



Total Maximum Daily Load for Metals in Ballona Creek

Implementation Plan

HAND DELIVERED

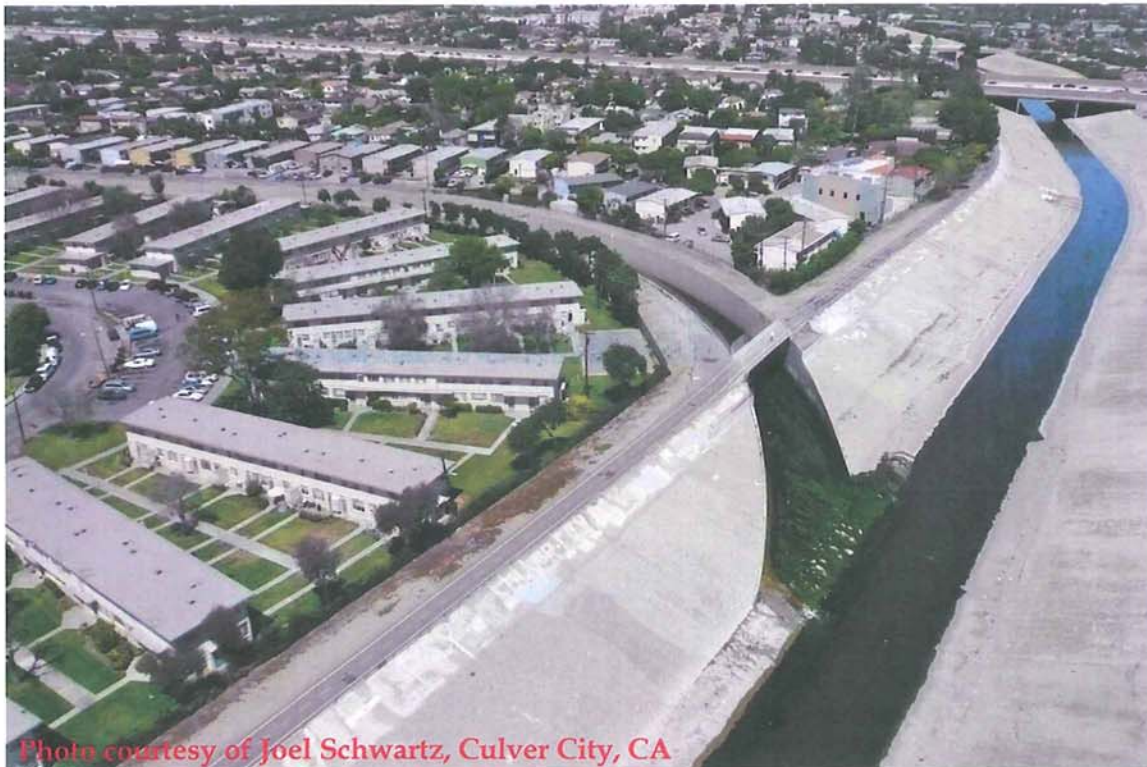


Photo courtesy of Joel Schwartz, Culver City, CA

Submitted on: October 7, 2010

Prepared by

**City of Beverly Hills, CalTrans, City of Culver City, City of Los Angeles,
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Acknowledgments

The Implementation Plan for the Ballona Creek Metals Total Maximum Daily Load 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 Metals TMDL Implementation Plan (Implementation Plan) defines the approaches that the cities of Los Angeles (lead agency), Culver City, 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 Metals TMDL* (Metals TMDL).

This Implementation Plan was developed along with the Ballona Creek Bacteria TMDL Implementation Plan. With the exception of institutional BMPs developed specifically to address metals, all of the BMPs identified to be implemented under this Implementation Plan serve to reduce both metals and bacteria in order to meet the numeric limits and waste load allocations of the Metals and Bacteria TMDLs, respectively.

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.
- ***Green Solutions:*** wherever possible, implement solutions that are “green,” sustainable, and compatible 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 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 (a reference to the applicable Clean Water Act section). 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 Ballona Creek Metals 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 Ballona Creek Metals TMDL was approved and became effective October 29, 2008. This TMDL requires that the responsible jurisdictions submit a TMDL Implementation Plan to the LARWQCB by January 11, 2010, which describes how the TMDL compliance targets will be achieved.

ES.3 Metals TMDL Numeric Limits

The TMDL includes numeric limits which are based on the metals water quality objectives established in the Basin Plan to protect non-contact recreational uses. Numeric targets are established for certain metals (e.g., copper, lead, zinc, and selenium). These numeric targets define allowable concentration of each metal expressed in micrograms per liter. The TMDL also defines wasteload allocations of metals (in grams per day) that prohibit any exceedances of these numeric targets during dry weather and wet weather conditions.

ES.4 Metals TMDL Compliance Milestones

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

- By **January 11, 2012**, demonstrate that 50% of the total drainage area is effectively meeting the dry-weather waste load allocations, and 25% of the total drainage area is effectively meeting the wet-weather waste load allocations.

- By **January 11, 2014**, demonstrate that 75% of the total drainage area is effectively meeting the dry-weather waste load allocations.
- By **January 11, 2016**, demonstrate that 100% of the total drainage area is effectively meeting the dry-weather waste load allocations, and 50% of the total drainage area is effectively meeting the wet-weather waste load allocations.
- By **January 11, 2021**, demonstrate that 100% of the total drainage area is effectively meeting both the dry-weather and wet-weather waste load allocations.

ES.4.1 Additional TMDLs and Watershed Impairments

Two additional TMDLs are effective in the Ballona Creek Watershed:

- *Ballona Creek, Estuary, and Sepulveda Channel Bacteria TMDL* - includes numeric limits and wasteload allocations applicable to urban runoff for total coliform, fecal coliform, enterococcus, and *E. coli*. (LARWQCB 2005). The TMDL effective date is April 27, 2007. A Draft TMDL Implementation Plan was submitted to the LARWQCB on November 25, 2009.
- *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 Metals TMDL Implementation Plan were coordinated with the technical analyses required for development of implementation plans for the bacteria and toxics pollutant TMDLs.

ES.5 Coordinated Monitoring Plan (CMP) Requirements

The Metals TMDL required that a CMP be submitted by the responsible jurisdictions (including Los Angeles County) by January 11, 2007. The CMP was submitted for the Ballona Creek Watershed to the LARWQCB on January 10, 2007, and was written to address both the Ballona Creek Metals TMDL and the Ballona Creek Estuary Toxic Pollutants TMDL. The CMP was revised and resubmitted on August 8, 2008 and again on May 4, 2009.

The CMP will characterize existing water quality based on applicable metals water quality objectives and assess compliance with the wasteload allocations in the Metals TMDL. The CMP identified eleven monitoring sites for TMDL effectiveness monitoring. Ten of these sites are applicable to the Metals and Toxics TMDLs, while one is relevant to the Toxics TMDL only.

ES.6 Responsible Agency Planning Process

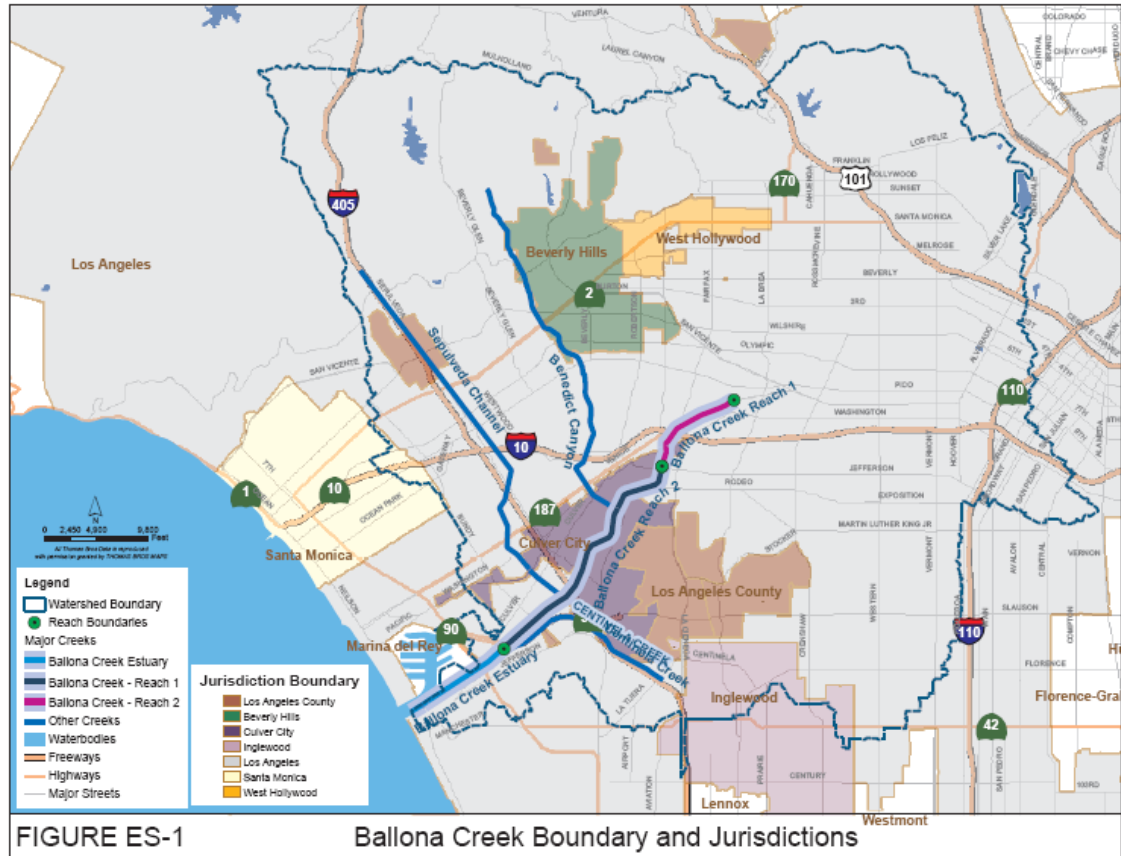
The jurisdictions named by the TMDL as responsible for meeting the wasteload allocations (except Los Angeles County) have developed a Memorandum of Understanding (MOU) to prepare one integrated Implementation Plan. Approximately 81 percent of the watershed is under the jurisdiction of the City of Los Angeles and the remainder of the watershed consists of the cities of Beverly Hills, West Hollywood, Culver City, Inglewood, 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 (82,000 acres) in size (Figure ES-1) and is bound 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.



Development of this 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 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

For over seven years, City of Los Angeles conducted Status and Trends Monitoring Program. On-going water quality monitoring programs includes TMDL Ambient and Effectiveness Monitoring Program conducted by the City of Los Angeles and the Municipal Separate Storm Sewer System (MS4) monitoring program conducted by the County of Los Angeles.

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.

The 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.

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

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

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.

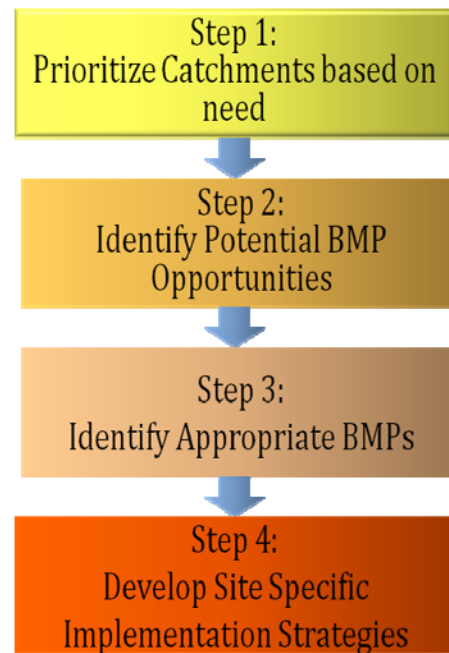


Figure ES-2
Steps for Selection of Structural BMPs

ES.11 Identification of Institutional BMP Programs

Due to 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 Metals TMDL Implementation Plan relied on information gathered from existing programs; information provided by stakeholders; and other regional and national institutional BMPs.

ES.12 Recommended BMP Implementation

The Implementation Plan relies on a combination of measures designed to decrease introduction and transport of metals, as well as other pollutants such as bacteria 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 January 2012, Phase 2 includes the period from 2012 through January 2014, Phase 3 includes the period from 2014 through January 2016, and Phase 4 includes the period from 2016 through January 2021.

Recommended BMPs include three general categories:

- Low Flow Treatment 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 treatment facilities in the watershed that divert a portion of the runoff from Ballona Creek and Sepulveda Canyon 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 supplement the watershed BMPs in achieving the necessary metals load reductions during dry-weather conditions for the purpose of meeting the interim compliance deadlines. Continued use of these LFTFs will be evaluated after the other suites of BMPs have been implemented.

ES.12.2 Wet Weather Structural BMPs Implementation

The Implementation Plan includes structural BMPs that will 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.

As a result of the extensive desktop and field analyses conducted in the watershed, 27 sites were selected to be implemented as priority distributed BMPs and eight sites were selected as priority regional BMPs based on opportunity potential, site conditions, ownership, drainage area, and geographic distribution. 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.

Priority distributed and regional projects proposed by this Implementation Plan are the same as proposed by the Implementation Plan for the Ballona Creek Bacteria TMDL and are shown in Table ES-3. Levels of implementation for distributed BMPs by landuse category is listed in Table 5-9 to 5-11.

In addition to these specific projects, it is expected that many additional BMP projects will need to be implemented to meet TMDL compliance requirements. It is estimated that the level of implementation required results in the need for runoff from 11,300 acres, or 13.9 percent of the Ballona Creek watershed, to be treated by distributed BMPs in order to meet the TMDL limits.

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.

The following institutional BMPs are recommended in Ballona Creek Bacteria TMDL Implementation Plan. These BMPs are designed to address multiple pollutants (bacteria, metals, and toxic pollutants) and can be categorized as follow:

- *Education and Outreach* - Some of these BMPs are already being implemented; but they and must be reevaluated and expanded to address metals 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 metals sources are included. Sources are addressed either through pollution prevention or activities that reduce the volume of runoff, e.g., downspout retrofit program. The following three direct source control BMPs are included in the Metals TMDL Implementation Plan. Two of these, the product replacement and targeted zinc reduction program, were not included in the Bacteria TMDL Implementation Plan as they only apply to metals.
- *Individual Car Washing* - This BMP targets car owners that wash their own cars. This activity increases dry-weather urban runoff and contributes metal concentrations in the watershed. To reduce dry-weather metal loads, educational outreach could be increased to encourage car owners to minimize washing activities that increase runoff to storm drains.
- *Enhanced Street Sweeping* - This BMP focuses on enhancing street sweeping activities to achieve a modest 15% increase in material picked up by 2021. To achieve this goal, the watershed agencies will evaluate opportunities to increase the efficiency of existing street sweeping programs. This evaluation will include a pilot study to evaluate effectiveness of street sweeping by evaluating parameters such as sweeping frequency, sweeper type, location (areas with highest potential pollutant loads), need for parking regulations, material captured (type and quality), etc. Based on the study findings, program features that improve sweeping effectiveness can be developed and implemented.
- *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.
- *Direct Source Control* - BMPs that directly address metals sources are included. The following direct source control BMPs are included in the Metals TMDL Implementation Plan. The product replacement and targeted zinc reduction program were not included in the Bacteria TMDL Implementation Plan as they only apply to metals.
 - *Product Replacement* - The purpose of this BMP is to reduce a significant source of metals in the environment by developing safe alternative products. To implement this BMP, the agencies will continue to support efforts to reduce metals in vehicle brake pads and wheel weights through

pending legislation (SB 346 and SB 757, respectively). In addition, if opportunities arise to participate in studies or legislation to reduce the metal content in other products, the agencies will consider its potential roles for participating in those efforts.

- *Targeted Zinc Reduction Program* - A Targeted Zinc Reduction Program is a proposed institutional BMP comprised of three elements: 1) generally identify potentially significant sources of zinc loading in the watershed, 2) conduct targeted monitoring to specifically identify significant sources of zinc into the storm drain system, and 3) conduct outreach to encourage stakeholders and property owners to reduce zinc loads and concentrations in runoff from their property (with some level of enforcement if necessary).

The Targeted Zinc Reduction Program will begin with a series of special monitoring studies to quantify the load of zinc from a number of the likely sources. Targeted monitoring of stormwater discharges to the MS4 will be conducted for suspected high zinc source areas, such as power substations, industrial complexes with large expanses of galvanized metals or heavy forklift traffic, or high litter areas. Special studies will be carried out within the public right-of-way, on Cities' properties, and cooperatively with the other Ballona Creek Watershed stakeholders.

The special monitoring studies conducted as part of this institutional BMP will identify high loading areas for targeted outreach. Preliminary monitoring efforts will help to establish attributes for sites that are likely to contribute significant zinc loads, thereby focusing subsequent outreach efforts. An outreach program will be developed and implemented that encourages facilities to implement a series of recommended source control and structural treatment control BMPs to reduce zinc load and concentration in the stormwater discharges from private property. Targeted enforcement could be used as a backstop to the outreach effort.

Site specific mitigation strategies fall into one of three categories:

- Source elimination (e.g., painting galvanized metals);
- Mobilization reduction (e.g., parking lot street sweeping); and
- Onsite treatment (e.g., perimeter biofilters, filter vaults).

Site-based monitoring will be conducted to confirm the effectiveness of the specific mitigation strategies implemented as part of the Targeted Zinc Reduction Program. Results of the monitoring will provide the basis for establishing the expected overall load reduction as a result of implementation of this institutional BMP.

Institutional BMP Implementation

Institutional BMPs are anticipated to be implemented under each phase. 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 three years following approval of this plan, enabling many of these strategies to be fully in effect by the second interim compliance milestone of 2014.

Under the remaining phases, 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 metals 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

Implementation of structural and institutional BMPs is proposed to address metals in wet and dry weather runoff. Potential pollutant reductions associated with the proposed structural BMPs were quantified using the SBPAT modeling software. 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 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 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 the implementation areas for source controls were assumed to 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. Ranges of annual load reductions are also estimated for 2021.

ES.13.1 Compliance with Wet Weather TMDL Limits

Wet weather Waste Load Allocation (WLA) for metals, when translated into an annual loading limit, is estimated to be 2,214 lbs/yr for copper, 14,640 lbs/yr for zinc, and 970 lbs/yr for lead, and these limits are predicted to be met.

The estimated average, low, and high annual metals load reductions at 2021 and comparison with the waste load allocations are summarized in Table ES-2:

**Table ES-2
Comparison of Estimated Metals Load Reductions with WLA in 2021**

	Average (lb/yr)	Est. Range
Copper: Total Copper Waste Load Allocation (MS4 + Caltrans)	2,214	--
Baseline Total Copper Load	2,681	--
Implementation Plan Copper Load Reduction at 2021	-454	-108 – -965
Estimated Copper Runoff Load at 2021	2,227	1,716 – 2,573
Lead: Total Lead Waste Load Allocation (MS4 + Caltrans)	7,561	-
Baseline Total Lead Load	1,187	-
Implementation Plan Lead Load Reduction at 2021	-217	-29 – -553
Estimated Runoff Lead Load at 2021	970	1,674 – 2,198
Zinc: Total Zinc Waste Load Allocation (MS4 + Caltrans)	14,640	-
Baseline Total Zinc Load	20,669	-
Implementation Plan Zinc Load Reduction at 2021	-6,029	-1,064 – -9,112
Estimated Runoff Zinc Load at 2021	14,640	11,577 – 19,605

Although the estimated average annual load for copper is slightly greater than the waste load allocation, the difference (13 lbs/yr or 0.6 percent of the WLA) is well within the variability of the compliance assessment methodology. The estimated average annual copper, lead, and zinc loads within Ballona Creek are predicted to be at or below the WLA by 2021 due to the implementation of the proposed structural and institutional BMPs within the watershed.

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.

This compliance analysis accounted for a great level of uncertainty in order to ensure that load reductions were not overestimated. At each step in the process, as previously described in this section, factors of safety were applied to the load reduction estimates in order to be conservative in the overall load reduction estimation at final compliance.

In addition to factors of safety, the method of quantification inherently provided a level of safety in that BMP effluent concentrations were used as opposed to percent removal efficiencies for each structural BMP. In addition, there was no overlap in areas treated with the various BMPs (e.g. for the entire tributary area of a regional BMP, no credit was taken for any institutional BMP or distributed BMP regardless of the likelihood that an institutional or distributed BMP may affect that tributary area). The range of post BMP loads presented also accounts for the variability of these estimates. It is therefore stated that every effort was taken to ensure that no overestimation was made in evaluating final compliance with the TMDL.

Selenium

An analysis of the current water quality monitoring data within Ballona Creek, summarized in Appendix L shows that the Basin Plan's water quality objective for selenium is being met and, therefore, no impairment exists. When the TMDL Staff Report was written, analytical methods for selenium detection were the restricting factor in determining impairment; the detection limit was 5 µg/L, thus the numeric target (5 µg/L) was considered 'less than' the detection limit. Following the development of revised analytical methods in 2002, the detection limit of selenium was decreased to 1 µg/L. Selenium wet-weather concentrations at the mass emissions monitoring station (Sawtelle) collected from 1998 - 2009 shows 3 exceedances in 63 samples, which meets the requirements for delisting on the basis of the SWRCB's delisting policy for toxicants.

ES.13.2 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 metals in dry weather flows through bio-retention and/or infiltration processes. 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 the new dry weather runoff diversion from Sepulveda Channel.

The combination of the LFTFs construction by 2013 and the significant structural and institutional BMPs necessary for wet weather compliance will provide more than the necessary load reductions needed for interim and final milestones for dry-weather because water quality monitoring data has show that those milestones are already being met for major portions of the watershed.

ES.14 Implementation Plan Schedule and Milestones

Table ES-3 summarizes the preliminary schedule and milestones for institutional BMPs, structural BMPs including regional and distributed, and low flow treatment projects for achieving compliance with TMDL limits in the Ballona Creek Watershed. The schedule identifies milestones from Phase 1 through 4, however, the schedule of the implementation is identical to, and driven by, the Ballona Creek Bacteria TMDL Implementation Plan schedule. 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-3 Ballona Creek Metals TMDL Implementation Schedule and Milestones

(Wet/Dry)	Objective	Type of BMP	Implementation Option Category/Site	Phase 1			Phase 2			Phase 3			Phase 4						
				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																
	Reduce or Eliminate Source of Bacteria	Institutional/ Non-Structural	Education & Outreach Program Development Planning & Coordination Direct Source Control																
Wet and Dry	Treat Wet-Weather Discharges	Structural	Priority Projects Ongoing Projects (e.g. SUSMP)																
	In-Stream Solutions	Stream Restoration	Additional Future Projects Wetlands Restorations/ Daylightings																
	Special Studies	Water Quality Monitoring	TMDL Effectiveness Monitoring																



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. 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 stated, this Implementation Plan was developed in combination with the Ballona Creek Bacteria TMDL Implementation Plan. The costs presented in Table ES-4 represent the cost already included in the Bacteria TMDL Implementation Plan for the distributed BMPs, regional BMP, LFTFs, and institutional BMPs.

The increase in cost for implementation of the metals-specific BMPs in this TMDL Implementation Plan is the O&M cost of \$1.6 million per year, as presented in Table ES-5. This represents the cost for the “Target Zinc Reduction Program” and the “Copper Brake Pad Product Replacement Program.”

The total capital cost is estimated to be \$1.3 billion, with \$36 million in O&M costs.

**Table ES-4
Total Costs from the Ballona Creek Bacteria TMDL Implementation Plan¹**

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 Facility-1 (NOTF)			\$10,600,000		\$1,060,000
Low Flow Treatment Facility-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 and Metals TMDL load reduction target and 8 Regional BMP facilities. See 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.

⁴The 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).

**Table ES-5
Total Costs for Bacteria and Metals TMDL Implementation Plans¹**

Ballona Creek Watershed BMPs	Treated Acres ²	Capital Cost per Treated Acre	Total Capital Cost	O&M Costs per acre	Annual O&M
Additional Institutional BMPs for Metals Compliance					
Target Zinc Reduction Program					\$1,000,000
Copper Break Pad Production Replacement Program					\$100,000
Subtotal for Additional Institutional BMPs for Metals Compliance					\$1,100,000
Additional Program Management, Engineering, Administration, and Monitoring (20% of capital cost) ²					\$200,000
Additional Program Contingency (30%)					\$300,000
Total Incremental Increase for Metals TMDL Compliance					\$1,600,000
Total Cost from Bacteria TMDL Implementation Plan			\$1,260,000,000		\$34,000,000
Total Cost for Implementation of Metals and Bacteria Implementation Plans			\$1,260,000,000		\$36,000,000

¹Included are the costs estimated to implement both the Bacteria and Metals TMDL Implementation Plans.

²The 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. 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.

Contents

Acknowledgments

Executive Summary

Section 1	Introduction	1-1
1.1	Guiding Principles.....	1-1
1.2	Regulatory and Permitting Requirements	1-2
1.2.1	Background	1-2
1.2.2	Metals TMDL Development History	1-3
1.2.3	Metals TMDL Numeric Limits	1-3
1.2.4	Additional TMDLs and Watershed Impairments.....	1-5
1.2.5	Coordinated Monitoring Plan (CMP) Requirements	1-6
1.2.6	Metals TMDL Compliance Requirements	1-8
1.3	Compliance Components	1-9
Section 2	Watershed Background.....	2-1
2.1	Ballona Creek Watershed	2-1
2.2	Watershed Characteristics.....	2-1
2.2.1	Topography	2-1
2.2.2	Hydrologic Connectivity and Storm Drain Network.....	2-1
2.2.3	City-Defined Catchment Areas	2-2
2.2.4	Land Use and Impervious Area	2-2
2.2.5	Soil Types.....	2-3
2.2.6	Parcel Ownership Data.....	2-4
2.2.7	Groundwater Depth.....	2-4
2.2.8	Liquefaction and Landslide Zones.....	2-5
2.3	Hydrology	2-5
2.3.1	Rainfall Data Summaries.....	2-5
2.3.2	Flow Data.....	2-5
2.4	Water Quality.....	2-6
Section 3	Stakeholder-Based Planning	3-1
3.1	Coordination with Stakeholders.....	3-1
3.2	Structural BMPs	3-2
3.3	Institutional BMPs	3-3
3.3.1	Program-Specific	3-3
3.3.2	Collaborations.....	3-4
3.3.3	Regulations and Enforcement	3-5

Ballona Creek Metals TMDL Implementation Plan

Section 4 Technical Analysis..... 4-1

- 4.1 Structural BMP Selection Methodology 4-1
 - 4.1.1 Catchment Prioritization 4-2
 - 4.1.2 Identification of Structural BMP Opportunity Sites 4-5
 - 4.1.3 Structural BMP Prioritization 4-6
- 4.2 Proposed Structural BMPs 4-10
 - 4.2.1 Regional BMP Opportunities..... 4-10
 - 4.2.2 Distributed BMP Opportunities 4-13
- 4.3 Identification of Institutional BMP Programs 4-14
 - 4.3.1 Methodology 4-15
 - 4.3.2 Evaluation of Institutional BMPs 4-15
 - 4.3.3 Recommended Institutional BMP Program..... 4-20

Section 5 Proposed Implementation Plan..... 5-1

- 5.1 Recommended BMP Implementation..... 5-1
 - 5.1.1 Dry Weather Low Flow Treatment Facilities 5-2
 - 5.1.2 Wet Weather Structural BMPs..... 5-5
 - 5.1.3 Recommended Institutional BMPs 5-14
- 5.2 Quantification of Water Quality Benefits 5-18
 - 5.2.1 Methodology 5-18
 - 5.2.2 Expected Combined Benefits from Structural and Institutional BMPs 5-31
 - 5.2.3 Compliance with Dry Weather TMDL..... 5-42
- 5.3 Monitoring and Special Studies..... 5-42
 - 5.3.1 Monitoring..... 5-42
 - 5.3.2 Special Studies 5-43
- 5.4 Implementation Plan Schedule and Milestones 5-44
 - 5.4.1 Interim Compliance for Wet Weather 5-45
 - 5.4.2 Interim Compliance for Dry Weather 5-49
 - 5.4.3 Institutional BMPs..... 5-50
 - 5.4.4 Structural BMPs..... 5-51
- 5.5 Quantification of Integrated Water Resources Benefits 5-53

Section 6 Program Cost and Budget..... 6-1

- 6.1 Introduction..... 6-1
- 6.2 Structural BMPs 6-1
 - 6.2.1 Structural BMP Capital Costs 6-2
 - 6.2.2 Structural BMP O&M Costs 6-4
- 6.3 Low Flow Treatment Facilities 6-4
- 6.4 Institutional BMPs 6-5
- 6.5 Implementation Plan Costs 6-7
- 6.6 Funding Availability 6-9

Section 7 References..... 7-1

Ballona Creek Metals TMDL Implementation Plan

List of Figures

- Figure 1-1 TMDL Regulatory Context
- 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 Landuse Ballona Creek Watershed
- 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 Rainfall (85th – percentile 24-hour rainfall depths) Ballona Creek Watershed
- Figure 2-11 Rainfall (85th-percentile 24-hour rainfall depths) Ballona Creek Watershed
- Figure 2-12 Average Flow at Ballona Creek 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 (1987-1998)
- Figure 2-15 Flow in Ballona Creek at Sawtelle Blvd (1987-2008)
- Figure 3-1 BMP Site Locations (NW)
- Figure 3-2 BMP Site Locations (SW)
- Figure 3-3 BMP Site Locations (NE)
- Figure 3-4 BMP Site Locations (SE)
- Figure 4-1 Steps for Selection of Structural BMPs
- 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
- Figure 5-1 Ballona Creek Watershed – Low Flow Treatment Facilities
- Figure 5-2 Ballona Creek Watershed – Priority Distributed and Regional BMP Sites
- Figure 5-3 Total Zinc Sensitivity Analysis
- Figure 5-4 Dissolved Zinc Sensitivity Analysis

Ballona Creek Metals TMDL Implementation Plan

List of Tables

Table 1-1	Ballona Creek and Sepulveda Canyon Channel Numeric Target
Table 1-2	Ballona Creek Metals TMDL Waste Load Allocations (WLA) for Stormwater during Dry Weather
Table 1-3	Ballona Creek Metals TMDL Waste Load Allocations (WLA) for Stormwater during Wet Weather
Table 1-4	TMDL Effectiveness Monitoring Tier I Sites
Table 1-5	TMDL Effectiveness Monitoring Tier II Sites
Table 2-1	Land Use in Ballona Creek Watershed with Associated Imperviousness Factor
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
Table 2-3	Monthly Mean Dry Stream Flow (cfs) (Less than 40 cfs)
Table 2-4	Monthly Mean Wet Stream Flow (cfs) (Greater than 40 cfs)
Table 4-1	Runoff Coefficient based on Land Use
Table 4-2	Pollutant Group Weights for Normalized Pollutant CPI Calculation
Table 4-3	Number of Catchments Compared to Potential Opportunities (by ranking)
Table 4-4	Green Solutions and Multiple Benefit BMPs
Table 5-1	City of Los Angeles Projects Reviewed and Conditioned to meet SUSMP Requirements
Table 5-2	Summary of Phase 1 Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation
Table 5-3	Summary of Phase 1 Regional BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan
Table 5-4	Summary of Phase 2 Distributed BMP Implementation Levels
Table 5-5	Regional BMP Sites Modeled with the Nexus Tool
Table 5-6	Metals Concentrations in Street Sediments
Table 5-7	Performance Estimate for Hydrodynamic Separators Applied to Ballona Creek Watershed
Table 5-8	Predicted Baseline (2005) Runoff Volume and Average Annual Metals Load for the Ballona Creek Watershed
Table 5-9	Predicted Copper Load Reductions (2021)
Table 5-10	Predicted Lead Load Reductions (2021)
Table 5-11	Predicted Zinc Load Reductions (2021)
Table 5-12	Comparison of Estimated Metals Load Reductions with WLA in 2021
Table 5-13	Sensitivity Analysis Design Parameters
Table 5-14	Sample Catchment and Average Ballona Creek Landuse Summaries
Table 5-15	Ballona Creek Metals TMDL Implementation Schedule and Milestones
Table 5-16	Implementation Schedule to Meet the Interim Wet Weather Compliance Dates for Zinc TMDL Numeric Limits

Ballona Creek Metals TMDL Implementation Plan

Table 5-17	Percent of MS4 Drainage Area at Status and Trends Monitoring Locations
Table 5-18	Compliance with Dry Weather Numeric Targets in Metals TMDL
Table 6-1	Summary of Cost Estimates for Selected Distributed BMPs in Ballona Creek Watershed
Table 6-2	Summary of Cost Estimates for Selected Regional BMPs in Ballona Creek Watershed
Table 6-3	Total Costs from the Ballona Creek Bacteria TMDL Implementation Plan
Table 6-4	Total Costs for Bacteria and Metals TMDL Implementation Plans

Appendices

<i>Appendix A Regional Board Resolution and Final Basin Plan Amendment</i>
<i>Appendix B Water Quality Data</i>
<i>Appendix C Stakeholder Workshop Presentations</i>
<i>Appendix D Stakeholder Recommended Structural BMP Locations</i>
<i>Appendix E Structural BMP Selection Methodology Summary</i>
<i>Appendix F Desktop and Field Evaluations (Provided on a CD)</i>
<i>Appendix G Phase 1 Distributed and Regional BMP Sites</i>
<i>Appendix H Institutional BMP Program</i>
<i>Appendix I Low Flow Treatment Facilities - Concept Drawings</i>
<i>Appendix J Street Sweeping Program</i>
<i>Appendix K Cost Analysis</i>
<i>Appendix L Wet Weather Selenium Delisting Documentation</i>
<i>Appendix M A Users Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT)</i>

Section 1

Introduction

The Ballona Creek Metals 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 Metals TMDL* (Metals TMDL).

