementing these BMPs.

- ***Other regional, national institutional BMP programs*** – Institutional BMP programs implemented in other regions of the United States were assessed to (1) guide selection of institutional BMPs, (2) assess short- and long-term implementation strategies, and (3) develop methods to quantify their effectiveness for the Ballona Creek Watershed. Examples of organizations or programs consulted include the Center for Watershed Protection and the cities of Portland, Seattle and Minneapolis stormwater management programs.

4.3.2 Evaluation of Institutional BMPs

The following sections describe the range of institutional BMPs that were evaluated and considered for inclusion in the Bacteria TMDL Implementation Plan. As described above, information for these BMPs was obtained from existing BMP implementation in the Ballona Creek Watershed, stakeholder input, and programs implemented elsewhere in the United States. For those BMPs already undergoing implementation in the watershed, the evaluation considered how BMPs could be enhanced to provide additional water quality benefits. The following sections also present BMP performance data, where available from other jurisdictions and targeted research studies. While the extent of these data is varied and much of it is not necessarily applicable to the Ballona Creek Watershed, the gathered information was used to provide guidance for evaluating potential water quality benefits that may be gained from implementing the BMP in the Ballona Creek Watershed. Estimation of these benefits is provided in Section 5.3.

4.3.2.1 Education and Outreach

Education and outreach programs for residents and businesses on water quality impacts from controllable sources of bacteria include brochures, posters, Websites, event attendance, utility bill inserts, and surveys. Education and outreach programs require a change in consumer behavior to be effective. To evaluate BMP performance, the City of Portland Bureau of Environmental Services assumed that eight percent of the public would change their habits based on educational programs. This figure was derived from public relations outreach data developed by Clean Water Services (Herrera, 2006). The following sections describe specific areas where targeting education and outreach activities can reduce bacterial loads in urban runoff.

Pet Waste Disposal

A BMP for pet waste disposal includes both educational outreach and enforcement to make residents and pet owners clean up after their pets. A survey of Chesapeake Bay residents indicated that about 60 percent of dog owners pick up after their pets; and a survey in Washington indicated that about 70 percent of dog owners pick up pet waste (Schueler, 2000a). Increasing pick-up rates for dog owners would reduce the potential for bacteria to be transported to storm drains during storm events. Options to control pet waste include park signage, receptacles for pet waste, designated dog parks, strict ordinances to regulate pet waste clean-up, and educational materials at pet stores, animal shelters, veterinary offices, and other sites frequented by pet owners. A potential mechanism to fund and maintain this program would be the application of a stormwater charge on dog license fees.

Restaurant Inspection and Trash Management

The Implementation Plan for the SMBB TMDL included a recommendation to implement restaurant and grocery store waste management programs. Uncontained restaurant and grocery store wastes can be a significant bacteria source in urban runoff, especially during wet weather. The SMBB program involved implementing an expanded program to increase restaurant and store operator awareness of this potential bacteria source and provide solutions to trash management concerns. Steps for implementation included developing a BMP-specific implementation plan, increasing education and outreach initiatives, and enhancing enforcement activities.

The Industrial Waste Management Division in the City of Los Angeles currently has a program for controlling fats, oil and grease (FOG) from entering the sanitary sewer. As this existing program already targets some restaurants in the watershed, it could be expanded to include other activities that affect stormwater.

Individual Car Washing

This BMP targets car owners that wash their own cars. Past surveys have indicated that 56 to 73 percent of car owners wash their own cars and over 90 percent of those let water drain to the pavement (CWP, 2008). This activity increases dry weather urban runoff and mobilizes bacteria present on impervious surfaces. To reduce bacteria loads, educational outreach could be increased to encourage car owners to minimize washing activities that increase runoff to storm drains. Educational materials could encourage car owners to use commercial car washes or wash cars on permeable surfaces. Car wash kits could be provided to charity car washes to block the storm drain or use an insert to catch water.

LADWP has a six phase Emergency Water Conservation Ordinance that includes restrictions on car washing. In the first phase, car washing is only permitted with a hose equipped with a shut-off device. In the fourth phase car washing is only permitted at commercial car wash facilities, and all commercial car washes are required to either recycle their wash water or send it to a clarifier that is connected to the sewer system.

4.3.2.2 Street Sweeping

Street sweeping removes sediment, debris, and other pollutants from road and parking lot surfaces. Several studies conducted on the effectiveness of street sweeping for pollution reduction have shown variable results dependent on traffic volume, type of sweeper used, frequency of sweeping, land use, and pavement type (Herrera, 2006). Another study reported an efficiency rate for mechanical sweepers of between 20 and 31 percent (Rosselet, 2007). In addition, new vacuum sweepers have shown a reduction of 50 to 88 percent in the annual sediment loading for a residential street, depending on sweeping frequency. A separate study found that the frequency of street sweeping necessary to maximize sediment removal is once every week (Brinkman and Graham, 2001). Given the number of variables involved, including sweeping frequency or sweeper efficiency, the effectiveness of this program can vary widely. Accordingly, urban runoff management programs would benefit from a careful evaluation of the existing program to determine how to increase efficiency of pollutant removal from surfaces.

4.3.2.3 Catch Basin Cleaning

Studies have shown that catch basins can be effective in removing 40 to 50 percent of total suspended solids (Herrera, 2006). Catch basin performance declines as flow increases, catch basin turbulence increases, and retention time decreases. In addition, when over 50 percent of the catch basin is full, then sediments can be re-suspended (Herrera, 2006). Catch basin cleaning can maintain higher pollutant removal rates and reduce remobilization of pollutants entrained in the sediments such as bacteria. However, increasing the cleaning frequency to more than quarterly provides little additional benefit. For example, one study determined that semi-annual cleaning is optimal for the average catch basin (Herrera, 2006). Overall, catch basin cleaning is an important institutional BMP, but the benefit to increased frequency of catch basin cleaning should be evaluated.

4.3.2.4 Downspout Retrofit

This BMP redirects runoff from roofs to pervious areas, resulting in reduced flow to storm drains. Implementation options include redirecting downspouts to lawns, gardens or swales, or installing a rain barrel or cistern to collect roof runoff for later use. The City of Portland has been implementing an effective downspout retrofit program since 1996. The program's Website indicates that over 56,000 property owners have disconnected downspouts. Given that the average Portland area rooftop sheds approximately 35,000 gallons of water over an average winter, the reduction in potential pollutant loading to storm drains from urban runoff is substantial (City of Portland Website). Downspout retrofit is an effective institutional BMP for commercial, industrial, and public buildings as well. This opportunity is especially important since buildings associated with these land use types tend to have roofing materials containing higher leachable metals content.

The City of Los Angeles currently has a program in place for downspout retrofit of single family residential roofs. The first phase will disconnect approximately one-sixth of the single family residential roof areas and the second phase would disconnect another one-sixth of the single family residential roof areas, for a total of one-third of all single family residential rooftop areas being disconnected.

4.3.2.5 Programmatic Enhancements

A critical component of institutional BMP implementation is the establishment of a programmatic structure that creates consistency in urban runoff management, encourages application of green solutions, provides adequate legal authority, and includes appropriate levels of coordination, planning, and collaboration. The WQCMPUR identified the need for improvement in a number of programmatic areas (City of Los Angeles, 2009). Watershed stakeholders have also indicated the importance of implementing a new, comprehensive approach to urban runoff management and have provided many examples where change is needed. Accordingly, this Implementation Plan includes a number of institutional BMPs directed at improving programmatic issues. Quantifying the water quality benefits that can be attributed to these improvements is not possible. However, the intangible benefits of these BMPs, when focused on achieving a common purpose (improved urban runoff management), have demonstrated an increase in the integration of water resources and long-term water quality improvements.

4.3.3 Opportunities for Collaboration with Stakeholders

Section 3 summarized the input obtained from watershed stakeholders regarding institutional BMP implementation. As a result of stakeholder input, it is clear that significant opportunities exist for collaboration on institutional BMP implementation in the Ballona Creek Watershed. Collaboration may occur in several ways, including but limited to:

- Participating in the development of policies and guidance that support urban runoff management.
- Contributing to education and outreach activities by assisting in the development of appropriate materials, and by potentially serving as an extension of the staff of the responsible jurisdictions and taking a lead role in implementing education and outreach activities.

- Continuing to implement elements of existing efforts, such as Ballona Creek Watershed Management Plan and Green Solutions Project, and also working with responsible jurisdictions to develop cost-share opportunities that create cost-effective opportunities to resolve localized urban runoff management concerns, such as green street projects.

- Assisting with the roll-out of new BMP programs by participating in efforts to educate property owners on the benefits of the programs, such as downspout retrofit or incentivized retrofits of private properties.

- Supporting development of new programs or data collection to support effectiveness evaluations of existing programs.

Finally, it is recognized that the nature of collaboration with stakeholders is dictated, to a large degree, by funding and staff resources, which includes not only funding to the responsible jurisdictions, but the stakeholders as well. Accordingly, an important institutional BMP incorporated into this plan is the need to establish stable, long-term funding sources for education and outreach. Having this funding in place would increase opportunities for active collaboration.

4.3.4 Recommended Institutional BMP Program

Extensive opportunities exist for implementing institutional BMPs. The institutional BMP program for this Implementation Plan was developed in conjunction with the structural BMPs. Accordingly the recommended institutional BMPs are described in Section 5.

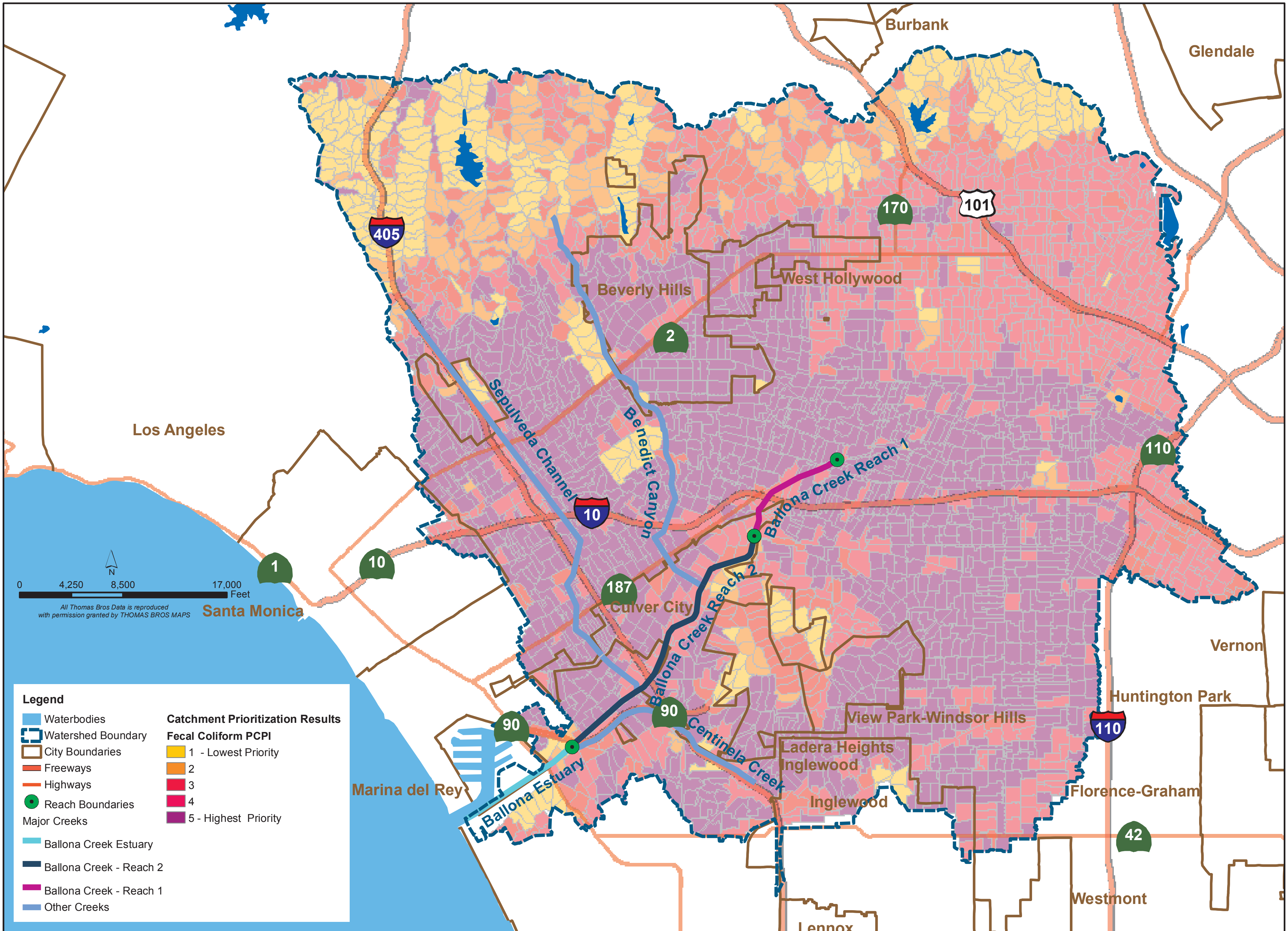

Figure 4-2 Ballona Creek Watershed - Fecal Coliform Catchment Prioritization Index