Following the multi-pollutant approach, this Implementation Plan was developed in conjunction with the Ballona Creek Bacteria TMDL Implementation Plan. With the exception of institutional BMPs developed specifically to address metals, all of the BMPs identified in this Implementation Plan serve to reduce both metals and bacteria in order to meet the numeric limits and waste load allocations of the Metals and Bacteria TMDLs, respectively.

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 TMDL 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 Metals TMDL.

1.2.2 Metals TMDL Development History

To address Metals TMDL development requirements, the LARWQCB published for public review draft technical documents, including the Staff Report, a proposed Basin Plan Amendment, Tentative Resolution, California Environmental Quality Act (CEQA) Checklist and Determination, and Staff Report in 2005. With the exception of the Staff Report, which was finalized on July 7, 2005, these documents were revised and published again on June 22, 2007, and following public comment, the documents were revised and published again on August 23, 2007.

The LARWQCB adopted the TMDL on September 6, 2007 (Appendix A). State Board and State Office of Administrative Law approvals occurred on June 17, 2008 and October 6, 2008, respectively. EPA Region 9 approved the TMDL on October 29, 2008 and the TMDL became effective that day.

1.2.3 Metals TMDL Numeric Limits

Table 1-1 summarizes the TMDL numeric limits which are based on the metals water quality objectives established for metals by the California Toxics Rule (CTR). Tables 1-2 and 1-3 summarize the waste load allocations for dry and wet weather conditions. Due to the different hardness values and flow conditions in Ballona Creek and Sepulveda Canyon Channel, the numeric targets are different for dry and wet weather. Based on the Staff Report dated July 7, 2005, the 90th percentile flow of 40 cubic feet per second (cfs) from 1987 to 1998 is considered the inflection point between dry- and wet-weather. Therefore dry weather numeric targets apply when the maximum flow in Ballona Creek is below 40 cfs, while wet weather numeric targets apply when flows are 40 cfs or greater. These requirements are part of the Amendment to the Basin Plan. However reanalysis of hourly flow measurements from 1987 to 2008 indicates that the 90th percentile flow has increased to 67 cfs. City of

Los Angeles communicated with the Regional Board staffs regarding the reevaluated flow and revised the wet-weather trigger flow in the CMP to be 67 cfs.

Pollutant	Dry Weather (µg/L)			Wet Weather ² (µg/L)		
	Diss	CF	TR	Diss	CF	TR
Copper	23	0.96	24	11	0.62	18
Lead	8.1	0.631	13	49	0.829	59
Selenium	--	--	5	--	--	5
Zinc	300	0.986	304	94	0.79	119

Source: Attachment A to Resolution No. R2007-015. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the Ballona Creek Metals TMDL. Adopted by the California Regional Water Quality Control Board, Los Angeles Region on September 6, 2007.

Metal	Ballona Creek			Sepulveda Channel		
	Total WLA	Apportioned between Storm Water Permits		Total WLA	Apportioned between Storm Water Permits	
		MS4 Permittees	Caltrans		MS4 Permittees	Caltrans
	(grams total recoverable metals/day)					
Copper	818.9	807.7	11.2	370.7	365.6	5.1
Lead	438.6	432.6	6.0	198.8	196.1	2.7
Selenium	171	169	2	77	76	1
Zinc	10,416.2	10,273.1	143.1	4,711.1	4,646.4	64.7

Source: Attachment A to Resolution No. R2007-015. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the Ballona Creek Metals TMDL. Adopted by the California Regional Water Quality Control Board, Los Angeles Region on September 6, 2007.

Metal	Total WLA	Apportioned between Storm Water Permits (for all reaches and tributaries)			
		MS4 Permittees	Caltrans	General Construction	Industrial
		(grams /day) x daily storm Volume (L)			
Copper	1.79E-05	1.70E-05	2.37E-07	4.94E-07	1.24E-07
Lead	5.87E-05	5.58E-05	7.78E-07	1.62E-06	4.06E-07
Selenium	4.97E-06	4.73E-06	6.59E-08	1.37E-07	3.44E-08
Zinc	1.18E-04	1.13 E-04	1.57 E-06	3.27 E-06	8.19E-07

Source: Attachment A to Resolution No. R2007-015. Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the Ballona Creek Metals TMDL. Adopted by the California Regional Water Quality Control Board, Los Angeles Region on September 6, 2007.

Notes (Tables 1-1, 1-2, and 1-3):

1. Numeric standards are based on CTR, expressed as total recoverable (TR) using default CTR conversion factors (dry weather) or regression of dissolved copper and zinc to total copper and zinc at Sawtelle (wet weather) and 50th

percentile hardness value (300 mg/L in dry weather; 77 mg/L in wet weather). Selenium is independent of hardness and expressed as total recoverable.

2. Wet weather numeric targets apply when the maximum daily flow in Ballona Creek is ≥ 40 cfs.
3. WLA for grouped MS4 discharges calculated by subtracting load allocation from loading capacity. Load allocations (not listed) are assigned to direct atmospheric deposition into Ballona Creek and Sepulveda Channel. Loading capacity = flow x numeric target. Dry weather median flow at Sawtelle = 14 cfs; in Sepulveda Channel = 6.3 cfs.
4. Wet weather waste load allocations = value provided in table x daily storm volume (L).

1.2.4 Additional TMDLs and Watershed Impairments

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

Adopted TMDLs

Two additional TMDLs are effective in the Ballona Creek Watershed:

- *Ballona Creek, Estuary, and Sepulveda Channel Bacteria TMDL* - includes numeric limits and wasteload allocations applicable to urban runoff for total coliform, fecal coliform, enterococcus, and *E. coli*. LARWQCB 2005). The TMDL effective date is April 27, 2007. The Draft TMDL Implementation Plan was due to the LARWQCB November 25, 2009, however an extension to this date was granted to the responsible agencies.
- *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 Metals TMDL Implementation Plan were coordinated with the technical analyses required for development of implementation plans for the bacteria 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) list¹. 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.

1.2.5 Coordinated Monitoring Plan (CMP) Requirements

The Metals TMDL required that a CMP be submitted by the responsible jurisdictions (including Los Angeles County) by January 11, 2007. The CMP was submitted for the Ballona Creek Watershed to the LARWQCB on January 10, 2007, and was written to address both the Ballona Creek Metals TMDL and the Ballona Creek Estuary Toxic Pollutants TMDL. The CMP was revised and resubmitted on August 8, 2008 and again on May 4, 2009. The Metals TMDL has the following objectives for the CMP:

TMDL Ambient Monitoring

An ambient monitoring program is necessary to assess water quality throughout Ballona Creek and its tributaries and the progress being made to remove the metals impairments. The MS4 and Caltrans storm water NPDES permittees are jointly responsible for implementing the ambient monitoring program. The responsible agencies shall analyze samples for total recoverable metals and dissolved metals, including cadmium and silver, and hardness once a month at each monitoring location. The reported detection limits shall be lower than the hardness adjusted CTR criteria to determine if water quality objectives are being met. At a minimum, there must be three ambient monitoring locations. Suggested Ambient Monitoring Locations are:

- *Ballona Creek, at Sawtelle Boulevard*

¹http://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](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.

- *Sepulveda Channel, just Above the Confluence with Ballona Creek*
- *Ballona Creek, at Inglewood Boulevard*

TMDL Effectiveness Monitoring

The MS4 and Caltrans storm water NPDES permittees are jointly responsible for assessing the progress in reducing pollutant loads to achieve the TMDL. The MS4 and Caltrans storm water NPDES permittees are required to submit for approval of the Executive Officer a coordinated monitoring plan that will demonstrate the effectiveness of the phased implementation schedule for this TMDL, which requires attainment of the applicable waste load allocations in prescribed percentages of the watershed over a 15-year period. The monitoring locations specified for the ambient monitoring program may be used as the effectiveness monitoring locations.

“The MS4 and Caltrans storm water NPDES permittees will be found to be effectively meeting the dry-weather waste load allocations if the in-stream pollutant concentrations or load at the first downstream monitoring location is equal to or less than the corresponding concentration- or load-based waste load allocation. Alternatively, effectiveness of the TMDL may be assessed at the storm drain outlet based on the concentration-based waste load allocation for the receiving water. For storm drains that discharge to other storm drains, the waste load allocation will be based on the waste load allocation for the ultimate receiving water for that storm drain system.

“The MS4 and Caltrans storm water NPDES permittees will be found to be effectively meeting the wet-weather waste load allocations if the loading at the most downstream monitoring location is equal to or less than the wet-weather waste load allocation. Compliance with individual general construction and industrial storm water permittees will be based on monitoring of discharges at the property boundary. Compliance may be assessed based on concentration and/or load allocations.

Based on these requirements, the CMP was developed and identifies Tier I and Tier II sampling locations. There are four Tier I locations applicable to the Metals TMDL, shown below as BC-1 to BC-4. Tier I samples are collected monthly. In the event that there are two consecutive exceedance at any of the Tier I locations, the responsible agencies will be required to collect additional samples at Tier II locations, labeled as BC-6 to BC-11. Tier I sites BC-1, BC-2, and BC-4 align with the historic monitoring sites that were part of the City of Los Angeles Status and Trends monitoring program and Tier I site BC-2 aligns with a County of Los Angeles mass emission monitoring site, and as such are used in the Implementation Plan for comparison purposes. The Tier I and Tier II monitoring sites are summarized in Tables 1-4 and 1-5, and are illustrated in Figure 1-1.

**Table 1-4
TMDL Effectiveness Monitoring Tier I Sites**

Station ID	BC-1	BC-2	BC-3	BC-4
Location	Centinela Ave. (at Creek)	Between Sawtelle Blvd and Sepulveda Blvd. (at Creek)	National Blvd (at creek)	Sepulveda Channel (just above confluence)
Historical ID & Agency	Cent	S01	Nat	TS08
Creek Section	Reach 2	Reach 2	Reach 1	Sepulveda Channel
Percent of Watershed Tributary	100%	78%	42%	20%
Sampling Frequency	Monthly	Monthly	Monthly	Monthly

**Table 1-5
TMDL Effectiveness Monitoring Tier II Sites**

Station ID	BC-6	BC-7	BC-8	BC-9	BC-10	BC-11
Station Name	Benedict Canyon	La Cienega	Fairfax	Cochran	Adams	Jefferson
Location (just above confluence)	Benedict Canyon	Near La Cienega Blvd within storm drain	Near Fairfax Ave within storm drain	Near Cochran Ave within storm drain	Near Adams Blvd within storm drain	Near La Jefferson Blvd within storm drain
Historical ID & Agency	TS09	N/A	TS11	TS12	TS10	N/A
Subwatershed	Benedict Canyon	Hollywood	Hollywood	Hollywood	Cienega	Cienega
Percent of Watershed Tributary	9.1%	7.1%	8%	19.8%	1.7%	15.7%
Sampling Frequency	Monthly, with the following criteria: Activation criteria: Two consecutive exceedance at any of the Tier I locations. Applicable to Tier II site(s) that are immediately upstream of the Tier I site(s) where the WLA exceedance occurred. Deactivation criteria: Data from two consecutive Tier II monitoring events is less than the WLA(s).					

1.2.6 Metals TMDL Compliance Requirements

The Metals TMDL defines milestones for achieving compliance with dry and wet weather metals limits:

- By **January 11, 2010**, MS4 and Caltrans stormwater NPDES permittees shall provide a written report to the Regional Board outlining the drainage areas to be address and how these areas will achieve compliance with the Waste Load Allocations and submit results of recommended special studies to the Regional Board.
- By **January 11, 2011**, the Regional Board shall reconsider this TMDL to re-evaluate the waste load allocations and the implementation schedule.

- By **January 11, 2012**, demonstrate that 50% of the total drainage area is effectively meeting the dry-weather waste load allocation (Table 1-2), and 25% of the total drainage area is effectively meeting the wet-weather waste load allocations (Table 1-3).
- By **January 11, 2014**, demonstrate that 75% of the total drainage area is effectively meeting the dry-weather waste load allocation (Table 1-2).
- By **January 11, 2016**, demonstrate that 100% of the total drainage area is effectively meeting the dry-weather waste load allocation (Table 1-2), and 50% of the total drainage area is effectively meeting the wet-weather waste load allocations (Table 1-3).
- By **January 11, 2021**, demonstrate that 100% of the total drainage area is effectively meeting both the dry-weather and wet-weather waste load allocation (Table 1-2 and 1-3).

1.3 Compliance Components

Adaptive Management

Re-evaluation of the Metals TMDL noted in the previous section is in line with the adaptive management approach of the Implementation Plan. Adaptive management recognizes that there is uncertainty associated with the development of the metals numeric TMDL limits and the waste load allocations.

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

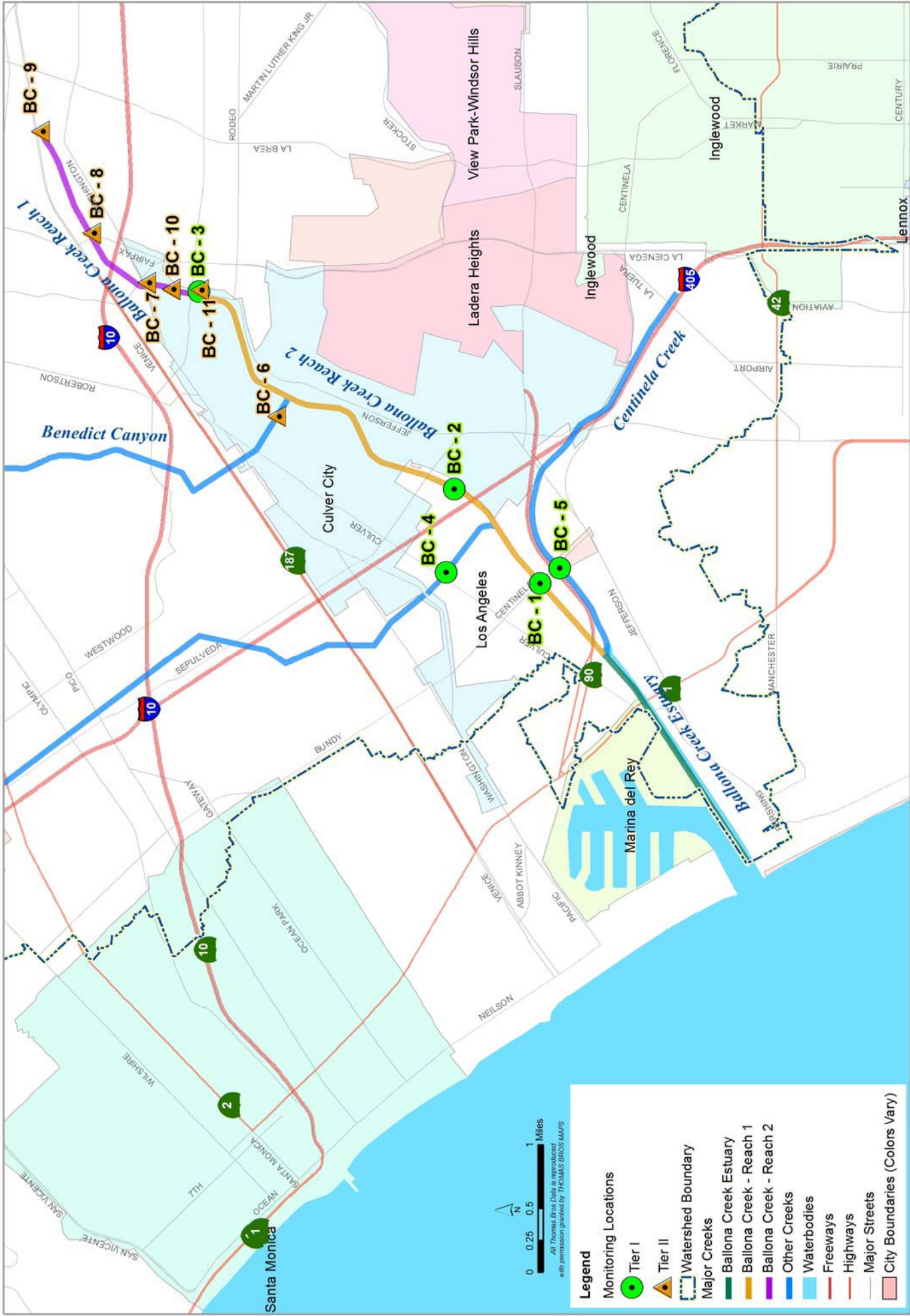
Based on the compliance requirements, there are four phases of implementation in the Implementation Plan (see Section 4 for BMP descriptions and Section 5 for implementation details):

Phase 1 (2010 – 2012) – This phase coincides with the first compliance milestone (January 11, 2012) and emphasizes institutional and distributed structural BMPs. 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 harvesting, 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. Priority structural BMPs are being planned targeting high priority catchments during this phase. The two LFTFs, which are scheduled to be completed to meet Bacteria dry-weather interim milestone, will also be underway during this phase.

Phase 2 (2012 – 2014) – This phase coincides with the second milestone (January 11, 2014) and includes the continued implementation of BMPs at the rate of implementation described in Section 5. Included here are the institutional and distributed structural BMPs started in Phase 1, as well as the regional BMPs and the target metals BMPs. Regional BMPs reduce the volume of runoff that reaches the receiving waters and typically treat the runoff from a larger tributary area and have a larger footprint than distributed BMPs. The target metals BMP involves identifying activities, materials, and behaviors throughout the watershed that contribute specifically to loading of the metals of concern. Two LFTFs are expected to be completed during this phase by 2013.

Phase 3 (2014 – 2016) – This phase coincides with the third milestone (January 11, 2016). Similar to Phase 2, this phase includes the continued implementation of BMPs from previous phases at the rate of implementation described in Section 5.

Phase 4 (2016 – 2021) – This phase coincides with the fourth milestone (January 11, 2021). This phase will also continue implementation of the institutional and structural BMPs at the rate of implementation defined in Section 5. Further, this phase will consider the need for further implementation of additional regional structural BMPs, low flow treatment facilities (LFTFs) 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 based on the ongoing effectiveness monitoring. As these are generally single-purpose facilities that offer little benefit beyond pollution reduction and represent a less holistic approach to runoff management, 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.



Legend

Monitoring Locations

- Tier I (Green circle)
- Tier II (Green triangle)

Watershed Boundary (Dashed line)

Major Creeks

- Ballona Creek Estuary (Blue line)
- Ballona Creek - Reach 1 (Orange line)
- Ballona Creek - Reach 2 (Purple line)
- Other Creeks (Light blue line)

Waterbodies (Light blue area)

Freeways (Thick red line)

Highways (Thin red line)

Major Streets (Thin grey line)

City Boundaries (Colors Vary) (Colored shaded areas)

Scale: 0 0.25 0.5 1 Miles
All Thomas Bros Data is reproduced with permission granted by THOMAS BROS MAPS

FIGURE 1-1 Ballona Creek CMP Monitoring Locations

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 City, 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 National Boulevard in Culver City. This Reach is characterized as concrete lined box channel .

- *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). All these tributaries are concrete lined channels and are 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 Residential 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 and 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 Metals TMDL.

Figures 2-14 and 2-15 present the flow in Ballona Creek at Sawetelle Blvd for the periods of 1987 to 1998 and 1987 to 2008, respectively. The graphs show that the average flow in Ballona Creek from the period of 1987 to 1998 was 61.76 cfs, while for the period of 1987 to 2008 the average flow was 70.10 cfs. This indicates that the average flow in the creek has been increasing over time.

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 Status and Trends Monitoring conducted by the City of Los Angeles and the Municipal Separate Storm Sewer System (MS4) monitoring program conducted by the County of Los Angeles. These programs are discussed below.

In addition 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 May 4, 2009 (Section 1).

The City of Los Angeles conducted status and trends water quality monitoring in Ballona Creek for metals (total recoverable and total dissolved for copper, lead, selenium, zinc, cadmium, and silver) 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 metals (total recoverable for copper, lead

selenium, zinc and cadmium) 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.

Summary of Metals Monitoring Results

The metals S&T monitoring included between 22 and 55 samples at each site (for total recoverable and total dissolved metals). The MS4 metals monitoring included between 2 and 55 samples at each site (total recoverable only). As shown, the majority of all metals sampled over the seven year period fall below the numeric targets. Selenium and zinc had significantly lower numbers of exceedances. Copper had the highest number of exceedances. Generally, the number of exceedances of the total recoverable numeric limit is exceeded more times than the numeric limit for total dissolved during dry weather. During wet weather the number of exceedances varies.

Zinc: S&T data indicates that majority of stations only had one sample exceeding the numeric target during dry-weather days over seven year period. For dry weather, many stations have no exceedances, and others had one or two exceedances over the seven year period. The MS4 data had similar results, with exceedances during wet weather only. While zinc exceeded the numeric limit, the concentrations observed were within the same order of magnitude as the numeric limit.

Selenium: for S&T, for all of the samples, the figures show only 9 dry weather and 10 wet weather exceedances, throughout the seven years of data. For the MS4 data, selenium was under in nearly all sites, with zero or one exceedance per site, though it had several exceedances at Sawtelle Blvd.

Copper: The largest number of exceedances occurred with copper. For example, the Alberta Drive monitoring location had 11 of 16 wet weather and 5 of 22 dry weather exceedances and the Culver Boulevard monitoring location had 9 of 22 dry weather and 9 of 16 wet weather exceedances. However, the mean concentrations at most stations are well below numeric limits.

Lead: there are a few to no exceedances for both S&T and MS4 stations.

Dissolved to Recoverable Metals Ratios

Appendix B also provides a table showing the calculated average total dissolved to total recoverable ratio, based on the S&T monitoring results, which can be compared to the conversion factor in the metals TMDL. The following observations can be made:

Copper: the average ratio calculated from monitoring was always lower than the conversion factor in the TMDL during dry weather flows. For wet weather flows, at all but at one station the calculated ratio was higher.

Lead: the average ratio calculated from monitoring was almost always lower than the conversion factor in the TMDL during both wet and dry weather flows.

Zinc: the average ratio calculated from monitoring is much lower than the conversion factor in the TMDL during both dry and wet weather flows.

**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	
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	8	14	3	2							29	
2001	2002	Monthly Total	0.09	2.00	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	0.01	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	0.84	0.01					0.01	8.34	
		Mean	0.02	0.26	0.13	0.09	0.21	0.01					0.01		
		Max Day	0.03	0.95	0.57	0.42	0.79	0.01					0.01		
		Min Day	0.01	0.02	0.01	0.01	0.01	0.01					0.01		
		# Rain Days	2	5	7	5	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
2005	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	
	Monthly Total			1.16	0.38	1.50	2.40	1.30	2.54	2.05	0.68	0.01				12.02
2006	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
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	
2008	# Rain Days			1	1	3	7	5	2	2			1		1	23
	Monthly Total			1.12	0.61	1.98	4.39	1.58	0.05	0.06	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						
Average by month of each parameter for the total period from Nov 1998 to May 2008 (based on daily precipitation):	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
	Mean			0.17	0.22	0.24	0.34	0.47	0.29	0.27	0.14	0.02	0.00	0	0.13	
	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	
	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)**

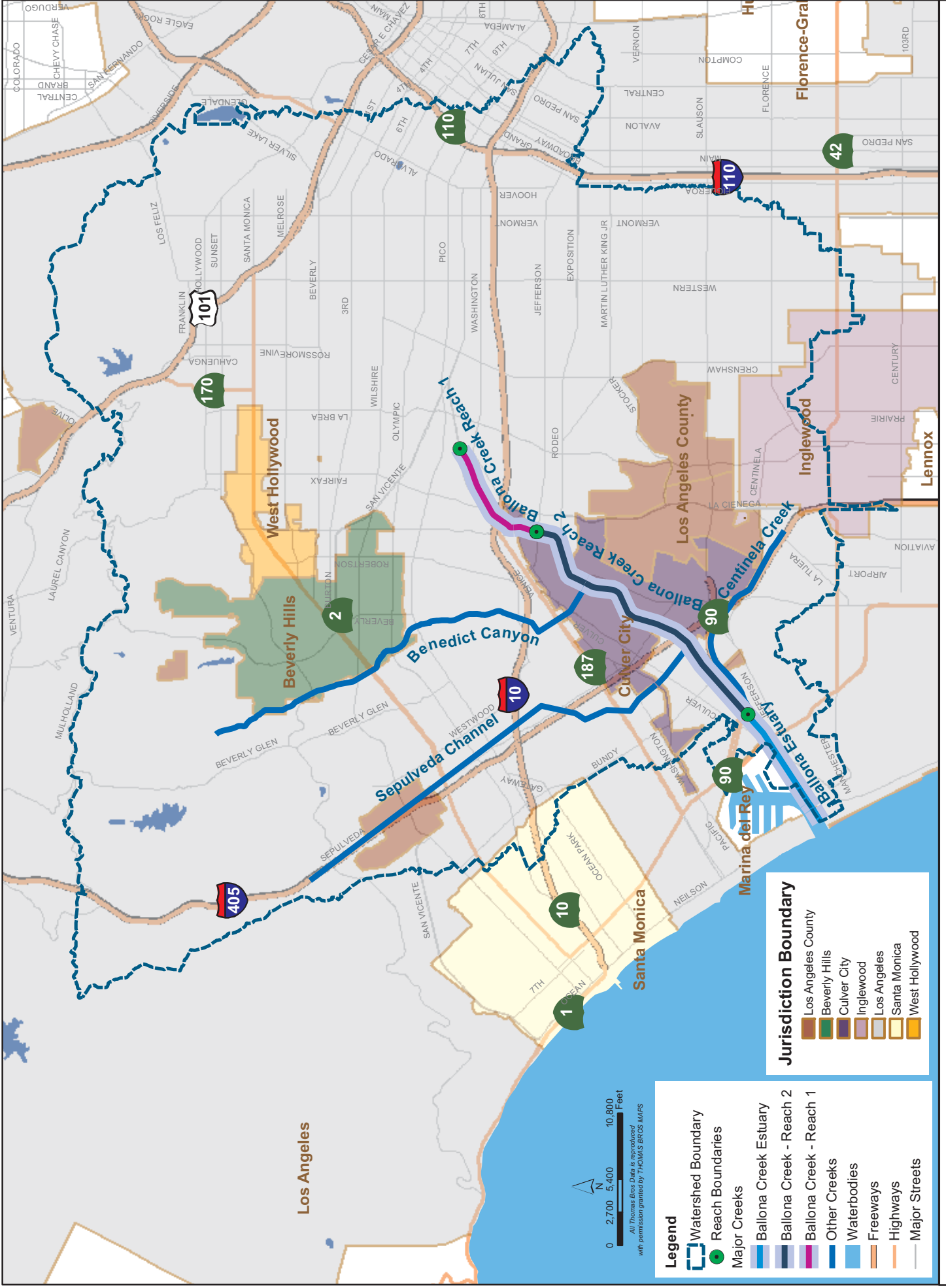
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998										28.1	15.2	17.3	
1999	17.9	13.2	13.4	17.3	27.5	18.9	16.9	16.3	14.6	15.0	20.0	19.8	17.6
2000	17.9	26.5	23.8	25.9	35.4	22.3	14.9	18.5	25.1	25.5	16.1	26.7	23.2
2001	19.1	15.7	26.2	25.4	21.3	25.8	21.8	25.2	18.1	25.7	23.2	27.9	22.9
2002	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/lwrdr/report/0607/runoff/discharge.cfm>, Site: Above Sawtelle Blvd.

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

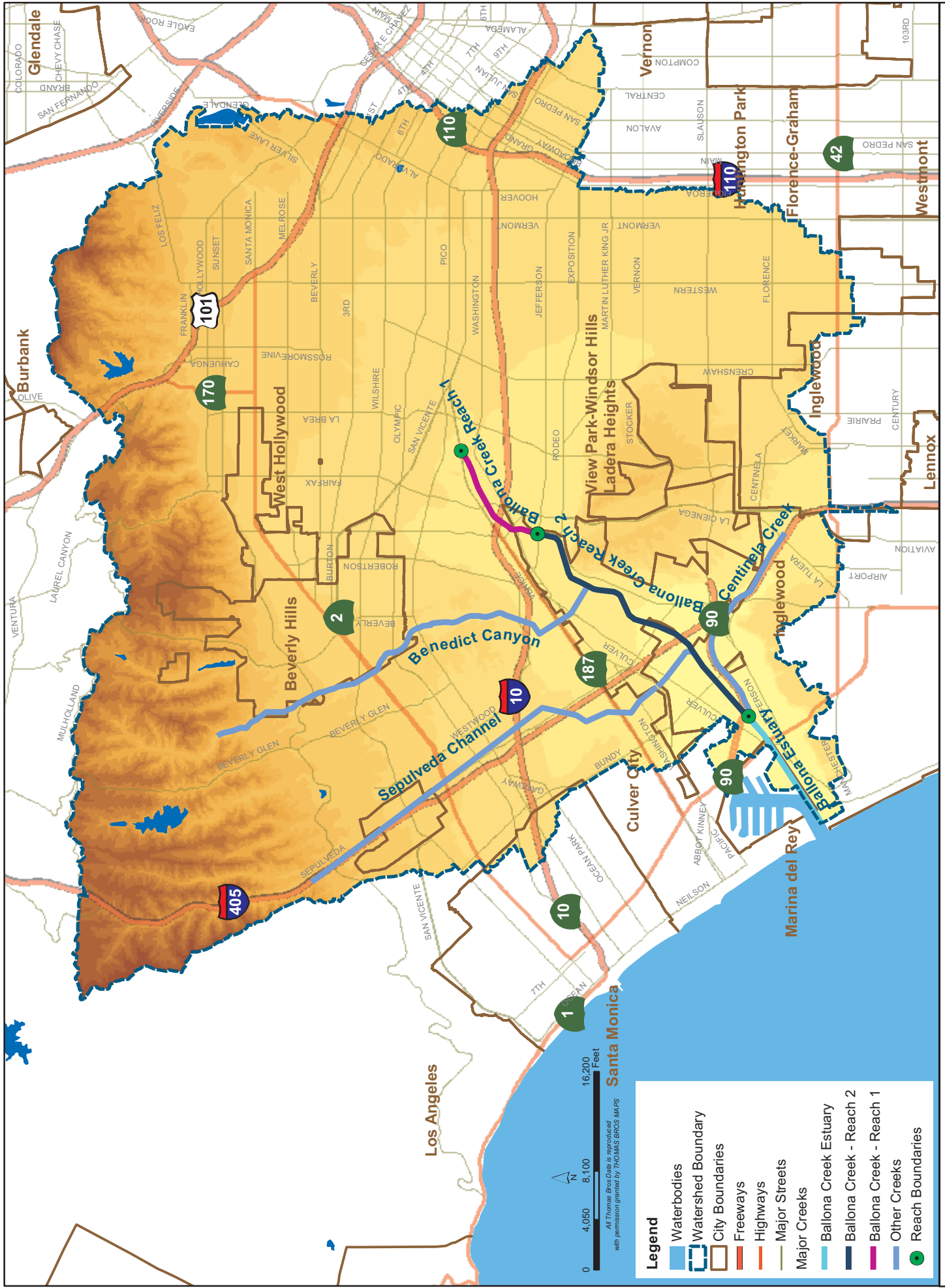
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998										43	624	194	
1999	421	206	522	421	49	352			95		382	392	315
2000	421	718	566	646	78			74	93	128		57	309
2001	336	774	335	302	48	47	64	63	85	42	126	192	201
2002	507	172	151	59	77	62	53	41	43		371	267	164
2003	332	550	1132	195	251		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.



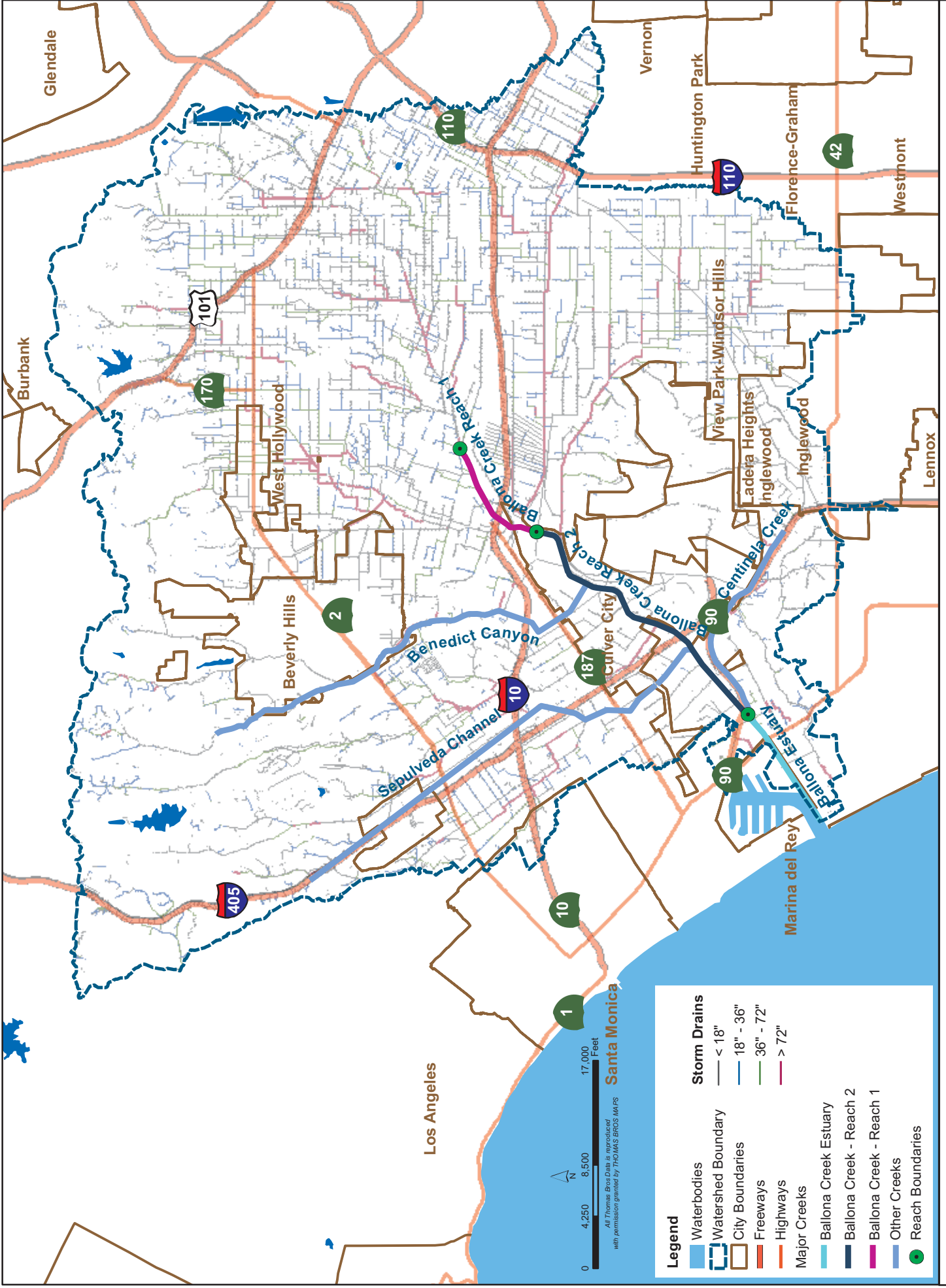
Ballona Creek Boundary and Jurisdictions

Figure 2-1



Ballona Creek Watershed - Topography

Figure 2-2



Ballona Creek Watershed - Storm Drains

Figure 2-3

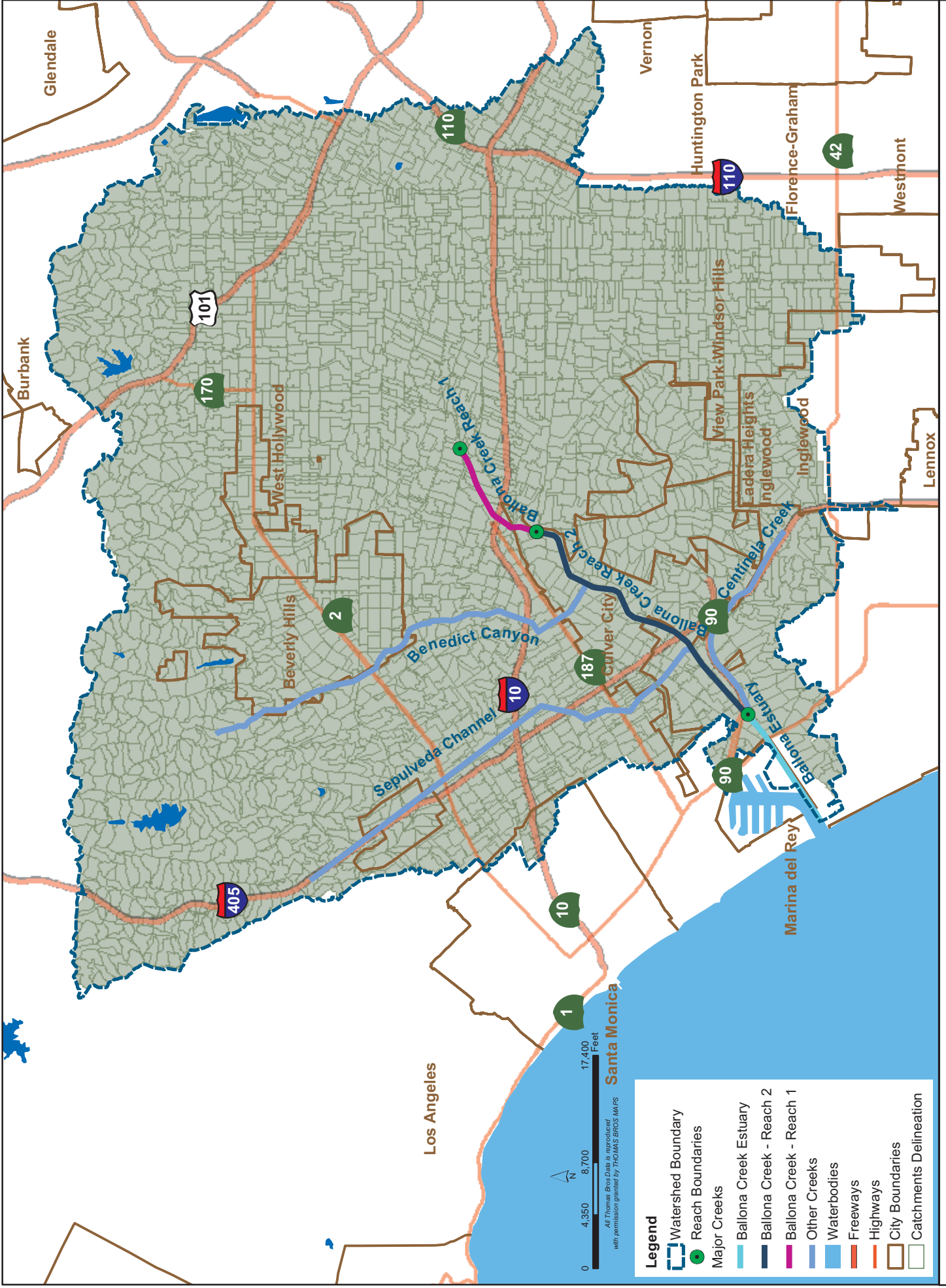
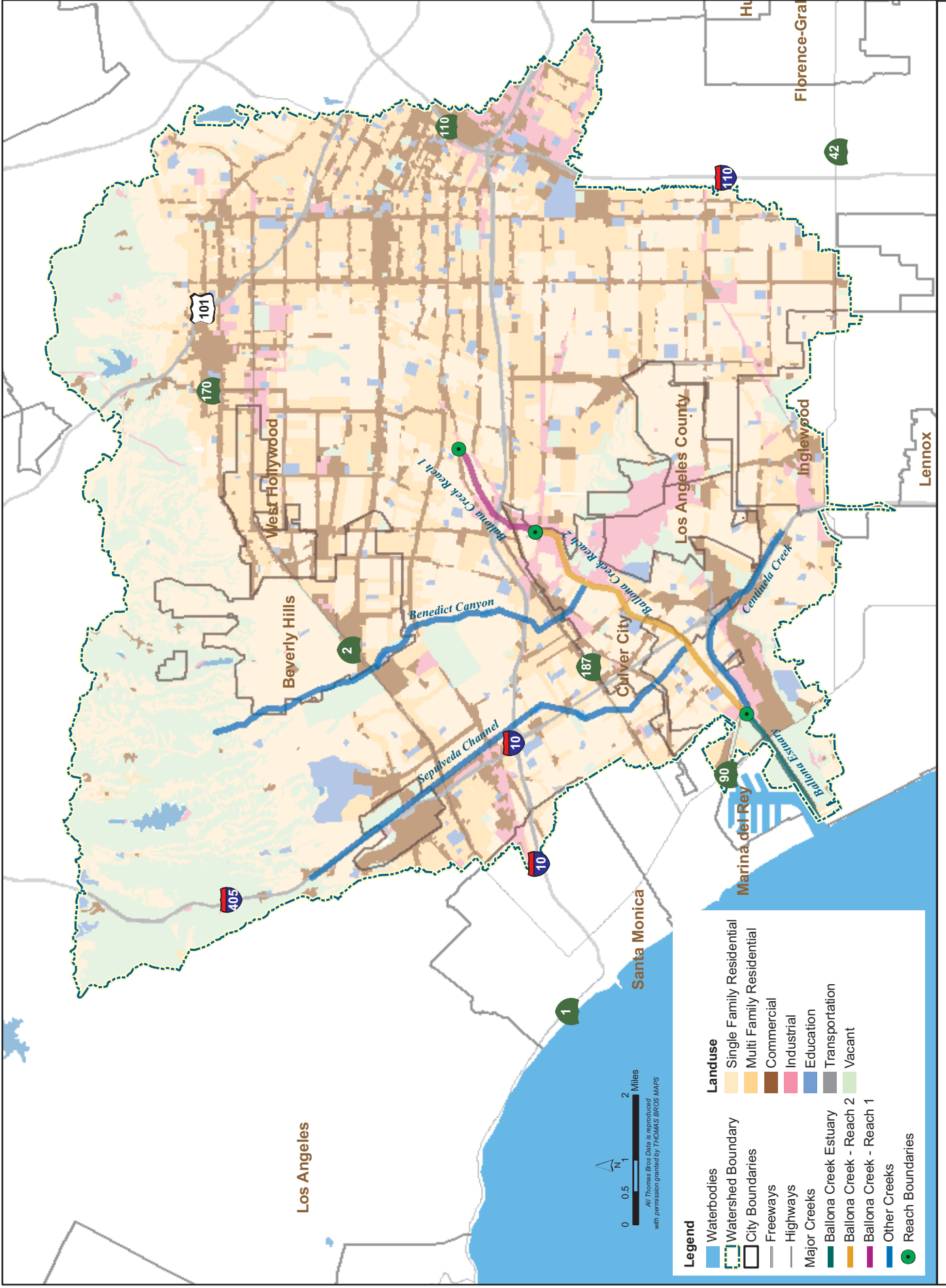
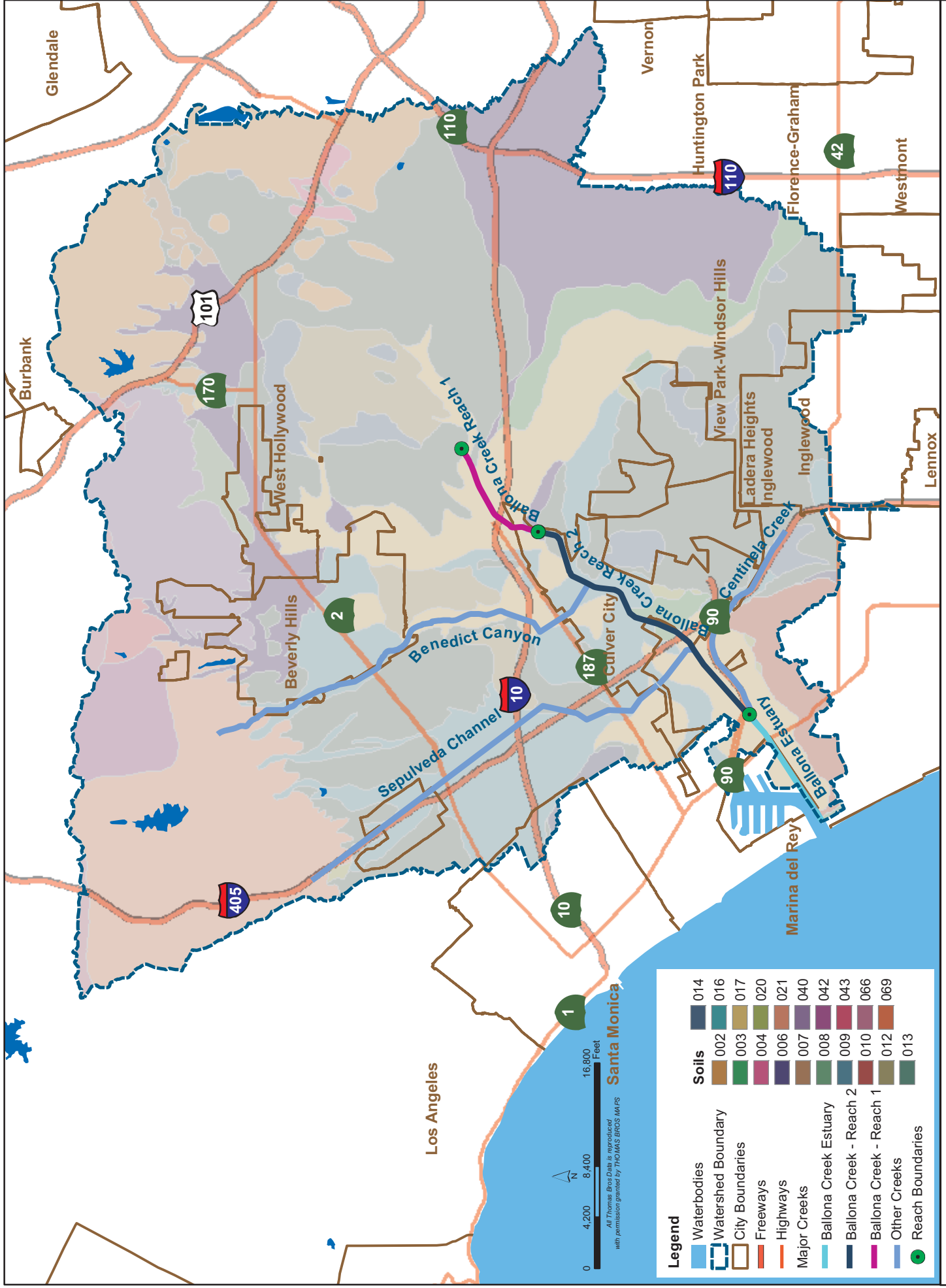


Figure 2-4 Ballona Creek Watershed Catchments



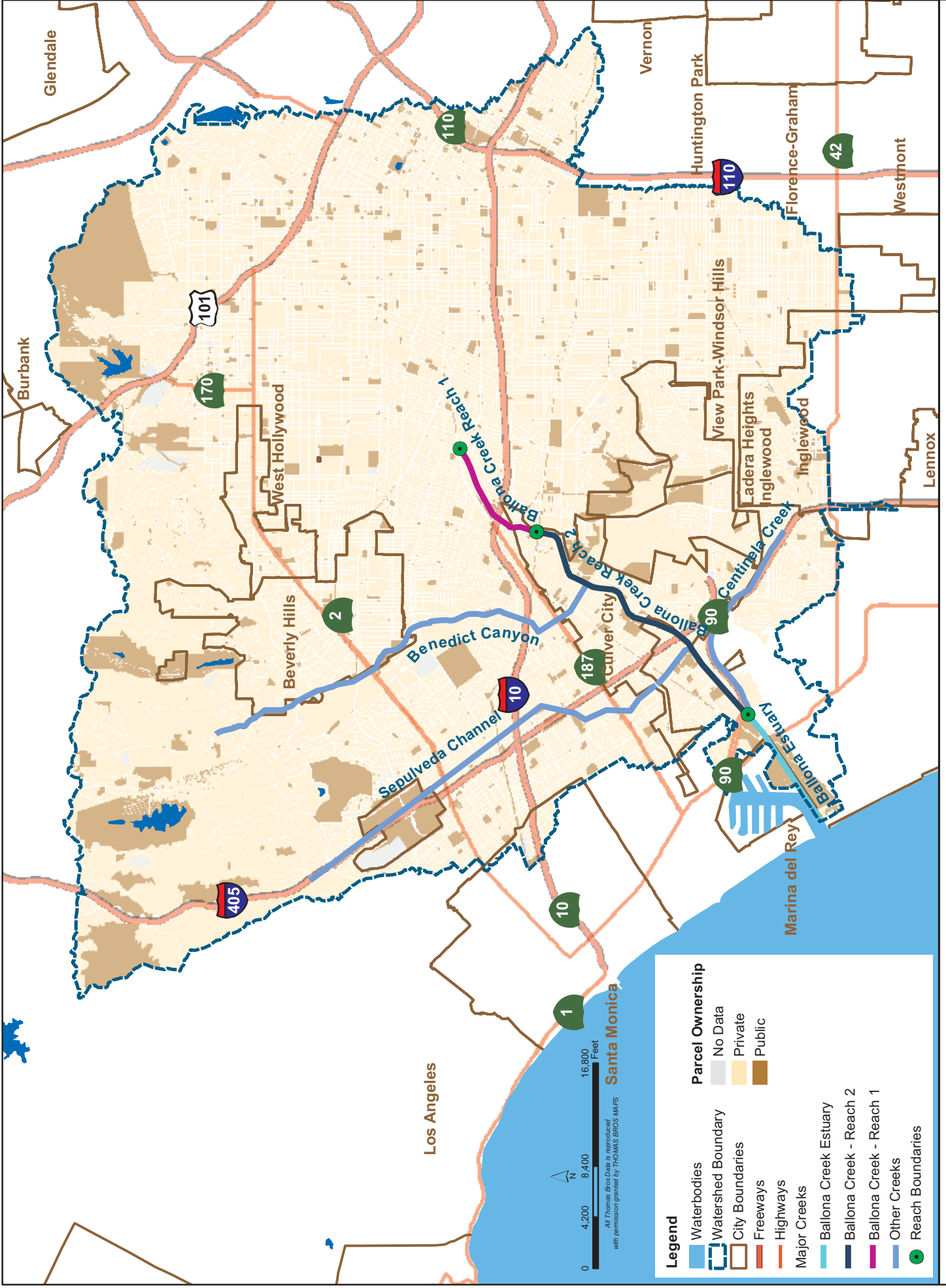
Ballona Creek Watershed - Land Use

Figure 2-5



Ballona Creek Watershed - Soils

Figure 2-6



Ballona Creek Watershed - Parcels

Figure 2-7

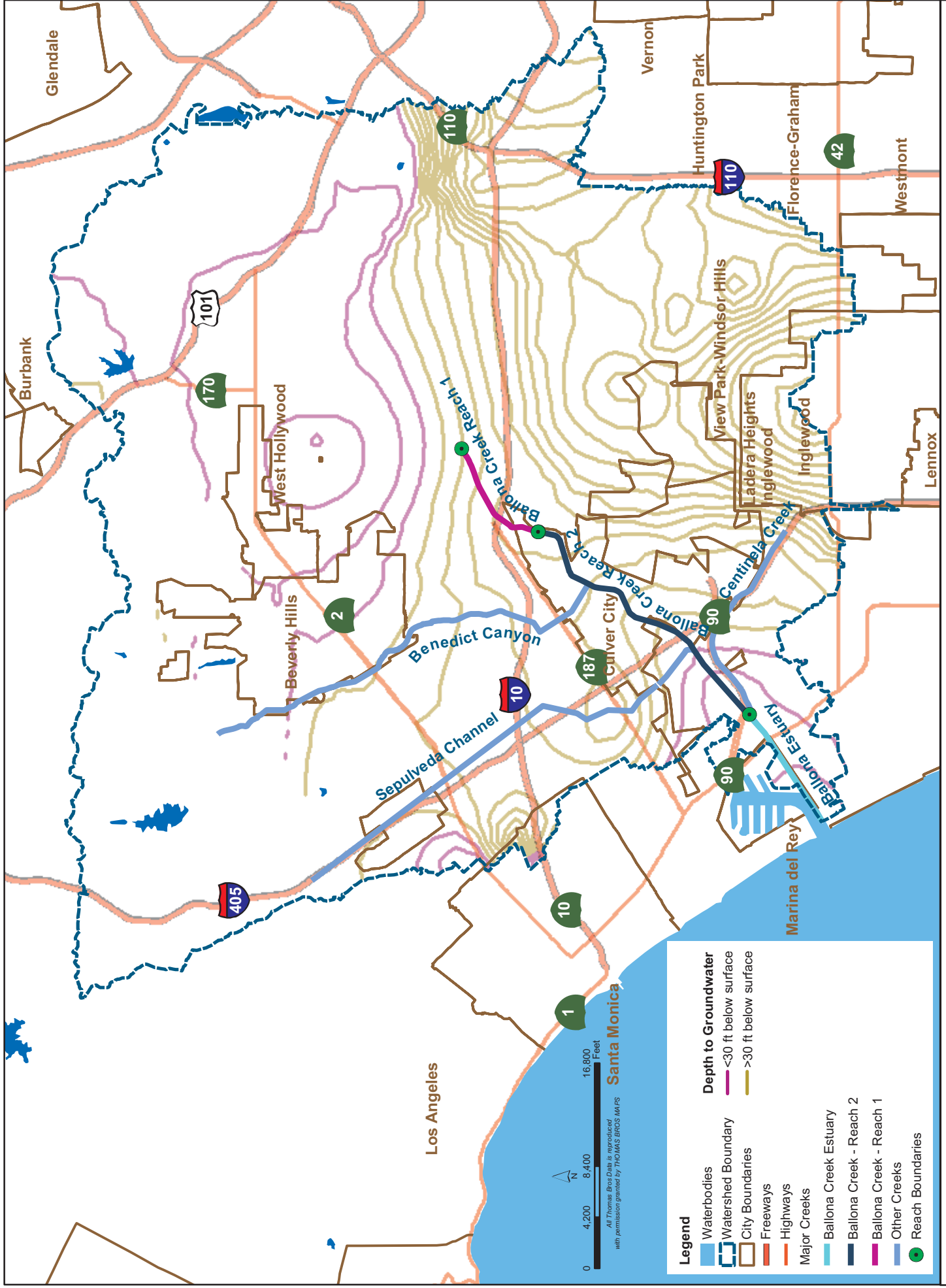


Figure 2-8 Ballona Creek Watershed - Depth to Groundwater

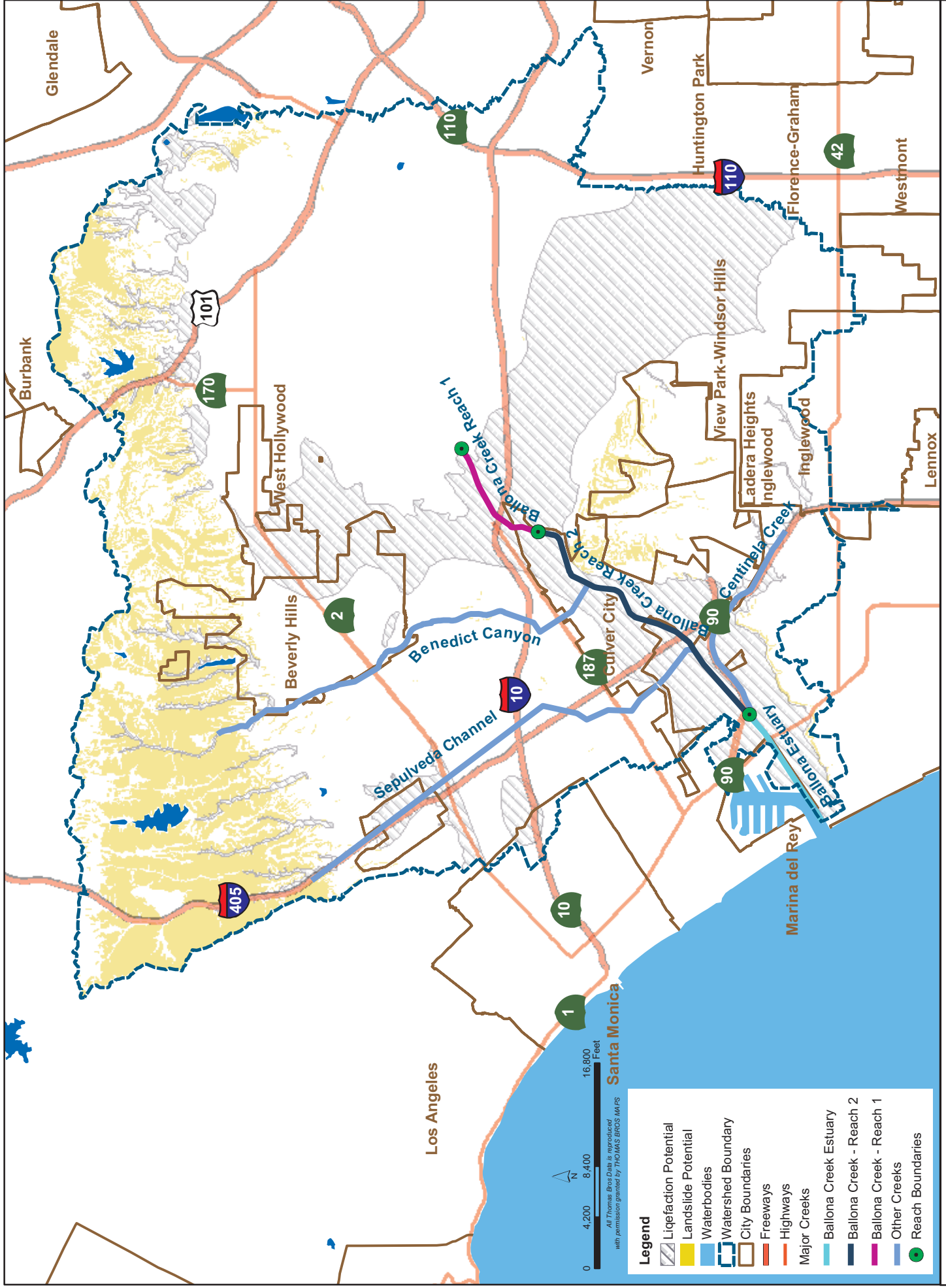


Figure 2-9 Ballona Creek Watershed - Areas of Landslide and Liquefaction Potential