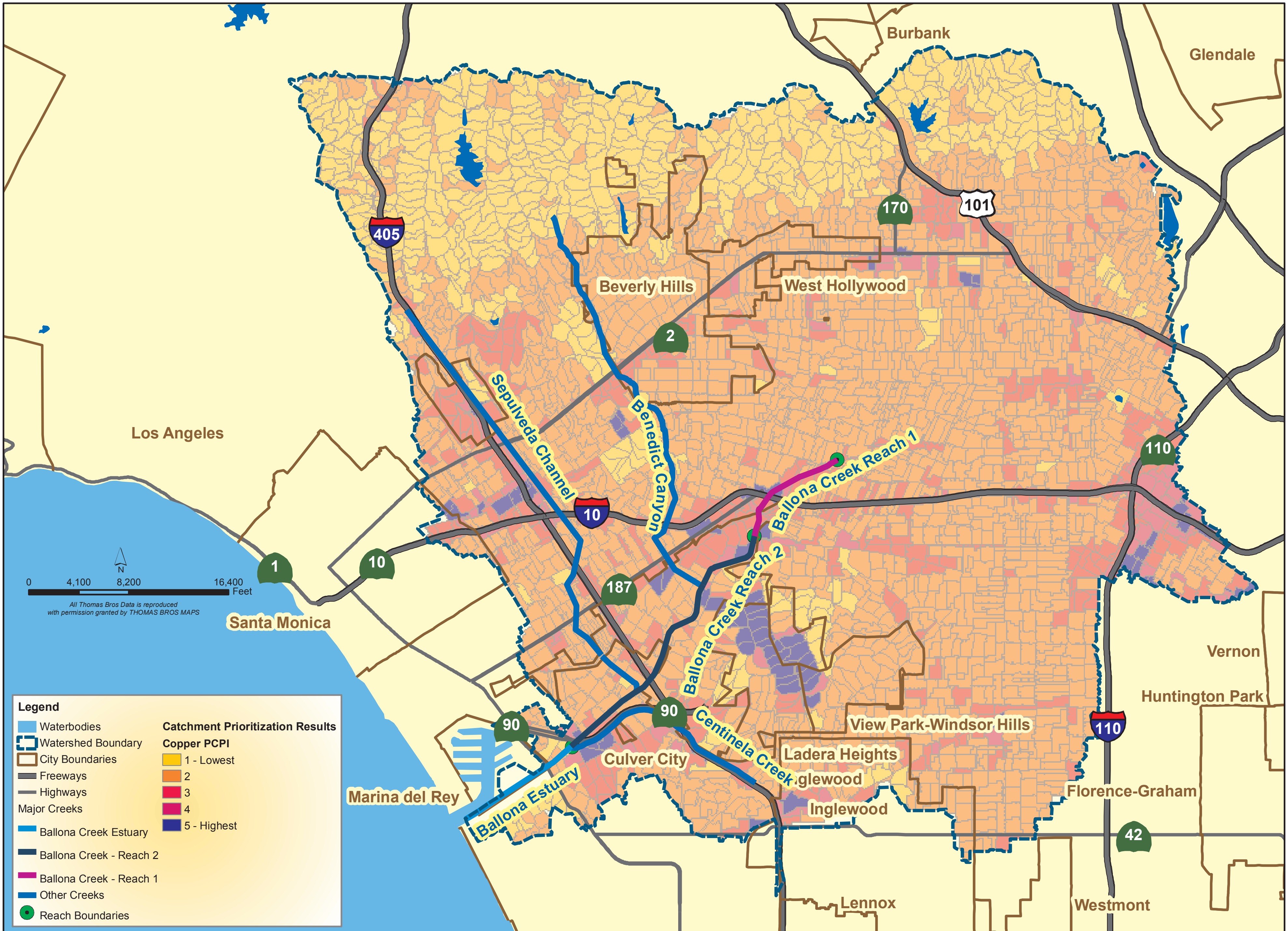

Figure 4-3 Ballona Creek Watershed - Copper Catchment Prioritization Index

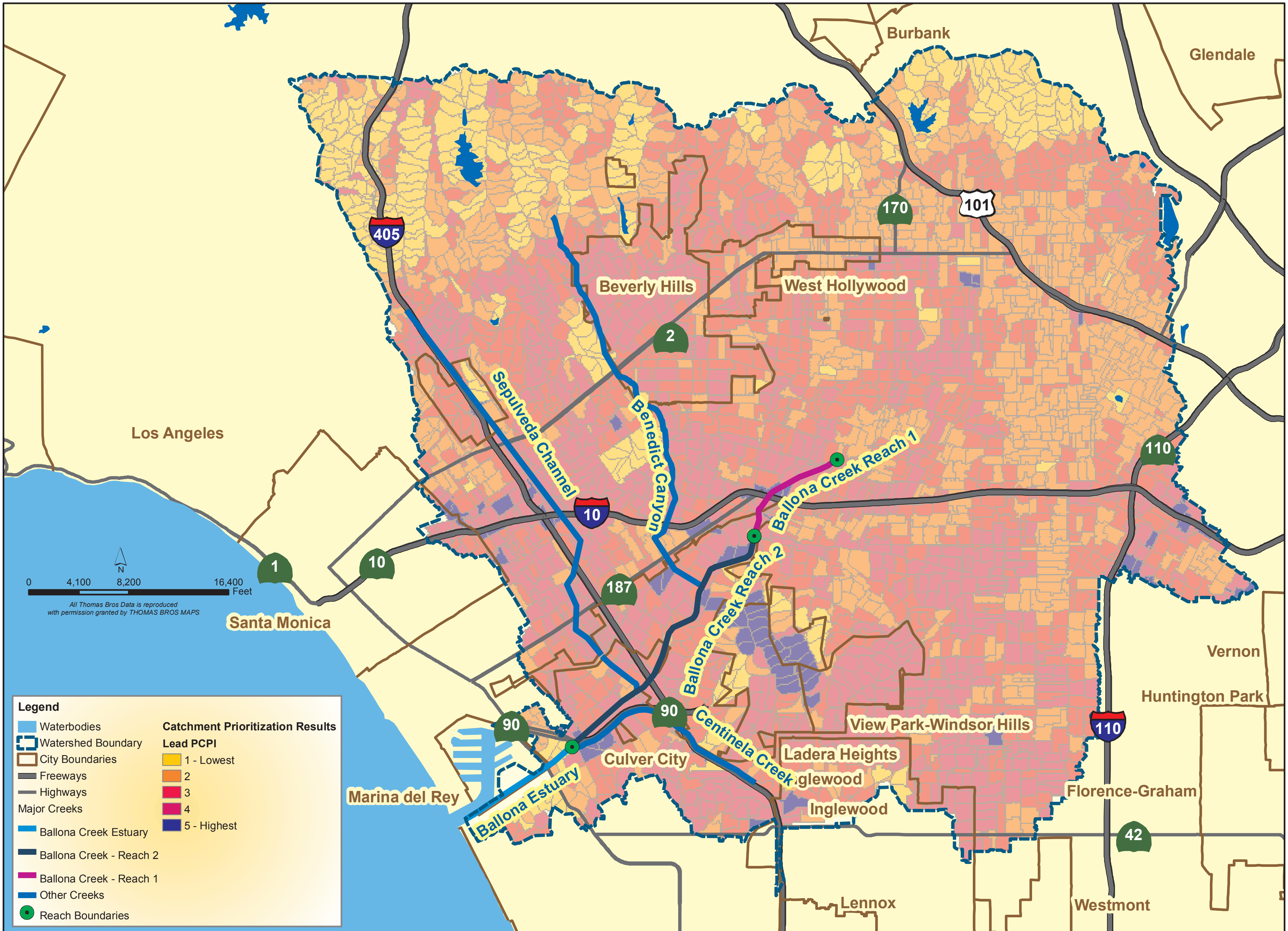

Figure 4-4 Ballona Creek Watershed - Lead Catchment Prioritization Index

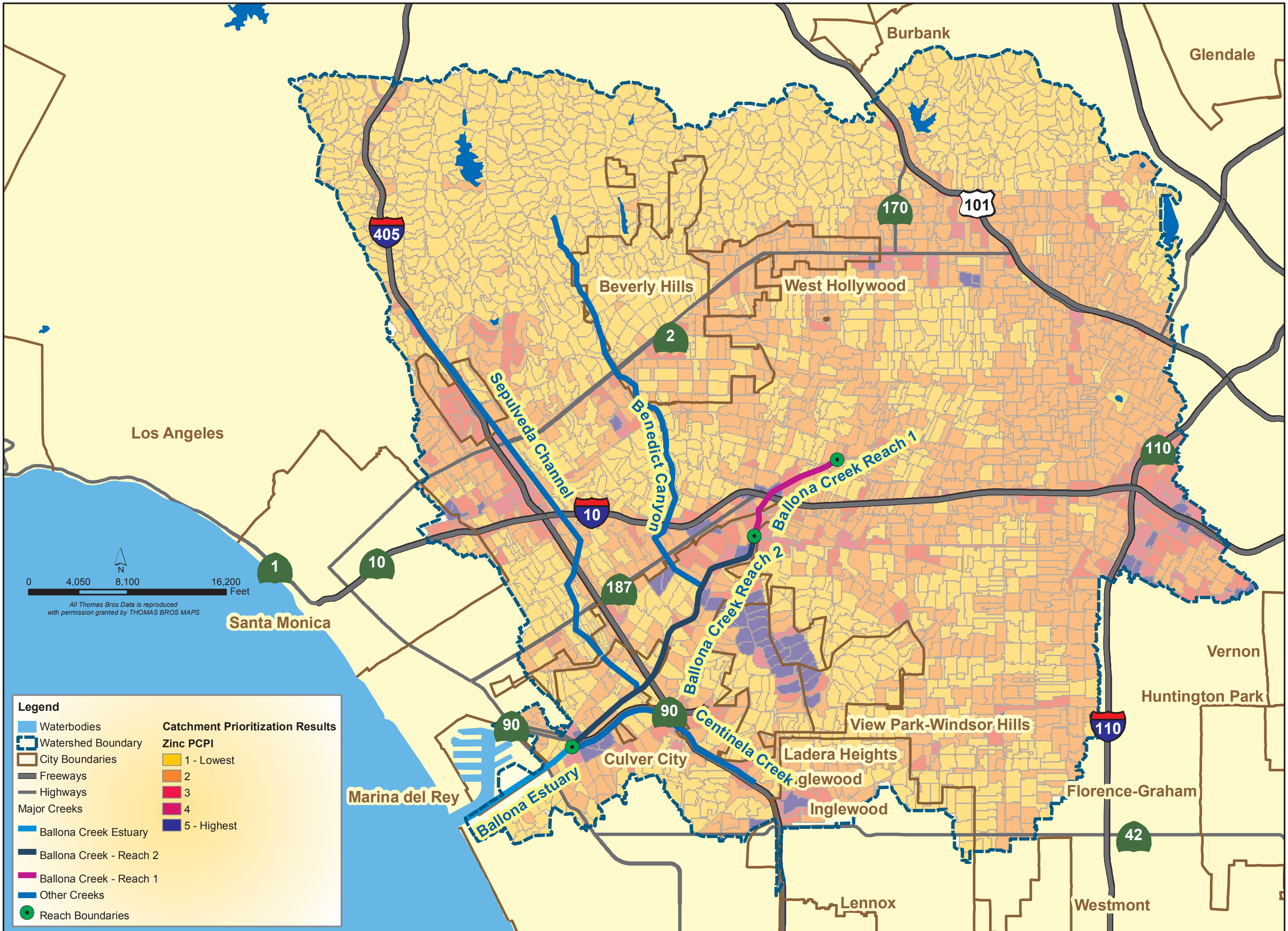

Figure 4-5 Ballona Creek Watershed - Zinc Catchment Prioritization Index

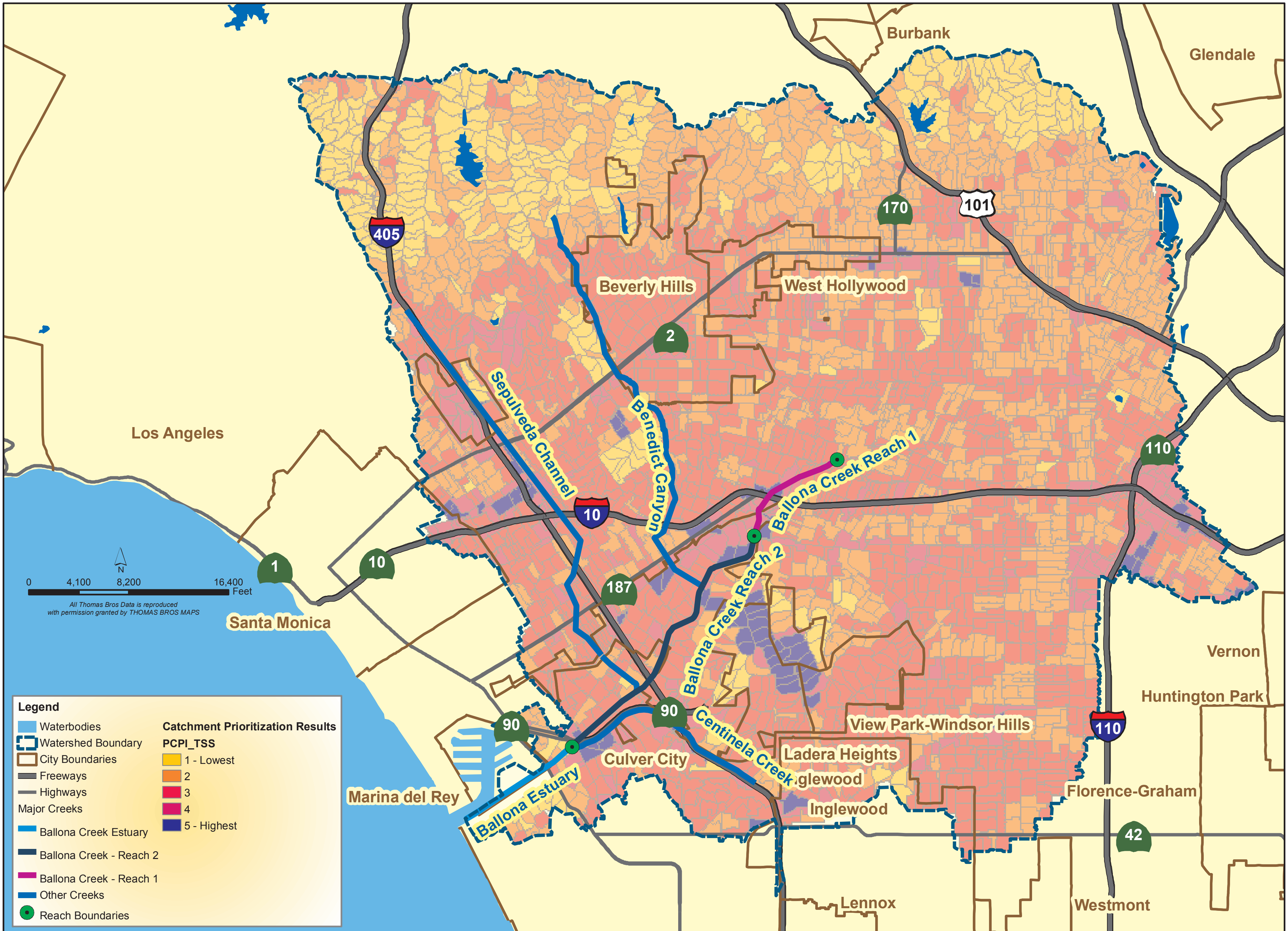

Figure 4-6 Ballona Creek Watershed - TSS Catchment Prioritization Index

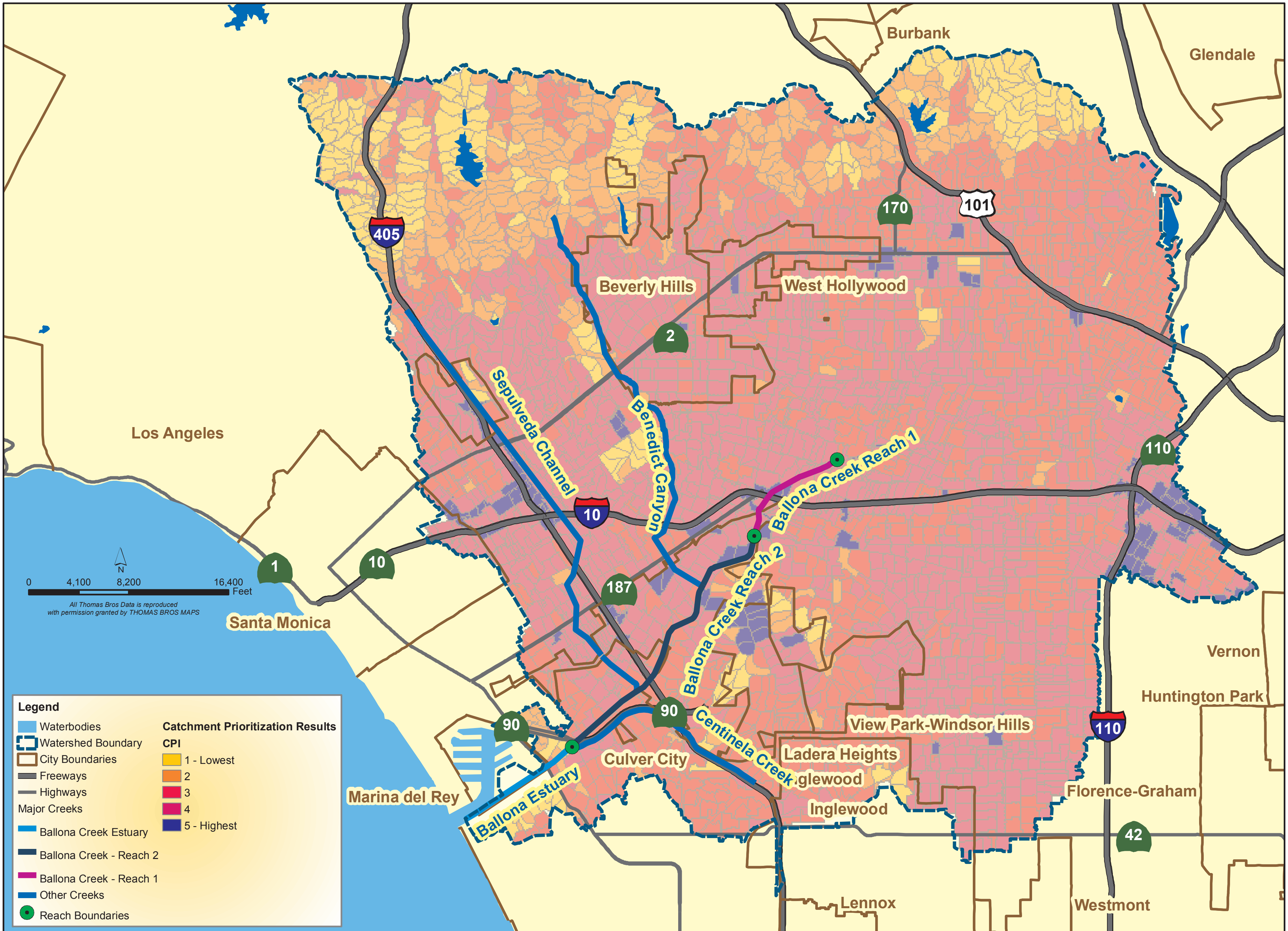

Figure 4-7 Ballona Creek Watershed - Catchment Prioritization Index

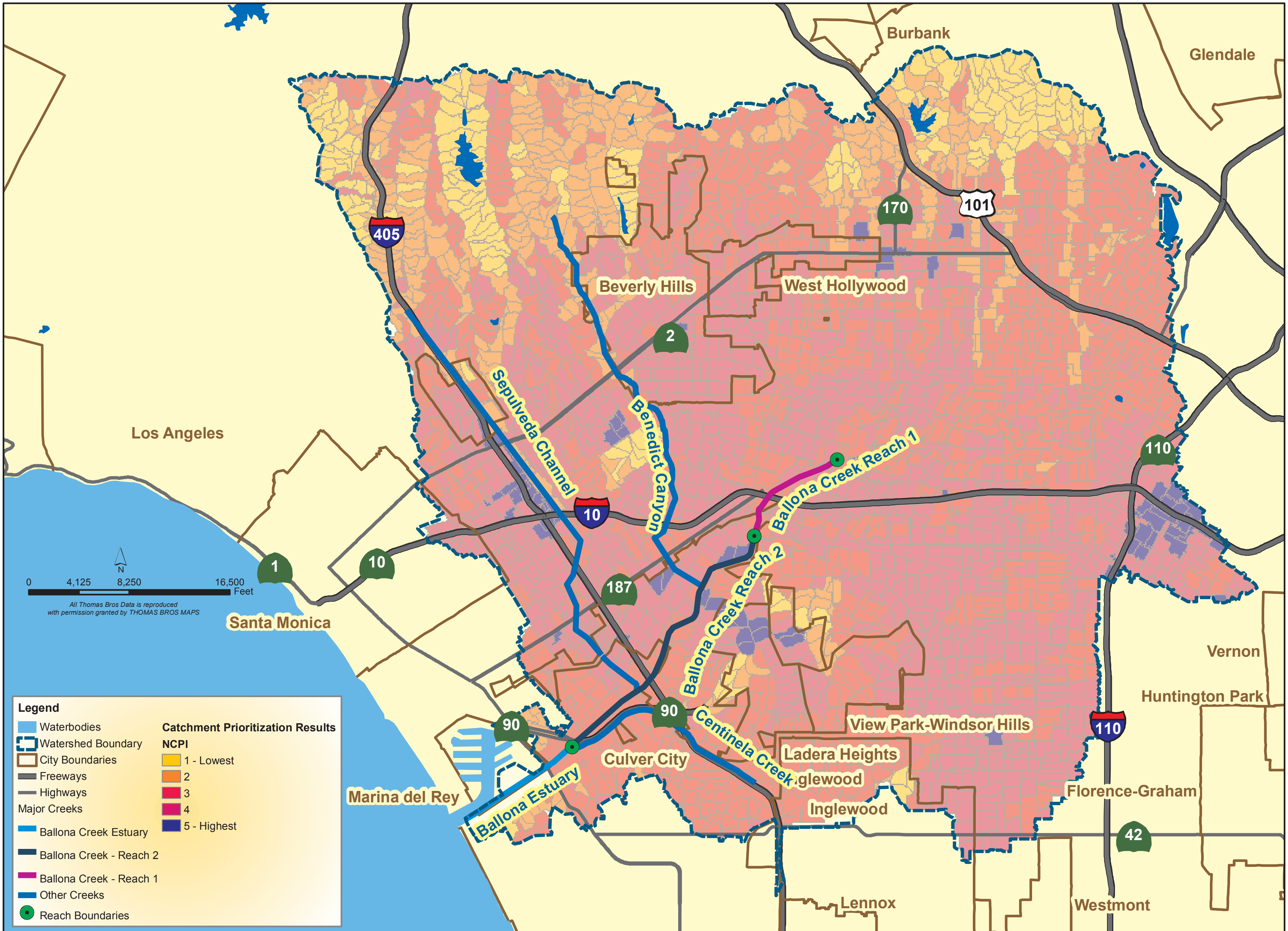

Figure 4-8 Ballona Creek Watershed - Nodal Catchment Prioritization Index

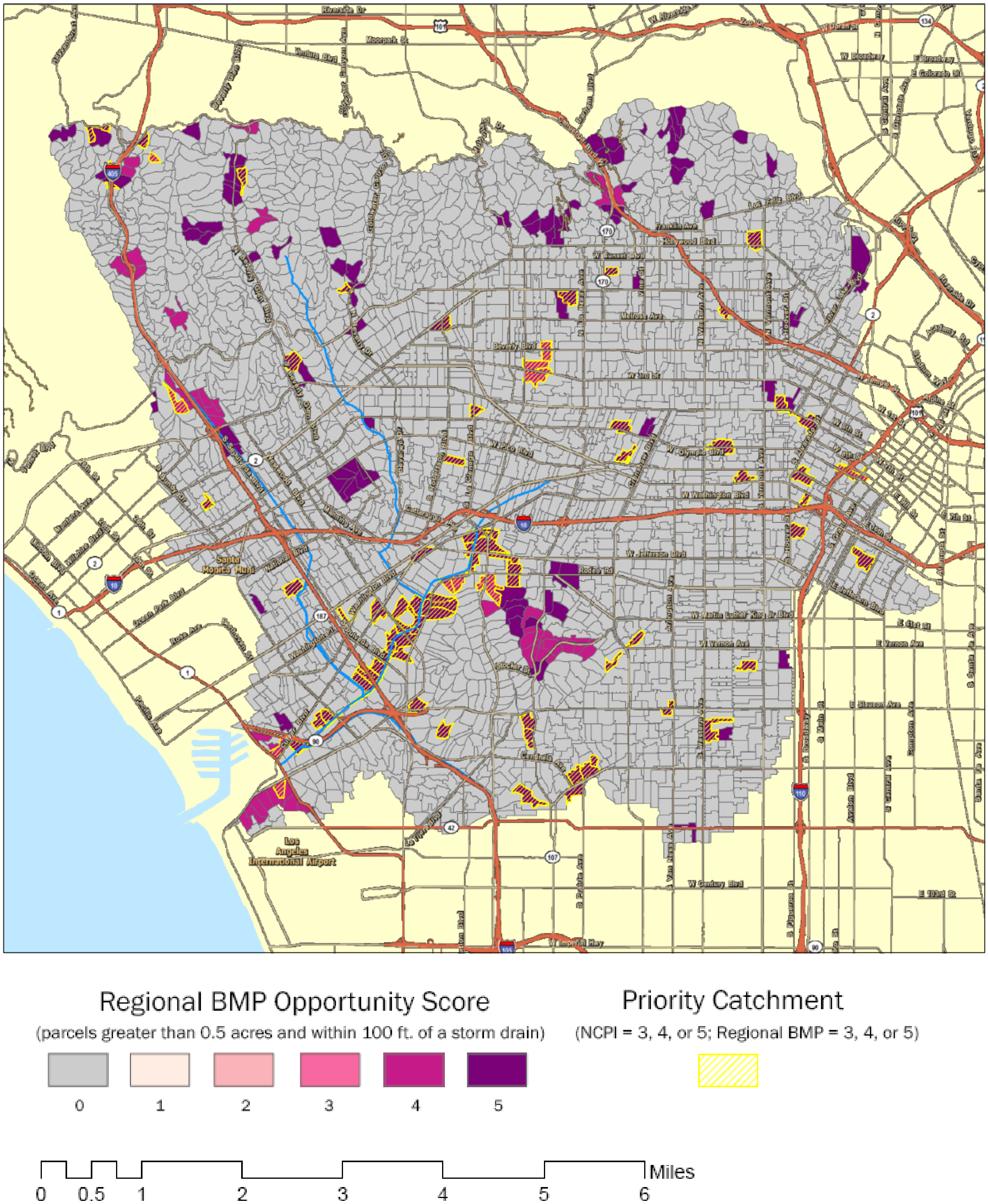

Figure 4-9
Regional BMP Opportunities

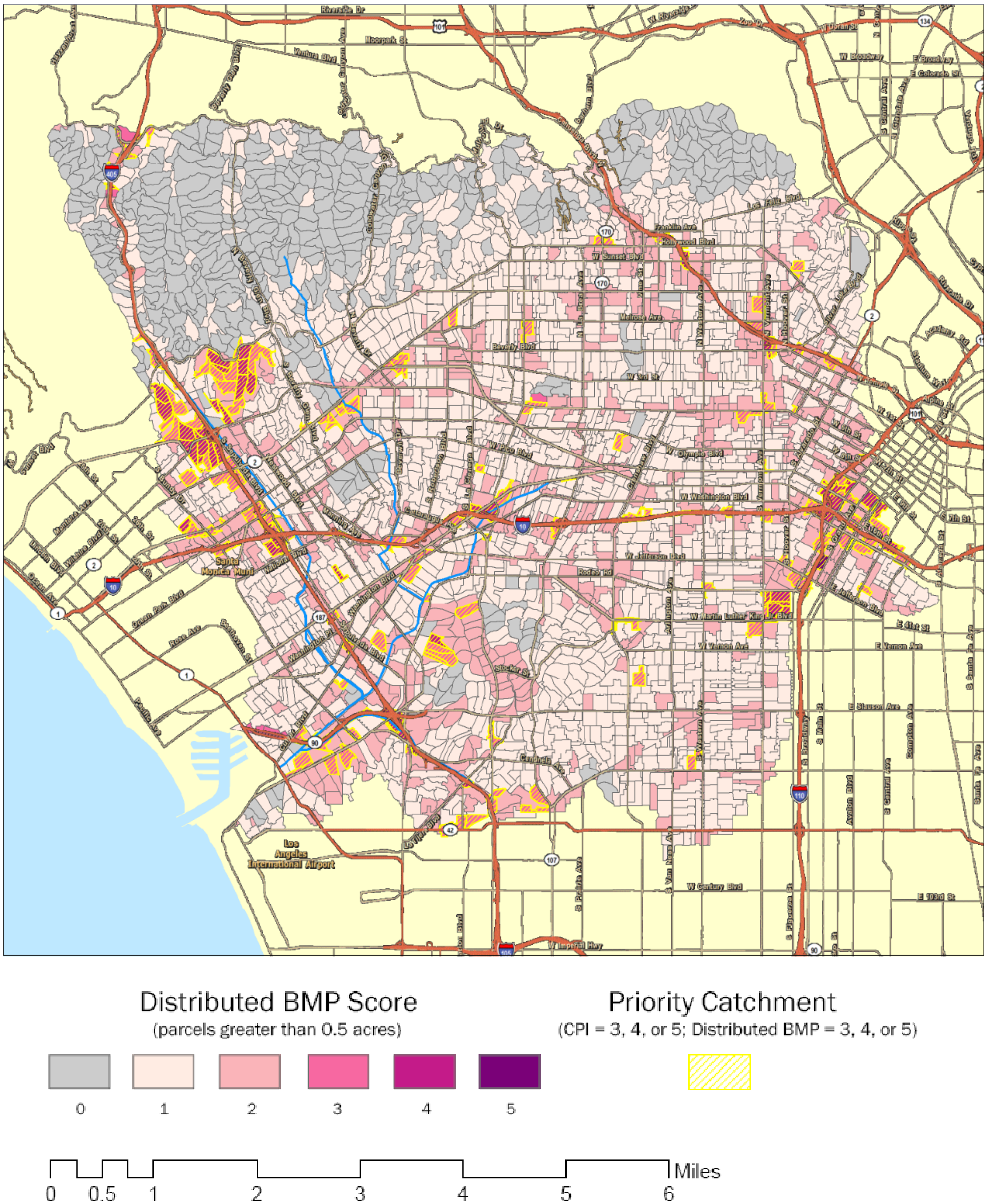

Figure 4-10
Distributed BMP Opportunities

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Section 5
Proposed Implementation Plan

The implementation approach for achieving compliance with the Ballona Creek Bacteria TMDL was based largely on local stakeholder input. The responsible jurisdictions are committed to including stakeholder input in order to achieve broader water quality benefits, and establish goals to enhance the Ballona Creek Watershed. Watershed stakeholders are interested in solutions that will reduce bacterial loading in Ballona Creek and improve compliance with TMDL limits, with an emphasis on watershed-based strategies to reduce both wet and dry weather flows and increase bacterial source control. Many of these strategies are similar to implementation approaches for meeting other TMDLs within the Ballona Creek Watershed, including the Ballona Creek Metals TMDL and the Ballona Creek Estuary Toxics TMDL. Refer to section 1 for further discussion on the responsible jurisdiction's guiding principles applied to the development of this Implementation Plan.

5.1 Recommended BMP Implementation

The Implementation Plan relies on a combination of measures designed to decrease migration and transport of bacteria, as well as other pollutants such as metals and organics, by (1) reducing the amount of dry weather and wet weather anthropogenic/urban runoff, (2) providing localized source control to reduce pollutant loads, and (3) incorporating opportunities for beneficial use of urban runoff.

Recommended BMPs include three general categories:

- Low Flow Treatment Facilities (LFTFs) for dry-weather WLA compliance (Section 5.1.1);
- Regional and distributed structural BMPs for dry- and wet-weather WLA compliance (Section 5.1.2); and
- Institutional BMPs (Section 5.1.3) for both wet and dry-weather compliance.

This section describes the recommended BMP implementation approach for each category.

5.1.1 Dry Weather Low Flow Treatment Facility (LFTF)

This Implementation Plan includes the construction of up to two LFTFs in the watershed. The purpose of these LFTFs is to significantly reduce bacteria concentrations in all reaches during dry-weather conditions (Figure 5-1).

The average dry weather flow in Ballona Creek is approximately 29 cfs based on a dry weather flow rate of 230 gallons/day/acre (CREST, 2005). It is expected that over time with implementation of institutional and structural BMPs in the watershed, the volume of dry weather flow will gradually decline, resulting in even less flow in Ballona Creek. Source control activities and structural BMPs in this Implementation Plan are projected to reduce 2013 urban runoff levels by approximately 2.7 MGD and 0.26 MGD, respectively (described in Section 5.2.4 and 5.4). However, even with this reduction in urban dry weather flow to Ballona Creek, the bacteria concentrations of the remaining dry weather runoff may be the same because there will still be significant upstream drainage areas where retrofitting effective urban runoff controls is not feasible. To supplement planned watershed BMP activities, the Implementation Plan includes up to two LFTF projects to achieve progress towards compliance with dry weather limits, Figure 5-1. Conceptually, the primary LFTF projects are as follows:

- *LFTF-1* – Construct an LFTF at a location adjacent to the North Outfall Treatment Facility (NOTF) where dry weather flows from the Hollywood, Cienega and Culver City sub-watersheds may be captured, pumped and treated. Treated dry weather flows that comply with REC-1 water quality objectives will be discharged back to Ballona Creek. With additional treatment, this facility could also provide a local source of non-potable water for reuse.

- *LFTF-2* – Construct an LFTF at a location along Sepulveda Channel to treat flows prior to discharge to Ballona Creek. The captured dry weather flow will be diverted to a double infiltration trench with irrigation.

Conceptual drawings for these two LFTFs are shown in Appendix I. LFTF-1 includes alternatives that were developed as part of the Ballona Creek Treatment Facility Feasibility Study and Preliminary Design report (Los Angeles, 1996). These alternatives, as well as the layout for LFTF-2, are subject to change during the design phase.

Detailed Description of LFTF-1

A dry weather diversion in Ballona Creek will be constructed adjacent to the existing NOTF. Retained flow would be pumped to the NOTF for treatment and downstream release or reuse. The NOTF is located approximately ½ mile upstream of the Overland Avenue crossing, near Jackson Avenue, on the south bank of Reach 2 of Ballona Creek (Figure 5-1). The facility is owned by the City of Los Angeles; originally it was constructed between 1986 and 1987 to detain and provide partial treatment of sanitary sewer overflows to Ballona Creek. Improvements to the City's interceptor sewer system, in particular construction of the North Outfall Relief Sewer, substantially reduced the potential that the NOTF would be needed for its intended purpose of treating sewage overflows. Later, recognizing the need to evaluate options for improving water quality in Ballona Creek, the City prepared a feasibility study and preliminary design report in 1995 to assess the potential for using this facility to capture and treat dry weather runoff flows and a portion of wet weather runoff flows.

As constructed, the facility can provide 1 million gallons of storage capacity and has a capacity for treatment of up to 150 cfs , including screening (course and fine screens) and disinfection (with sodium hypochlorite, NaOCl) (City of Los Angeles, 1996). At this time, the NOTF is not currently in use. With this facility already in place, the only other infrastructure required to implement this BMP is the construction of the LFTF structure at a location adjacent to the NOTF, and associated pump stations and conveyances.

This LFTF will capture 100% of the dry weather flows in Ballona Creek at the diversion point. Flow data from each Ballona Creek sub-watershed is somewhat limited. However, since approximately 65% of the Ballona Creek Watershed is upstream of NOTF (City of Los Angeles, 1996) and since the total dry weather flow in Ballona Creek, as stated above, is 29 cfs, the portion of the flow that is upstream of NOTF is approximately 19 cfs. Assuming that approximately 16 percent of the upstream flow would be reduced through the implementation of institutional and structural BMP programs, the average dry weather flow available for capture and diversion from upstream subwatersheds to the NOTF is 15.9 cfs. Following treatment to achieve a bacteria concentration that is below REC-1 water quality objectives (e.g. limited filtration coupled with ultraviolet disinfection), the Implementation Plan proposes at this time to discharge all treated dry weather flows to Ballona Creek. However, additional options include:

- *LFTF-1 Implementation, Option 1* - Consider upgrading the NOTF to allow reuse of a portion of the captured dry weather flow. If implemented, additional treatment facilities will be constructed to achieve water quality equivalent to Title 22 requirements for unrestricted irrigation. A portion of the captured dry weather flow will be diverted for reuse and a portion will be discharged to Ballona Creek. The relative portion of captured dry weather flow used for reuse vs. discharged to Ballona Creek will vary by season and demand for water reuse. Assuming an average captured flow of 15.9 cfs (as described above), if this option is implemented at least 7 cfs will at all times be returned to Ballona Creek.

- *LFTF-1 Implementation, Option 2* – Utilizing the 1 million gallons of available storage, the LFTF and NOTF can be operated in a manner that allows for the diversion, treatment and return of as much wet weather flow as possible without construction of additional storage. Using the available storage and screens with additional retrofit facilities, it was previously estimated that the NOTF could be operated to manage and partially treat up to 150 cfs of wet weather flow. This would be approximately equivalent to the flow in Ballona Creek at that location resulting from a rainfall event in the range of 0.15 – 0.2 inches. The responsible jurisdictions will consider incorporating this operational element into this BMP as they evaluate water quality benefits gained from implementation of other elements of its wet weather management program.

Detailed Description of LFTF-2

A second LFTF will be constructed to divert flow from Sepulveda Channel to the "oval" streets, which are East Boulevard, Park Avenue and Marcasel Avenue. The proposed diversion would consist of a 4.5 mile long double infiltration trench with irrigation element. The project could be implemented in three phases, with each phase consisting of approximately 1.5 miles of retrofit.

Sepulveda Channel flows as a rectangular open channel for 1.2 miles from Military Ave and Queensland St before flowing as an underground channel from Venice Blvd and McClaughlin Ave. It reemerges as a rectangular open channel at Washington Blvd and McClaughlin Ave before discharging into Ballona Creek 0.8 miles downstream. Tributary area for Sepulveda Channel is approximately 18% of the total watershed or 14,760 acres (Bacteria CMP, City of Los Angeles). Using dry-weather runoff generation rate of 230 gal/acre/day (CREST, 2005), Sepulveda Channel discharges approximately 5.25 cfs of flow into Ballona Creek Reach 2.

Implementation of this LFTF requires limited infrastructure – construction of an interception and diversion to divert flow from Sepulveda Channel at Venice and McClaughlin before the channel flows underground, pump station, and conveyance to the location of the infiltration trench. This LFTF is expected to divert and treat 2 to 3 cfs dry-weather flow. Treated water will flow back into the Channel at Washington Blvd. Further details are provided in Appendix I (under Option 2 for LFTF-2).

LFTF Implementation Assumptions

Timely implementation of LFTF BMPs is based on the following three critical assumptions:

- Diversion of dry weather flow from Ballona Creek does not adversely impact beneficial uses within the Ballona Creek Estuary. Various investigations over the years have generally demonstrated that flow in the estuary is dominated by tidal flow and the fresh water outflow from Ballona Creek during non-storm flow conditions is confined to a narrow freshwater lens near the surface of the estuary. Therefore, it is assumed that reduction in estuarine conditions will not be significantly affected by a reduction of dry weather flows. However, this issue may require further study.

- Implementation of a diversion, treatment, and discharge facility for LFTF-1 does not result in a requirement for the NOTF facility to obtain an NPDES permit for the discharge of treated stormwater back to Ballona Creek (Note: However, if the facility is upgraded to allow reuse of treated dry weather flow, then Waste Discharge Requirements developed with input from California Department of Public Health would need to be obtained for implementation of the reuse option).

- Monitoring for compliance with the TMDL for corresponding reaches may be conducted downstream of the two LFTF locations.

5.1.2 Wet Weather Structural BMPs

The Implementation Plan includes structural BMPs that would be designed to treat wet weather runoff. Structural BMPs include regional projects serving multiple catchments as well as distributed BMPs that consist of small-scale decentralized, structural BMPs.

Structural BMPs include existing projects, new priority projects and potential future projects. The potential future projects were identified during stakeholder workshops and during field meetings with stakeholder groups.

5.1.2.1 Existing Projects

SUSMP Projects

The Standard Urban Stormwater Mitigation Plan (SUSMP) requirements of the existing MS4 permit apply to new development and redevelopment projects. The MS4 in the Ballona Creek Watershed is permitted under a single permit issued to Los Angeles County and 84 incorporated cities (all except the City of Long Beach). An important part of the MS4 permit is the SUSMP infiltration requirements. In general, SUSMP applies to new developments and redevelopments of a certain minimum size. The BMPs installed on-site must be able to infiltrate, capture and reuse, or treat all of the runoff from an 85th percentile storm, which is equivalent to a ¾", 24-hour storm. New guidelines approved on July 9, 2008 require developers to give top priority to BMPs that infiltrate stormwater and lowest priority to mechanical/hydrodynamic units. Table 5-1 provides a summary of the types of projects required to meet SUSMP requirements in the City of Los Angeles in recent years.

Table 5-1
City of Los Angeles Projects Reviewed and Conditioned to meet SUSMP Requirements[1]

	Single Family	10+ Housing Dev.	Commercial/ Industrial	Auto-motive Services	Retail Gasoline	Restaurants	Parking Lots	Discharges to ESAs[2]	All Category Total
2001-02	5	0	22	2	1	2	8	0	40
2002-03	76	46	42	1	1	4	15	2	187
2003-04	184	219	98	11	5	3	21	1	542
2004-05	303	207	125	10	4	5	24	9	687
2005-06	215	202	76	9	2	1	32	6	543
2006-07	165	192	81	4	6	0	42	21	511
2007-08	246	179	132	9	5	4	56	38	669
2008-09	90	104	78	11	7	2	47	20	359
Total:	**1284**	**1149**	**654**	**57**	**31**	**21**	**245**	**97**	**3538**

Notes:
[1] Los Angeles County MS4 Permit (City of Los Angeles Annual Report Summary)
[2] Permits issued to projects located in or directly adjacent to or discharging directly to an environmentally sensitive areas

Proposition O Water Quality Projects

Los Angeles voters passed Proposition O in November 2004, which authorized the City of Los Angeles to issue up to $500 million in general obligation bonds for projects that mitigate water pollution in order to meet federal CWA requirements. Proposition

O also funds improvements to protect water quality, provide flood protection, and increase water conservation, habitat protection, and open space.