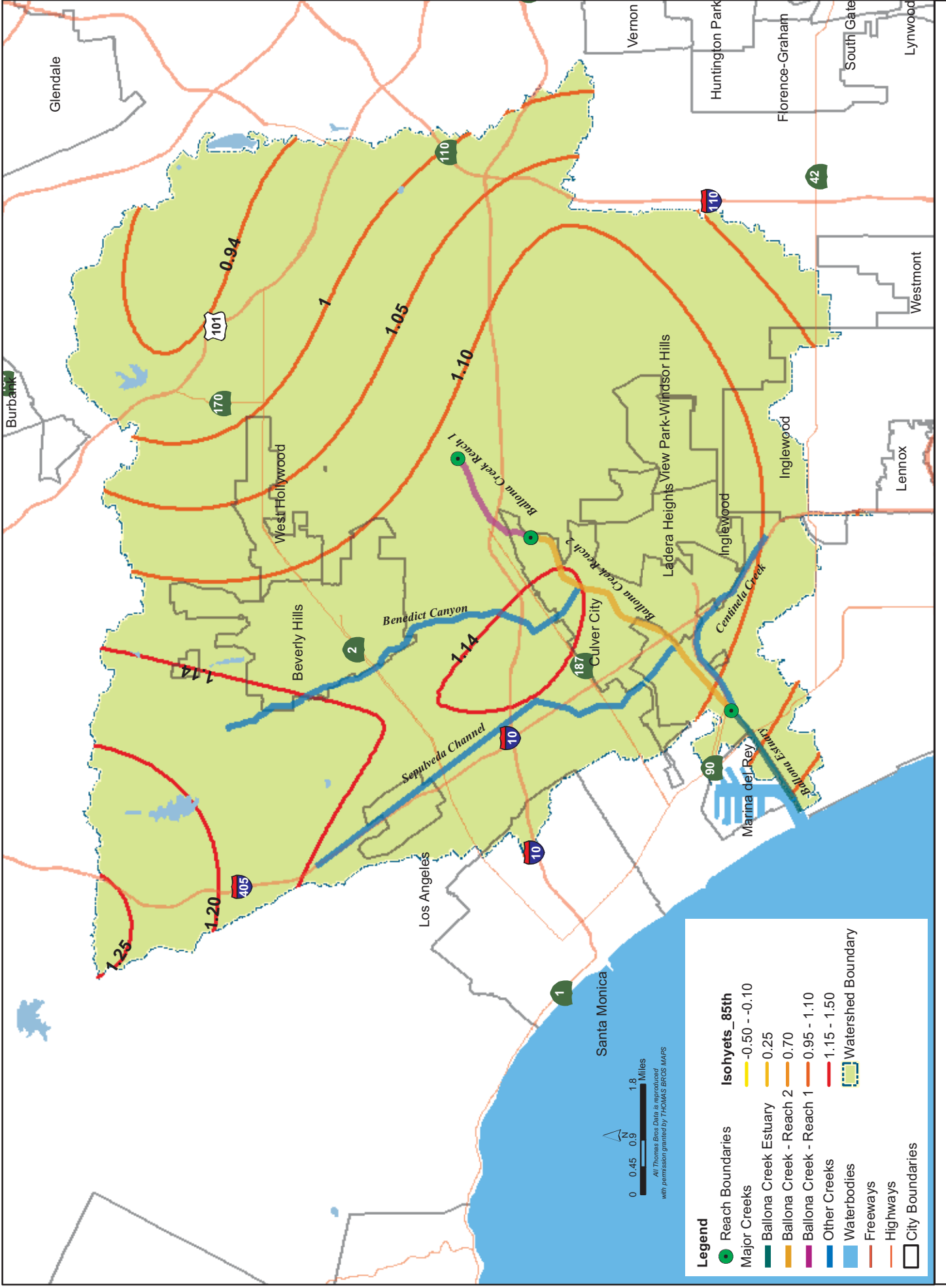


Figure 2-10 Ballona Creek Watershed - Rainfall (85th-percentile 24-hour rainfall depths)

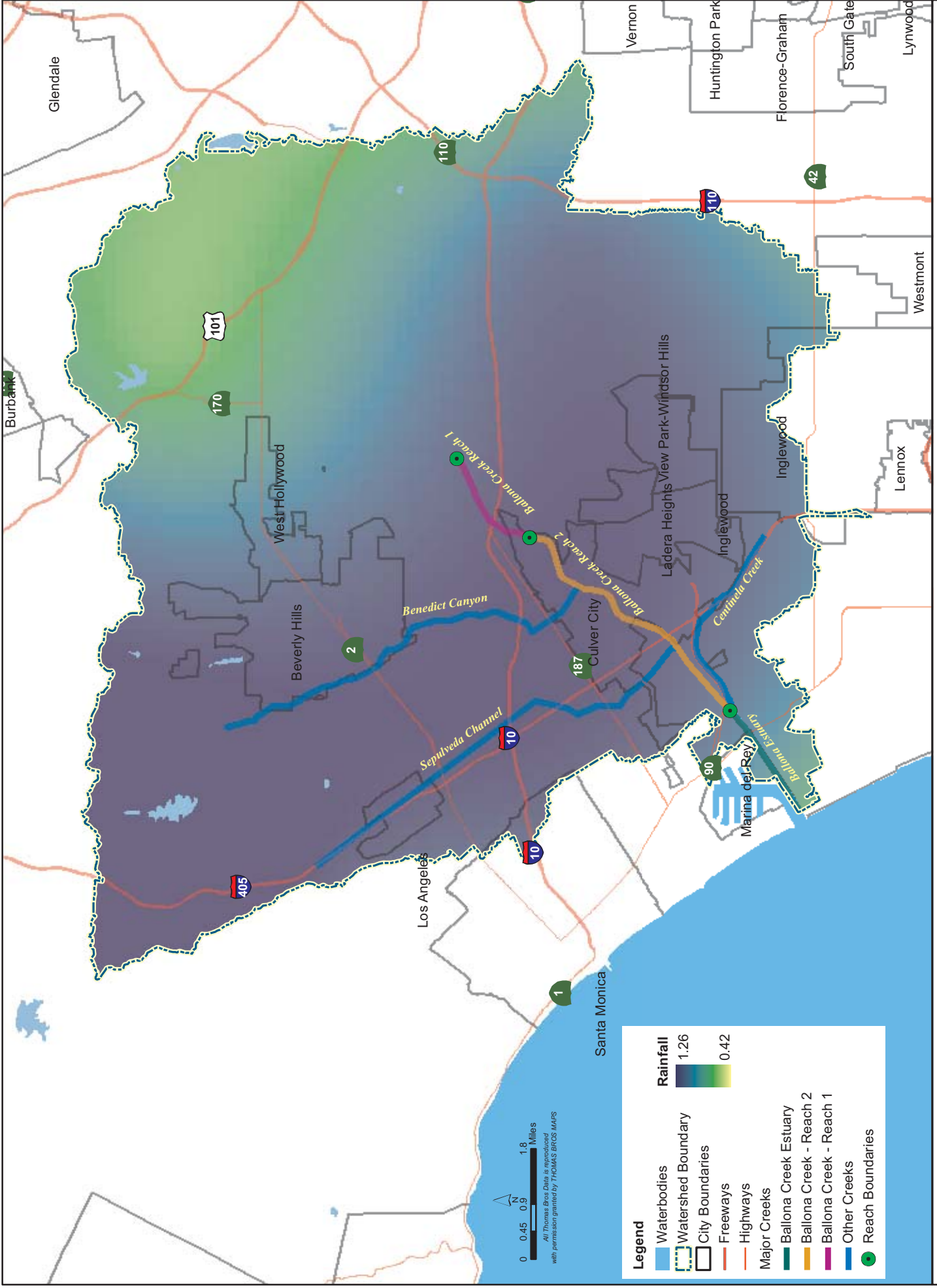
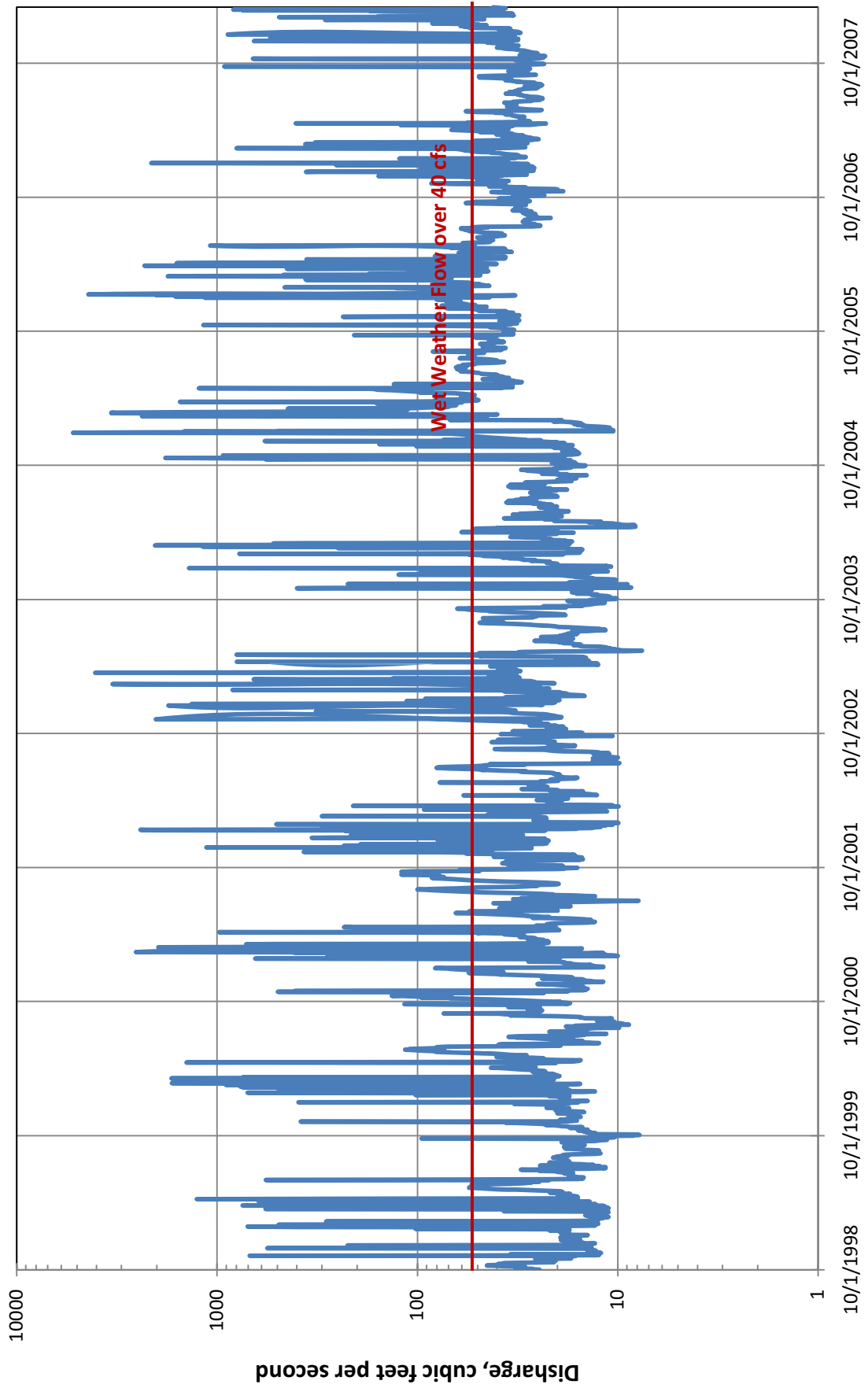
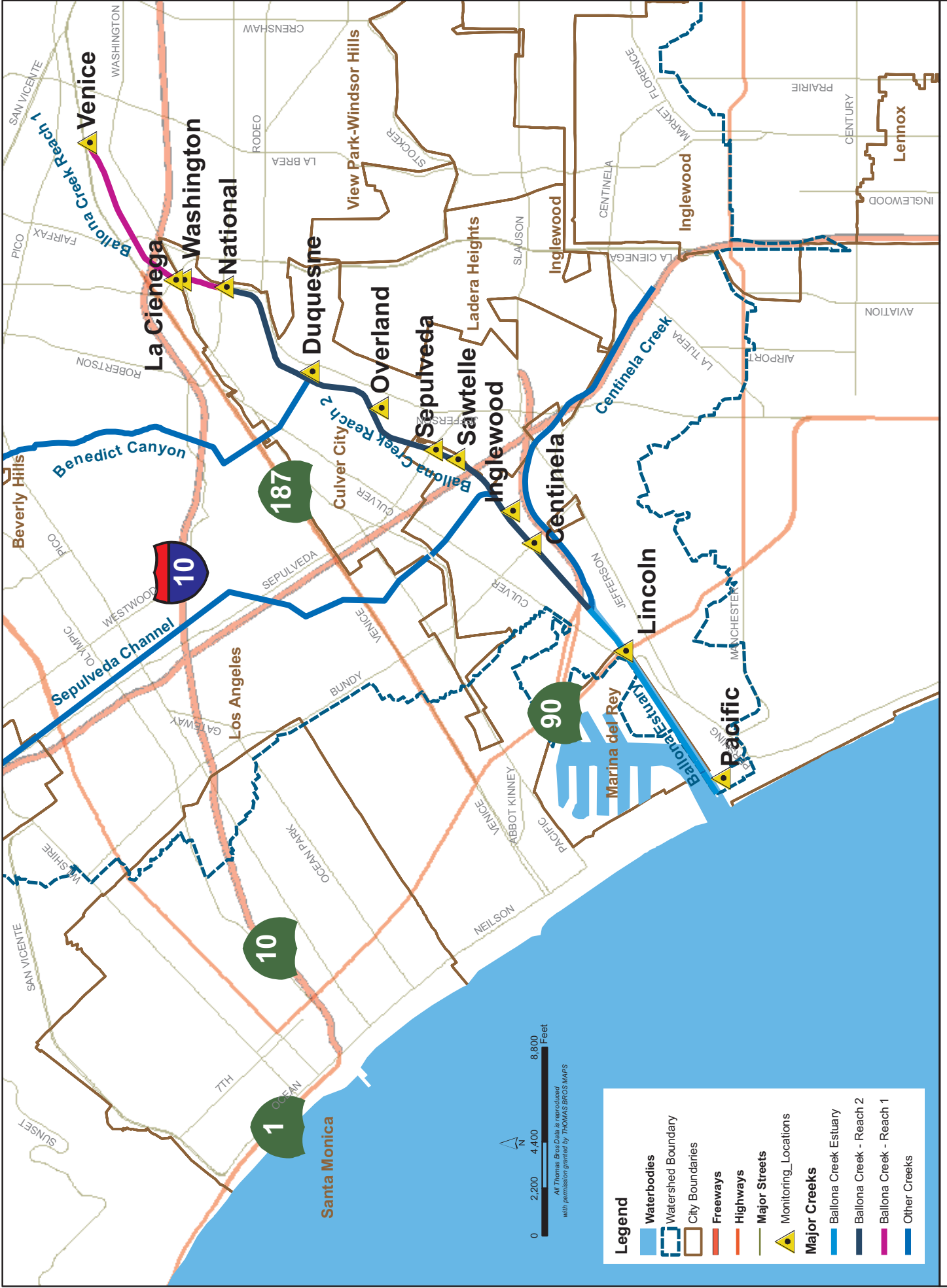


Figure 2-11 Ballona Creek Watershed - Rainfall (85th-percentile 24-hour rainfall depths)

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





Ballona Creek Watershed - Monitoring Locations

Figure 2-13

Flow in Ballona Creek at Sawtelle Blvd (1987 to 1998)

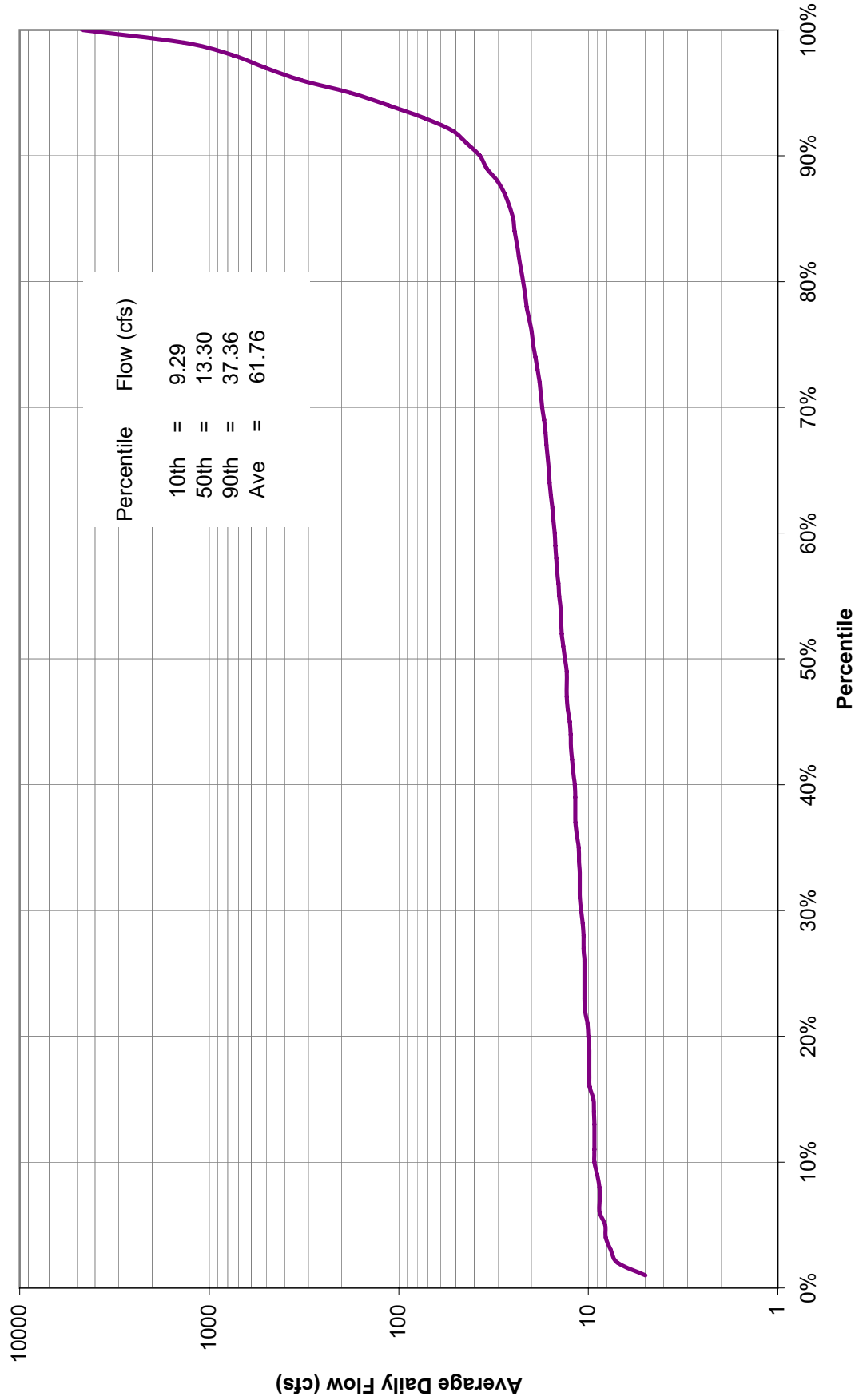


Figure 2-14
Flow In Ballona Creek at Sawtelle Blvd (1987 to 1998)

Flow in Ballona Creek at Sawtelle Blvd (1987-2008)

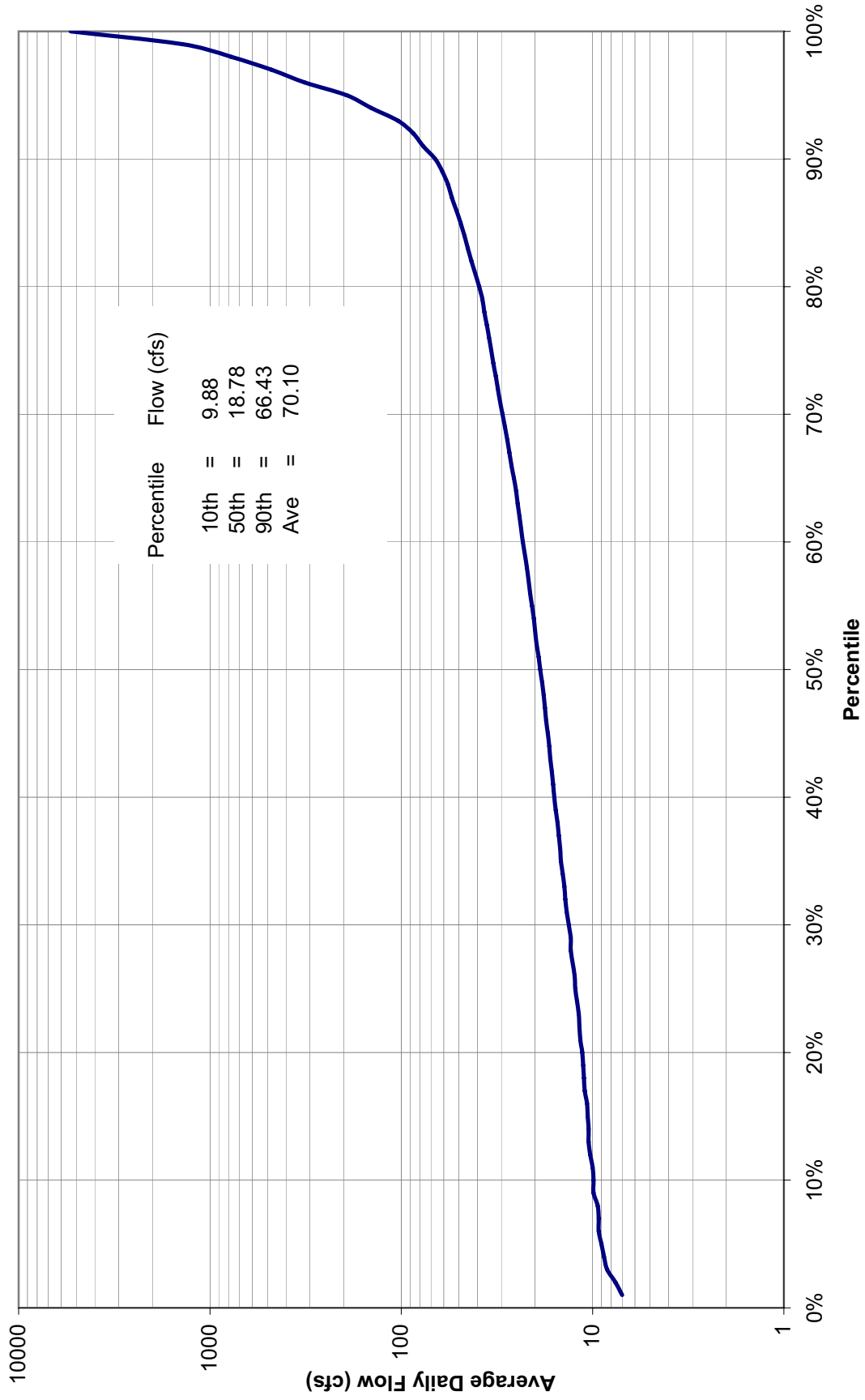


Figure 2-15
Flow in Ballona Creek at Sawtelle Blvd (1987 to 2008)

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

Three 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: *Ballona 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 projects¹ 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 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 Institutional BMPs

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-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

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.

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 WQCMR (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.

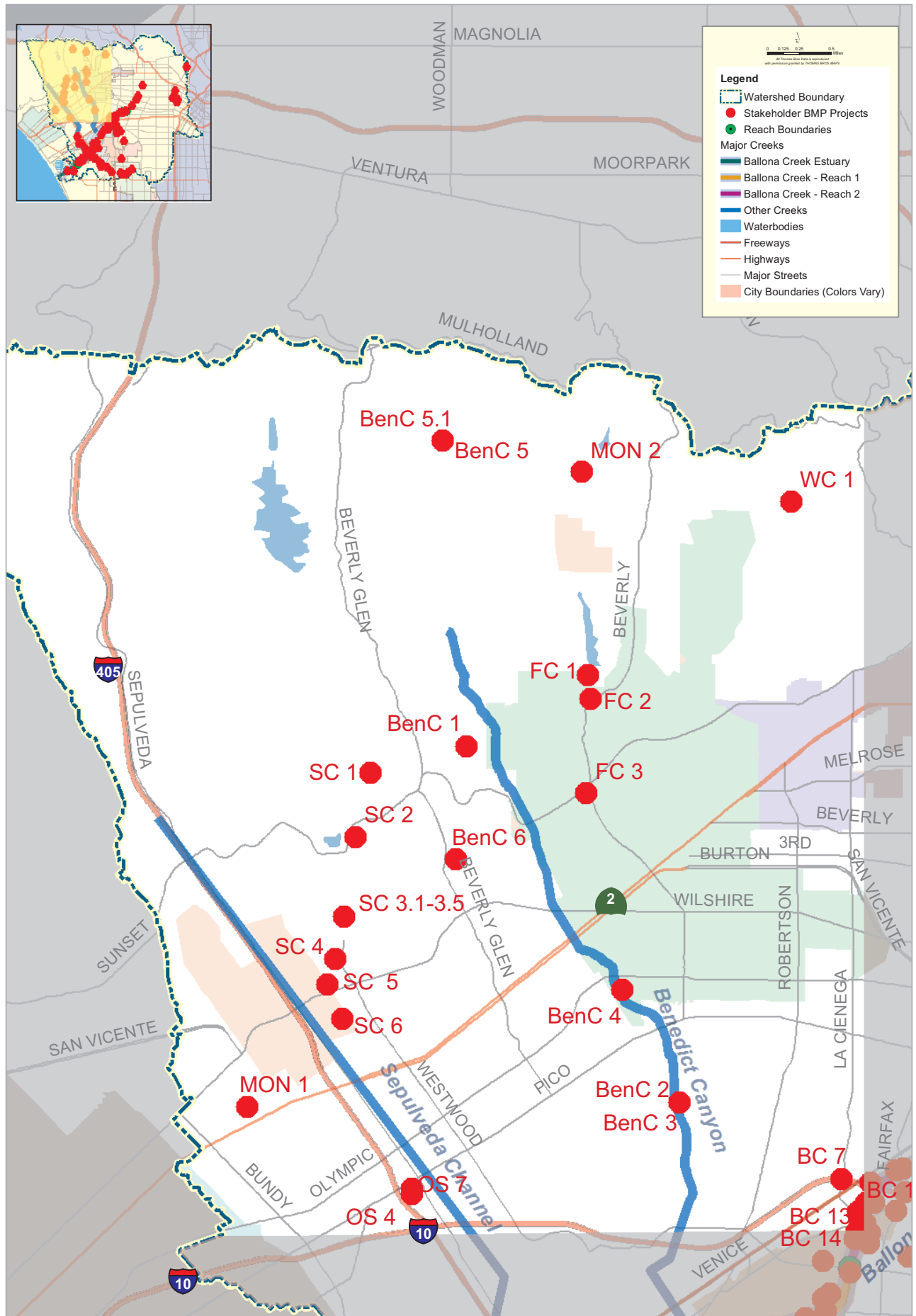


Figure 3-1 Stakeholder Identified BMP Opportunities (NW Quadrant)

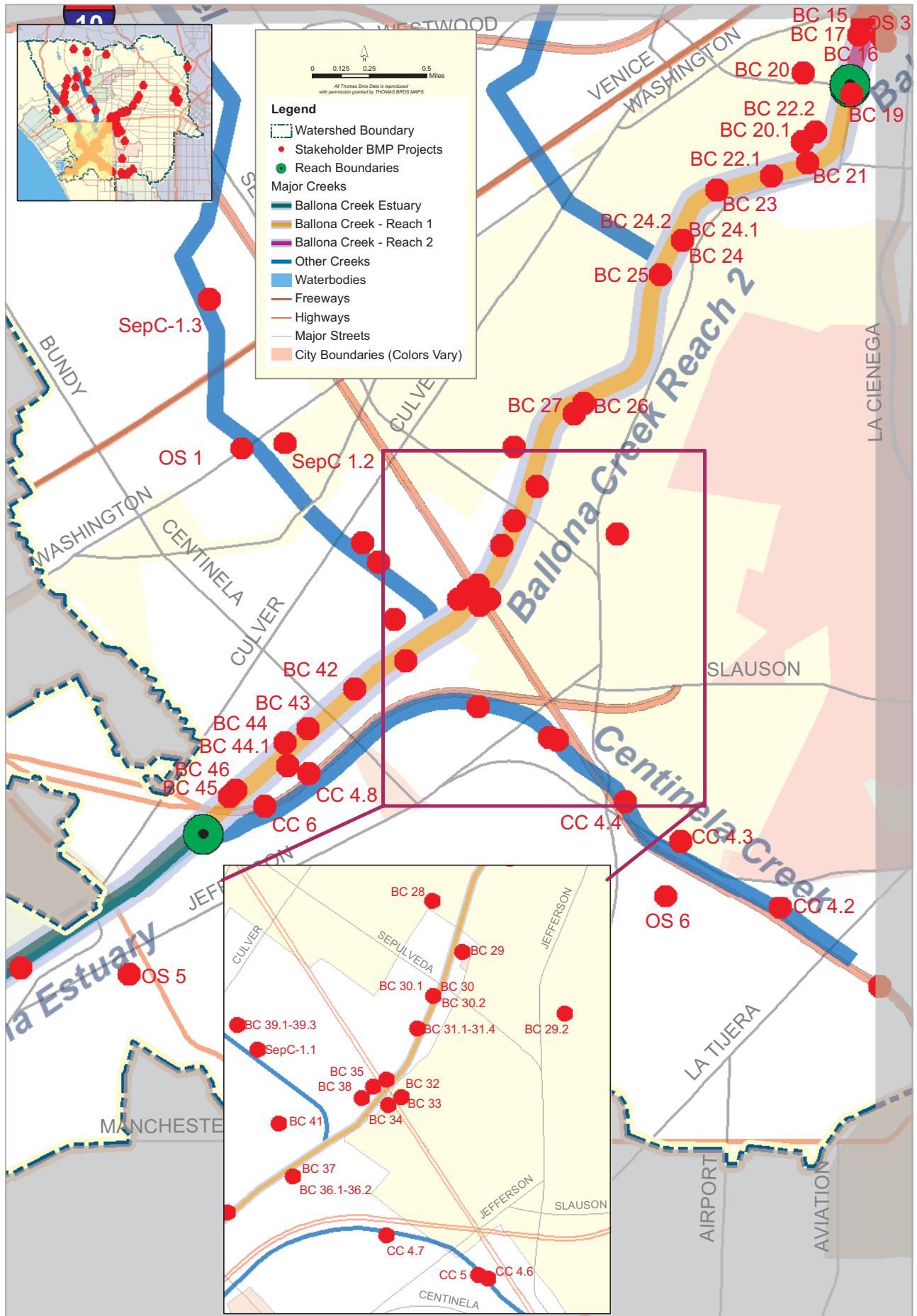


Figure 3-2 Stakeholder Identified BMP Opportunities (SW Quadrant)