The Proposition O project that is in the Ballona Creek Watershed is the Westside Park Rainwater Irrigation Project which has a drainage area of 3,700 acres. The project consists of installing a flow diversion facility, a stormwater lift station, a subsurface rainwater irrigation use system that can store up to 180,000 gallons of surface runoff, and a dry creek to return water to the storm drain system. Additionally, there will be recreational elements such as park benches, exercise equipments, and playground structures.

5.1.2.2 New Priority Projects

Distributed Structural BMPs

Section 4 summarized the process for identifying distributed BMP projects. Based on the screening results, 27 distributed BMP sites were selected for priority implementation (Figure 5-2). For these sites, Table 5-2 presents a short BMP project description, jurisdiction, and the IWRA benefits provided by each project based on the criteria presented in the Basin Plan Amendment Attachment A to Resolution No. 2006-011. Preliminary concept drawings are included in Appendix G. Implementation of these projects will be subject to confirmation of engineering feasibility and, where appropriate, the water quality treatment approach may be modified. These priority BMPs will start in Phase 1 (2010-2013) and are expected to be completed by the middle of Phase 2 (2013-2021).

Regional Structural BMPs

As a result of the extensive desktop and field analyses conducted in the watershed (as discussed in Section 4), eight sites were selected as priority regional sites based on opportunity potential, site conditions, ownership, drainage area, and geographic distribution (Figure 5-2). Table 5-3 summarizes the characteristics of each of these eight recommended regional structural BMPs. A concept level drawing for each of these sites is provided in Appendix G. These preliminary concepts are subject to change and modification upon additional more detailed study. Implementation of these pilot projects will be subject to confirmation of engineering feasibility and, where appropriate, the water quality treatment approach may be modified.

5.1.2.3 Additional Future Projects

The above sections describe the priority projects planned for implementation during Phase 1. However, it is expected that many additional BMP projects will need to be implemented to meet TMDL compliance requirements. The estimated level of implementation required, sorted by land use, is summarized in Table 5-4. As shown, runoff from 11,300 acres, or 13.9 percent of the Ballona Creek watershed, will need to be treated by distributed BMPs in order to meet the TMDL limits. Refer to Section 5.2 for further discussion.

During the development of this Plan, additional specific structural BMP projects were identified that could be implemented as part of the second phase of implementation, provided conditions at these sites do not change in the interim. These projects are summarized as follows: (a) Stakeholder BMP projects, Table D-1 in Appendix D; (b) Regional BMPs, Table F-1 in Appendix F; and (c) Distributed BMPs, in Appendix F (summary of field investigations at approximately 70 catchments throughout the watershed).

Table 5-2
Summary of New Priority Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan

Site ID	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits[2]
1	Baldwin to Ballona Trail: Jefferson Blvd & Fairfax Ave	205869 28.2 acres	Vegetated swales, bioretention in parkway with underdrains, permeable pavement, bioretention facilities	Los Angeles	1, 2
2	Ballona Greenway: Berryman Ave at Ballona Creek East of 405 Fwy	207784 23.8 acres	Bioretention in parkway with underdrains, vegetated swales, bioretention facilities	Los Angeles / Culver City	1
3	Ballona Greenway: Milton Street at Ballona Creek near Bundy	208755 28.5 acres	Bioretention in parkway with underdrains, vegetated swales, Permeable Pavement	Los Angeles	1
4	Ballona Greenway: Washington and Ballona Creek east of Fairfax	203627 19.3 acres	Bioretention in parkway with underdrains, vegetated swales	Los Angeles	1
5	Ballona Greenway: Hauser Blvd at Ballona Creek	205522 33.2 acres	Bioretention in parkway with underdrains, green street medians	Los Angeles	1
6	Occidental Blvd & 2nd St	200551 30.7 acres	Bioretention in parkway with underdrains	Los Angeles	1
7	405 Fwy & Wilshire Blvd	208406 18.4 acres	Vegetated swales and bioretention facilities	Los Angeles County/Caltrans	1
8	Ballona Greenway: Street ends, Cochran to Fairfax	203586 11.2 acres	Bioretention in parkway with drains, vegetated swales, green street medians	Los Angeles	1, 2
9	Ballona Greenway: Fairfax Ave & Apple St	203979 20.5	Permeable pavement, bioretention in parkway connected via drains, vegetated swales	Los Angeles	1, 2
10	Ballona Greenway: Fairfax Ave & 10 Fwy, including Ballona Narrows Park	203980 52.0 acres	Permeable pavement, bioretention facilities	Los Angeles	1, 2

Table 5-2
Summary of New Priority Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan

Site ID	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits[2]
11	Ballona Greenway: Jefferson Blvd at Ballona Creek	206647 38.2 acres	Bioretention in parkway with underdrains, permeable pavement, green street medians	Culver City	1, 2
12	Baldwin to Ballona Trail: Between Rodeo Rd & Jefferson Blvd east of La Cienega	206625 30.4 acres	Permeable Pavement, bioretention, green street medians, bioretention on parkway w/underdrains, vegetated swales	Los Angeles	1, 2
13	Ballona Greenway: Duquesne Ave at Ballona Creek	206698 6.8 acres	Permeable pavement, vegetated swales, bioretention in parkway w/underdrains	Culver City	1, 2
14	Martin Luther King Jr. Dr. & Crenshaw Blvd	206562 30.2 acres	Permeable pavement, vegetated swales, cisterns	Los Angeles	1, 2, 4
15	Ballona Greenway: Ballona Creek near Sepulveda Blvd	207618 36.7 acres	Permeable pavement, bioretention in parkway with underdrains, vegetated swales, bioretention	Culver City	1, 2
16	Mar Vista Oval Street Project: Mar Vista Oval St & Venice Blvd	208701 27.8 acres	Bioretention in parkway w/underdrains	Los Angeles	1
17	Ballona Greenway: Lindberg Park at Ballona Creek near Sepulveda Blvd	207628 32.2 acres	Bioretention in parkway with underdrains, permeable pavement	Culver City	1, 2
18	405 Fwy & Sunset Blvd	208374 33.6 acres	Vegetated swales, bioretention facilities	Los Angeles/Caltrans	1
19	Venice Blvd: Wade St to Walgrove Ave	180101 21.8 acres	Bioretention facilities	Los Angeles	1
20	S Vermont Ave & W Pico Blvd	200753 6.5 acres	Permeable pavement, bioretention in parkway with underdrains	Los Angeles	1, 2
21	N Fairfax Ave & Rosewood Ave	204074 35.7 acres	Bioretention in parkway with underdrains, pervious pavement	Los Angeles	1, 2
22	S San Pedro St & E 30th St	205439 17.1 acres	Bioretention in parkway with underdrains, pervious pavement	Los Angeles	1, 2
23	110 Fwy & W 30th St	205717 26.3 acres	Pervious pavement, bioretention in parkway with underdrains, cisterns	Los Angeles/Caltrans	1, 2, 4

Table 5-2
Summary of New Priority Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan

Site ID	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits[2]
24	S Western Ave & Exposition Blvd	205819 19.7 acres	Pervious pavement, cisterns	Los Angeles	1, 2, 4
25	W Jefferson Blvd & Rodeo Dr	206670 35.2 acres	Vegetated swales	Culver City / Los Angeles	1, 2
26	W Beach Ave & W Hazel St	208829 37.2 acres	Permeable pavement, bioretention facilities	Inglewood	1, 2
27	S La Cienega Blvd: W 58th Pl to W Fairview Blvd	208938 32.3 acres	Bioretention facilities	Los Angeles County / Los Angeles / Inglewood	1

Notes:
[1] Site numbers correspond to sites shown in Figure 5-2
[2] Integrated Water Resources Approach (IWRA) Criteria (Basin Plan Amendment Attachment A to Resolution No. 2006-011, p.7):

1. Provides reductions in other pollutants
2. Provides groundwater recharge benefits
3. Provides multi-use benefits
4. Provides beneficial reuse of urban runoff

Table 5-3
Summary of New Priority Regional BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan

Site ID[1] (Figure ID)	Title	Catchment #/ Tributary Drainage Area	BMP Description/Footprint Area	Jurisdiction	Other IWRA Benefits[3]
A (Figure G-28)	Centinela Park (Centinela Ave & Florence Ave)	208805 736 acres	Sub-Surface Flow Wetland with Storage – 20 acres	Inglewood	1, 2, 3
B (Figure G-29)	La Cienega Park (La Cienega Blvd & Olympic Blvd)	204346 374 acres	Multi-Use, Sub-Surface Detention Basin – 5.1 acres	Beverly Hills	1
C (Figure G-30)	Harvard Recreation Center (Harvard Blvd & 61st St)	206172 235 acres	Multi-Use, Sub-Surface Detention Basin – 4.6 acres	Los Angeles Council District 8	1
D (Figure G-31)	Rancho Cienega Sports Center	206496 162 acres	Multi-Use Subsurface Detention Basin – 4.3 acres	Los Angeles Council District 10	1, 3
E (Figure G-32)	MacArthur Park (Alvarado St & 6th St)	200624 135.5 acres	Bioretention Basin with Under Drains – 3 acres	Los Angeles Council District 1	1, 2, 3
F (Figure G-33)	Los Angeles Unified School District Site (Los Angeles and 23rd St)	205397 99 acres	Multi-Use, Sub-Surface Detention basin – 8.3 acres	Los Angeles Council District 9	1
G (Figure G-34)	Lemon Grove Recreational Center (Lemon Grove Ave & 101 Fwy)	200283 63.2 acres	Extended Detention Basin – 0.4 acres	Los Angeles Council District 13	1, 3
H (Figure G-35)	Van Ness Recreation Center and Street Median (W. Slauson Ave and 2nd Ave)	206223 36 acres	Stormwater Drywell Infiltration System – 0.5 acres	Los Angeles Council District 8	1, 2

Notes:
[1] Site numbers correspond to sites shown in Figure 5-2
[2] Site layout figures can be found in Appendix G
[3] Integrated Water Resources Approach (IWRA) Criteria (Basin Plan Amendment Attachment A to Resolution No. 2006-011, p.7):

1. Provides reductions in other pollutants
2. Provides groundwater recharge benefits
3. Provides multi-use benefits
4. Provides beneficial reuse of urban runoff

Table 5-4
Summary of Overall Distributed BMP Implementation Levels

Distributed BMPs	% of Land Use Treated	Acres Treated	% of Watershed
Commercial	17%	1,861	2.3%
Green Streets	15.4%	1,691	2.08%
SUSMP Redevelopment	1.6%	170	0.21%
Education	4%	108	0.1%
LAUSD and UCLA	3.6%	92	0.11%
SUSMP Redevelopment (Private Schools)	0.6%	16	0.02%
Industrial	6%	214	0.26%
Green Streets	1.9%	74	0.09%
SUSMP Redevelopment	3.7%	140	0.17%
Transportation	27%	453	0.6%
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%
Single Family Residential	19%	5,683	7.0%
Green Streets	10.1%	3,077	3.78%
Downspout Disconnect	8.6%	2,607	3.20%
Multiple Family Residential	16%	2,919	3.6%
Green Streets	11.4%	2,039	2.50%
SUSMP Redevelopment	4.9%	880	1.08%
Total Distributed		11,200	13.8%

Note: for Distributed BMPs designated as SUSMP redevelopment, it is assumed that these acres will be retrofit at the expense of the property owner, as described in the SUSMP program.

5.1.3 Recommended Institutional BMPs

The BMPs described in this section represent the range of potential institutional BMPs, most of which are consistent with the WQCMPUR. Institutional BMPs are program-level activities that provide source control measures intended to prevent or reduce bacteria, or bacterial sources (e.g., garbage, trash, and pet waste) from being picked up by runoff whether onsite, in the curb/street, or in the storm drain system. In some cases, these BMPs recognize or supplement institutional BMPs already being implemented through the MS4 permit programs of each jurisdiction. Other BMPs are new and recommended for implementation to help address urban runoff management concerns in general and target bacteria sources specifically.

The institutional BMPs planned for consideration and/or implementation have been categorized into four broad areas:

Education and Outreach – Some of these BMPs are already being implemented; however, they are very important and must be reevaluated and expanded to address bacteria sources more effectively. This category also includes BMPs that are more programmatic in nature to help ensure that education and outreach activities receive the needed funding, are consistent across the watershed, and are based on current policies and guidance.

Program Development – This category addresses the need for ordinance, policy and guidance development. It includes the need to consider how to persuade private landowners, especially commercial and industrial property owners, to implement BMPs.

Planning and Coordination – Coordination is required among agencies to create opportunities, increase efficiency and effectiveness, and prevent the responsible jurisdictions from working at cross-purposes. For example, new education and outreach materials, green policies, and downspout retrofit specifications need not be developed separately by each jurisdiction. Moreover, opportunities may exist to work collaboratively with NGOs to implement selected elements of the institutional BMPs.

Direct Source Control – BMPs that directly address bacteria sources are included. Sources are addressed either through pollution prevention or activities that reduce the volume of runoff, e.g., downspout retrofit program.

Appendix H provides a summary matrix of the BMPs applicable to each of the above areas and a general schedule for implementation, where the BMP is implemented by a responsible jurisdiction. In some cases, the BMP may not be applicable to a specific jurisdiction (e.g., Caltrans cannot develop ordinances) or is not being considered for implementation by a specific jurisdiction.

5.2 Quantification of Water Quality Benefits

5.2.1 Methodology

As described in Section 5.1, implementation of structural and institutional BMPs is proposed to address bacteria in wet and dry weather runoff. Potential pollutant reductions associated with the proposed structural BMPs were quantified using SBPAT (Section 4 and Appendix E). Pollutant reductions associated with institutional BMPs were quantified using a spreadsheet model that accounts for specific pollutant sources and the predicted performance of source control measures based on literature values, mass balance accounting, and best professional judgment. The predicted pollutant reductions associated with the proposed structural and institutional BMPs were then combined to estimate the range of progress towards achieving compliance with Bacteria TMDL limits in Ballona Creek.

The general approach taken to quantify pollutant reductions is as follows:

- Pollutant reductions are quantified for the implementation of regional BMPs, distributed BMPs, and source controls described in Section 5.1.2 and Section 5.1.3 by the year 2021.
- The results for the regional BMPs, distributed BMPs, and source controls are added together to predict the pollutant load reduction for the entire watershed. The catchment areas tributary to each treatment BMP and source controls do not overlap to avoid over-predicting load reductions.
- The predicted BMP pollutant reduction results for the watershed are summarized in terms of average annual load reduction. A range of annual load reduction is also estimated for 2021.
- Data from wet weather samples collected in Ballona Creek are used to estimate in-stream assimilative capacity.
- The estimated load reduction and in-stream assimilative capacity are then compared to the TMDL limits calculated as an annual load.

A discussion of uncertainty and limitations of the quantification approach is also provided.

5.2.1.1 Structural BMPs

The BMP modeling and analysis component of SBPAT, also referred to as the Nexus Tool, utilizes a modified U.S. EPA Storm Water Management Model (SWMM) and a Monte Carlo water quality model to predict average annual runoff volumes and loads from user-specified urban drainage areas. Both regional and distributed BMPs were modeled using the Nexus Tool with an assumed design storm volume of 0.75 inches for volume-based BMPs and an assumed design storm intensity of 0.2 in/hr for flow-based BMPs[1], except where specifically noted for regional BMPs in Table 5-5 below.

Regional BMPs

The priority regional BMP sites identified in Section 5.1.2.2 were selected for analysis using the Nexus Tool. Available BMP footprint areas and approximate tributary drainage areas were identified to estimate whether each BMP site could accommodate the 0.75-inch assumed design storm volume. Of the eight sites that were evaluated, Lemon Grove Recreation Center, MacArthur Park, Harvard Recreational Center, and Van Ness Recreational Center are area-limited, that is, the tributary catchment area is large in comparison to the area available to site the treatment BMP, so the design storm volume for these sites will be less than 0.75 inches. Table 5-5 summarizes the eight regional BMPs and sizing assumptions. Based on these assumptions, the total estimated

[1] BMPs will be designed to treat the achievable tributary area given site constraints, such as topography, soils, and existing infrastructure, with the goal of treating storm sizes of 0.5-1 inch.

catchment area tributary to these eight regional BMPs is approximately 1,840 acres (approximately 2.3 percent of the 82,000 acre watershed).

Table 5-5
Regional BMP Sites Modeled with the Nexus Tool

Site Location	Proposed BMP(s)	BMP Sizing Assumptions/Available BMP Area	Drainage Catchment Area (ac)[1]	Drainage Catchment Imperviousness
Centinela Park (Figure G-28)	Subsurface Flow Wetland with Equalization Storage	Tributary area-limited; assumed 0.75 inch design storm. Treatment flow rate equal to 24-hour drain time of subsurface storage. Area of subsurface flow wetland based on an estimated media porosity of 0.3, an average depth of 6 feet, and a 24-hour residence time. 20 acres available.	736	48%
La Cienega Park (Figure G-29)	Multi-Use Detention Basin	Tributary area-limited; assumed 0.75 inch design storm with 4 foot average ponding depth and a 48-hour drain time. 5.1 acres available.	374	78%
Harvard Recreation Center (Figure G-30)	Multi-Use Detention Basin	BMP area limited; 4 foot volume depth. 6 foot average ponding depth and a 48-hour drain time. Approximate design storm is 0.4 in. 4.6 acres available.	235	63%
Rancho Cienega Sports Center (Figure G-31)	Multi-Use Detention Basin	Tributary area-limited; assumed 0.75 inch design storm with 4 foot average ponding depth and a 48-hour drain time. 4.3 acres available.	162	55%
MacArthur Park (Figure G-32)	Multi-Use Bioretention with Underdrain	BMP area-limited; Volume equal to 18 inch ponding depth over 3 acre BMP area could be collected and treated. Treatment flow rate equivalent to a 2 in/hr filtration rate to underdrain. Approximate design storm is 0.5 in. 3 acres available.	135	85%
Los Angeles Unified School District Site (Figure G-33)	Multi-Use Detention Basin	Tributary area-limited; assumed 0.75 inch design storm with 4 foot average ponding depth and a 48-hour drain time. 8.3 acres available.	99	90%
Lemon Grove Recreation Center (Figure G-34)	Subsurface Detention Basin	BMP area-limited; Volume equal to 4 foot average ponding depth over 0.4 acre BMP area could be treated. 48-hour drain time. Approximate design storm is 0.4 in. 0.4 acres available.	63	71%
Van Ness Recreation Center and Street Median (Figure G-35)	Stormwater Drywell Infiltration System	BMP area limited; SUSMP volume with 4 foot average ponding depth and a 48-hour drain time. Approximate design storm is 0.4 in. 0.5 acres available.	36	73%

[1] The estimated drainage areas were based on existing catchment delineation.