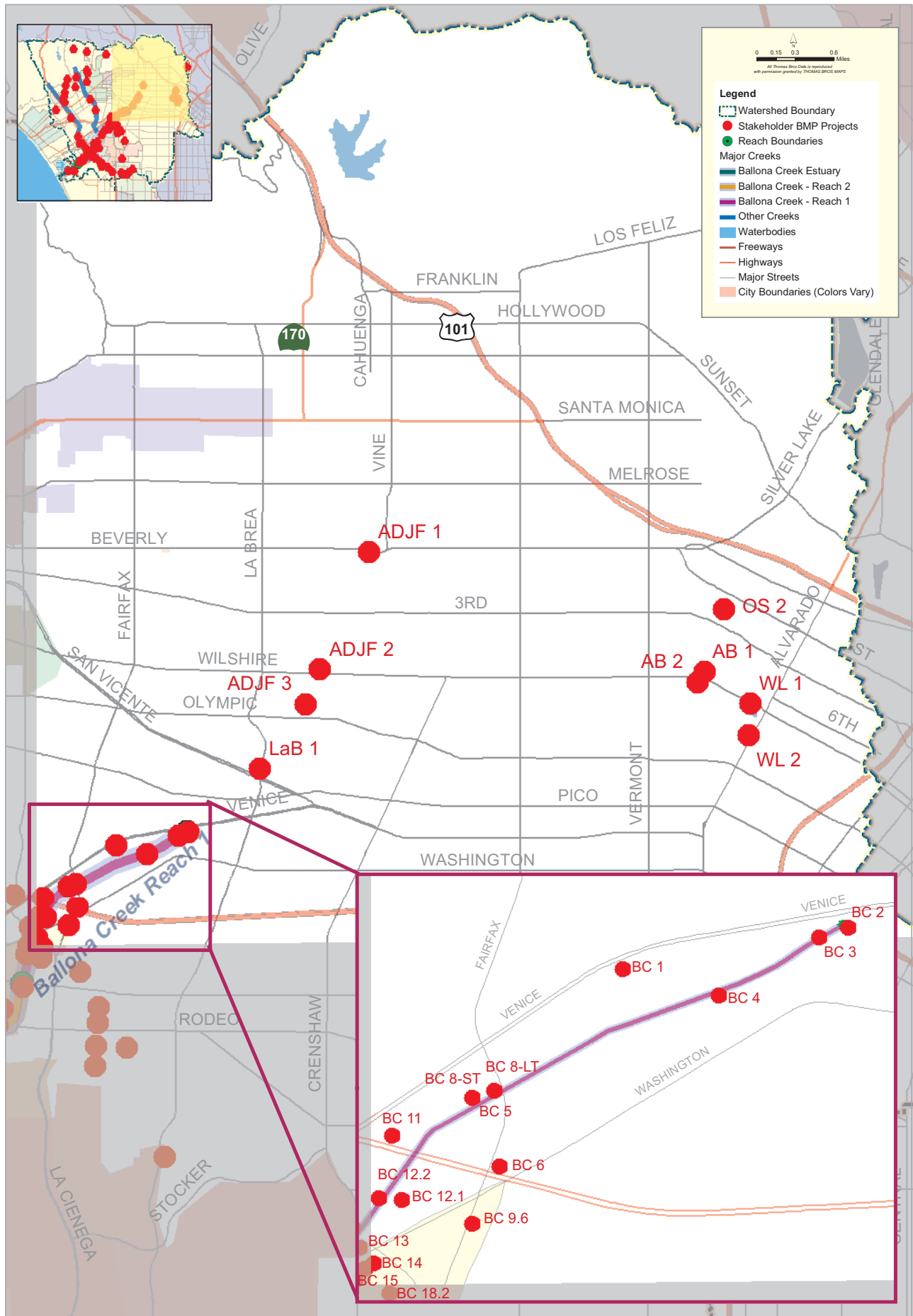


Figure 3-3 Stakeholder Identified BMP Opportunities (NE Quadrant)

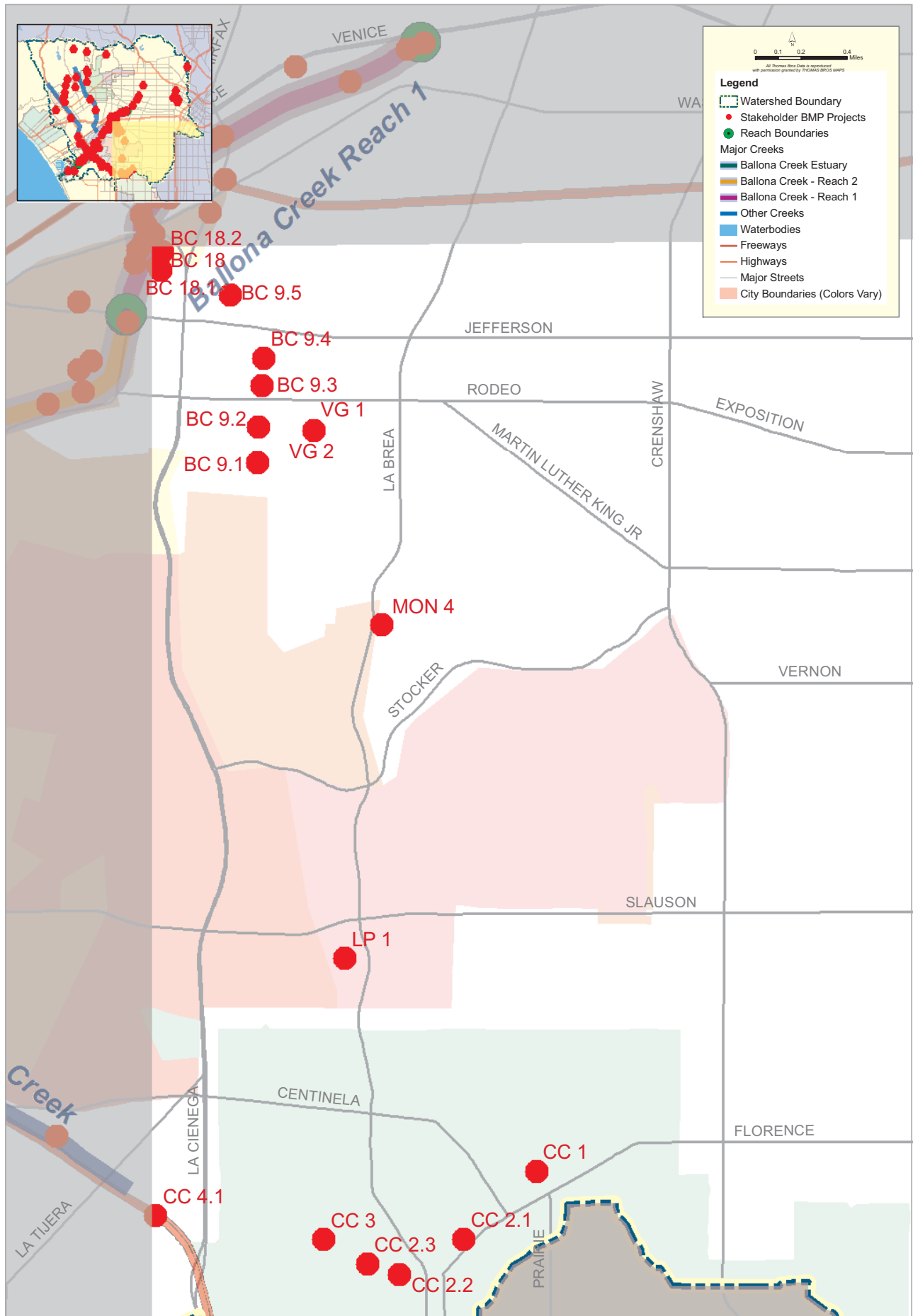


Figure 3-4 Stakeholder Identified BMP Opportunities (SE Quadrant)

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):

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).

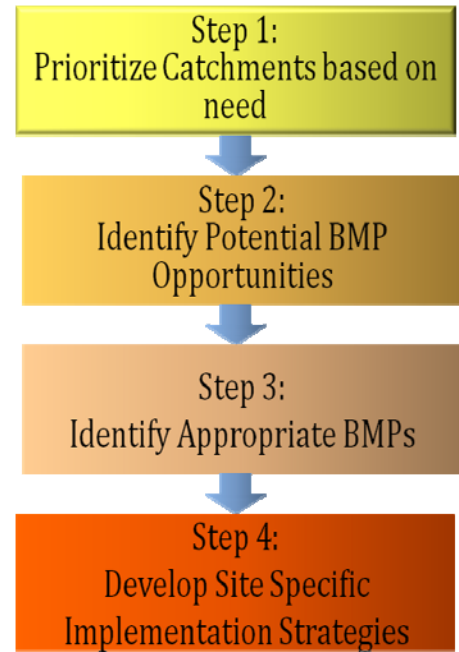


Figure 4-1

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, 2008) included in Appendix M.

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, for bacteria, fecal coliform was modeled and was used as a surrogate for enterococcus and *E. coli*. The model includes three of the metals that are included in the Metals TMDL: copper, lead and zinc. Selenium is also listed in the Metals TMDL, but selenium is being addressed in this Implementation Plan differently than copper, lead and zinc, for the following reasons:

- Data used to list selenium was very limited and mostly non-detects with a detection limit greater than the CTR criterion. As presented in Appendix B, current sampling data shows that for wet weather conditions, selenium meets the

State Board’s delisting criteria. The responsible agencies will submit the data to the State Board to initiate the delisting process. As such, selenium is not included in the wet weather modeling process, which includes the identification of priority catchments.

- Current data is not sufficient to support delisting selenium during dry weather at this time. BMP strategies for selenium will be based on reducing selenium levels during dry weather only. Dry weather compliance strategies are discussed in Section 5.

Further, while this Implementation Plan is being submitted to meet the requirements of the Metals 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 bacteria 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 metals and fecal coliform 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 naturalistic 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 and Appendix M 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 Metals 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 reduce copper in brake pads will reduce the amount of copper that enters 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 Metals 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, 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 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 not 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.

4.3.3 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.

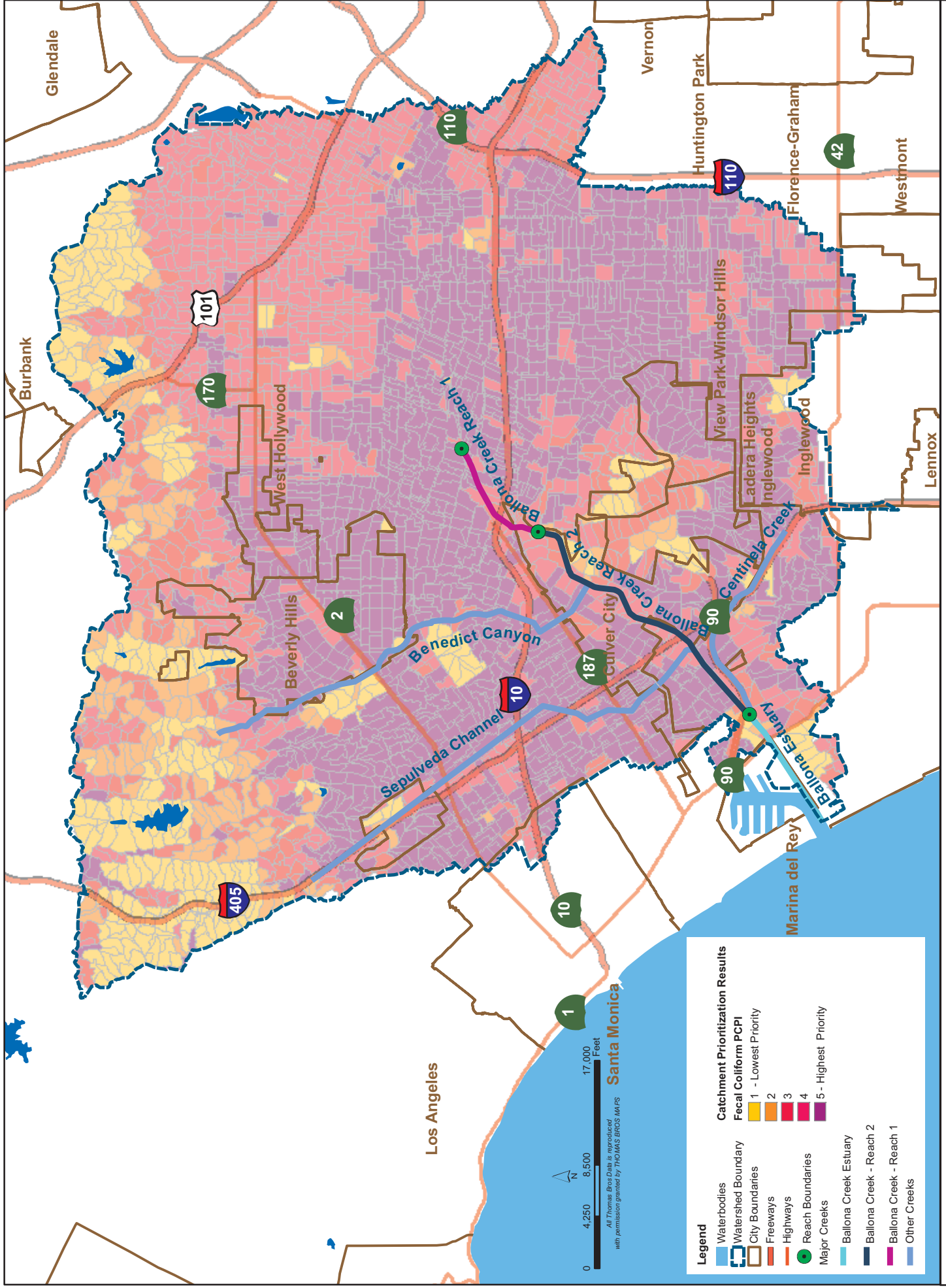


Figure 4-2 Ballona Creek Watershed - Fecal Coliform Catchment Prioritization Index

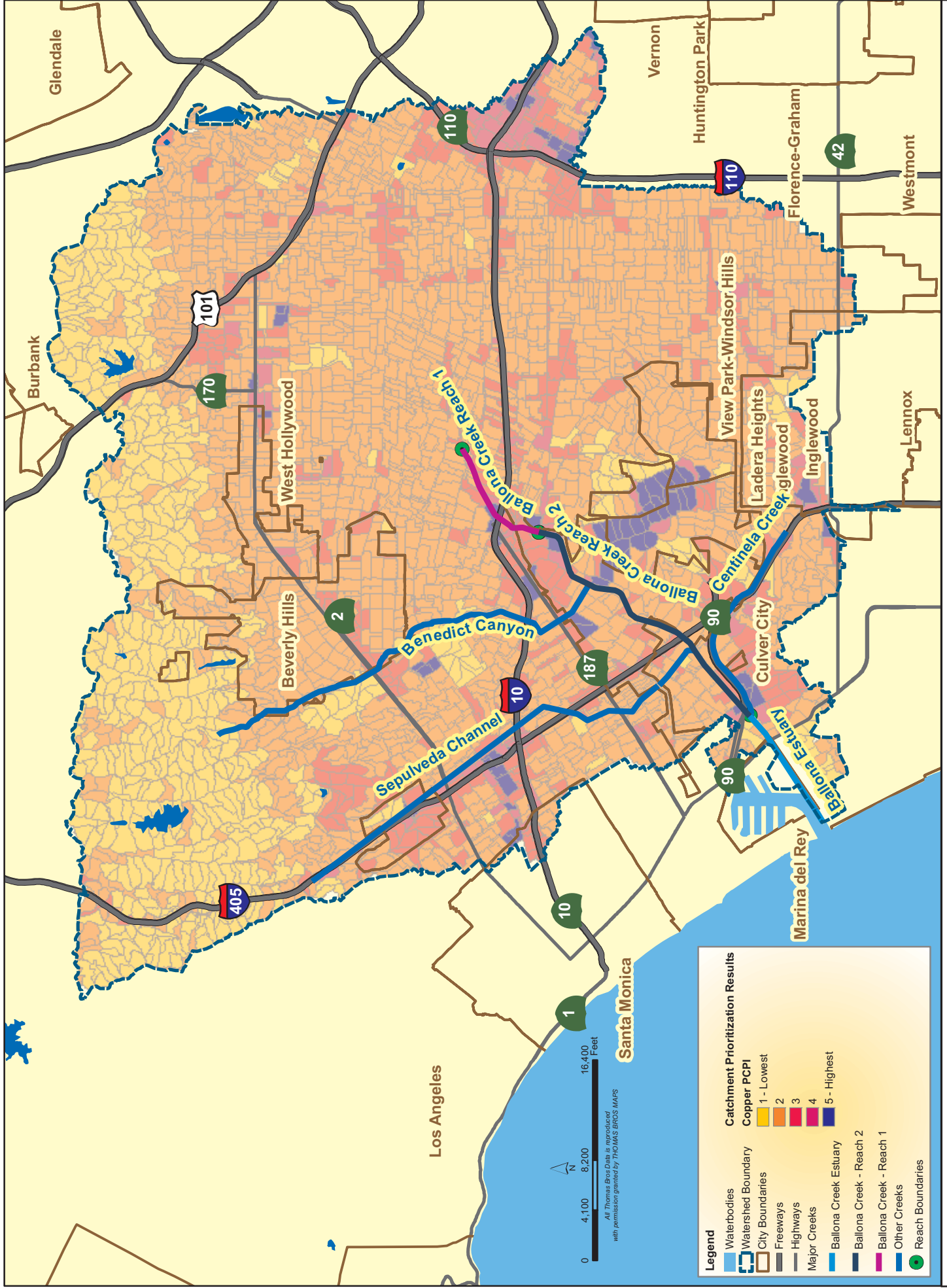


Figure 4-3 Ballona Creek Watershed - Copper Catchment Prioritization Index

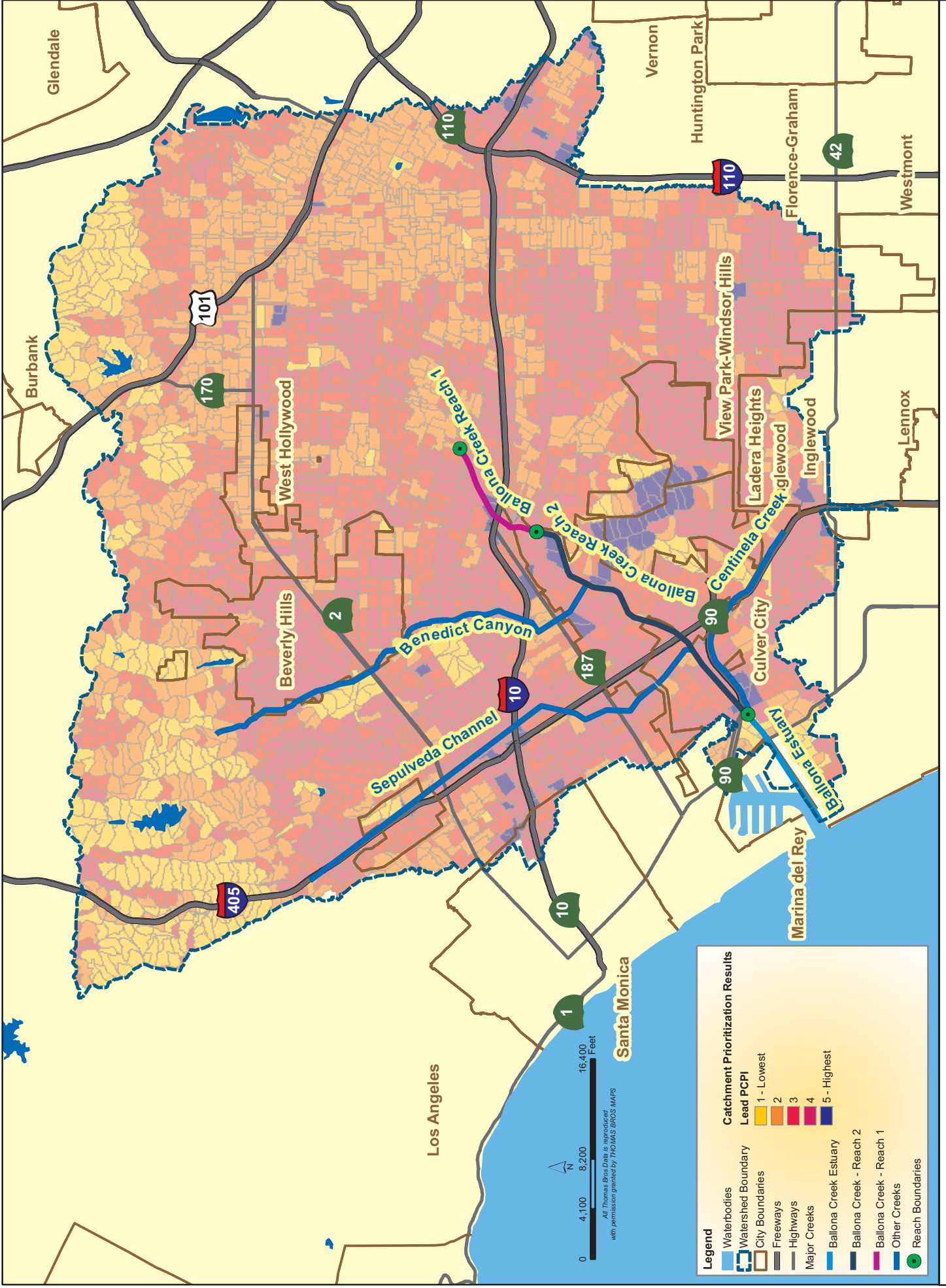


Figure 4-4 Ballona Creek Watershed - Lead Catchment Prioritization Index

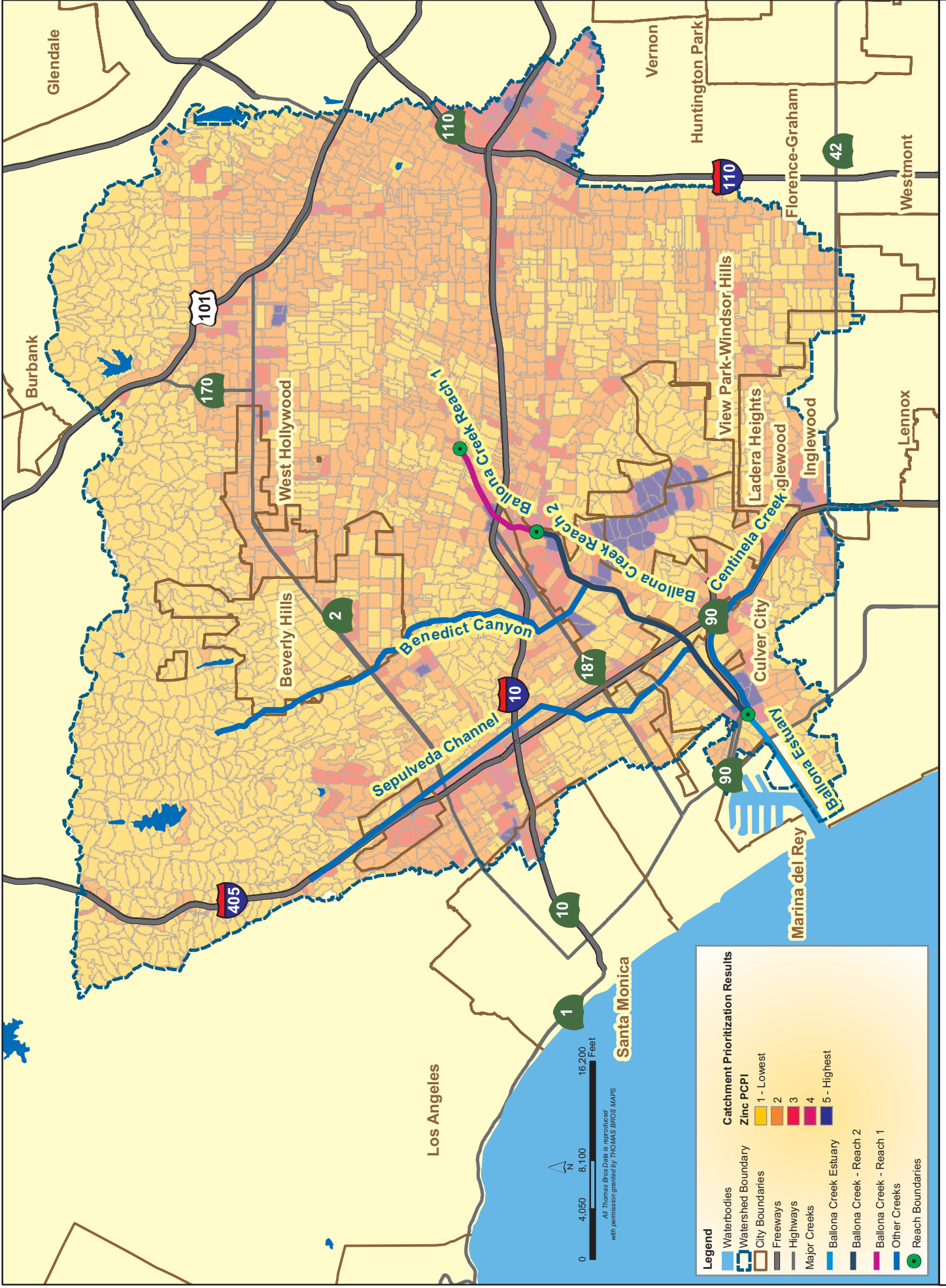


Figure 4-5 Ballona Creek Watershed - Zinc Catchment Prioritization Index

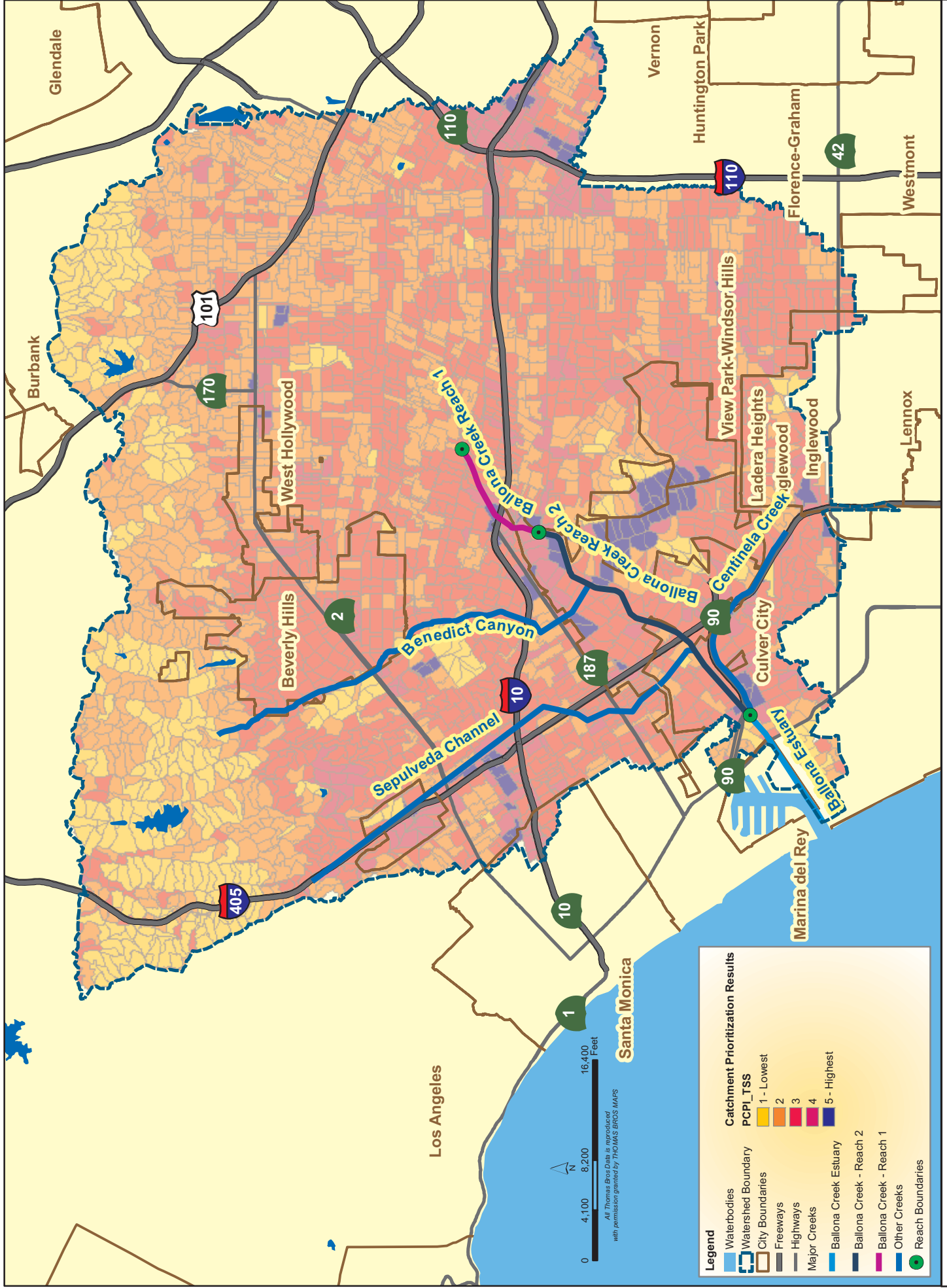
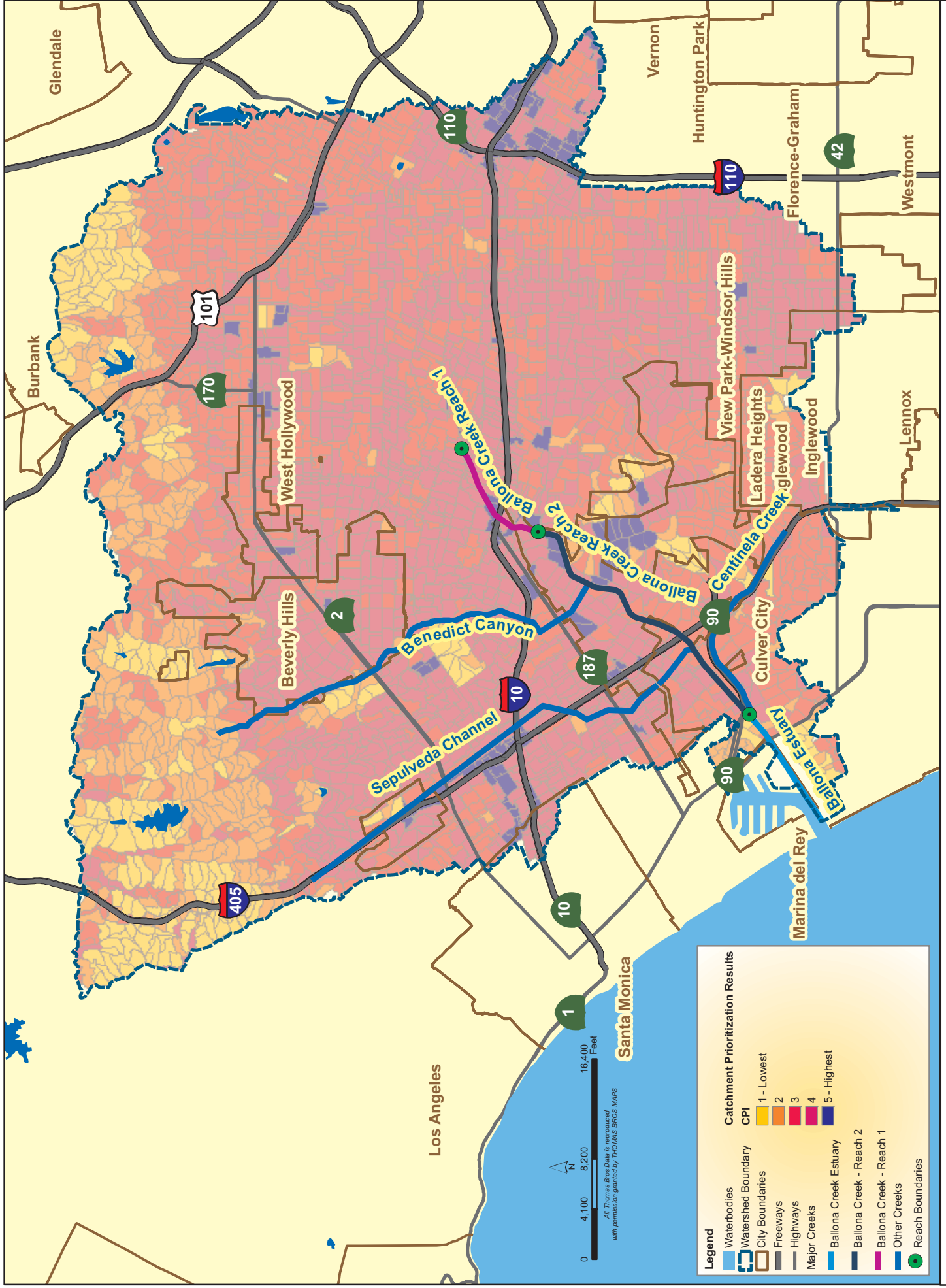