Distributed BMPs

Distributed BMP implementation levels were assigned for each of the following six primary land use categories: a) commercial, b) education, c) industrial, d) transportation, e) multi-family residential (MFR), and f) single family residential (SFR). The remaining land uses within the watershed include agriculture, open water, and vacant.

Private and public parcels within each land use category were identified by merging the Los Angeles County assessor's parcel database with the SCAG land uses. The merged datasets were also used to estimate the percent of each land use that consisted of roadways and rooftops. The transportation land use category consists only of major roadways (i.e., Caltrans parcels, primary highways, and arterials), while smaller secondary streets are included in each of the other land uses. Additional spatial analyses were conducted to identify parcels owned by specific public agencies such as the Los Angeles Unified School District (LAUSD).

Agricultural and open water land uses areas within the watershed were not assigned distributed BMPs; source control measures will be applied to these areas. Agricultural lands are comprised of arboreta, nurseries, horse ranches, and orchards/vineyards, which have low imperviousness and make up a very small proportion of the watershed (0.04%). Open water comprises 0.4% of the watershed. Vacant land areas (17% of the watershed) are comprised of privately-owned parcels that are undeveloped and publicly-owned vacant parcels and open space. Privately-owned vacant parcels were assumed to be developed by 2021 and, as such, those parcels would be required to implement the new development stormwater treatment requirements (SUSMP requirements), such that the net change in runoff volumes and pollutant loads after development of these parcels would be negligible. Publicly-owned vacant parcels and open space were assumed to remain undeveloped.

The type of distributed BMPs and the extent of implementation vary among the six primary land uses based on catchment priority, parcel ownership type, field-identified opportunities, and programmatic-level assumptions. The levels of distributed BMP implementation applied to each land use category and the assumptions used in the Nexus modeling are summarized below.

Land Use Category: Commercial

Redevelopment of Commercial Parcels

- The rate of commercial parcel redevelopment was estimated based on the City of Los Angeles redevelopment project records between 2003 and 2009.

- The average number of redevelopment projects for automotive, retail gas, restaurants, and parking SUSMP classes [10 projects] and commercial projects [15 projects] was assumed to occur each year for 10 years.

- The average redevelopment project size is 0.25 acres for automotive, retail gas, restaurants, and parking lots and 1 acre for commercial projects.

- Distributed BMP type and relative implementation levels were based on the median levels recommended from the field investigations [47% swales, 21% cisterns, 19% bioretention, 13% permeable pavement].

- Using the above assumptions, approximately 17 acres of commercial land use will be redeveloped to SUSMP standards per year for 10 years [*170 acres treated by 2021*].

Green Street Projects in Commercial Areas

- 35% of the commercial land use area is roadways.

- Green street projects will accept 50% additional non-roadway drainage area from adjacent parcels, on average.

- Green street projects will incorporate bioretention (50%) and vegetated swales (50%).

- 30% of roadways within the commercial land use will be retrofitted as green streets over 10 years [*1,691 acres treated by 2021*].

Land Use Category: Industrial

Redevelopment of Industrial Parcels

- The rate of industrial redevelopment was estimated based on the City of Los Angeles redevelopment project records between 2003 and 2009.

- The average number of industrial redevelopment projects is 7 per year.

- Average industrial redevelopment project size is 2 acres.

- Distributed BMP type and relative implementation levels were based on the median levels recommended from the field investigations [47% swales, 21% cisterns, 19% bioretention, 13% permeable pavement].

- Approximately 14 acres of industrial land use will be redeveloped to SUSMP standards per year for 10 years [*140 acres treated by 2021*].

Green Street Projects in Industrial Areas

- 4% of the industrial land use is roadways.

- Green street treatment would be sized to accept 50% additional non-roadway drainage area.

- Green street treatment achieved through equal implementation of bioretention (50%) and vegetated swales (50%).

- 30% of roads within the industrial land use will be retrofitted as green streets over 10 years [*74 acres treated by 2021*].

Land Use Category: Transportation Land Use Areas

- The level of distributed BMP implementation for transportation land use areas within the watershed was based on the results of the BMP implementation field investigations.
  - Class A: High priority catchments with both catchment prioritization index (CPI) and BMP opportunity scores ≥ 3.
  - Class B: High priority catchments with CPI ≥ 3 and BMP opportunity scores ≤ 2.
- 50th percentile levels of implementation from the range of distributed BMP implementation results from the field investigations were applied to Class A catchment areas [46% swales, 42% bioretention, 12% permeable pavement].
- 25th percentile levels of implementation from the range of distributed BMP implementation results from the field investigations were applied Class B catchment areas [59% swales, 24% bioretention, 17% permeable pavement].
- 377 acres in Class A, 76 acres in Class B would be treated over 10 years [*453 acres treated by 2021*]

Land Use Category: Education

Redevelopment of Education Parcels

- Rate of private education redevelopment assumed to be approximately equal to commercial redevelopment rate of 2.5% per year.
- Distributed BMP type and relative implementation for private schools were based on the median levels recommended from the field investigations applied to private education land use [47% swales, 21% cisterns, 19% bioretention, 13% permeable pavement].
- The LAUSD is currently engaged in a school construction building program. By approximately 2013, LAUSD will complete the construction of 132 new schools to accommodate growth in the student population. New schools and site expansions will require the acquisition of over 450 acres of land. The New Construction Program is composed of 417 overall projects, which include the new schools, 64 additions, 38 early education centers and expansions, and a variety of other projects.
  - New schools and expansion are assumed to redevelop existing urban parcels, equally distributed throughout the District.
  - 17% of LAUSD falls within the Ballona Creek Watershed, therefore approximately 67 acres will be developed as part of the New Construction Program.

- Based on the long range plan, the estimated redevelopment rate for UCLA is approximately 5%.

- No significant redevelopment or retrofit of the Culver City Unified School District or the Beverly Hills Unified School District was assumed.

- Public schools (LAUSD and UCLA) were assumed to implement bioretention.

- Approximately 16 acres of private education land use will be redeveloped to SUSMP standards and approximately 92 acres of public education land use area will be treated by 2021 [*108 acres treated by 2021*].

Land Use Category: Single Family Residential (SFR)

Roof Downspout Disconnection

- 35% of SFR land use area is roof area (consistent with the median building footprint of SFR parcels of 25%, SCAG area weight imperviousness of 40%, and zoning set back requirements that would lead to 37% roofs for a standard lot size).

- SFR rooftops will be disconnected and routed into bioretention cells via a Roof Downspout Disconnection Program.

- The roof downspout disconnection rate will be 33% within 10 years [*2,607 acres treated by 2021*].

Green Street Projects in Single Family Residential Areas

- 23% of the SFR land use is roadways and 50% of the SFR land use area drains or can be routed to the roadway.

- Green street treatment will be achieved through equal implementation of bioretention (50%) and vegetated swales (50%) for the roadways and permeable pavement for alleys.

- 30% of the roadway area within the SFR land use area within the watershed will be retrofit within 10 years [*3,077 acres treated by 2021*].

Land Use Category: Multifamily Residential (MFR)

Redevelopment of MFR Parcels

- The rate of MFR redevelopment was estimated based on the City of Los Angeles redevelopment project records between 2003 and 2009. SFR projects subject to SUSMP (projects less than 10 residential units) as specified in the City records were considered MFR in this analysis.

- An average of 39 “10+ Unit” projects were redeveloped annually from 2003 to 2009. The average “10+” unit project size is approximately 2 acres.

- An average of 42 smaller MFR projects were redeveloped annually from 2003 to 2009. The average project size for these smaller projects is approximately 0.25 acres.

- Approximately 88 acres of MFR land use would be redeveloped to SUSMP standards per year for 10 years [*880 acres total area treated*].

Green Street Projects in MFR Areas

- 26% of the SFR land use is roadways and 50% of MFR land use area drains or can be routed to the roadway.

- Green street treatment will be achieved through equal implementation of bioretention (50%) and vegetated swales (50%) for the roadways and permeable pavement for alleys.

- 30% of the roadway area within the MFR land use area within the watershed will be retrofit within 10 years [*2,119 acres treated by 2021*].

5.2.1.2 Institutional BMPs

Institutional BMPs reduce pollutant loads by either reducing the source of a pollutant or capturing built-up pollutants before they can be washed off by stormwater. Quantifying the sources of bacteria in urban watersheds is difficult, because sources and activities that mobilize bacteria are numerous and diverse. Nationwide, watershed management plans identify pet waste and impervious surface runoff as two of the most significant sources of bacteria in urbanized watersheds (Schueler, 2000). Reduction of bacteria from these two pollutant sources can be achieved by educating watershed residents about the importance of pet waste pick-up and through enhancement of street sweeping programs, respectively.

Education and Outreach for Better Pet Waste Pick-Up

Pet waste is a potentially significant source of fecal bacteria in the Ballona Creek Watershed, where the dog population is approximately 240,000 (2000 Census data). Previous studies have measured a fecal coliform concentration of 10 billion fecal coliform units, or Most Probable Number (MPN) of colonies, per pound of dog feces (van der Wel, 1995). The EPA estimates that an average size dog excretes three quarters of a pound of waste per day (274 lbs/yr). Assuming 20 percent of pet owners do not pick up waste and 15 percent of the annual waste load build-up is available for wash off immediately prior to storm events, then nearly 17 quadrillion colonies per year from dog feces may be transported to Ballona Creek from the watershed area that Education and Outreach for Better Pet Waste Pick-Up could potentially address. These estimates of pet waste pickup and transport potential are similar with those used by the City of Portland's Bureau of Environmental Services to estimate the effectiveness of pet waste education and outreach programs (Herrera, 2006) and several other studies (Swann, 1999; City of Tacoma, 2008; City of Austin, 2008; Hardwick, 1997; HGIC, 1996). This quantity of bacteria coming from dog feces represents a significant portion of the total wet-weather bacteria load estimated by the SBPAT model in the Ballona Creek watershed.

Public education and outreach emphasizing the importance of picking up pet waste will result in a change in behavior in some individuals. The fraction of the population that does not pick up pet waste that would change behavior in response to pet waste pickup outreach has been quantified for several outreach efforts within the United States. The primary method to estimate the effectiveness of this BMP is through conducting surveys prior to and following enhanced public education and outreach about pet waste pickup.

Results of such "before and after" surveys on pet waste pickup from other watersheds show that the effectiveness of an outreach program can vary widely. Some studies showed no significant impact pre- and post-outreach, including the Burnt Mill Creek Outreach and Demonstration Project in Wilmington, NC (Imperial and Jones, 2005) and for statewide outreach conducted by the North Carolina Clean Water Education Partnership (CWEP, 2008). Conversely, public surveys pre- and post-outreach in the City of Austin indicated a 9 percent improvement in the number of pet owners who claim to regularly pick up waste (City of Austin, 2008). The City of Portland Bureau of Environmental Services estimated 8 percent effectiveness for public education and outreach, based on the fraction of individuals who received a mailing that requested additional information. Considering the results of these assessments, an estimate of 5 percent was used to predict the effectiveness of pet waste pickup education and outreach to change behavior of dog owners in the Ballona Creek watershed.

Enhanced Street Sweeping

Bacteria released to the urban environment during dry weather conditions are likely to adsorb on street sediments, which provide a transport mechanism for bacteria to reach downstream waterbodies (Anchorage, 2003). Removal of accumulated sediments and associated pollutants from streets is another institutional BMP that can reduce pollutant loads in runoff entering receiving waterbodies.

The rate of sediment accumulation per length of street has been studied in numerous watersheds and typically ranges from 43 to 74 lbs/curb mile/day (Sartor and Gaboury, 1984). In a more recent study to support the Brake Pad Partnership in California, Rosselot (2007) measured a street sediment accumulation rate of 50 lbs/curb mile/day. Using this rate, the annual accumulation of sediment on 1,977 miles of roadways in the Ballona Creek Watershed is estimated to be 72.2 million lbs (50 lbs/curb mile/day * 1977 miles * 2 curbs/mile street * 365 days).

Concentrations of fecal coliform bacteria in street sediments provide an estimate of annual bacteria loading in the Ballona Creek watershed attributable to accumulated street sediment. Several studies in the Chicago area collected samples of wet-weather runoff from streets, avoiding gutter flow that may have originated from other land cover types (Bannerman et al., 1993; Steuer et al., 1997; Pitt and Maclean, 1986). Bacteria concentrations in street sediment from these studies are equivalent to the fecal coliform concentrations divided by the total sediment concentration from concurrent samples, assuming bacteria in rainwater is negligible. Accordingly, bacteria concentrations in street sediment range from 1×10^7 to 1×10^9 colonies/lb. For the Ballona Creek Watershed, 1×10^7 colonies/lb of street sediment was assumed. Combining the estimated accumulation of street sediment from above with a sediment mobilization rate of 20% (Pitt et al., 2004), and this assumed concentration of bacteria in street sediment, the total controllable source of bacteria in street sediments by enhanced street sweeping in the Ballona Creek watershed is approximately $1{,}430 \times 10^{12}$ colonies.

The City of Los Angeles Bureau of Street Services currently conducts routine street sweeping throughout the City. One alternative to enhance this program to achieve more sediment removal is to replace older street sweeper models in the existing fleet with new high-efficiency equipment. Several studies comparing mechanical broom sweepers to newer high efficiency alternative equipment have shown increases in sediment removal of 35 percent (Pitt, 2002), 15 to 60 percent (Minton, 1998), and up to 140 percent (Schwarze Industries). Another alternative for increasing sediment removal through street sweeping is to increase the frequency of operation. Previous studies estimate that in urbanized areas of southern Michigan, it appears that the most cost-effective maintenance practice involves high-efficiency or regenerative air sweeping with annual catchbasin cleaning approximately every 15 to 30 days during the sweeping season depending upon the actual land use (Sutherland and Jelen, 2002). The City of Dana Point doubled sediment removal by increasing street sweeping from biweekly to weekly (Dana Point, 2005).

Enhancement of either street sweeping equipment or frequency of operation or both could be implemented for streets within the Ballona Creek Watershed. Given that numerous street sweeper effectiveness studies show that significant additional sediment removal can be achieved with program enhancement, a reasonable estimate of increased annual sediment removal for this Plan was set at 15 percent by 2021. A detailed study is recommended to assess the existing street sweeping program and alternatives for enhancing sediment removal. The objective of this study will be to develop an approach for achieving at least 15% more sediment removal per year from Ballona Creek Watershed roadways (in catchments not treated with structural BMPs) by 2021. The bacteria load reduction achieved by increasing street sediment removal by 15 percent from current levels is approximately 80×10^{12} MPN/yr. A preliminary analysis of the number of new curb-miles that would need to be swept to achieve this goal is presented in Appendix J.

5.2.2 Expected Combined Benefits from Structural and Institutional BMPs

SBPAT was used to estimate the baseline (2005) average runoff volume and bacteria load from all land uses (except open water areas) in the watershed. Results of the baseline analysis are provided in Table 5-6.

Table 5-6
Baseline (2005) Runoff Volume and Bacteria Load for the Ballona Creek Watershed

Ballona Creek Watershed Area	81,038 acres
Total Runoff Volume	47,124 ac-ft/yr
Fecal Coliform Load	13,730 x 10^{12} MPN/yr

Based on the methodology and assumptions described, load reductions associated with the implementation of the regional and distributed structural BMPs and institutional BMP source controls were estimated for the entire watershed. Predicted average annual bacteria load reductions, estimated load reduction ranges, as well as area and the percent of the watershed treated, are provided for each type of BMP in Table 5-7.

Load reduction ranges for regional BMPs are automatically generated during modeling. Ranges associated with distributed BMP program reductions are based on a stochastic simulation of annual pollutant loads that considers the variability associated with runoff volumes and concentrations. The 5^{th} and 95^{th} percentile annual loads computed were used to define the range.

Load reductions attributed to institutional BMPs were calculated based on the range of literature values presented in Section 5.2.1.2. The low range of the estimate for Education and Outreach for Better Pet Waste Pick-Up assumes an education outreach that is only 1 percent effective (as opposed to the 5 percent effectiveness used for the average load reduction calculation). The high end of the range for this BMP assumes an education outreach effectiveness of 5 percent but assumes the high end of the range of literature values for current pet waste left on the ground by dog walkers (50% as opposed to 30%) to increase the relative portion of pet waste to all sources of fecal coliform in wet weather runoff.

The low end of the range of street sweeping effectiveness assumes a 5 x 10^6 cfu/lb sediment concentration as reported by Steuer et al. (1997) as opposed to the assumed concentration (1 x 10^7 cfu/lb) used for the average load calculation. The high end of the range of estimates of street sweeping effectiveness assumes a bacteria concentration in street sediment of 5 x 10^8 cfu/lb as reported by Bannerman et al. (1993).

Table 5-7
Predicted Bacteria Load Reductions (2021)

BMP Type		Acres Treated	% of Watershed	Load Reduction (10^{12} MPN/Yr)	
				Average	Est. Range
Regional BMPs					
Centinela Park		736	0.90%	88	16 - 210
La Cienega Park		374	0.46%	65	1 - 192
Harvard Recreation Center		235	0.29%	15.2	0.4 - 53
Rancho Cienega Sports Center		162	0.20%	12	0.5 - 39
MacArthur Park		135	0.17%	22	1 - 71
Los Angeles Unified School District Site		99	0.12%	9	0.2 - 32
Lemon Grove Recreation Center		63	0.08%	4	0.1 - 14
Van Ness Recreation Center		36	0.04%	4	0.1 - 14
Total Regional BMP Load Reduction		**1,840**	**2.3%**	**219**	**20 - 625**
Distributed BMPs					
Commercial	17%	1,861	2.3%	793	19 – 2660
Green Streets	15.4%	1,691	2.08%	678	17 – 2295
SUSMP Redevelopment	1.6%	170	0.21%	115	3 – 365
Industrial	6%	214	0.26%	4	1 - 8
Green Streets	1.9%	74	0.09%	1.4	0.3 – 3
SUSMP Redevelopment	3.7%	140	0.17%	2.2	0.5 – 5
Transportation	27%	453	0.6%	3.4	1 – 6
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%	3	1 – 5
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%	1	0.2 – 1
Education	4%	108	0.1%	39	1 - 124
LAUSD and UCLA	3.6%	92	0.11%	33	1 - 108
Private Schools Redevelopment	0.6%	16	0.02%	6	0.1 - 16
SFR	19%	5,683	7.0%	409	66 - 1038
Green Streets	10.1%	3,077	3.78%	222	33 – 585
Downspout Disconnect	8.6%	2,607	3.20%	186	33 - 452
MFR	16%	2,919	3.6%	141	27 - 338
Green Streets	11.4%	2,039	2.5%	96	17 – 237
SUSMP Redevelopment	4.9%	880	1.1%	45	10 – 101
Total Distributed BMP Load Reduction		**11,238**	**13.8%**	**1,389**	**116 - 4173**
Institutional BMPs					
Pet Waste Pick Up Education and Outreach		52,682	65%	827	100 - 1760
Enhanced Street Sweeping		15,278	19%	21	11 – 1073
Total Institutional BMP Load Reduction		**67,960**	**83%**	**848**	**111 - 2833**
TOTALS		**81,038**	**100%**	**2,456**	**247 - 7632**

5.2.3 Compliance with Wet Weather TMDL Limits

5.2.3.1 Target Load Reduction

The wet weather wasteload allocation (WLA) for bacteria is based on bacteriological water quality objectives for marine and freshwater to protect the contact and non-contact recreation uses (400 MPN/100 mL) and an allowable number of wet-weather exceedance days (17 days per year). Assuming that the eight largest storms in a given year are responsible for 17 days of exceedance (i.e., approximately two exceedance days per storm[2]), the ninth largest and all smaller storms are the targeted storms for the purposes of compliance with the TMDL WLA. Additional exceedance days are allowed beyond 17 days in Ballona Creek Reach 2 to account for the high flow suspension of recreational uses for years when there are many storms ≥ 0.5 inches.

Based on an analysis of hourly rainfall data at the Los Angeles Civic Center National Climatic Data Center gage (COOP ID #45115), approximately 86% of the average annual rainfall is associated with the eight largest storm events per year plus any additional storm events occurring in those years that are greater than or equal to 0.5 inches. Therefore, approximately 14% of the average annual runoff must be treated to achieve the TMDL WLA. Fourteen percent of the average annual baseline runoff volume is approximately 6600 ac-ft/yr (i.e., 14% x 47,124 ac-ft/yr).

A target bacteria loading can then be computed by multiplying the numeric limit used to calculate the WLA by the baseline runoff volume:

Limit FC Load = (6,600 ac-ft/yr) x (400 MPN/100 mL) x (1.23 x 107 100 mL/ac-ft) = 33 x 1012 MPN/yr

The revised baseline load for TMDL-applicable storms can be computed by multiplying 14% of the estimated total load:

Baseline FC Load in TMDL Storms = (14%) x (13,730 x 1012 MPN/yr) = 1922 x 1012 MPN/yr

Similarly, the estimated institutional BMP load reduction was scaled to the applicable runoff volume. The estimated structural BMP load reduction was scaled to the percentage of applicable storms (less than 0.5 inches and more than 8 per year) and weighted for the treated area (approximately 21% for regional and distributed BMPs based on the level of physical implementation and design criteria):

Predicted Implementation Plan Average Load Reduction = (14%)(848 x 10^{12} MPN/yr) + (21%)(1389 x 10^{12} MPN/yr) + (21%)(219 x 10^{12} MPN/yr) = 451 x 10^{12} MPN/yr

The predicted range of Implementation Plan load reductions were calculated as follows:

[2] The average storm duration in the rainfall data at the Los Angeles Civic Center National Climatic Data Center gage (COOP ID #45115) is less than 13 hours, but many storms in the record span two days. Wet weather is defined in the TMDL as three days following a storm event. Two days of exceedance per storm event was selected as a conservative assumption for the purposes of this analysis.

Predicted Implementation Plan Low[3] Load Reduction = (14%)(111 x 10^{12} MPN/yr) + (21%)(116 x 10^{12} MPN/yr) + (21%)(20 x 10^{12} MPN/yr) = 44 x 10^{12} MPN/yr

Predicted Implementation Plan High[4] Load Reduction = (14%)(2833 x 10^{12} MPN/yr) + (21%)(4173 x 10^{12} MPN/yr) + (21%)(625 x 10^{12} MPN/yr) = 1387 x 10^{12} MPN/yr

The estimated average, low, and high annual bacteria load reductions at 2021 are summarized in Table 5-8:

Table 5-8
Estimated Runoff Load Reduction at 2021

	Average	Low	High
Baseline Fecal Coliform Load (10^{12} MPN/yr)	1922	1922	1922
Implementation Plan Load Reduction at 2021 (10^{12} MPN/yr)	-451	-44	-1387
Estimated Runoff Load at 2021 (10^{12} MPN/yr)	1472	1879	535

While the estimated runoff bacteria loads are greater than the estimated annual bacteria WLA limit of 33 x 10^{12} MPN, the estimated average annual bacteria load within Ballona Creek is predicted to be at or below the WLA by 2021 due to the assimilative capacity provided within Ballona Creek and its tributaries. The assimilative capacity is a function of flow rate and attenuation and decay within the system, as can be seen in an analysis of the Ballona Creek watershed monitoring data discussed below.

5.2.3.2 Existing In-stream Bacteria Assimilative Capacity

Data from 31 wet weather samples collected from 2001-2007 at the water quality monitoring stations at Centinela Avenue and Culver Boulevard indicate that in-stream *E. coli* concentrations range from 100 to 25,000 MPN/100 mL (City of Los Angeles, 2009). Summary statistics for these 31 data points are shown in Table 5-9. The table also presents land use-based EMC statistics for fecal coliform based on Southern California Coastal Water Research Project (SCCWRP) monitoring data within the watershed. Both area-weighted statistics and the range of the statistic for all of the land uses are provided, for comparison. This comparison (using a 1:1 *E. coli* to fecal coliform ratio[5]) shows that the land-use based EMCs are much greater than the observed in-stream concentrations indicating there is significant in-stream assimilative capacity.

[3] Assumes 5th percentile estimated structural BMP annual load reduction for applicable storms.
[4] Assumes 95th percentile estimated structural BMP annual load reduction for applicable storms.
[5] This ratio was used in the development of the Ballona Creek Bacteria TMDL. See page 20 of the final staff report (RWQCB, 2006).

Table 5-9
Summary Statistics for Observed In-Stream Bacteria Concentrations

Summary Statistic	Observed *E. Coli* Concentration (MPN/100 mL)	Land Use-Based Fecal Coliform EMCs for Ballona Creek Watershed (MPN/100 mL)	Range of Land Use-Based Fecal Coliform Concentrations (MPN/100 mL)
Arithmetic Mean	3,547	24,025	1,681 - 60,328
Geometric Mean	1,310	6,279	1,623 - 22,168
Median	1,100	6,712	1,737 - 30,120
10th Percentile	300	2,451	152 - 5,004
25th Percentile	465	3,985	380 - 7,392
75th Percentile	2,800	21,991	2,057 - 69,960
90th Percentile	5,700	47,648	2,248 - 10,7904

Note: Located at Centinela Blvd.

Assuming that the average annual flow-weighted in-stream concentration for TMDL-applicable storm events (<0.5 inches) is equal to the 90th percentile concentration, and using a 1:1 *E. coli* to fecal coliform ratio, the average annual existing in-stream bacteria loading for applicable storm events can be calculated as:

Existing FC Load = (6,600 ac-ft/yr) x (5,700 MPN/100 mL) x (1.23 x 107 100 mL/ac-ft) = 464 x 1012 MPN/yr

A comparison of this value to the predicted fecal coliform loading shown in Table 5-6 indicates that significant assimilative capacity results from natural bacteria reductions occurs within the system. Without additional point or nonpoint sources, in-stream bacteria would be expected to naturally decay because the wet weather environment is not ideal for the growth of bacteria that are endemic to the intestine of warm blooded animals (Olivieri et al. 2007). The difference between the land use-based loadings and receiving water loadings can be accounted for as a measure of in-stream assimilative capacity resulting from in-stream decay and attenuation resulting in a separate natural load reduction as follows:

Existing FC Load Reduction = (1922 x 10^{12} MPN/yr) - (464 x 10^{12} MPN/yr) = 1458 x 10^{12} MPN/yr

Applying this natural in-stream reduction, the 2021 annual load reduction limit (33 x 10^{12} MPN) is predicted to be met, on average, with the implementation of the structural and institutional BMPs proposed for implementation within the Ballona Creek watershed. The estimated average, low, and high annual bacteria load reductions at 2021, after accounting for in-stream decay and attenuation, are summarized in Table 5-10:

Table 5-10
Estimated In-Stream Loading at 2021

	Average	Low	High
Baseline Fecal Coliform Load (10^{12} MPN/yr)	1922	1922	1922
Implementation Plan Load Reduction at 2021 (10^{12} MPN/yr)	-451	-44	-1387
Estimated Runoff Load at 2021 (10^{12} MPN/yr)	1472	1879	535
Load Reduction due to In-Stream Attenuation and Decay (10^{12} MPN/yr)	-1458	-1458	-1458
In-Stream Loading at 2021 (10^{12} MPN/yr)	14	421	0

5.2.3.3 Uncertainty and Limitations of the Quantification Approach

An attempt was made to minimize the statistical bias of the quantification results through the use of data central tendencies (i.e., means and medians) for computing watershed-wide, average annual load estimates. However, as described below, there are several unavoidable sources of uncertainty in the pollutant load reduction estimates for structural and institutional BMPs due to data limitations, unknown future conditions, simplifying assumptions, and site-specific factors.

***Uncertainty #1*: Available BMP Areas and Drainage Areas**

- For regional BMPs, the available areas were estimated based on aerial imagery, land use data, and parcel information. An assessment of conflicting uses or level of use was not conducted and on-site subsurface utilities were not identified. The tributary areas of the proposed BMP sites were approximated based on existing catchment delineations and identified storm drains. Some drainage areas may be larger or smaller than estimated.

- Specific sites for distributed BMPs were not determined. BMPs were assumed to be, on average, sized to capture 0.75 inches of runoff for volume-based BMPs and 0.2 in/hr for flow-based BMPs. Footprint areas and treatment area ratios were based on the SBPAT default values for each modeled BMPs type. The actual BMP design capacities, footprints and treatable runoff will vary from site to site.

***Uncertainty #2*: Land Use Imperviousness and Changes to Land Uses over Time**

- Los Angeles County imperviousness estimates were used in the assessment. The imperviousness for specific areas may vary from the average land use value used, which impacts the runoff volume estimated by the hydrologic model.

- 2005 SCAG land use data were used to identify BMP opportunities and estimate runoff concentrations. Land use designations may change in many areas as the watershed is redeveloped over the next 10 years (e.g., conversion from industrial to multifamily residential or commercial land uses). The current assessment assumes land uses will not significantly change due to redevelopment.

<u>Uncertainty #3</u>: Water Quality Modeling and Monitoring Data for Bacteria

- Land use monitoring data collected by the SCCWRP are used by the SBPAT to represent bacteria runoff concentrations. These data are limited (see Appendix C of Geosyntec (2008)). For example, data are only available for *E. coli*, so a constant 1:1 *E. coli* to fecal coliform translator was used to convert the data to fecal coliform. Furthermore, the EMC data sample sizes per land use category are extremely limited (n = 2 to 7); therefore, significant uncertainty should be recognized for the estimated bacteria summary statistics used.

- SBPAT uses BMP performance data from the International BMP Database (www.bmpdatabase.org), the most comprehensive source of BMP data, but this database is also significantly limited for bacteria. For the BMP types considered in the quantitative evaluation, the number of data points for fecal coliform effluent concentrations ranged from 3 to 6.

- Water quality modeling of bacteria loading and structural BMP treatment relying heavily on these limited datasets was carried out to aid the use of IWRA to meet multiple TMDLs. Results of Nexus Tool modeling, showing baseline and post-BMP implementation loading of fecal coliform, are intended to be used in high level TMDL implementation planning exercises and provide guidance for the development and subsequent adaptive management of stormwater programs to ensure compliance with WLAs. Estimated fecal coliform load reductions derived from structural BMP treatment will be verified, and revised if necessary, throughout the implementation of stormwater programs as the body of literature regarding bacterial loading and treatment unit processes grows.

<u>Uncertainty #4</u>: Institutional BMP Performance Quantification

- Available data on the performance of source controls is scarce and highly uncertain. Two approaches for quantifying the downstream benefits of source controls includes reference watersheds or before/after studies. Both of these approaches typically require many years of monitoring to detect statistically significant differences due to natural variability in hydrology and water quality, unknown changes in land uses or activities in the control or target watersheds, and episodic or illicit discharges of pollutants. Due to the lack of statistically conclusive studies, the quantification of potential bacteria load reductions from sources controls was based on a combination of data-supported assumptions and best professional judgment.

  The effectiveness of education and outreach on dog waste pick up is based on survey data that indicates some dog owners would change their behavior in response to the outreach. A change in behavior is expected to result in a change in downstream pollutant loading. However, currently there are no known studies that statistically validate this assumption.

- The effectiveness of enhanced street sweeping was based on an estimate of bacteria concentrations in street sediment and the expected performance of high-efficiency sweepers. Sediment bacteria concentrations would be expected to be highly variable and site specific. In addition, all of the studies base sweeper performance on the quantity of collected sediment rather than changes in downstream water quality. Finally, the proportion of collected sediment that would have reached the receiving water is unknown.

***Uncertainty #5*: Redevelopment Rate Assumptions**

- Redevelopment rates for LAUSD are based on current levels of new school construction for the entire district that have been scaled to the Ballona Creek Watershed. This assumes that the construction rates are approximately evenly distributed across the district and that new construction in the Ballona Creek watershed includes redevelopment of currently developed parcels.

- Redevelopment rates for MFR was estimated to be 200 projects per year with an average project size of two acres based on the number of SUSMP applications for 10+ housing developments from 2003-2008 in the Ballona Creek watershed. Future redevelopment rates may be higher or lower than this amount.

5.2.4 Compliance with Dry Weather TMDL

Most of the structural BMPs in this plan to meet the wet-weather TMDL load allocation by 2021 will provide complete removal of bacteria through bioretention and/or infiltration processes. A subset of these projects will be completed by the 2013 dry weather TMDL compliance date, as presented in Section 5.4. Allowing for a constant annual rate of implementation between 2011 and 2021, a reasonable estimate of the drainage area treated by distributed and regional structural BMPs completed by 2013 is 1,386 acres. Of this treated area, approximately 1,100 acres would be treated by infiltration-based BMPs. This would provide a reduction of dry weather runoff of approximately 0.4 cfs using the dry weather runoff generation rate of 230 gal/acre/day (CREST, 2005).

Management of dry weather in Ballona Creek will involve a few key facilities and source control programs in addition to recommended wet-weather BMPs that provide infiltration and/or treatment of dry weather flow. Generally, these additional management strategies involve source control to reduce over irrigation and other urban sources of dry weather runoff, use of the existing NOTF, and a new dry weather runoff diversion from Sepulveda Channel. In a study of dry weather bacteria in Ballona Creek storm drains, Stein et al. (2003) determined that four storm drain outfalls to Ballona Creek are responsible for up to 85 percent of dry weather runoff (Centinela Creek, Sepulveda Channel, BC300, and BC310). Projects in these drainage areas should be prioritized for implementation.

Source control to reduce over-irrigation and other sources of nuisance runoff during dry weather can significantly reduce outflow from storm drains to Ballona Creek. Irvine Ranch Water District (IRWD, 2003) conducted a residential runoff reduction study in Irvine, CA and found dry weather runoff reduction of 20 to 70 percent with education alone or education combined with installation of irrigation controllers over an 18-month period. Assuming public participation in prevention of urban dry weather runoff can provide a reduction in runoff generating urban acres of 15 percent by 2013, and using a dry weather runoff generation rate of 230 gal/acre/day (CREST, 2005), approximately 4.2 cfs of dry weather runoff reduction could be achieved. The City of Los Angeles IRP set a target of 25 percent urban runoff reduction using a toolbox of source control BMPs. Thus, this Plan's implementation level of 15 percent could be partially or entirely achieved through collaboration with water suppliers in the watershed. Despite the storm drain outflow reduction expected from structural BMPs and source control in the watershed, diversion of dry weather runoff from at least one storm drain (Sepulveda Channel to Oval Street Parkway Retrofit) will be necessary to ensure that water quality in Ballona Creek meets dry weather TMDL limits.

These reductions to dry weather flow are presented in Table 5-13. The table is separated into the flow upstream of the NOTF facility and downstream of the NOTF facility. As shown, the base flows are reduced by the various activities going on in the watershed, including institutional BMP implementation and regional and distributed BMP implementation (see Section 5.4 for implementation schedule). As shown, the NOTF facility will treat and discharge all of the dry weather flow that remains in Ballona Creek after the implementation of these BMPs. Downstream of the NOTF, all but 6.0 cfs of flow is treated by either institutional BMPs, structural BMPs or the Sepulveda Channel LFTF. The resulting water quality is 272 MPN/100 mL. Therefore, this concentration meets the bacteria TMDL numeric limit for dry weather flows, which is a maximum single sample concentration of fecal coliform in the estuary of 400 MPN/100ml.