Figure 4-6 Ballona Creek Watershed - TSS Catchment Prioritization Index



Ballona Creek Watershed - Catchment Prioritization Index

Figure 4-7

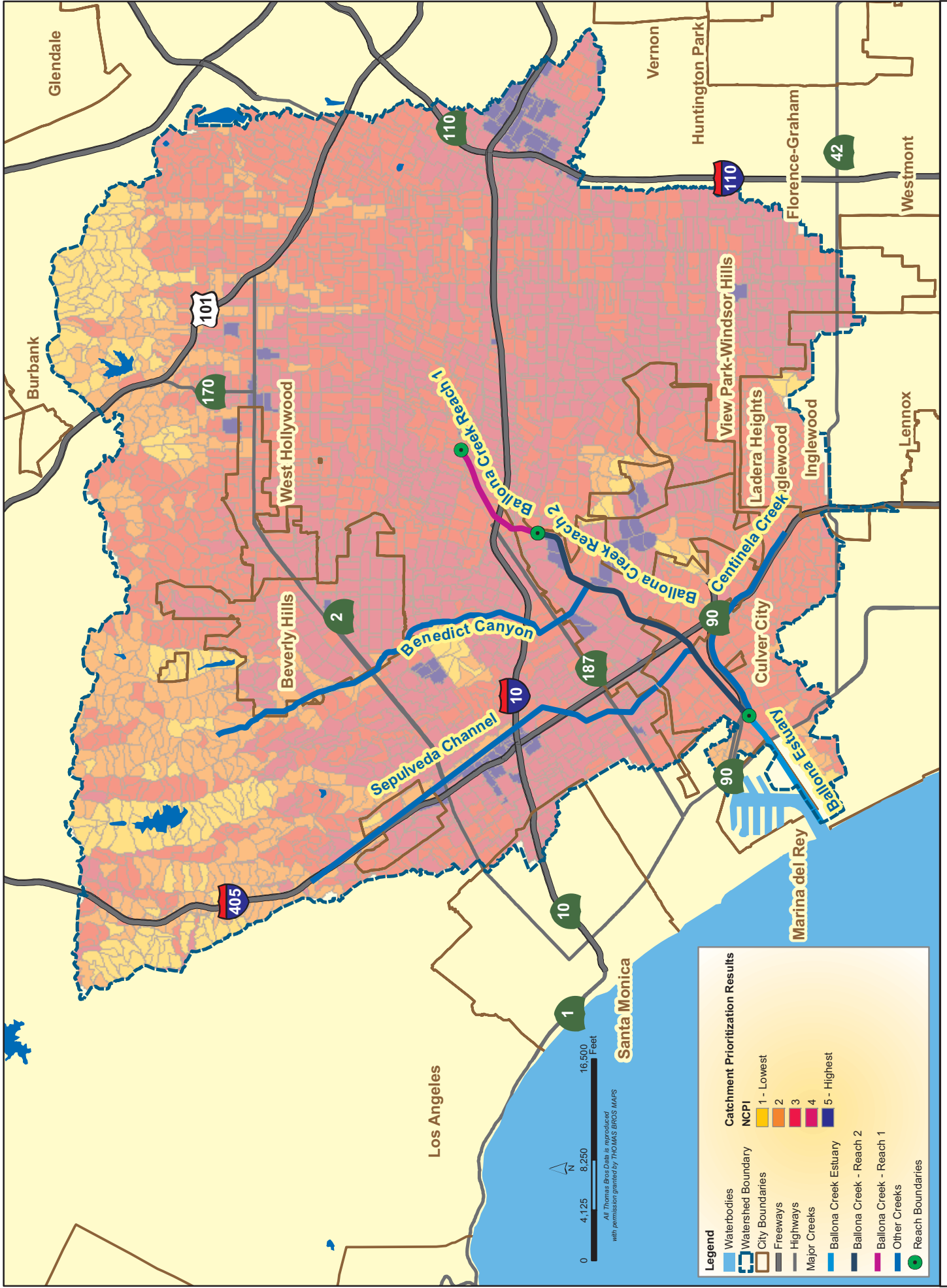


Figure 4-8 Ballona Creek Watershed - Nodal Catchment Prioritization Index

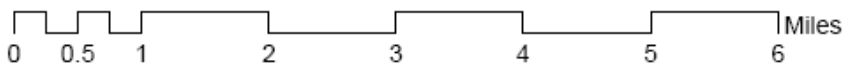
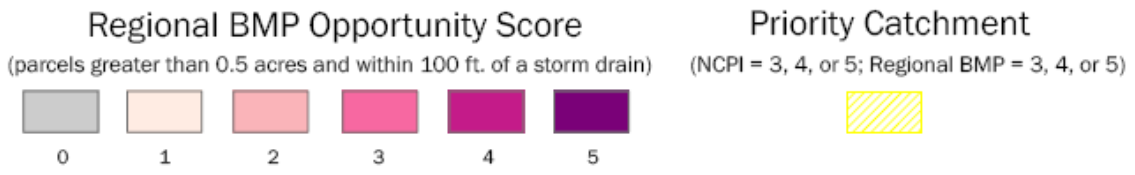
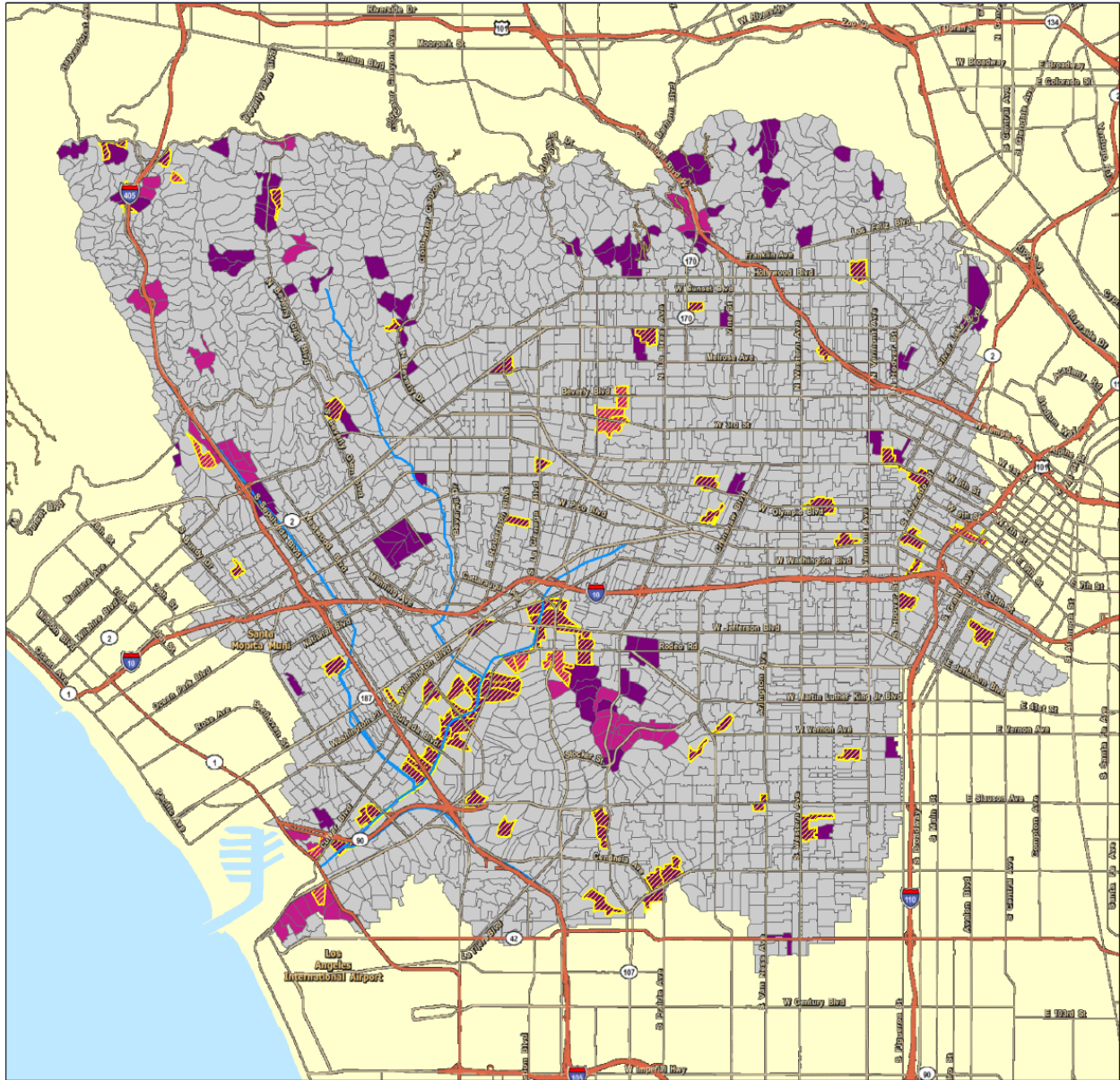


Figure 4-9
Regional BMP Opportunities



Distributed BMP Score
(parcels greater than 0.5 acres)

Priority Catchment
(CPI = 3, 4, or 5; Distributed BMP = 3, 4, or 5)

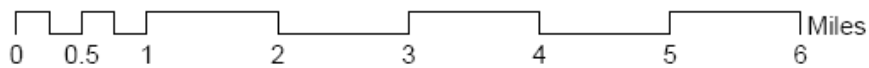


Figure 4-10
Distributed BMP Opportunities

Section 5

Proposed Implementation Plan

The implementation approach for achieving compliance with the Ballona Creek Metals 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 metals loadings 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 metals institutional BMPs.

Since the Metals TMDL Implementation Plan was developed along with the Ballona Creek Bacteria TMDL Implementation Plan, the structural BMPs described herein are the same projects identified in the Bacteria TMDL Implementation Plan. In addition, with the exception of metals-specific BMPs, many of the institutional BMPs are also the same as those identified in the Bacteria TMDL Implementation Plan.

5.1 Recommended BMP Implementation

The Implementation Plan relies on a combination of measures designed to decrease loading and transport of metals, as well as other pollutants such as trash, bacteria 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.

The institutional BMPs were described in Section 5.1.3 (however, see Section 5.2.1.2 for information regarding quantified benefits). This section describes the recommended BMP implementation approach for the LFTFs and regional and distributed BMPs.

5.1.1 Dry Weather Low Flow Treatment Facilities

5.1.1.1 Existing Projects

In 2006, Santa Monica, with the support of the County and the City of Los Angeles, completed the Westside Water Quality Improvement Project. The project diverts dry-

weather and some wet-weather runoff from the Sawtelle Channel (78 inch Reinforced Concrete stormdrain) and treats it at Mar Vista Park, in the City of Los Angeles. The facility treats up to 5 cfs of stormdrain flow. The project includes diversion structure, pump station, separator, storage tank, circulation pump station and disinfection. A 24-inch pipe diverts water from the stormdrain to a hydrodynamic separator, which is screened to remove trash and suspended solids. Flow is then diverted into underground detention tank which includes recirculation pumps and disinfection system. Construction is expected to begin in October 2009 and estimated project completion date is April 2010.

5.1.1.2 New Low Flow Treatment Facilities (LFTFs)

This Implementation Plan includes the construction of up to two LFTFs in the watershed. The purpose of these LFTFs is to significantly reduce pollutant concentrations (including metals) 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. Institutional BMP activities and structural BMPs in this Implementation Plan are projected to reduce 2013 urban runoff levels by approximately 4.2 cfs (2.7 mgd) and 0.4 cfs (0.26 mgd), respectively. However, even with this reduction in urban dry weather flow to Ballona Creek, the metals concentrations of the remaining dry weather runoff may be the same because there will still be significant upstream drainage areas where implementing effective urban runoff controls is not feasible. To supplement planned watershed BMP activities, the Implementation Plan includes up to two LFTF projects to achieve 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 the metals water quality objectives will be discharged back to Ballona Creek.
- *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 include 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. Consultation with appropriate local, state and federal agencies (e.g. the

Department of Fish and Game) will occur during planning and design to ensure that requirements for wild life and other beneficial uses are met.

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, implementing this BMP would require the construction of a diversion structure at a location adjacent to the NOTF, and associated pump stations and conveyances.

This LFTF will capture 100 percent 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 percent 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, filtration to achieve metals concentrations below water quality objectives, and disinfection to comply with Bacteria TMDL numeric limits, 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 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 an 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 percent 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 approximately 2.5 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; 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 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 3/4-inch, 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 Requirements¹**

Year	Single Family	10+ Housing Dev.	Commer- cial/ Industrial	Auto- motive Services	Retail Gaso- line	Restau- rants	Parking Lots	Discharges to ESAs ²	All Category Total
01-02	5	0	22	2	1	2	8	0	40
02-03	76	46	42	1	1	4	15	2	187
03-04	184	219	98	11	5	3	21	1	542
04-05	303	207	125	10	4	5	24	9	687
05-06	215	202	76	9	2	1	32	6	543
06-07	165	192	81	4	6	0	42	21	511
07-08	246	179	132	9	5	4	56	38	669
08-09	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.

Proposition O projects in the Ballona Creek Watershed include the Westside Park Rainwater Irrigation Project and the Mar Vista Recreation Center Stormwater BMP. The Westside Park Rainwater Irrigation Project 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.

The Mar Vista Recreation Center Stormwater BMP Project (Section 5.1.1.1) will divert dry weather flows and the “first flush” from the Sawtelle Channel to the adjacent Mar Vista Recreation Center and Park. The project consists of installation of a stormwater lift station, flow diversion facility, a hydrodynamic separator, an underground detention tank, chlorination facility, final effluent pump station, recirculation pump and overflow piping. Off-site surface runoff from a 240 acre drainage area will be diverted from the existing 63-inch RCP at Sawtelle Blvd for treatment.

Trash TMDL Implementation

In September 2001, the Environmental Protection Agency adopted the Ballona Creek and Ballona Creek Wetlands Trash TMDL, which established limits on the amount of trash allowed into Ballona Creek. The TMDL required Southern California cities discharging into Ballona Creek to reduce their trash contribution to these water

bodies by 10 percent each year for a period of 10 years with the goal of zero trash in the two waterways by 2015. The first milestone was a 20 percent trash reduction in Ballona Creek by September 30, 2006, which the City met and since has achieved every yearly milestone, solely based on its structural measures without having to take credit for its implemented institutional measures.

Implementation of BMPs to address the Trash TMDL is also expected to help reduce metals loadings and achieve compliance with the Metals TMDL waste load allocations since litter has the potential to leach heavy metals into receiving waters. The contribution of metals loading from trash is a function of the type of litter, the duration of contact with stormwater, and the chemistry of stormwater (see Section 5.2.1.3).

The Watershed Protection Division (WPD) of the Bureau of Sanitation is the lead office in charge of the city-wide Trash TMDL Implementation. In its undertaking of the Trash TMDL, WPD in the spring of 2002 completed a study entitled High Trash Generation Areas and Control Measures, which identified the spatial distribution of trash in the City for both the Los Angeles River and Ballona Creek watersheds. The study examined the amount of trash accumulating in City-owned catch basins beginning in 1999 through the end of 2003. The ensuing analysis of the data resulted in the identification of three distinctive trash generation areas within the City. Those areas were categorized as low, medium, and high trash generation areas. The high trash generation area was shown to contribute approximately sixty percent of the trash within the City. It was concluded that implementing both institutional and structural control measures first in the high and medium trash generating areas would have the greatest impact in reducing trash discharged to the Ballona Creek. Accordingly, a trash reduction in Ballona Creek will become more noticeable as more of the source points are eliminated.

The City's strategy for compliance is based on using the following two-prong approach: 1) implementing institutional measures such as, public outreach, street sweeping, catch basin cleaning, enforcement, etc., with a special focus on the high trash generation areas, and 2) installing structural trash control devices in the storm drain system, targeting first the high trash generating areas of the City, followed by the medium and low trash generating areas.

As of September 2008, the City has installed over 7,700 catch basin inserts in the high trash generating areas and 14,900 catch basin opening screen covers in the high and medium trash generating areas of the City. In addition, 13 netting systems and three CDS units certified as full capture devices, have been strategically installed throughout the City and continue to operate effectively in preventing the trash from getting to the LA River and Ballona Creek. Thus far, the City has invested approximately \$39 million to achieve compliance using online structures and catch basin capture devices.

At the inception of the program, the implementation of the trash TMDL in the City was projected to cost well over \$1.5 billion in capital costs to achieve full compliance. Through the City's leadership and use of its strategic two-pronged approach, paralleled with a commitment to invest in piloting new products and BMPs, the capital costs are now projected at approximately \$85 million to achieve compliance. The last phase will be undertaken through a contract over a period of several years, funded through Proposition O, and will address the future regulatory milestones by installing catch basin opening covers. The City will achieve full compliance several years before the mandated compliance deadlines.

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 to be implemented first (Figure 5-2). For these sites, Table 5-2 presents a short BMP project description, jurisdiction, and the integrated water resources benefits provided by each project. Preliminary concept drawings are included in Appendix G. Implementation of these projects, which provide multi-pollutant benefits, will be subject to confirmation of engineering feasibility and, where appropriate, the water quality treatment approach may be modified.

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 projects, which will provide multi-pollutant benefits, 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

Section 5.1.2.2 describes the priority projects planned for implementation. 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. Many of these projects are implemented as a result of SUSMP, and as such, these projects are currently ongoing and therefore are included in all phases of the Implementation Plan. Refer to Section 5.2 for further discussion.

During the development of this Plan, additional specific structural BMP projects were identified that may be implemented after priority projects are completed, provided

conditions at these sites do not change in the interim. Alternatively, if during design, a priority project is deemed unsuitable, then one of these projects could be implemented instead, upon further investigation. 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 Phase 1 Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan¹**

Site ID ²	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits ³
1	Baldwin to Ballona Trail: Jefferson Blvd & Fairfax Ave	205869 28.2 acres	Vegetated swales, bio-retention in parkway with underdrains, permeable pavement, bio-retention facilities	Los Angeles	1, 2
2	Ballona Greenway: Berryman Ave at Ballona Creek East of 405 Fwy	207784 23.8 acres	Bio-retention in parkway with underdrains, vegetated swales, bio- retention facilities	Los Angeles / Culver City	1
3	Ballona Greenway: Milton Street at Ballona Creek near Bundy	208755 28.5 acres	Bio-retention 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	Bio-retention in parkway with underdrains, vegetated swales	Los Angeles	1
5	Ballona Greenway: Hauser Blvd at Ballona Creek	205522 33.2 acres	Bio-retention in parkway with underdrains, green street medians	Los Angeles	1
6	Occidental Blvd & 2nd St	200551 30.7 acres	Bio-retention in parkway with underdrains	Los Angeles	1
7	405 Fwy & Wilshire Blvd	208406 18.4 acres	Vegetated swales and bio-retention facilities	Los Angeles County/Caltrans	1
8	Ballona Greenway: Street ends, Cochran to Fairfax	203586 11.2 acres	Bio-retention 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, bio-retention 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, bio-retention facilities	Los Angeles	1, 2

**Table 5-2
Summary of Phase 1 Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan¹**

Site ID ²	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits ³
11	Ballona Greenway: Jefferson Blvd at Ballona Creek	206647 38.2 acres	Bio-retention 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, bio-retention, green street medians, bio-retention 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, bio-retention 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, bio-retention in parkway with underdrains, vegetated swales, bio-retention	Culver City	1, 2
16	Mar Vista Oval Street Project: Mar Vista Oval St & Venice Blvd	208701 27.8 acres	Bio-retention in parkway w/underdrains	Los Angeles	1
17	Ballona Greenway: Lindberg Park at Ballona Creek near Sepulveda Blvd	207628 32.2 acres	Bio-retention in parkway with underdrains, permeable pavement	Culver City	1, 2
18	405 Fwy & Sunset Blvd	208374 33.6 acres	Vegetated swales, bio-retention facilities	Los Angeles/Caltrans	1
19	Venice Blvd: Wade St to Walgrove Ave	180101 21.8 acres	Bio-retention facilities	Los Angeles	1
20	S Vermont Ave & W Pico Blvd	200753 6.5 acres	Permeable pavement, bio-retention in parkway with underdrains	Los Angeles	1, 2
21	N Fairfax Ave & Rosewood Ave	204074 35.7 acres	Bio-retention in parkway with underdrains, pervious pavement	Los Angeles	1, 2
22	S San Pedro St & E 30 th St	205439 17.1 acres	Bio-retention in parkway with underdrains, pervious pavement	Los Angeles	1, 2
23	110 Fwy & W 30 th St	205717 26.3 acres	Pervious pavement, bio-retention in parkway with underdrains, cisterns	Los Angeles/Caltrans	1, 2, 4

**Table 5-2
Summary of Phase 1 Distributed BMP Sites in Ballona Creek Bacteria TMDL Implementation Plan¹**

Site ID ²	Title/Location	Catchment #/ Catchment Area	BMP/Project Description	Jurisdiction	Other IWRA Benefits ³
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, bio-retention facilities	Inglewood	1, 2
27	S La Cienega Blvd: W 58 th Pl to W Fairview Blvd	208938 32.3 acres	Bio-retention facilities	Los Angeles County / Los Angeles / Inglewood	1

Notes:

¹ The BMPs listed here will reduce both metals and bacteria

² Site numbers correspond to sites shown in Figure 5-2

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 5-3
Summary of Phase 1 Regional BMP Sites in Ballona Creek Bacteria
TMDL Implementation Plan¹**

Site ID ² (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 & 61 st 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 & 6 th St)	200624 135.5 acres	Bio-retention 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 23 rd 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:¹The BMPs listed here will reduce both metals and bacteria² Site numbers correspond to sites shown in Figure 5-2. Site layout figures can be found in Appendix G³ 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 Phase 2 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 retrofitted at the expense of the property owner, as described in the SUSMP program.

5.1.3 Recommended Institutional BMPs

The following sections describe the range of institutional BMPs that were evaluated and considered for inclusion in the Metals 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.

5.1.3.1 Education and Outreach

Education and outreach programs for residents and businesses on water quality impacts from controllable sources of metals 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). Implementation activities include:

Urban Runoff Websites – The City will continue to manage its stormwater Website (www.lastormwater.org) to provide information on urban runoff management practices, and add specific information on Los Angeles River metals TMDL implementation.

Regulatory and Policy Education – The City will develop and implement a process to educate and provide outreach to appropriate City departments and agencies to support implementing newly developed policies, ordinances, and incentive programs.

Rapid Transit Promotion – The City will continue to promote the use of rapid transit to minimize the number of vehicle miles driven in the watershed. In addition, the City will evaluate opportunities to develop and implement incentives to further reduce miles driven.

Education and Outreach Effectiveness Evaluation – The City will develop evaluation and monitoring methods to better understand the performance of education and outreach programs. Based on this information, prioritize educational campaigns on the basis of their effectiveness (e.g., information dissemination through brochures, public meetings, signage, school education, etc.).

Watershed-wide Education – The purpose of this ongoing BMP is to improve the consistency and efficiency of urban runoff management education efforts watershed-wide. The City will continue to collaborate with other jurisdictions, City agencies, and NGOs to develop appropriate watershed-wide educational programs.

Education and Outreach Funding – The City will work with its watershed partners to establish a long-term stable fund for supporting watershed-wide education activities that is cost-shared among jurisdictions and organizations including, but not limited to, the cities, Los Angeles County, and NGOs. Establishing this fund would include developing an agreement on the methods for governing fund expenditures.

Environmental Learning Center – The City will complete construction of the Environmental Learning Center by the end of 2010, and establish a secure funding source so that the facility is regularly open to provide environmental education.

Targeted Metals Education & Outreach—The City currently implements a comprehensive education program to reduce potential mobilization of metals into storm drains from car washing (both at home and charity car washes, see below), hosing down driveways, improper disposal of used oil, and vehicle maintenance activities at home. The City will evaluate its existing education and outreach program to determine the need to enhance this effort to improve the effectiveness of this BMP.

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 washes metals off of the car, and increases dry weather urban runoff and mobilizes metals present on impervious surfaces. To reduce metals 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.

5.1.3.2 Product Replacement

The purpose of this BMP is to reduce a significant source of metals in the environment by developing safe alternative products. To implement this BMP, the City will continue to support efforts to reduce metals in vehicle brake pads and wheel weights through pending legislation (SB 346 and SB 757, respectively). In addition, if opportunities arise to participate in studies or legislation to reduce the metal content in other products, the City will consider participating in those efforts.

5.1.3.3 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.

5.1.3.4 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 metals. 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.

5.1.3.5 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 in the watershed 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.

5.1.3.6 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.

5.2 Quantification of Water Quality Benefits

5.2.1 Methodology

Potential pollutant reductions associated with the proposed structural BMPs were quantified using SBPAT (Section 4 and Appendix E and M). Pollutant reductions associated with institutional BMPs were quantified using a spreadsheet model that accounts for specific pollutant sources and the predicted performance of institutional BMPs 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 Metals TMDL limits in Ballona Creek.

The BMP performance and pollutant load reductions are based on the effluent concentrations of the target pollutants. Load reduction values are expressed in high, low and average values in Table 5-9 to 5-11. For the purpose of compliance analysis, average values are used in this Implementation Plan.

In order to ensure that load reductions at 100% compliance point were not overestimated, the analysis ensured that load reductions in any given catchments of the watershed were not double counted. For example, in areas where a regional or distributed BMP was installed, no credit was taken for load reductions from institutional BMPs. Further, where a regional BMP was installed, also no credit was taken in the entire tributary area of the regional BMPs for load reductions due to any distributed BMPs.

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

- Pollutant reductions are quantified for the implementation of regional BMPs, distributed BMPs, and institutional BMPs described in Section 5.1.3 and Section 4.3 by the year 2021.
- The results for the regional BMPs, distributed BMPs, and institutional BMPs are added together to predict the pollutant load reduction for the entire watershed. The catchment areas tributary to each treatment BMP and the implementation areas for institutional BMPs were assumed to 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. Ranges of annual load reductions are also estimated for 2021.

A discussion of uncertainty and limitations of the quantification approach is provided following the discussion of structural and institutional BMP implementation strategies below.

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 inches per hour for flow-based BMPs¹, 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 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 ¹	Proposed BMP(s)	BMP Sizing Assumptions/Available BMP Area	Drainage Catchment Area (ac) ²	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	235	63%

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.

		available.		
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 Bio-retention 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 Figures can be found in Appendix G.

² 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; institutional BMPs 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 percent). Open water comprises 0.4 percent of the watershed. Vacant land areas (17 percent 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 percent swales, 21 percent cisterns, 19 percent bio-retention, and 13 percent 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 percent of the commercial land use area is roadways.
- Green street projects will accept 50 percent additional non-roadway drainage area from adjacent parcels, on average.
- Green street projects will incorporate bio-retention (50 percent) and vegetated swales (50 percent).
- 30 percent 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 percent swales, 21 percent cisterns, 19 percent bio-retention, and 13 percent 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 percent of the industrial land use is roadways.
- Green street treatment would be sized to accept 50 percent additional non-roadway drainage area.
- Green street treatment achieved through equal implementation of bio-retention (50 percent) and vegetated swales (50 percent).
- 30 percent 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 percent swales, 42 percent bio-retention, and 12 percent 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 percent swales, 24 percent bio-retention, and 17 percent 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 percent per year.
- Distributed BMP type and relative implementation for private schools were based on the median levels recommended from the field investigations in commercial land uses that were applied to private education land uses [47 percent swales, 21 percent cisterns, 19 percent bio-retention, and 13 percent 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 percent 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 percent.
- 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 bio-retention.
- 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 percent of SFR land use area is roof area (consistent with the median building footprint of SFR parcels of 25 percent, SCAG area weight imperviousness of 40

percent, and zoning set back requirements that would lead to 37 percent roofs for a standard lot size).

- SFR rooftops will be disconnected and routed into bio-retention cells via a Roof Downspout Disconnection Program.
- The roof downspout disconnection rate will be 33 percent within 10 years [2,607 acres treated by 2021].

Green Street Projects in Single Family Residential Areas

- 23 percent of the SFR land use is roadways and 50 percent of the SFR land use area drains or can be routed to the roadway.
- Green street treatment will be achieved through equal implementation of bio-retention (50 percent) and vegetated swales (50 percent) for the roadways and permeable pavement for alleys.
- 30 percent 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 percent of the SFR land use is roadways and 50 percent of MFR land use area drains or can be routed to the roadway.
- Green street treatment will be achieved through equal implementation of bio-retention (50 percent) and vegetated swales (50 percent) for the roadways and permeable pavement for alleys.
- 30 percent 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 metals in urban watersheds is difficult because sources and activities that mobilize different metals are numerous and diverse. Nationwide, watershed management plans identify vehicle brake pads, tire tread, roadway sediment, used motor oil, and building materials as significant sources of metals in urbanized watersheds. Reductions of copper, lead, and zinc from these pollutant sources can be achieved by implementing 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 into local waterbodies. Estimating the pollutant load reduction achieved through the implementation of these BMPs involves two distinct computations:

- Pollutant Buildup – Determining the relative contribution of the pollutant from a targeted source to the watershed land surface.
- Pollutant Wash-off – the transport of pollutants from the watershed surface to downstream waterbodies.

Institutional Load Quantification Methodology

A total of 57 years of historical rainfall records were used to estimate the buildup of metals from controllable sources prior to a storm event (Pt), as a function of preceding dry days (DD). Using SBPAT, watershed-wide hydrologic simulations were used to estimate runoff volumes for distinct storm events in the historical rainfall record. The produced time series of discrete runoff events were then used in a spreadsheet model to estimate the wash-off of pollutants from the watershed surface (W), as a function of runoff depth (R). Numerous studies have found that pollutant buildup and wash-off are most appropriately estimated using non-linear relationships. Pollutant buildup occurs at the fastest rate in the initial days following a wash-off event, but decline as buildup approaches the maximum carrying capacity (Pmax) for the watershed over longer dry periods (Sartor and Boyd, 1972; EPA NURP Study, 1983). Maximum possible mass build-up occurs after approximately 20 dry days within an urban watershed (Pitt and Shawlee, 1982). These studies also show that the greatest amount of pollutant wash-off occurs with the first ½ inch of runoff, with lower wash-off rates associated with each increment of additional runoff. Therefore, exponential functions were used to estimate pollutant buildup and wash-off associated with specific sources of metals in the watershed. These exponential functions are consistent with the TMDL model (SCCWRP, 2004) and other researchers (Chen and Adams, 2006) and include:

$$P_t = P_{\max} * [1 - e^{(-k_b * DD)}] + [P_{t-1} - W_{t-1}] * e^{-k_b * DD}$$

$$W_t = P_t * [1 - e^{(k_w * R)}]$$

Where: P_t is the pollutant buildup for the current storm (lbs)
 P_{\max} is the maximum possible mass build-up (lbs)
 k_b is the build-up rate coefficient (hr^{-1})
 P_{t-1} is the pollutant build-up of the previous storm (lbs)
 W_{t-1} is the pollutant wash-off of the previous storm (lbs)
 DD is the dry interevent period (hr)
 k_w is the wash-off rate coefficient (in^{-1})
 R is the runoff depth (in)

Pollutant buildup and wash-off analyses were completed for specific sources of metals including copper in brake pad dust, copper, lead and zinc in street sediment, and atmospheric deposition to quantify water quality benefits associated with brake pad product replacement and enhanced street sweeping. These institutional BMPs were identified as BMPs for which water quality benefits can be most reliably quantified.