Table 5-11
Evaluation of Dry Weather Bacteria for Compliance with TMDL Limits

Runoff Management Strategy	Dry Weather Runoff (cfs)		Fecal coliform (MPN/100ml)
	Upstream of NOTF	Downstream of NOTF	
Current [1]	19	10	990[2]
Source control (by 2013)	[-2.8]	[-1.4]	0 [3]
Regional and Distributed Structural BMPs (implemented by 2013)	[-0.3]	[-0.1]	0 [3]
NOTF treat and discharge	15.9	NA	2.2 [4]
Sepulveda Channel Diversion	NA	[-2.5]	0 [3]
Remaining untreated dry weather storm drain discharge	0[5]	6.0	990[2]
Remaining Flow	15.9[5]	6.0	
Estimated dry weather runoff entering Ballona estuary	21.9[6]		272[7]

1) Dry weather runoff generation rate of 230 gal/acre/day (CREST, 2005) from 81,038 acres, 2/3 upstream of NOTF, 1/3 downstream of NOTF.
2) 75^{th} percentile of E. coli concentration observed in City of Los Angeles Status and Trends monitoring data 2001-2008 (see Appendix B) during dry weather in Ballona Creek at Centinela Ave is 990 MPN/100ml. One to one translation of E. coli to fecal coliform is used.
3) Bacteria and flow are completely removed from Ballona Creek through regional and distributed BMPs (see Section 5.4 for implementation schedule) and LFTF-2 (Sepulveda Channel diversion to Oval Streets)
4) Estimate of effluent quality from Title 22 requirements for reclaimed water, which is 2.2 MPN/100ml for total coliform. Assumed same values for fecal coliform.
5) Since the NOTF treats the flow, it results in 0 cfs untreated, but since the 15.9 cfs is discharged back into Ballona Creek, it is shown as flow in the creek.
6) The flow entering Ballona Estuary is the sum of the 15.9 cfs of treated discharge from NOTF plus the 6.0 cfs of untreated flow downstream of NOTF.
7) Flow weighted mean [(15.9 cfs x 2.2 MPN) + (6.0 cfs * 990 MPN)]/ (21.4 cfs) = 272 MPN

5.3 Monitoring and Special Studies

Monitoring

As discussed in Section 1, the Ballona Creek Bacteria TMDL requires ongoing baseline and performance monitoring, which is described in the Coordinated Monitoring Plan. The SMBB TMDL also requires baseline and performance monitoring in accordance with the Coordinated Shoreline Monitoring Plan. Together, these data will provide an indication of the current and future patterns of bacterial indicators (total coliform, fecal coliform, and enterococcus) regulated under the TMDL. Upstream sampling of the regulated bacteria can be used to identify "hot spots" that show consistent patterns of high bacteria densities that would represent candidates for additional structural controls if necessary.

Special Studies
Completion of the Implementation Plan has identified several data gaps and information needs. Accordingly, the following special studies are recommended for implementation:

Source Characterization Studies
Source characterization studies should be implemented in the watershed to identify additional contributing factors to metal and bacteria pollutants and estimate their loading rates. Estimates of pollutant emissions can be based on inventories, emissions factors or modeling. Inspections of houses and business facilities can help identify additional sources, as well as studies to identify locations of pollutant "hot spots" within the watershed.

Pilot Programs
Small-scale pilot programs can be a cost-effective way to determine what institutional BMPs are effective and should be expanded to a watershed-wide level. Pilot programs can be designed to collect new source data and provide unit area based cost and benefit information for institutional BMPs to determine need and applicability and evaluate effectiveness. If a pilot study identifies that an institutional BMP is costly and provides limited water quality benefits, the responsible jurisdictions should not deploy it across the entire watershed. Pilot programs can include targeted areas for street sweeping or neighborhoods for downspout retrofit programs.

Outreach and Education Surveys and Data Collection
As previously described, successful education and outreach programs rely on communities to change their behavior regarding pollution problems. Surveys, formal or informal, are an effective tool to gauge the performance of education and outreach programs by directly asking community members about their knowledge of runoff pollution problems and prevention measures, and what, if any, steps they are taking to reduce polluted runoff. Surveys can occur via mail or in-person by randomly interviewing attendees at a community area or event. Prior to any surveys, the responsible jurisdictions should identify quantifiable, measurable goals for education and outreach programs. Initial surveys can then be performed to help define effective outreach programs. Informal surveys can yield important results, such as existing knowledge and awareness in the watershed and the behaviors that should be target for change. After implementation, surveys can be used to evaluate behavior changes and progress towards goals. Data collection can also be used to indirectly measure baseline behavior and program effectiveness. For example, the number of dog bags used at local parks could be tracked before and during an outreach campaign.

Monitoring within MS4s
Institutional BMP implementation should include a long-term monitoring and tracking program. Flow and pollutant monitoring within MS4s provide information on runoff pollutants and the impact of BMPs. Additionally, monitoring can be used to find pollutant "hot spots" by identifying sites of high pollutant concentrations and backtracking to their source. Monitoring should be conducted throughout the entire

period when the BMPs are being implemented as well as afterwards to measure their impact on pollutant loading. Additional monitoring should be performed downstream of “hot spot” sites to ensure safety precautions to prevent polluted runoff from the site are being implemented.

5.4 Implementation Plan Schedule and Milestones

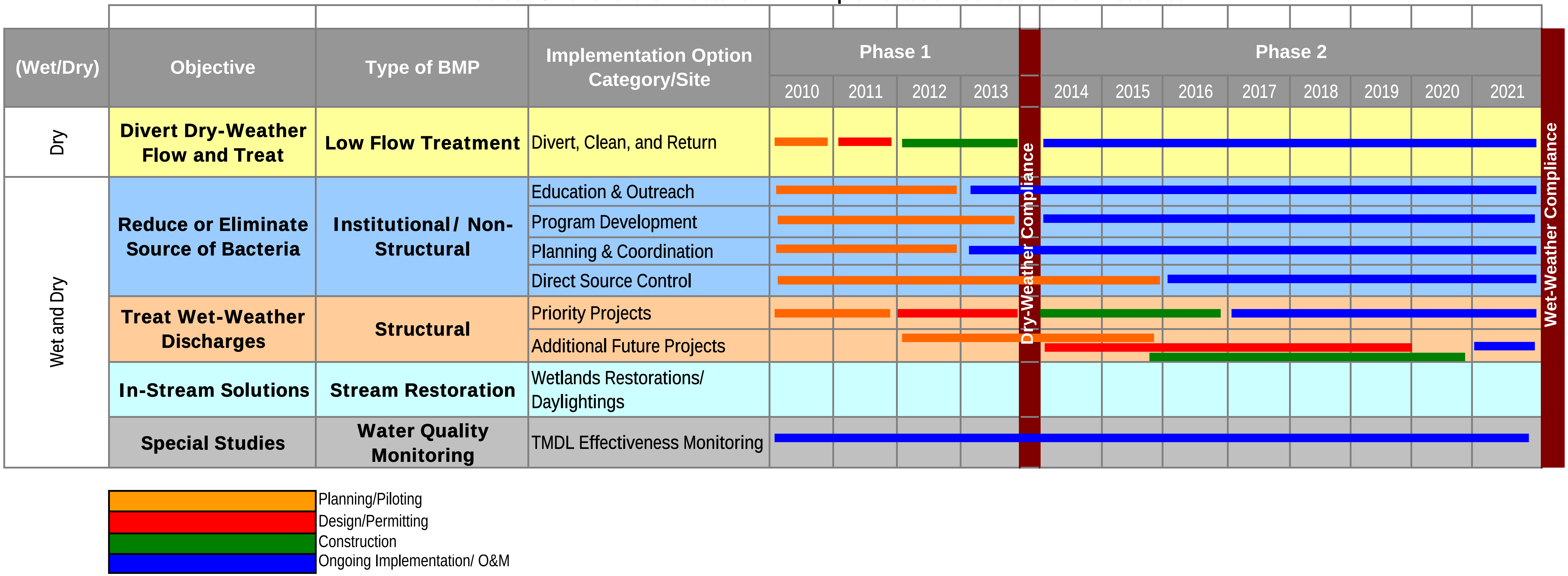
Table 5-12 and 5-13 summarize the preliminary schedule and milestones for institutional BMPs, structural BMPs, and LFTF projects for achieving compliance with TMDL limits in the Ballona Creek Watershed. Both tables identify activities applicable to Phase 1 (2010-2013) and Phase 2 (2014-2021). Table 5-12 shows the rate of implementation for the various BMPs and the percent implementation at each phase. For each BMP, Table 5-13 shows the proposed initiation and duration of: (1) planning/piloting activities, (2) design and permitting, (3) construction, and (4) ongoing implementation/operation & maintenance (O&M). It is assumed that the responsible jurisdictions will continue to act collaboratively and coordinate on scheduling the implementation activities. Caltrans, however reserves the right to proceed independently to address the TMDL goals depending on the specific costs and implementation measures identified during the implementation process.

Table 5-12
Implementation Phasing

BMP Type		Ac/Yr Treated	Phase 1: through 2013		Phase 2: through 2021	
			Treated Acreage	% of Total Target	Treated Acreage	% of Total Target
LFTF	Dry Weather LFTF			100%		
Distributed BMPs	Commercial	186	186	10%	1,861	100%
	Industrial	21	21	10%	214	100%
	Transportation	NA (implemented in Phase 2)			453	100%
	Education	2	94	87%	108	100%
	MFR	292	292	10%	2,919	100%
	SFR	568	568	10%	5,683	100%
	Distributed BMP Total[1]	1,069	1,161	10%	11,238	100%
Regional BMPs	Regional BMP Total[1]		225	12%	1,840	100%
Institutional	Enhanced Street Sweeping			**0%**	15,278	100%
	Pet Waste Pick Up Education & Outreach		26341	**50%**	52682	100%
	Institutional BMP Total		26,341	39%	67,960	100%
Total Treatment			**27,727**	**34%**	**81,038**	**100%**

Notes
1. New priority projects described in Table 5-2 and 5-3 are expected to be implemented by 2016 and overall implementation schedules and milestones are discussed in Table 5-13.

Table5-13 Ballona Crek Bacteria TMDL Implementation Schedule and Milestones



5.4.1 Institutional BMPs

Institutional BMPs are anticipated to be implemented under Phase 1 and Phase 2. The responsible jurisdictions have already implemented several of the institutional BMPs that are identified in this Plan. Implementation of these institutional BMPs will generally follow a typical project cycle including planning, preparation of a detailed BMP specific BMP action plan, development of a pilot program, leading into the subsequent implementation phases. Each of these project phases is expected to take approximately one year. Where feasible, the pilot programs will be prioritized to target the higher priority catchments, (i.e., those with a CPI score > 3). A detailed institutional BMP action plan will be developed for each program and will focus on what each specific agency is currently doing, how resources could be shifted to target high priority catchments initially, and what can be done to enhance activities that will be implemented by each jurisdiction within the first 3 years following approval of this plan, enabling these strategies to be fully in effect by the first interim compliance milestone of 2013.

Under Phase 2, as the institutional BMPs become better defined through the iterative, adaptive approach, specific, quantifiable performance measures will be identified and included in the respective program implementation plans. In addition, as water quality monitoring results are obtained from the CMP, institutional BMPs can be honed to target specific locations where high bacterial contributions are found, and the implementation plan for the affected programs modified accordingly.

5.4.2 Structural BMPs

Regional Structural BMPs

A minimum of eight regional structural BMPs will be implemented by the end of Phase 2. Under Phase 1, a small subset of projects will be implemented that equate to approximately 12 percent to the total targeted acres treated. This subset of projects includes the Lemon Grove Recreation Center and the Rancho Cienega Sports Center projects. The remaining six projects are recommended for implementation during phase 2.

Generally, Phase 1 implementation activities will primarily focus on planning and coordination. This is necessary because the proposed regional structural BMPs must be retrofit into existing public parks which will require extensive planning and coordination with multiple agencies. In addition, the regional structural BMPs are intended to achieve multiple-objectives and address other Ballona Creek TMDL compliance limits for metals and toxicity. The scheduling of regional BMP projects may be adjusted if necessary pending the results of additional more detailed engineering feasibility studies.

The proposed Implementation Plan will complete construction of all eight regional BMPs by year 2021. Additional regional BMP sites may be investigated for implementation should one or more of the sites be found infeasible. All of the projects would be subject to resolution of permitting and right-of-way issues. Project flow rates and treatment levels will depend on the available area and detailed project engineering design. The treatment volumes for pilot projects may fall below the full treatment volumes as necessitated by existing conditions at the sites and subject to the constraints of retrofitting BMPs on developed sites.

Distributed Structural BMPs

Under Phase 1 (through 2013), distributed BMPs that treat approximately 10 percent of the total targeted acreage will be implemented. Implementation of the distributed structural BMPs consists of several steps: (1) planning and coordination; (2) design, permitting/environmental documentation; (3) advertisement/bid /award/construction; and (4) long-term operation and maintenance. Following implementation, the effectiveness of the structural BMP system will be determined from a combination of baseline and influent/effluent monitoring over the course of approximately 1 year. Depending on magnitude and complexity of these projects, the overall duration from developing the concept to assessing the project's effectiveness will range from 2 to 5 years from inception.

For planning purposes, it is assumed that the distributed structural BMP program will be an ongoing program, implementing projects that treat runoff from 1,069 acres per year as shown in Table 5-12. This assumes that these BMPs will be necessary to achieve TMDL compliance limits for bacteria as well as the metals and toxicity TMDLs. Any issues and unexpected conditions during these processes may ultimately impact the scheduled timeline and jurisdictions may need to adjust timeframes as these arise. The LARWQCB will be apprised of any significant impacts to the schedule, as well as project accomplishments, through the responsible jurisdictions annual MS4 permit reports.

Low Flow Treatment Facilities

The primary purpose of the LFTF BMPs is to achieve compliance with the TMDL 2013 dry weather compliance limits. Accordingly, the responsible jurisdictions plan to implement LFTF-1 and LFTF-2 as a priority projects for completion before 2013.

In-stream Solutions

Several unique projects may be feasible along Ballona Creek. These include various stakeholder identified "stream daylighting" projects which are intended to restore portions of Ballona Creek and major tributaries into 'natural' stream channels. These projects will be evaluated opportunistically and their implementation schedule is to be determined.

The Ballona Creek Wetlands present another unique opportunity to achieve multi-objective watershed project. Several agencies including the Coastal Conservancy, Department of Fish and Game, State Lands Commission, and Santa Monica Bay

Restoration Commission have initiated a project to enhance habitat and public access at the 600-acre property along both sides of Ballona Creek Estuary. The BMPs implemented under this plan will provide upstream water quality treatment for flows into this wetlands area. It may be possible for a portion of the wetlands to provide additional "polishing." Additional distributed structural BMPs for public parking and access areas could be included in the project design to provide additional water quality treatment.

5.5 Quantification of IWRA Benefits

As discussed in Section 1, quantification of the additional water resource benefits must be provided to illustrate that the Implementation Plan meets the definition of an IWRA.

Reductions in Other Pollutants

The IWRA plan included in the Bacteria TMDL Implementation Plan will also address other pollutants of concern in the Ballona Creek watershed. The structural BMPs included in the Implementation Plan are predicted to reduce loads of TSS, copper, lead, and zinc and substantially contribute to attainment of the WLAs in the Ballona Creek Metals TMDL and the Ballona Estuary Toxic Pollutants TMDL.

Groundwater Recharged

As the Ballona Creek watershed sits above a confined aquifer, it is not known whether the infiltration projects identified in the Implementation Plan will serve to recharge the groundwater basin. However, there are multiple BMPs that include infiltration elements. For the distributed BMPs, assuming that 80 percent of them have an infiltration element, approximately 1.9 MGD of runoff could be infiltrated (50% x 10,000 acres x 230 gpd/ac). For Regional BMPs, four of the eight sites include infiltration elements, with a total potential infiltration rate of 0.3 MGD (1,100 acres x 230 gpd/ac). For both regional and distributed BMPs, this results in a total possible infiltration rate of 2.2 MGD.

Acres of Multi-use Projects

Of the eight regional project identified, four include multi-use elements. These four projects have a total footprint of approximately 28 acres. Further, during design many of the distributed BMPs could be coupled with multi-use projects, such as trails and bike paths, based on community needs, project partnerships, and site appropriateness.

Urban Runoff Beneficially Reused

The NOTF facility will have the option to reuse treated effluent, up to 6.5 MGD. Further, a subset of the distributed BMPs that will be implemented include reuse BMPs such as cisterns. Assuming that only a small portion utilize cisterns, such as 5 percent, this would result in approximately 0.1 MGD of reuse watershed wide (5% x 11,200 acres retrofit by 2021 x 230 gpd/ac).

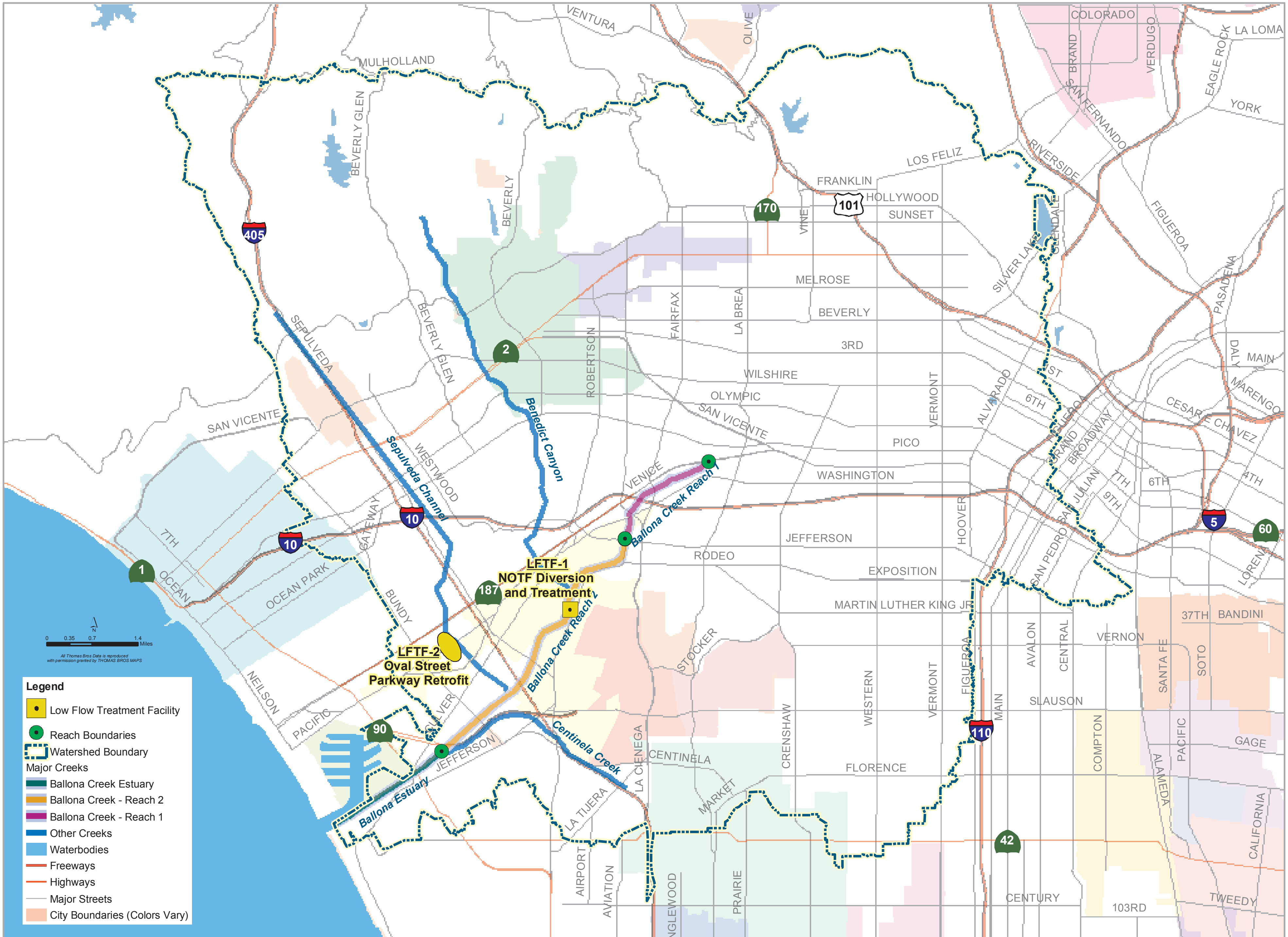


Figure 5-1 Ballona Creek Watershed - Low Flow Treatment Facility (LFTF)

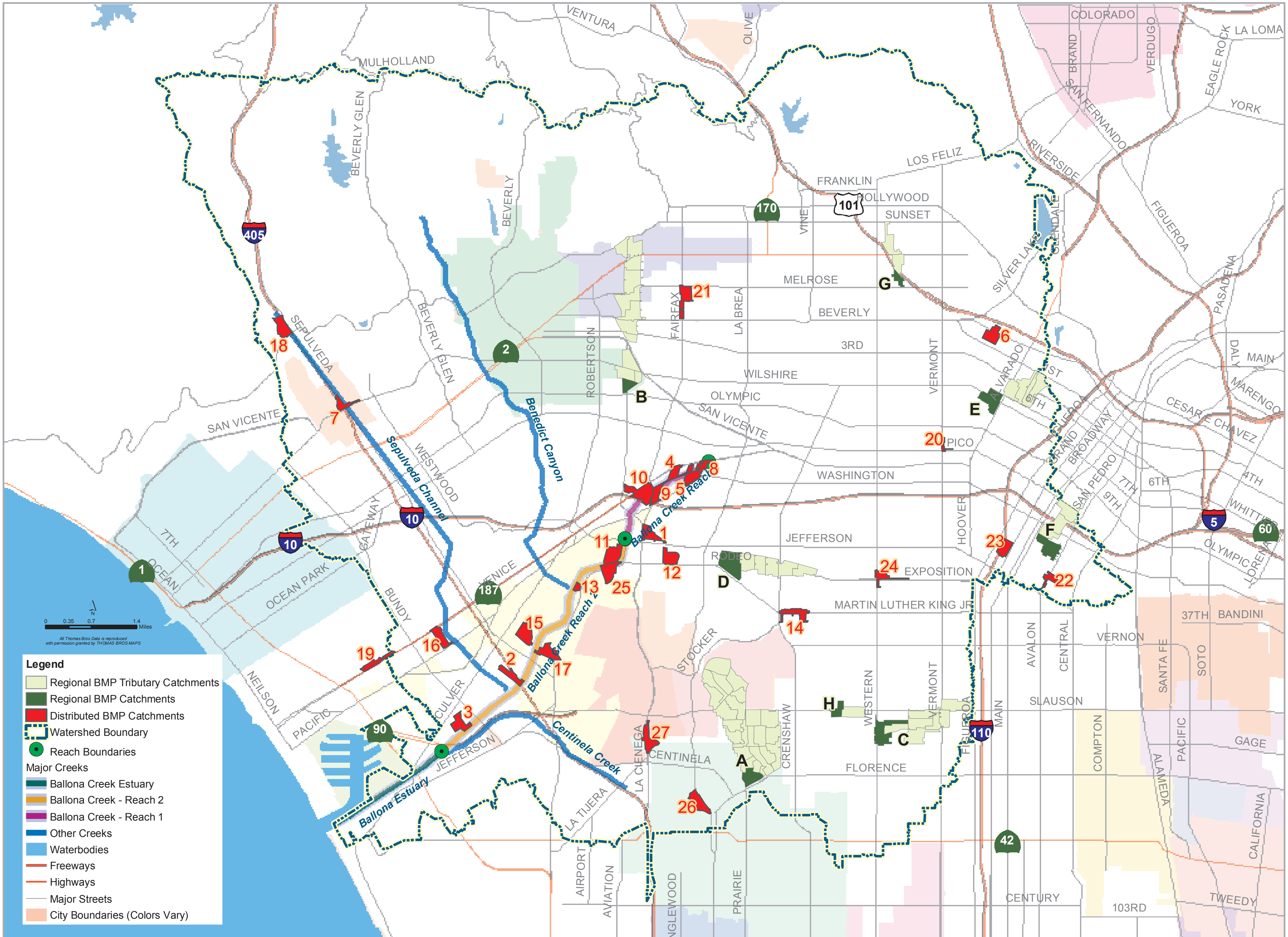


Figure 5-2 Ballona Creek Watershed - Priority Distributed and Regional BMP Sites

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Section 6
Program Cost and Budget

6.1 Introduction

Planning-level (order-of-magnitude) capital and O&M budgets and staff resources estimates were developed based on the preliminary project and program concepts presented in Section 5. These estimates are intended to provide decision-makers with an order-of-magnitude sense of what expenditures and staff resources may be anticipated over the 12-year implementation schedule. Given the iterative and adaptive nature of the implementation plan, and the many uncertainties associated with many of the projects and programs, the budget forecasts, especially for later phases, should be considered relatively speculative. The cost estimate is for the Implementation Plan as a whole; the allocation of costs to specific jurisdictional agencies is not addressed.

6.2 Structural BMPs

The Water Environment Research Federation (WERF) Whole Life Cycle cost spreadsheets provide the basis for developing the cost estimates for structural BMPs. (http://www.werf.org/bmpcost). The Whole Life Cycle costing approach was applied to five selected distributed BMP sites and four selected regional BMP sites. Cost estimates for construction of these facilities were prepared using construction cost data prepared for other City of Los Angeles Proposition O projects, revised as necessary from other sources (such as bid tabulations and contacts with venders and contractors to incorporate features not previously included in Proposition O construction cost estimates). Whole life costs (regular operations and maintenance costs prorated over the expected useful life of the project) were calculated using the spreadsheet model included in the 2005 WERF final report: *Performance and Whole Life Costs of Best Management Practices and Sustainable Urban Drainage Systems*.

Appendix K presents the detailed results of the structural BMP cost estimates for each of the selected distributed and regional BMPs. The detailed cost estimates include the present value estimated for the whole life-cycle costs for a 50 year service period.

6.2.1 Structural BMP Capital Costs

Summaries of the structural BMP cost estimate tables are presented in Tables 6-1 for the distributed BMPs and Table 6-2 for the regional BMPs. Total facility capital costs and annual O&M costs are provided. The upstream drainage area "treated" by each BMP project is also presented. The total capital and O&M costs are divided by the treated areas to provide "per acre" costs that can be extrapolated to the remainder of the watershed.

Table 6-1
Summary of Cost Estimates for Selected Distributed BMPs in Ballona Creek Watershed

Site #[1]	Total Facility Capital Cost	Total Annual O&M Costs	Acres Treated	Capital Cost per Treated Acre	Maintenance Cost per Treated Acre
1	$830,000	$35,200	19.6	$40,000	$1,800
2	$630,000	$34,800	13.7	$50,000	$2,500
3	$1,600,000	$35,200	12.3	$130,000	$2,900
4	$600,000	$34,300	11.5	$50,000	$3,000
5	$700,000	$35,600	9.8	$70,000	$3,600
		Total Acres:	66.9		
			Average Cost per Treated Acre	$68,000	$2,800

[1]The Site Number corresponds to the sites listed in Section 5, Table 5-2 and in Appendix G (as Figure G-1 for Site 1, G-2 for Site 2, etc.).

Table 6-2
Summary of Cost Estimates for Selected Regional BMPs in Ballona Creek Watershed

Regional BMP Site	Total Facility Capital Cost	Total Annual O&M Costs	Acres Treated	Capital Cost per Treated Acre	Maintenance Cost per Treated Acre
MacArthur Park	$6,570,000	$187,100	136	$50,000	$1,400
Lemon Grove	$870,000	$38,500	63	$10,000	$600
Jim Gilliam Park[1]	$1,460,000	$37,200	171	$10,000	$200
Centinela Park	$12,890,000	$81,800	736	$20,000	$100
Total Acres			1,106		
Average Cost per Treated Acre				$22,500	$600

[1] The layout for the Lemon Grove site has been modified since this cost estimate was prepared. However, as this cost estimate was used to determine the cost per treated acre, the costs presented here combined with the treated acres shown here are valid as part of the unit cost calculation.
[2]The regional site Jim Gilliam Park is not included in the final list of eight priority regional projects identified, but could be implemented in the future. However, as the cost estimate was developed for this site, it is presented here as an appropriate factor in determining the cost per treated acre.

The facility costs were determined through two steps. First, an assumed unit cost was applied to each estimated conceptual BMP identified for each distributed catchment or regional site in order to calculate the facility base costs. Second, the facility base costs were scaled up to account for the following additional capital costs, which were applied as a percent of the total facility base cost:

- Project Management (15%) includes Engineering: Preliminary and Final Design, Topographic Survey, Geotechnical, and Landscape Design,
- Utility Relocation (2%),

- Legal Services (2%),
- Permitting & Construction Inspection (3%),
- Contingency (35%).

Land acquisition costs (site, easements, etc.) were not included in the cost estimates because the facility sites were selected to be on public property or will be implemented as part of a public/private partnership.

Tables 6-1 and 6-2 present the average per acre capital cost for distributed BMPs, $68,000/acre and regional BMPs, $22,500/acre, respectively. These average costs were applied across the watershed to estimate overall structural BMP costs for the Implementation Plan (Section 6.5).

6.2.2 Structural BMP O&M Costs

Costs for routine maintenance activities include:

- Inspections,
- Reporting & information management,
- Vegetation management with trash and minor debris removal,
- Vector control.

Corrective and infrequent maintenance activities (e.g., unplanned and assumed to be every three years or more) include:

- Intermittent facility maintenance, and
- Sediment removal.

Similar to the capital cost estimate, in order to extrapolate O&M costs to watershed wide implementation, "per acre" O&M costs were calculated. Tables 6-1 and 6-2 present the average per acre O&M cost for distributed BMPs ($2,800/acre) and regional BMPs ($600/acre), respectively. These average costs were applied to estimate overall structural BMP O&M costs for the Implementation Plan (Section 6.5).

6.3 Low Flow Treatment Facilities (LFTFs)

Two LFTF are proposed for the Ballona Creek TMDL Implementation Plan. Planning level costs for each facility are presented in this section.

LFTF-1/North Outfall Treatment Facility

For LFTF-1, the estimated costs are estimated for the diversion, treatment and discharge to Ballona Creek of water meeting REC-1 water quality objectives. This cost considers (1) the construction, operation and maintenance of low flow diversions upstream of the NOTF; (2) conveyance of dry weather flows to the NOTF; and (3) start-up requirements, operation and maintenance at the NOTF. The total estimated cost of implementation of LFTF-1 is $10.6 million:

- The base facility costs are $4.9 million. These costs assume a maximum dry weather runoff of 23 cfs. The runoff collection system costs assume use of an inflatable dam to retain dry weather flows only. The facility processes would include an influent channel, influent pumping/screening, oil and grease removal, chlorine disinfection, and dechlorination. Costs also include necessary site work and odor control.

- Estimated costs for optional implementation activities were also included (i.e., upgrading NOTF treatment capabilities to meet Title 22 reuse standards, and/or operating the facilities to capture and treat a portion of wet weather flows). Based on estimates previously developed as part of the Ballona Creek Treatment Facility Feasibility Study and Preliminary Design, and adjusted to August 2009 dollars (Los Angeles, 1996), the estimated cost of upgrading the NOTF to treat a portion of wet weather flows and have the capability of treating a portion of diverted flows to Title 22 reuse standards (up to 6.5 MGD) is $5.7 million.

- Average annual operating and maintenance costs are estimated at $1.06 million/year.

LFTF-2/Sepulveda Channel Diversion to Oval Streets

LFTF-2 will be constructed at a location along Sepulveda Channel to treat flows prior to discharge to Ballona Creek. The captured dry weather flow will be diverted to a double infiltration basin with irrigation. Estimated capital costs are $14.7 million, and include the following:

- Dry weather flow from Sepulveda Channel to be pumped using a solar powered pump,

- The new curb and gutter with curb cuts every 10-feet,

- Two 4-foot silty sand filled trench at each side of parkway,

- A flow buffer island with moving water friendly vegetation before water flows into the swales,

- 8-inch HDPE pipes will be used under driveways to connect two parkways. Lateral trench across the parkway will be added to provide adequate soil moisture for the plants throughout the year. Lateral trench will be at least 10-feet away from the Palm trees root system.

LFTF-2 Operations and Maintenance Costs: Costs include plant maintenance, sediment removal, vector control, and pumping. O&M costs are estimated to be 10% of the total capital costs, or $1.5 million.

6.4 Institutional BMPs

A cost estimate for the institutional BMPs enhanced street sweeping, enhanced pet waste pickup and education program, and downspout disconnection are provided below.

Enhanced Street Sweeping

Expanding the City of Los Angeles Bureau of Street Services (BOSS) program to achieve an additional 15% load reduction provided the basis for estimating the cost of an enhanced street sweeping program. BOSS already has an aggressive sweeping program which includes both weekly and monthly sweeping of most of the streets in the City. The additional load reduction may be achieved by expanding the sweeping program incrementally to increase total annual number of curb-miles swept within the Ballona Creek Watershed through increasing the frequency of sweeping on streets that are currently swept monthly. The primary capital costs associated with an enhanced street sweeping program is the equipment procurement. Either mechanical or more efficient vacuum sweepers could be used to expand the sweeping program. Street sweeper equipment can range from $140,000 to $280,000 per unit (SCVURPPP 2005 adjusted to 2008 dollars). As shown in Appendix J, the City would need to purchase additional sweepers to sweep these additional curb-miles. Based on the calculations, an estimated 3 to 4 new sweepers would be required in the Ballona Creek watershed to sweep these additional curb-miles and achieve a 15% increase in sediment load removal.

Operation and maintenance costs include labor costs for additional operators and ongoing operation and maintenance of the equipment as well as transportation and disposal costs of the materials collected.

The estimated cost for an enhanced street sweeping program in the Ballona Creek Watershed is: $560,000 - $840,000 capital costs for new equipment and $600,000 per year in additional O&M costs. Appendix J presents a detailed worksheet of the enhanced street sweeping program cost estimate assumptions and calculations.

Education and Outreach for Better Pet Waste Pick-Up and Other Education and Outreach

Cost estimates for an expanded education and outreach program may include the production and distribution communication materials (signs, ads, brochures). In addition, the City may incur capital costs if the program includes facilities such as waste pick-up bag dispensers and disposal stations. The cost estimate for the Education and Outreach program, including the Pet Waste Pick-up program is $2,000,000. The operation and maintenance cost is assumed to be 10 percent of this, or $200,000.

Downspout Retrofit Program

The Implementation Plan includes costs associated with the downspout retrofit program. Approximately one-third of the single family homes in Ballona Creek Watershed will be part of the downspout retrofit program, which equates to the 2,600 acres of runoff managed by this program, as shown in Section 5). The average roof area was estimated to be 2,100 square feet, or 0.05 acres. Therefore, there are approximately 52,000 single family homes that will be part of the downspout retrofit program.

Based on the cost estimate for the City WPD downspout retrofit pilot program (City of Los Angeles, 2008), which involved downspout disconnection at 600 properties and had a total cost of $1 million, a unit cost per downspout disconnection is estimated to be $1,700 per property.

Based on 52,000 homes being retrofitted, the total capital cost is estimated to be $88.4 million. It is assumed that there will be no operation and maintenance cost for the responsible agencies as the retrofit downspouts will be the responsibility of the property owners.

6.5 Implementation Plan Costs

Costs estimates for the distributed BMPs, regional BMP, LFTFs, and institutional BMPs are presented in Table 6-3.Based on information provided in previous sections, average “per acre” costs were calculated and applied to estimate the overall costs of the structural BMP program when applied across the Ballona Creek Watershed. As shown, the total capital cost is estimated to be $1.2 billion, with $34 million in O&M costs.

The implementation of this plan is subject to the availability of the necessary funding. Currently none of the BMPs and projects identified in this plan are funded, except for some of the institutional measures. Responsible cities and agencies continue to pursue funding alternatives in partnership with each other.

Table 6-3
Draft TMDL Implementation Plan Costs for Ballona Creek Watershed[1]

Ballona Creek Watershed BMPs	Treated Acres [2]	Capital Cost per Treated Acre	Total Capital Cost	O&M Costs per acre	Annual O&M
Structural BMPs					
Distributed BMPs	*10,100*[3]	$68,000	$686,800,000	*$2,800*	$18,180,000
Regional BMPs	*1,840*	$22,500	$41,400,000	*$600*	$1,100,000
Low Flow Treatment-1 (NOTF)			$10,600,000		$1,060,000
Low Flow Treatment-2 (Oval St)			$14,700,000		$1,470,000
Institutional BMPs					
Enhanced Street Sweeping			$840,000		$600,000
Downspout Disconnection			$88,400,000		$0
Enhance Pet Waste Pickup and Education Program			$2,000,000		$200,000
Subtotal			**$840,000,000**		**$22,600,000**
Program Management, Engineering, Administration, and Monitoring (20% of capital cost)[4]			$170,000,000		$4,500,000
Program Contingency (30%)			$250,000,000		$6,800,000
Total Cost			**$1,260,000,000**		**$34,000,000**

[1] Selected BMPs will address multiple pollutants including bacteria, metals and toxicity.
[2] Treated Acres based on draft Implementation Plan selected scenario assuming distributed BMP deployment as required to meet Bacteria TMDL load reduction target and 8 Regional BMP facilities. See Table 5-7 in Section 5.
[3] Excludes the acres that will be retrofited through the SUSMP program, as these costs would not be the responsibility of the responsible jurisdictions.
[4]The responsible agencies will require additional resources in order to manage the BMPs implementation described in this Implementation Plan. The costs associated with this include administration, engineering, and ongoing monitoring of the program. The costs are estimated to be 20% of the total capital costs, or $160,000,000 through 2021. This cost would include increased staff for oversight of the design and implementation of the structural BMPs as well as implementation of the institutional BMPs (reviewing and enhancing existing policies, etc, as listed in Appendix G).

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Section 7
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