The concentration of metals in accumulated sediment is reduced by implementing institutional BMPs, therefore wash-off of accumulated sediment in the future will have a reduced associated metals loading. These institutional BMPs have a similar effect on buildup rates of copper, lead, and zinc.

The following sections describe load reductions expected from selected institutional BMPs. Additional institutional BMPs included in this TMDL Implementation Plan (See Section 5.1.3 and 4.3) were not quantified, yet may provide additional pollutant removal. Water quality monitoring will determine if the non-quantified BMPs provide an additional benefit, resulting in potential reduction in the need for structural BMPs to comply with later compliance milestones.

Vehicle Brake Pad Product Replacement

The purpose of this BMP is to reduce a significant source of metals in the environment by developing safe alternative products. To implement this BMP, the City will continue to support efforts to reduce metals in vehicle brake pads and wheel weights through pending legislation.

Copper from vehicle brake pad wear debris accounts for a significant portion of total copper loads in urban watersheds. In subwatersheds of the San Francisco Bay, brake pad wear debris accounted for 15-50 percent of total copper loads, depending upon the land use in each subwatershed (AquaTerra 2007). The Santa Clara Valley Urban Runoff Program estimated that brake pads are responsible for 42 percent of copper loading to the San Francisco Bay (SCVURP 1997). To develop this Implementation Plan, a similar analysis for the Ballona Creek Watershed estimated the fraction of total copper loading manageable through direct source control activities related to copper content in brake pads. The mass of copper released to the watershed per vehicular kilometers traveled (VKmT) provides a basis to quantify baseline loads of total copper from brake pad wear debris. Copper loading rates per VKmT were estimated in

several targeted studies conducted by the Brake Pad Partnership (Rosselot 2006). Rosselot 2006 identified a brake pad wear rate of approximately 0.5 mg per VKmT. Rosselot 2006 also evaluated the copper content in different types of vehicles within the San Francisco Bay area.

Based on the previously mentioned studies, an average copper content for vehicles in the Ballona Creek Watershed was assumed to be 6.5 percent. Thus, 6.5 percent of 7.0 mg per VKmT is the rate at which copper is released to the Ballona Creek Watershed for every VKmT. Daily VKmT was estimated by taking the number of vehicles in the watershed (~1 million, per 2000 Census) with an assumed average annual driving of 16,000 kilometers. However, studies have shown equilibrium pollutant carrying capacity occurs after approximately 20 dry days within an urban watershed (Pitt and Shawlee, 1982). Therefore, the maximum buildup of copper on impervious areas is estimated as the buildup over 20 dry days.

In the Ballona Creek Watershed, this is approximately 414 kg of copper ($7 \text{ mg/VKmT} * 1\text{E-6 kg/mg} * 0.065 \text{ Cu} * 20 \text{ days} * 45.5 \text{ million VKmT/day}$). Brake pad dust was assumed to be uniformly distributed across the watershed but can only be washed off from impervious surfaces. The mass of accumulated sediment on a given day is an exponential function of this maximum carrying capacity, residual pollutant not washed off during the preceding runoff event, and dry days prior to the event.

If implemented, State Bill 346 would require new brake pads in the State of California to contain less than 5 percent copper by 2021. Given these changes in copper content in brake pad wear debris, the mass of copper built up on the watershed, and available for wash-off, will be reduced. To account for the introduction of new brake pads into the market, this compliance analysis assumed average copper content could be reduced to 5 percent by the 2021 compliance milestone.

Enhanced Street Sweeping

Metals released to the urban environment during dry weather conditions are likely to adsorb on street sediments, which provide a transport mechanism for metals to reach downstream waterbodies (Golding, 2006). The City of Los Angeles Bureau of Street Services (BSS) currently operates a street sweeping program that includes over 130 mechanical broom sweepers with a staff of over 100 operators. Citywide, BSS conducts Routine Street sweeping for 7,600 curb-km of posted streets on a weekly basis, and an additional 13,000 curb-km of non-posted or arterial streets on a monthly basis. Approximately 6,500 curb-km (4,000 curb-mi) of these swept roads (both weekly or monthly frequency) lies within the City's portion of the Ballona Creek Watershed.

Several alternatives exist for BSS to enhance its program by capturing more sediment for roads within the City, including increased frequency of sweeping on non-posted roadways or replacement of aging mechanical broom sweepers within the current fleet with new more efficient types of street sweepers. The City of Dana Point doubled sediment removal by increasing street sweeping from biweekly to weekly (Dana Point

2005). 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). This TMDL Implementation Plan uses a conservative target of increasing current sediment removal by 15 percent with enhancements to street sweeping. Appendix J provides an analysis of the number of additional curb-miles that would need to be swept to achieve this goal of increasing street sweeping by 15 percent. Additional studies and potential pilot programs, working closely with BSS, will be necessary to evaluate the most effective and suitable approach to achieve this target.

Findings of local studies of accumulation rate and metals composition in street sediment provide necessary information to quantify the metals loading. Sartor and Gaboury (1984) estimated sediment accumulation for impervious surfaces to range from 12 to 21 kg/curb-km/day. In a more recent study to support the Brake Pad Partnership in California, Rosselot (2007) measured a street sediment accumulation rate of 14 kg/curb-km/day. Using this rate of accumulation for 20 days following a wash-off event, and the estimated 6,500 curb-miles within the City's portion of the Ballona Creek Watershed, a maximum carrying capacity of sediment on streets within the watershed is approximately 1.8 million kg. The mass of accumulated sediment on a given day is an exponential function of this maximum carrying capacity, residual pollutant not washed off during the preceding runoff event, and dry days prior to the event.

Accumulated street sediments contain a high concentration of metals of concern in the Ballona Creek Watershed, based on the findings of Lau and Stenstrom (2005) from several roadways (Table 5-6). These values facilitate quantification of reductions in pollutant buildup for specific metals associated with additional sediment removal from current BSS street cleaning operations.

Based on the concentration of each metal in sediment shown in Table 5-6, the predicted average annual load reduction achieved by increasing street sediment removal by 15 percent from current levels is approximately 8 pounds per year (lbs/yr) for copper, 11 lb/yr for lead, and 31 lbs/yr for zinc (Table 5-6).

**Table 5-6
Metals Concentrations in Street Sediments**

Metal	Concentration (ppm)	Pounds Removed by 15% Increase in Street Sweeping¹
Copper	99	8
Lead	133	11
Zinc	371	31
¹ Based on a storm by storm buildup and wash-off analysis.		

Targeted Zinc Reduction Program

Site-based monitoring will be conducted to confirm the effectiveness of the specific mitigation strategies implemented as part of the Targeted Zinc Reduction Program. Results of the monitoring will provide the basis for establishing the expected overall load reduction as a result of implementation of this institutional BMP.

5.2.1.3 Performance Estimation of Trash Capture Devices

Litter has the potential to leach heavy metals into receiving waters. The contribution of metals loading from trash is a function of the type of litter, the duration of contact with stormwater, and the chemistry of stormwater. Therefore, implementation of BMPs to address the Trash TMDL is also expected to help reduce metals loadings and achieve compliance with the Metals TMDL waste load allocations.

Data to estimate the effectiveness of catch basin inserts, catch basin screens, and trash nets at reducing metal loads in stormwater is not available, although data is available for hydrodynamic separators. SBPAT was used to quantify the effectiveness of hypothetically applying hydrodynamic separators to the entire Ballona Creek watershed, which represents an upper limit to the effectiveness of the trash capture devices being installed for the Trash TMDL. The average metal load reductions achieved with this hypothetical scenario are summarized in Table 5-7. Based on these results, it is expected that the Trash TMDL implementation will achieve significant reductions in metals loadings to Ballona Creek. The ongoing instream TMDL Monitoring should confirm these expectations over time. A special monitoring study could be conducted to assess the metals reductions that are attained by the implementation of specific trash capture devices.

**Table 5-7
Performance Estimate for Hydrodynamic Separators Applied to
Ballona Creek Watershed**

Pollutant	Average Load Reduced (lbs/year)	Estimated Range of Load Reduction (lbs/year)
Total Copper	910	210 – 1,915
Total Lead	419	49 – 1,084
Total Zinc	8,985	2,105 – 18,165

For quantification purposes in this current analysis, metals removal associated with Trash TMDL implementation measures were conservatively assumed to be 50 percent of the load reductions estimated by SBPAT in Table 5-7 minus the load reductions estimated for all other structural and non-structural BMPs shown in Tables 5-9, 5-10, and 5-11 (below). The use of an adjusted SBPAT-derived effectiveness for wet weather hydrodynamic separator treatment is based upon a series of pilot studies carried out by the City of Los Angeles WPD and an understanding of the unit processes involved in the removal of particulate bound metals in hydrodynamic separators, catch basin screens, and catch basin inserts. This assumption does not account for the load reductions associated with the capture and subsequent removal of trash that may otherwise leach heavy metals if this trash were allowed to enter the

receiving water. For this reason, a special study is recommended to quantify the actual total metals load reductions associated with trash removal.

The estimate of the load reduction for this current analysis was therefore calculated as follows:

$$LR_{\text{Trash}} = (50\%) \cdot LR_{\text{HDS}} - LR_{\text{RBMPs}} - LR_{\text{DBMPs}} - LR_{\text{IBMPs}}$$

Where:

LR_{Trash} is the load removed due to the trash TMDL (lbs/yr)

LR_{HDS} is load removed by hydrodynamic separators implemented on the entire Ballona Creek watershed (lbs/yr) as shown in Table 5-7

LR_{RBMPs} is the load removed due to regional BMPs (lbs/yr)

LR_{DBMPs} is the load removed due to distributed BMPs (lbs/yr)

LR_{IBMPs} is the load removed due to institutional BMPs (lbs/yr)

A Los Angeles City WPD technical study demonstrated that catch basin covers were 58 to 79 percent effective at deflecting trash greater than the minimum treatment diameter of one inch during storm events (Los Angeles WPD, 2006). A similar study showed that catch basin inserts (steel screen sheets with 5 millimeters (0.197 inch) openings) captured 80 to 90 percent of mobile trash. Hydrodynamic separators such as a Continuous Deflection Separation or CDS units are considered full trash capture devices by the Los Angeles Regional Board and therefore, can be considered to treat 100 percent of trash in the unit's tributary area (Los Angeles WPD, 2006).

All of these structural BMPs employ the same unit processes to remove trash from wet weather flows. Hydrodynamic separators, such as CDS units, separate floatables and other particulate matter from large runoff volumes through physical processes (i.e., primarily screening, but also skimming and centrifugal settling). Catch basin covers and catch basin inserts effectively treat smaller volumes of stormwater through the passive screening of large particulates. The final composition of structural trash BMPs implemented to meet the 2015 final compliance target of 100 percent trash removal is an unknown. However, based on current rates of implementation, approximately twice as many catch basin covers than catch basin inserts will be implemented along with a number of hydrodynamic separators. A theoretical area-weighted percent effectiveness given the effectiveness of these structural BMPs demonstrated in WPD pilot studies is expected to be significantly greater than the conservative 50 percent treatment assumption with a minimum effectiveness range of 58 to 79 percent for catch basin covers, greater performance from catch basin screens (80 to 90 percent effectiveness), and full capture hydrodynamic separators.

5.2.2 Expected Combined Benefits from Structural and Institutional BMPs

SBPAT was used to estimate the baseline (2005) average runoff volume and metals load from all land uses (except open water areas) in the watershed. Results of the baseline analysis are provided in Table 5-8.

**Table 5-8
Predicted Baseline (2005) Runoff Volume and Average Annual
Metals Load for the Ballona Creek Watershed**

Ballona Creek Watershed Area	81,038 acres
Total Runoff Volume	47,124 ac-ft/yr
Total Copper Load	2,681 lb/yr
Total Lead Load	1,187 lb/yr
Total Selenium	See Section 5.2.2.1
Total Zinc Load	20,669 lb/yr

Based on the methodology and assumptions described, load reductions associated with the implementation of the regional and distributed structural BMPs and institutional BMP were estimated for the entire watershed. Predicted average annual metals 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 Tables 5-9, 5-10, and 5-11 (for copper, lead, and zinc, respectively). As stated previously in Section 5.2.1, to ensure that load reductions were not overestimated, there was no overlap between areas credited with load reductions due to distributed, regional or institutional BMPs.

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 5th and 95th percentile annual loads computed were used to define the range.

Similarly, load reductions attributed to institutional BMPs were calculated based on the range of load reductions achieved per year for the 57 years of discrete build-up/wash-off storm events modeled. The 5th and 95th percentile annual loads computed were used to define the range.

**Table 5-9
Predicted Copper Load Reductions (2021)**

BMP Type	Acres Treated	% of Watershed	Load Reduction (lb/yr) ^{1,2}		
			Average	Est. Range	
Regional BMPs					
Centinela Park	736	0.90%	11	3 – 20	
La Cienega Park	374	0.46%	7	2 – 13	
Harvard Recreation Center	235	0.29%	1	0 – 1	
Rancho Cienega Sports Center	162	0.20%	2	1 – 4	
MacArthur Park	135	0.17%	2	1 – 5	
Los Angeles Unified School District Site	99	0.12%	4	1 – 7	
Lemon Grove Recreation Center	63	0.08%	1	0 – 1	
Van Ness Recreation Center	36	0.04%	2	1 – 3	
Total Regional BMP Load Reduction	1,840	2.3%	30	9 – 54	
Distributed BMPs					
Commercial	17%	1,861	2.3%	94	26 – 183
Green Streets	15.4%	1,691	2.08%	80	22 – 156
SUSMP Redevelopment	1.6%	170	0.21%	14	4 – 27
Industrial	6%	214	0.26%	10	3 – 21
Green Streets	1.9%	74	0.09%	4	1 – 8
SUSMP Redevelopment	3.7%	140	0.17%	6	2 – 13
Transportation	27%	453	0.6%	43	12 – 83
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%	35	10 – 67
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%	8	2 – 16
Education	4%	108	0.1%	3	1 – 6
LAUSD and UCLA	3.6%	92	0.11%	3	1 – 5
Private Schools Redevelopment	0.6%	16	0.02%	0	0 – 1
SFR	19%	5,683	7.0%	67	21 – 126
Green Streets	10.1%	3,077	3.78%	34	10 – 66
Downspout Disconnect	8.6%	2,607	3.20%	33	11 – 60
MFR	16%	2,919	3.6%	35	11 – 61
Green Streets	11.4%	2,039	2.5%	22	7 – 39
SUSMP Redevelopment	4.9%	880	1.1%	13	4 – 22
Total Distributed BMP Load Reduction	11,238	13.8%	252	74 - 480	
Institutional BMPs					
Enhanced Street Sweeping	15,278	19%	8	4 - 11	
Vehicle Product Replacement (Brake Pads)	52,682	64%	27	12 - 38	
Total Institutional BMP Load Reduction	N/A	N/A	35	16 - 49	
Trash TMDL BMP Implementation	81,038	100%	137	9 - 382	
TOTAL	N/A	N/A	454	108 – 965	

Notes:

¹Refer to Appendix E for a summary of the methodology for estimating load reductions, and Appendix M for a complete copy of the SBPAT User Manual.

²There is no overlap between areas credited with load reductions due to institutional, regional and distributed BMPs. See Section 5.2.1.3 for the calculation associated with Trash TMDL BMP Implementation.

**Table 5-10
Predicted Lead Load Reductions (2021)**

BMP Type	Acres Treated	% of Watershed	Load Reduction (lb/yr) ^{1,2}		
			Average	Est. Range	
Regional BMPs					
Centinela Park	736	0.90%	4	0.6 - 11	
La Cienega Park	374	0.46%	2	0.2 - 6	
Harvard Recreation Center	235	0.29%	0.5	0.1 - 1	
Rancho Cienega Sports Center	162	0.20%	0.8	0.1 - 2	
MacArthur Park	135	0.17%	0.7	0 - 2	
Los Angeles Unified School District Site	99	0.12%	1	0.1 - 3	
Lemon Grove Recreation Center	63	0.08%	0.2	0 - 0.5	
Van Ness Recreation Center	36	0.04%	0.2	0 - 0.5	
Total Regional BMP Load Reduction	1,840	2.3%	9	1 - 26	
Distributed BMPs					
Commercial	17%	1,861	2.3%	36	5 - 100
Green Streets	15.4%	1,691	2.08%	31	4 - 86
SUSMP Redevelopment	1.6%	170	0.21%	5	1 - 14
Industrial	6%	214	0.26%	5	1 - 13
Green Streets	1.9%	74	0.09%	2	0 - 5
SUSMP Redevelopment	3.7%	140	0.17%	3	1 - 8
Transportation	27%	453	0.6%	6	1 - 14
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%	5	1 - 12
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%	1	0 - 2
Education	4%	108	0.1%	1	0 - 1
LAUSD and UCLA	3.6%	92	0.11%	1	0 - 1
Private Schools Redevelopment	0.6%	16	0.02%	0	0 - 0
SFR	19%	5,683	7.0%	41	9 - 89
Green Streets	10.1%	3,077	3.78%	21	4 - 48
Downspout Disconnect	8.6%	2,607	3.20%	20	5 - 41
MFR	16%	2,919	3.6%	13	3 - 31
Green Streets	11.4%	2,039	2.5%	8	2 - 20
SUSMP Redevelopment	4.9%	880	1.1%	5	1 - 11
Total Distributed BMP Load Reduction	11,238	13.8%	102	19 - 248	
Institutional BMPs					
Enhanced Street Sweeping	15,278	19%	11	6 - 16	
Vehicle Product Replacement (Brake Pads)	N/A	N/A	N/A	N/A	
Total Institutional BMP Load Reduction	N/A	N/A	11	6 - 16	
Trash TMDL BMP Implementation	81,038	100%	95	3 - 263	
TOTALS	N/A	N/A	217	29 - 553	

¹Refer to Appendix E for a summary of the methodology for estimating load reductions, and Appendix M for a complete copy of the SBPAT User Manual.

²There is no overlap between areas credited with load reductions due to institutional, regional and distributed BMPs. See Section 5.2.1.3 for the calculation associated with Trash TMDL BMP Implementation.

**Table 5-11
Predicted Zinc Load Reductions (2021)**

BMP Type	Acres Treated	% of Watershed	Load Reduction (lb/yr) ^{1,2}		
			Average	Est. Range	
Regional BMPs					
Centinela Park	736	0.90%	71	23 – 128	
La Cienega Park	374	0.46%	63	19 – 118	
Harvard Recreation Center	235	0.29%	6	2 – 11	
Rancho Cienega Sports Center	162	0.20%	18	5 – 33	
MacArthur Park	135	0.17%	29	8 – 55	
Los Angeles Unified School District Site	99	0.12%	58	18 – 107	
Lemon Grove Recreation Center	63	0.08%	7	2 – 13	
Van Ness Recreation Center	36	0.04%	18	6 – 32	
Total Regional BMP Load Reduction	1,840	2.3%	270	83 – 497	
Distributed BMPs					
Commercial	17%	1,861	2.3%	777	230 – 1439
Green Streets	15.4%	1,691	2.08%	664	196 – 1227
SUSMP Redevelopment	1.6%	170	0.21%	113	34 – 212
Industrial	6%	214	0.26%	178	51 – 347
Green Streets	1.9%	74	0.09%	65	19 – 127
SUSMP Redevelopment	3.7%	140	0.17%	113	32 – 220
Transportation	27%	453	0.6%	252	73 – 481
Class A Catchments (high priority/high opportunity)	22.8%	377	0.46%	205	60 – 388
Class B Catchments (high priority/low opportunity)	4.6%	76	0.09%	47	13 – 93
Education	4%	108	0.1%	20	7 – 37
LAUSD and UCLA	3.6%	92	0.11%	17	6 – 33
Private Schools Redevelopment	0.6%	16	0.02%	3	1 – 4
SFR	19%	5,683	7.0%	263	75 – 505
Green Streets	10.1%	3,077	3.78%	137	37 – 273
Downspout Disconnect	8.6%	2,607	3.20%	126	38 – 232
MFR	16%	2,919	3.6%	434	128 – 828
Green Streets	11.4%	2,039	2.5%	304	87 – 591
SUSMP Redevelopment	4.9%	880	1.1%	130	41 – 237
Total Distributed BMP Load Reduction	11,238	13.8%	1,924	564 – 3,637	
Institutional BMPs					
Enhanced Street Sweeping	15,278	19%	31	16 - 43	
Vehicle Product Replacement (Brake Pads)	N/A	N/A	N/A	N/A	
Targeted Zinc Reduction Program	TBD	--	777 ³	--	
Total Institutional BMP Load Reduction	N/A	N/A	808	--	
Trash TMDL BMP Implementation	81,038	100%	2,289	401 – 4,935	
Special Study To Reassess WLA	N/A	N/A	738	--	
TOTALS	81,038	N/A	6,029	1,064 – 9,112	

¹Refer to Appendix E for a summary of the methodology for estimating load reductions, and Appendix M for a complete copy of the SBPAT User Manual.

²There is no overlap between areas credited with load reductions due to institutional, regional and distributed BMPs. See Section 5.2.1.3 for the calculation associated with Trash TMDL BMP Implementation.

³This is the estimated load reduction needed from the Targeted Zinc Reduction Program to achieve the zinc waste load allocation.

5.2.2.1 Compliance with Wet Weather TMDL Limits

The waste load allocations for metals were computed using the average annual runoff volume predicted from the SBPAT baseline model run for the entire Ballona Creek Watershed (47,124 ac-ft/yr) and the concentration-based numeric targets listed in the Ballona Creek Metals TMDL (total copper = 18 µg/L, total lead = 59 µg/L, and total zinc = 119 µg/L; which were calculated using the CTR criteria using a median hardness concentration of 77 mg/L as CaCO₃). All storms producing runoff in the baseline conditions were assumed to create wet weather flow conditions as defined in the TMDL (i.e., average daily flow of 40 cfs); thus the average annual runoff volume was estimated to approximately equal the TMDL-applicable volume.

From Table 6-9 of the TMDL Staff Report, the areal extent of the watershed under the MS4 permit (94.7 percent) and the Caltrans Stormwater Permit (1.3 percent) were used to estimate the applicable proportion of total waste load allocation (96 percent). Based on the above assumptions, the following calculation was used to compute the metals waste load allocations:

$$L_M = V_B \cdot C_M \cdot (0.96) \cdot (43560 \text{ ft}^2/\text{ac}) \cdot \left(28.32 \text{ L}/\text{ft}^3 \cdot (2.2 \times 10^{-9} \text{ lb}/\mu\text{g}) \right)$$

Where: L_M is the pollutant load for metal M (lbs/yr)
 V_B is baseline average annual runoff volume (ac-ft/yr)
 C_M is the concentration-based target listed in the TMDL (µg/L)

The estimated average, low, and high annual metals load reductions at 2021 and comparison with the waste load allocations are summarized in Table 5-12:

**Table 5-12
Comparison of Estimated Metals Load Reductions with WLA in 2021**

	Average (lb/yr)	Est. Range
Copper: Total Copper Waste Load Allocation (MS4 + Caltrans)	2,214	--
<i>Baseline Total Copper Load</i>	2,681	--
<i>Implementation Plan Copper Load Reduction at 2021</i>	-454	-108 – -965
Estimated Copper Runoff Load at 2021	2,227	1,716 – 2,573
Lead: Total Lead Waste Load Allocation (MS4 + Caltrans)	7,561	–
<i>Baseline Total Lead Load</i>	1,187	–
<i>Implementation Plan Lead Load Reduction at 2021</i>	-217	-29 – -553
Estimated Runoff Lead Load at 2021	970	1,674 – 2,198
Zinc: Total Zinc Waste Load Allocation (MS4 + Caltrans)	14,640	–
<i>Baseline Total Zinc Load</i>	20,669	–
<i>Implementation Plan Zinc Load Reduction at 2021</i>	-6,029	-1,064 – -9,112
Estimated Runoff Zinc Load at 2021	14,640	11,577 – 19,605

Although the estimated average annual load for copper is slightly greater than the waste load allocation, the difference (13 lbs/yr or 0.6 percent of the WLA) is well within the variability of the compliance assessment methodology. The estimated average annual copper, lead, and zinc loads within Ballona Creek are predicted to be at or below the WLA by 2021 due to the implementation of the proposed structural and institutional BMPs within the watershed.

This compliance analysis accounted for a great level of uncertainty in order to ensure that load reductions were not overestimated. At each step in the process, as previously described in this section, factors of safety were applied to the load reduction estimates in order to be conservative in the overall load reduction estimation at final compliance.

In addition to factors of safety, the method of quantification inherently provided a level of safety in that BMP effluent concentrations were used as opposed to percent removal efficiencies for each structural BMP. In addition, there was no overlap in areas treated with the various BMPs (e.g. for the entire tributary area of a regional BMP, no credit was taken for any institutional BMP or distributed BMP regardless of the likelihood that an institutional or distributed BMP may affect that tributary area). The range of post BMP loads presented also accounts for the variability of these estimates. It is therefore stated that every effort was taken to ensure that no overestimation was made in evaluating final compliance with the TMDL.

Selenium

An analysis of the current water quality monitoring data within Ballona Creek, summarized in Appendix L shows that the Basin Plan's water quality objective for selenium is being met and, therefore, no impairment exists. When the TMDL Staff Report was written, analytical methods for selenium detection were the restricting factor in determining impairment; the detection limit was 5 µg/L, thus the numeric target (5 µg/L) was considered 'less than' the detection limit. Following the development of revised analytical methods in 2002, the detection limit of selenium was decreased to 1 µg/L. Selenium wet-weather concentrations at the mass emissions monitoring station (Centinela) collected from 1998 - 2009 shows 3 exceedances in 63 samples, which meets the requirements for delisting on the basis of the SWRCB's delisting policy for toxicants.

5.2.2.2 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 BMP type. The actual BMP design capacities, footprints and treatable runoff will vary from site to site. Refer to Section 5.2.2.3 for the sensitivity analysis of the design parameters.

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.

Uncertainty #3: Water Quality Modeling and Monitoring Data for Metals

- Water quality modeling of metals loading and structural BMP treatment relying heavily on limited datasets was carried out to aid the use of integrated water resources approaches to meet multiple TMDLs. Results of Nexus Tool modeling, showing baseline and post-BMP implementation loading of metals, 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 metals 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 metals loading and treatment unit processes grows.

Uncertainty #4: Institutional BMP Performance Quantification

- Available data on the performance of institutional BMPs is scarce and highly uncertain. Two approaches for quantifying the downstream benefits of institutional BMPs 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 metals load reductions from sources controls was based on a combination of data-supported assumptions and best professional judgment.

- The effectiveness of enhanced street sweeping was based on an estimate of metals concentrations in street sediment and the expected performance of high-efficiency sweepers. Sediment metals 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.

5.2.2.3 Sensitivity Analysis of the Design Parameters

When simulating pollutant removal, SBPAT calculates the standard deviation of the resulting pollutant loading based on the variation of flow and event-mean concentration (EMC) data. However, variation in the design parameters used in the model can also have a significant impact on pollutant removal. A sensitivity analysis was conducted for the SBPAT model to determine how variation in BMP design parameters affects pollutant removal. The distributed BMPs swales, cisterns, bioretention, and permeable pavement were evaluated in this analysis.

The methodology of the sensitivity analysis involves selecting a representative catchment and running the SBPAT model with varying design storm parameters for the distributed BMPs. Sizing parameter for each of the BMPs are different based on the sizing equations, including design storm (as inches of rainfall for the storm), rainfall intensity (as inches per hour of rainfall), and the ratio of the size of the BMP to tributary area. Table 5-13 lists the BMPs and design parameters used for the sensitivity analysis.

A catchment with typical characteristics was selected as the sample catchment to conduct the sensitivity analysis. The selected catchment was one of the distributed catchments discussed in Section 5.1.2.2 and listed in Table 5-2, as catchment number 12, and shown in Appendix G, Figure G-12. This catchment proposes a suite of

distributed BMPs, and since each of the BMPs has different design parameters, in order to simultaneously perform the sensitivity analysis on each BMP throughout the catchment, each of the BMP’s design storm parameters was varied by a percent of the baseline value (0.75 in and 0.2 in/hr) used in the analysis. A summary of the parameters used for the sensitivity analysis and values are shown in table 5-13.

**Table 5-13
Sensitivity Analysis Design Parameters**

BMP	Parameters	Units	Percent Variance from Average Design Storm Parameters								
			-60%	-40%	-20%	0%	20%	40%	60%	80%	100%
Swales	Design Storm intensity	in/hr	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40
Cisterns	Design Storm	in	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
Bioretention	Design Storm	in	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
Permeable Pavement	Tributary Area ratio	bmp area/(trib + bmp area)	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

A summary of the catchment’s landuse is shown in Table 5-14 as well as the average landuse for the Ballona Creek catchments. The table shows the catchment is primarily made up of residential land uses, as is typical in the Ballona Creek watershed. The catchment has a higher percent of agriculture and education landuses, and a lower percent of commercial and industrial landuse. For the purpose of the sensitivity analysis, with the range of BMPs included in the preliminary site layout and the typical high residential land use, this catchment is expected to provide a representative example of the sensitivity to the design parameters in the model.

**Table 5-14
Sample Catchment and Average Ballona Creek Landuse Summaries**

Landuse Classification	Catchment Area (acres)	% of Total Area within Catchment	Average % for Ballona Creek Catchments
Agriculture	3.4	11.2%	0.04%
Commercial	0.0	0.0%	14.4%
Education	8.1	26.7%	3.0%
Multi-Family Residential	1.7	5.6%	22.8%
Industrial	0.0	0.0%	4.5%
Transportation	0.0	0.0%	2.4%
Single Family Residential	12.6	41.6%	36.8%
Vacant/Open Space	4.5	14.9%	16.0%
Total	30.3	100.0%	100.0%

Figure 5-3 shows the results of the sensitivity analysis for total zinc, and Figure 5-4 shows the results of the sensitivity analysis for dissolved zinc. Zinc was selected because it is the primary metal of concern in the watershed. The upper and lower boundaries based on standard deviations of the model results are also shown. The variation is due to the storm event precipitation and variations in the EMC data (see Appendix M for additional discussion on the SBPAT model). The figures show that the variation of pollutant removal due to changes in design storm parameters are within range of the variation due to storm events and EMCs. Even if the design storm parameters are reduced by 60% or doubled, they are still within bounds of the storm and EMC variation.

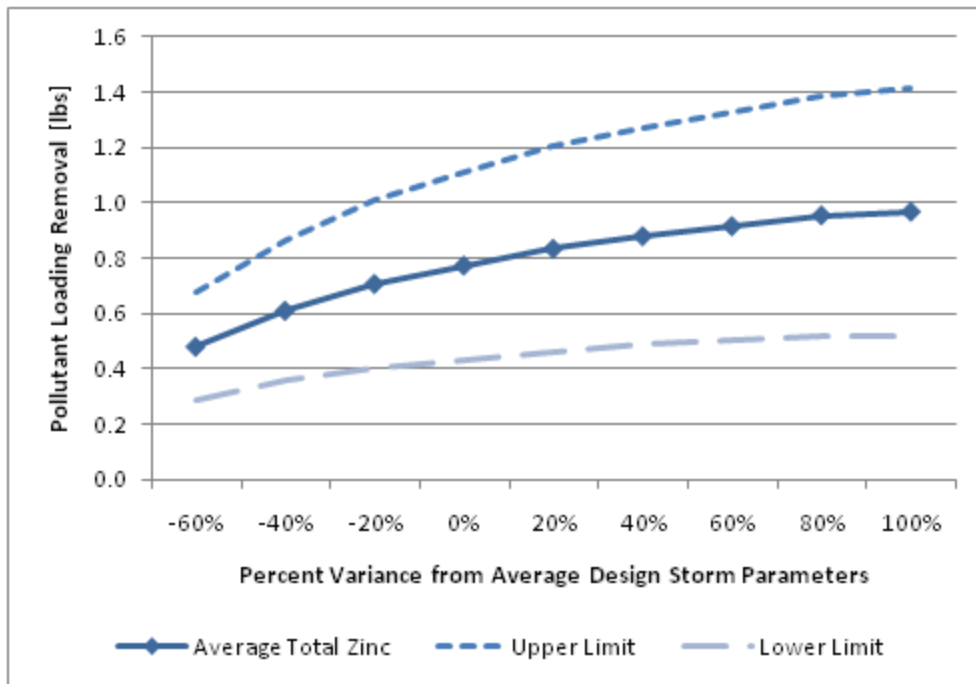


Figure 5-3
Total Zinc Sensitivity Analysis

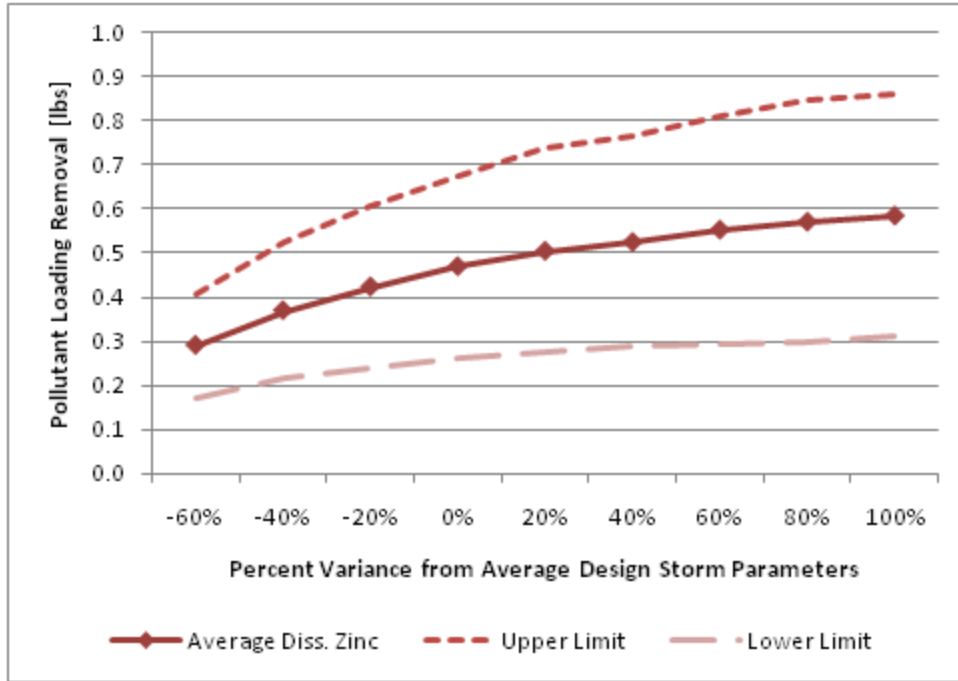


Figure 5-4
Dissolved Zinc Sensitivity Analysis

5.2.3 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 metals in dry weather flows through bio-retention and/or infiltration processes. Management of dry weather in Ballona Creek will involve a few key facilities and institutional BMP 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 the new dry weather runoff diversion from Sepulveda Channel (see Section 5.1.1). Interim compliance of the dry weather milestones is discussed in Section 5.4.2.

5.3 Monitoring and Special Studies

5.3.1 Monitoring

As discussed in Section 1, the Ballona Creek Metals TMDLs require ongoing baseline and performance monitoring, which is described in the Coordinated Monitoring Plan. These data will provide an indication of the current and future patterns of copper, lead, and zinc loading regulated under the TMDL. Upstream monitoring for these constituents can be used to identify “hot spots” that show consistent patterns of high metal concentrations that would represent candidates for additional structural controls if necessary.

5.3.2 Special Studies

Completion of the Implementation Plan has identified several data gaps and information needs. The following studies are recommended for implementation:

5.3.2.1 Source Characterization Studies

Source characterization studies should be implemented in the watershed to identify additional contributing factors to copper and zinc 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.

5.3.2.2 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.

5.3.2.3 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.

5.3.2.4 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.

Waste Load Allocation Reassessment Using New Monitoring Data

The TMDL numeric targets and waste load allocations for copper, lead, and zinc are calculated as a function of hardness using the equations in the California Toxics Rule. The calculated waste load allocations would increase with an increase in hardness or decrease with lower hardness.

The waste load allocations for the Ballona Creek Watershed were established based on dissolved metals and hardness data collected from Ballona Creek by the LACDPW stormwater program at Sawtelle Boulevard. A median of 77 mg/L hardness was calculated based upon 55 composite samples collected between 1996 and 2002.

A preliminary examination of the new monitoring data collected since 2002 shows that the median hardness concentration for the period of record from 1996 to 2009 is approximately 82 mg CaCO₃/L. The recalculated zinc numeric target, using a hardness of 82 mg/L, is 125 µg/L, which would allow for a waste load of 15,378 pounds of zinc per year using the same baseline runoff volume assumption. This change represents an increase of 738 pounds of zinc per year above the existing WLA. Calculations using the revised median hardness value do not significantly change the numeric target and waste load allocations for lead and copper.

5.4 Implementation Plan Schedule and Milestones

Sections 5.4.1 and 5.4.2 summarize the wet and dry weather preliminary schedules and milestones for institutional BMPs, structural BMPs, and LFTF projects for achieving compliance with relevant TMDL limits in the Ballona Creek Watershed. For each BMP, Table 5-15 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.

5.4.1 Interim Compliance for Wet Weather

In Section 5.2.2, metals load reductions from each of the elements of the Implementation Plan scheduled for implementation prior to 2021 were summed and removed from the baseline loading to demonstrate compliance with the TMDL for total copper, total lead, and total zinc. Total zinc proved to be the driving constituent, requiring the greatest implementation of BMPs within the City to meet the TMDL numeric limits. As such, total zinc is used to demonstrate meeting the interim compliance milestones. The compliance milestones for wet weather, as discussed in Section 1 include the following:

- January 11, 2012: 25 percent of the total drainage area served by the MS4 system is effectively meeting the wet-weather waste load allocations
- January 11, 2016: 50 percent of the total drainage area served by the MS4 system is effectively meeting the wet-weather waste load allocations
- January 11, 2021: 100 percent of the total drainage area served by the MS4 system is effectively meeting wet-weather waste load allocations

Assuming that load reduction is proportional to MS4 drainage area compliance, compliance with interim milestones can be computed without extensive upstream geospatial analysis. For instance, to achieve the first milestone of 25 percent of MS4 drainage area in compliance, 25 percent of the necessary load reduction must be demonstrated. Therefore, the recommended BMP projects in the Metals TMDL Implementation Plan provide sufficient treatment of urban runoff to achieve interim milestones based on the fraction of necessary load reduction achieved, as presented below. Since the BMPs were selected to target high pollutant loading catchments, distributed throughout the watershed (see Section 4), retrofit of only a fraction of the watershed land area is required to achieve full compliance.

The rate of implementation for each of the BMP categories in this Implementation Plan was established and presented in Table 5-16. The implementation of distributed BMPs is based on a uniform annual rate of implementation, while regional BMPs require more substantial planning and the dates that each of the eight regional BMPs would be completed was estimated separately. To be conservative, it is assumed that the institutional BMPs will not be completed until 2021, whereas implementation of the Trash TMDL BMPs is already 40 percent completed and will be 100 percent complete by 2015.

Table 5-16 presents the estimated pollutant load reduction expected by each interim date. As shown, for each BMP type, the expected pollutant load reduction is established and summed to arrive at the total pollutant load reduction by each interim compliance date. This includes:

- January 2012: 41 percent of the total load reduction required by 2021 will be achieved, which exceeds the required 25 percent. This is based on a combination of 20 percent of the total required retrofit acres of distributed BMPs completed and at least 50 percent of the Trash TMDL BMPs will be implemented.
- January 2016: 58 percent of the total load reduction required by 2021 will be achieved, which exceeds the required 50 percent. This is based on a combination of 60 percent of the total required retrofit acres of distributed BMPs completed, two regional BMPs will be completed and 100 percent of the Trash TMDL BMPs will be implemented.
- January 2021: 100 percent of the total load reduction required by 2021.

Table 5-15 Ballona Creek Metals TMDL Implementation Schedule and Milestones

(Wet/Dry)	Objective	Type of BMP	Implementation Option Category/Site	Phase 1			Phase 2			Phase 3			Phase 4								
				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	Orange	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Wet and Dry	Reduce or Eliminate Source of Bacteria	Institutional/ Non-Structural	Education & Outreach	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	
			Program Development	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
	Treat Wet-Weather Discharges	Structural	Planning & Coordination	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
			Direct Source Control	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
			Priority Projects	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
In-Stream Solutions	Stream Restoration	Ongoing Projects (e.g. SUSMP)	Orange	Orange	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
		Additional Future Projects	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
Special Studies	Water Quality Monitoring	Water Quality Monitoring	TMDL Effectiveness Monitoring	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	



Table 5-16
Implementation Schedule to Meet the Interim Wet Weather Compliance
Dates for Zinc TMDL Numeric Limits¹

BMP Type	Ac/Yr Treated	Through Jan 2012		Through Jan 2016		Through Jan 2021	
		(2 Years)		(6 Years)		(10 Years)	
		Area Retrofit (ac)	Load Reduction (lbs/yr)	Area Retrofit (ac)	Load Reduction (lbs/yr)	Area Retrofit (ac)	Load Reduction (lbs/yr)
<i>Distributed BMPs</i>							
Commercial	186	372	155.4	1,116	466.2	1,861	777
Industrial	21	43	35.6	128	106.8	214	178
Transportation	-		50.4	377	151.2	453	252
Private Education	1.6	3	0.6	10	1.8	16	3
Public Education	-			92	17	92	17
MFR	292	584	86.8	1,752	260.4	2,919	434
SFR	568	1,137	52.6	3,408	157.8	5,683	263
<i>Distributed BMP Total</i>	<i>1,069</i>	<i>2,139</i>	<i>381.4</i>	<i>6,883</i>	<i>1161.2</i>	<i>11,238</i>	<i>1924</i>
Regional BMPs		0	0	631	25	1,840	270
Trash TMDL BMPs		40,519	2,066	81,038	2,289	81,038	2,289
Institutional BMPs (Enhanced Street Sweeping only)						67,960	31
Targeted Metals BMP							777
Reassessment of WLA Calculation							738
Wet Weather Total Load Reduction			2,448	NA	3,475	NA	6,029
TMDL Requirements							
Zinc: Total Required 2021 Load Reduction to Meet TMDL Numeric Limits ²							6,029
Target % from TMDL			25%	NA	50%	NA	100%
% of Total Required 2021 Load Reduction to Meet TMDL Numeric Limits³			41%	NA	58%	NA	100%

Notes:

¹Wet weather is defined in the Metals TMDL as flow that is greater than 40 cfs in Ballona Creek.

²The total 2021 load reduction required to meet the TMDL numeric limit for zinc is 6,029 lbs/yr, presented in Table 5-11 (Compliance Analysis 2021), which is the difference between baseline loading and TMDL numeric limit.

³The percent of total required 2021 load reduction to meet TMDL numeric limits is the load reduction achieved at each interim compliance date divided by the load reduction required by 2021. For 2012, this is 2,448 lbs/yr zinc / 6,029 lbs/yr zinc = 41% of the total required to be reduced.

5.4.2 Interim Compliance for Dry Weather

As is discussed in Section 1, the dry weather interim compliance milestones include:

- January 11, 2012: 50 percent of the total drainage area served by the MS4 system is effectively meeting the dry-weather waste load allocations
- January 11, 2014: 75 percent of the total drainage area served by the MS4 system is effectively meeting the dry-weather waste load allocations
- January 11, 2016: 100 percent of the total drainage area served by the MS4 system is effectively meeting dry-weather waste load allocations

For dry weather conditions, water quality samples collected at five locations for the City of Los Angeles Status and Trends monitoring program were used to estimate the portion of the MS4 drainage area in compliance for each sampling event (Figure 2-13). Assuming that each monitoring location represents water quality conditions within its upstream drainage area, the portion of the MS4 drainage area in compliance with numeric targets in the TMDL is evaluated for each sampling event. Table 5-17 summarizes the portion of the MS4 drainage area associated with each of the five Status and Trends sampling locations. Table 5-18 shows the area in compliance for each dry weather sample event from April 2007 to April 2008. These results show that dry weather compliance is achieved for greater than 75 percent of the MS4 drainage area in 10 of 11 months of TMDL ambient monitoring for total copper, in 9 of 11 months of sampling for total lead (dry weather compliance is achieved for greater than 50 percent of the MS4 drainage area in all 11 months for total lead), and in all 11 months of sampling for selenium and zinc. The dry-weather metal concentrations from TMDL compliance monitoring program also reflect the metal concentrations from Status and Trends program from 2001 to 2007 described in Appendix B, Table B-1 to B-96. Therefore, the metals TMDL Implementation Plan for dry weather will focus on achieving 100 percent compliance for the 2016 target. The combination of the LFTF construction by 2013 (prior to the 75 percent compliance milestone) and the significant structural and institutional BMPs necessary for wet weather compliance will provide more than the necessary load reductions needed during dry weather conditions to achieve this milestone.

Table 5-17
Percent of MS4 Drainage Area at Status and Trends
Monitoring Locations

CMP Station Name	Location	Percent of MS4 Drainage Area
National (NAT)	National Blvd. (at creek)	58%
Duquensne (DUQ)	Duquesne Ave. at Benedict Channel	9%
Overland (OVR)	Overland Ave. (at creek)	68%
Alberta (ALB)	Alberta Dr. at Centinela Creek	8%
Culver (CUL)	Culver Blvd. at Sepulveda Channel	18%

Note: NAT + DUQ = OVR; ALB and CUL are tributary locations

Table 5-18
Compliance with Dry Weather Numeric Targets in Metals TMDL

Sample Date	Percent of MS4 Drainage Area in Compliance with Dry Weather Numeric Target (%)			
	Total Copper	Total Lead	Total Selenium	Total Zinc
4/24/2007	76	76	94	94
5/29/2007	94	76	94	94
6/26/2007	85	86	94	94
7/24/2007	9	94	94	94
8/28/2007	85	58	94	85
10/30/2007	94	94	94	94
11/27/2007	94	94	94	94
12/11/2007	94	94	94	94
02/26/2008	94	94	94	94
03/25/2008	76	84	86	86
04/22/2008	94	66	86	94

5.4.3 Institutional BMPs

Institutional BMPs are anticipated to be implemented under each phase. 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 three years following approval of this plan, enabling many of these strategies to be fully in effect by the second interim compliance milestone of 2014.

Under the remaining phases, 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.

5.4.4 Structural BMPs

Regional Structural BMPs

A minimum of eight regional structural BMPs will be implemented by the end of Phase 4. By the end of Phase 2, 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. Three additional projects will be implemented by the end of Phase 3 (2016) and the remaining three projects will be implemented by the end of Phase 4 (2021).

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 2012), 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 one 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 two to five 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 interim TMDL milestones. The responsible jurisdictions understand that water quality standards have to be met throughout reaches and tributaries and that LFTFs will not improve the water quality in the upstream reaches above the diversion points.

However, the City of Los Angeles has conducted Status and Trends water quality monitoring in the creek and tributaries and the data indicates that the concentrations of most metals are well under TMDL numeric limits during dry weather. And up to 94% of total watershed area is already meeting the dry-weather limits, as shown in Table 5-18.

As described in Section 5.2.1, using a watershed-wide, multi-benefit approach, this Implementation Plan proposes a suite of BMPs that will be installed throughout the watersheds as a long term solution to improving the water quality.

Because the implementation of projects at a watershed-wide scale is expected to take several years, as shown in Table 5-15, these LFTFs are considered as an important component of the multi pollutant approach.

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 Integrated Water Resources Benefits

One of the goals of the Implementation Plan, as expressed by stakeholders, was to develop an integrated plan. Following is a summary of some of the integrated water resources benefits included in the Implementation Plan.

Reductions in Other Pollutants

The IWRA plan included in the Metals 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 bacteria by approximately 18 percent. The overall Implementation Plan is predicted to comply with the WLAs in the Ballona Creek Bacteria 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 percent 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 percent x 11,200 acres retrofit by 2021 x 230 gpd/ac).

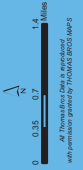
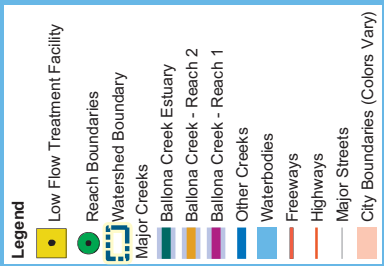
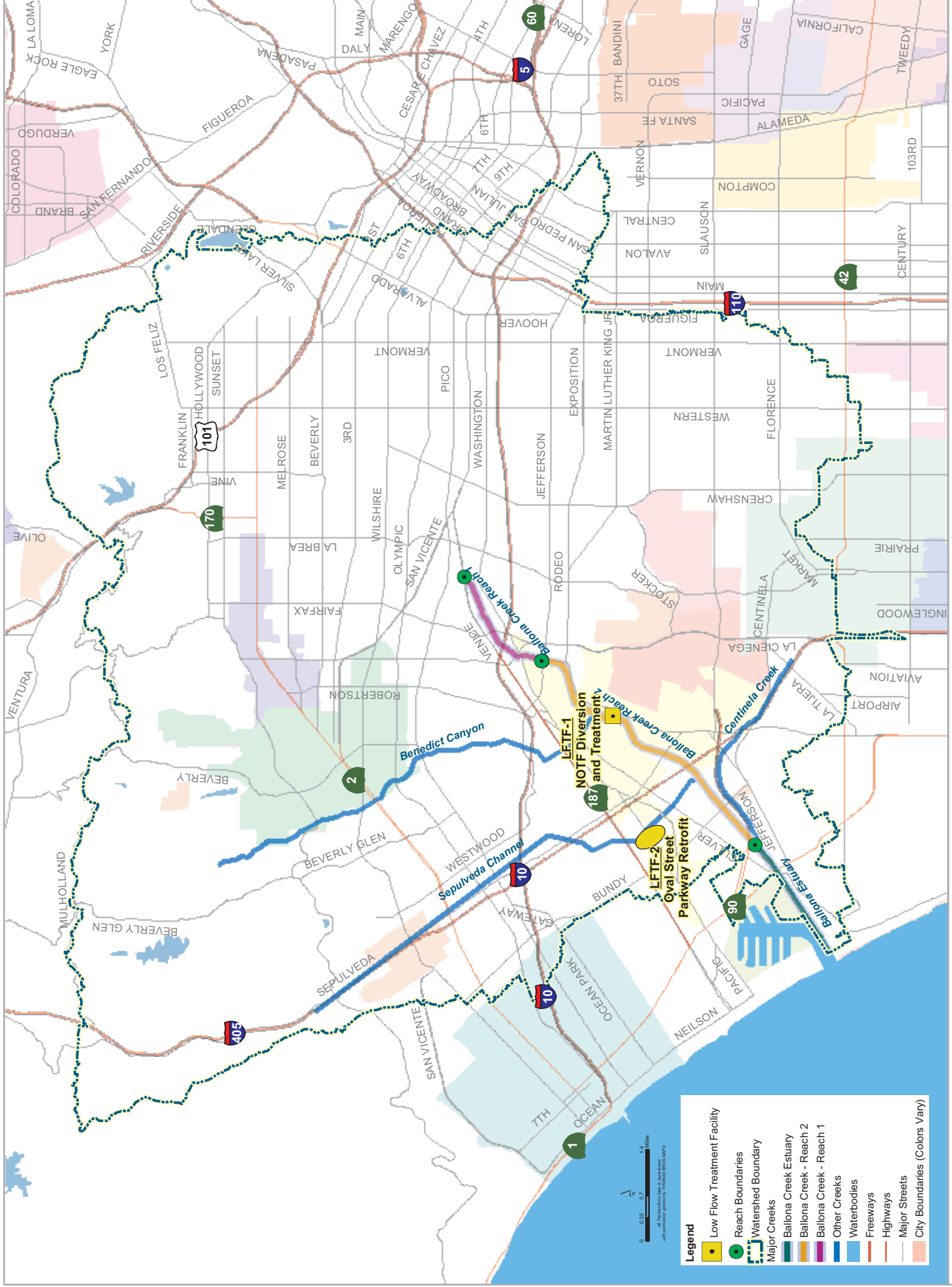


Figure 5-1 Ballona Creek Watershed - Low Flow Treatment Facility (LFTF)

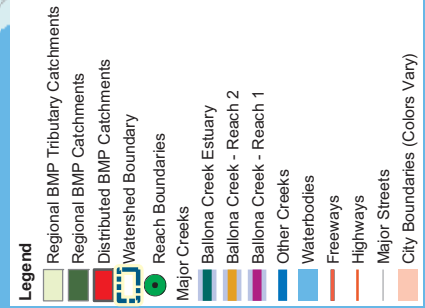
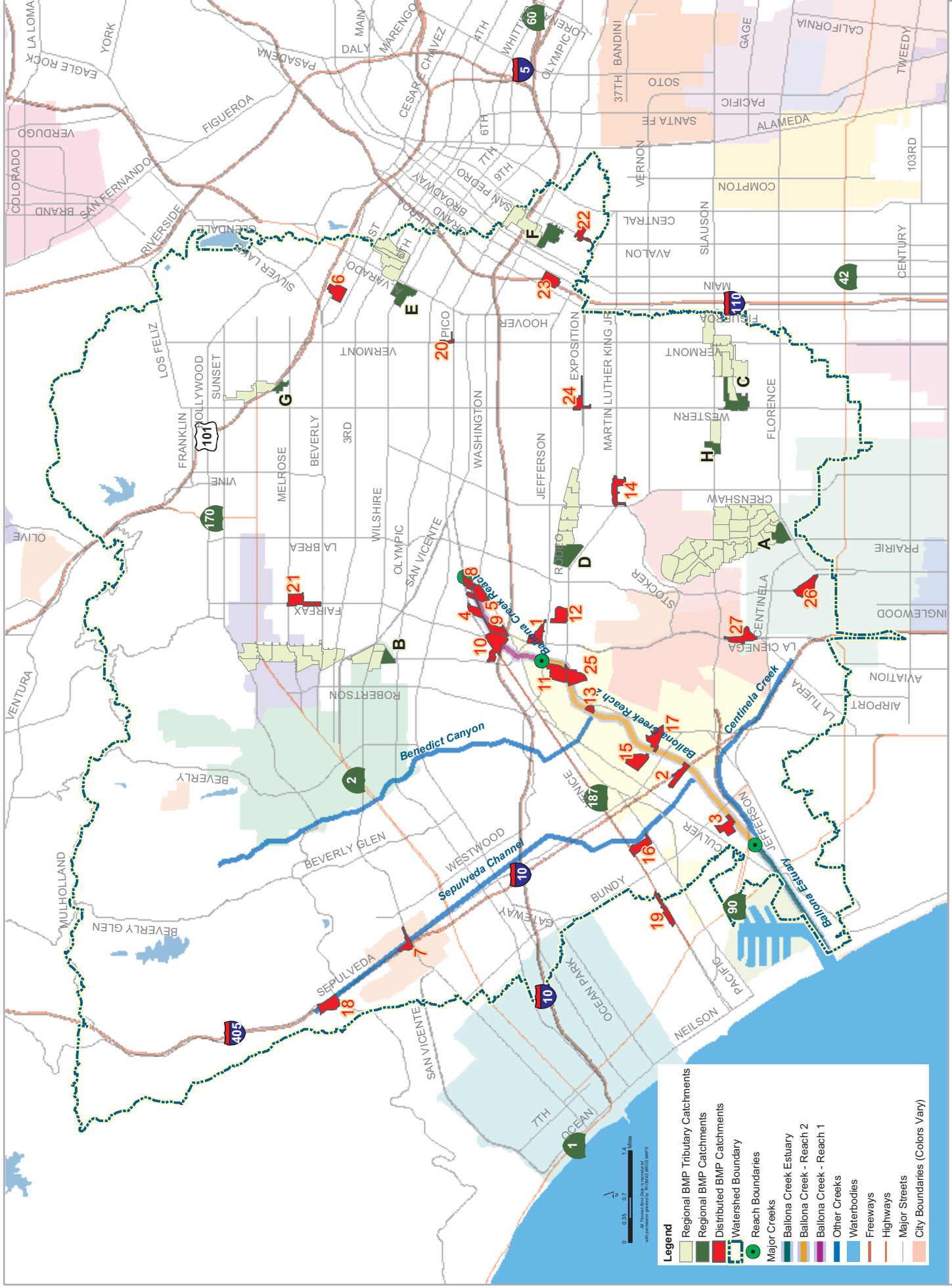


Figure 5-2 Ballona Creek Watershed - Priority Distributed and Regional BMP Sites

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.

This Metals TMDL Implementation Plan was developed in combination with the Ballona Creek Bacteria TMDL and Ballona Creek Estuary Toxics TMDL. The Bacteria TMDL Implementation Plan was due to the Regional Board first and was submitted in November 2009. This document also included a program cost and budget section. Since the planning process involved identification of BMPs for both bacteria and metals, the majority of the BMPs identified and cost estimated in the Bacteria TMDL Implementation Plan will treat both metals and bacteria. As such, to implement the Metals TMDL Implementation Plan, the Responsible Agencies will incur only a slight increase from the costs previously presented in the Bacteria TMDL Implementation Plan. This incremental cost is related to the implementation of two metals specific BMPs.

Given the iterative and adaptive nature of the implementation plan, and the many uncertainties associated with a lot 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 vendors 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 which are planned to address multiple pollutants, including bacteria and metals. 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. The implementation of these BMPs will treat both metals and bacteria, and these costs were included in the Bacteria TMDL Implementation Plan. As such, they are not additional costs specific to the Metals TMDL Implementation Plan.

Table 6-1
Summary of Cost Estimates for Selected Distributed BMPs
in Ballona Creek Watershed¹

Site # ²	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 These BMPs will treat both metals and bacteria, to meet the Metals TMDL and Bacteria TMDL numeric limits, and as such the costs of these BMPs have previously been presented in the Bacteria TMDL Implementation Plan and are not to be considered additional costs. ² The Site Number corresponds to the sites listed in Section 5, Figure 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 Watershed¹**

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 ²	\$870,000	\$38,500	63	\$10,000	\$600
Jim Gilliam Park ³	\$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 These BMPs will treat both metals and bacteria, to meet the Metals TMDL and Bacteria TMDL numeric limits, and as such the costs of these BMPs have previously been presented in the Bacteria TMDL Implementation Plan and are not to be considered additional costs. ² 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. ³ 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

Planning level costs for the two low flow treatment facilities are presented in this section. While these LFTFs are designed to reduce bacteria, they will also provide water quality benefits by reducing total recoverable metals loads.

LFTF-1/North Outfall Treatment Facility

For LFTF-1, the 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 (these costs were included in the Bacteria TMDL Implementation Plan and are not additional costs specific to the Metals TMDL Implementation Plan):

- 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, filtration, 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.

These costs were included in the Bacteria TMDL Implementation Plan and are not additional costs specific to the Metals TMDL Implementation Plan.

6.4 Institutional BMPs

The cost estimate for three of the institutional BMPs listed below (enhanced street sweeping, education program, and downspout disconnection) are all also included in the Bacteria TMDL Implementation Plan. As such, these are not additional costs beyond what is presented in the Bacteria TMDL Implementation Plan. The two institutional BMPs that are specifically included to treat metals are the targeted zinc

reduction program and the product replacement program. The cost for these two BMPs is an additional cost that is beyond the cost presented in the Bacteria TMDL Implementation Plan.

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.

These costs were included in the Bacteria TMDL Implementation Plan and are not additional costs specific to the Metals TMDL Implementation Plan.

Education and Outreach

Cost estimates for an expanded education and outreach program may include the production and distribution communication materials (signs, ads, brochures). The cost estimate for the Education and Outreach program is \$2,000,000, and this is expected to cover both metals and bacteria related education. The operation and maintenance cost is assumed to be 10 percent of this, or \$200,000. Since these costs were also included in the Bacteria TMDL Implementation Plan they are not additional costs specific to the Metals TMDL Implementation Plan.

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 retrofit, 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.

Since this cost was also included in the Bacteria TMDL Implementation Plan it is not an additional costs specific to the Metals TMDL Implementation Plan.

Targeted Zinc Reduction Program

The Targeted Zinc Reduction Program is an institutional BMP that involves generally identifying potential significant sources of zinc loading in the watershed, conducting targeted monitoring to specifically identify significant sources of zinc into the storm drain system, and conducting outreach to encourage stakeholders and property owners to reduce zinc loads and concentrations in runoff from their property and potentially modify existing ordinances if enforcement is necessary. The cost associated with this BMP has been estimated to be \$1 million per year. This BMP is specific to the Metals TMDL Implementation Plan and is an incremental cost that is to be considered in addition to the costs presented in the Bacteria TMDL Implementation Plan.

Product Replacement Program

The implementation plan includes costs associate with the efforts to reduce metals in vehicle brake pads and wheel weights through pending legislation (SB 346 and SB 757, respectively). The cost associated with this initiative for the responsible agencies is estimated to be \$100,000 per year. This BMP is specific to the Metals TMDL Implementation Plan and is an incremental cost that is to be considered in addition to the costs presented in the Bacteria TMDL Implementation Plan.

6.5 Implementation Plan Costs

As stated, this TMDL Metals Implementation Plan was developed in combination with the Ballona Creek Bacteria TMDL Implementation Plan. The costs presented in Table 6-3 represent the cost already included in the Bacteria TMDL Implementation Plan for the distributed BMPs, regional BMPs, LFTFs, and institutional BMPs. 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.

The increase in cost for implementation of the Metals TMDL Implementation Plan is the O&M cost of \$1.6 million per year, as presented in Table 6-4. This represents the cost for the two metals specific BMPs, which are the “Target Zinc Reduction Program” and the “Copper Brake Pad Product Replacement Program.”

The total capital cost is estimated to be \$1.3 billion, with \$36 million in O&M costs.

**Table 6-3
Total Costs from the Ballona Creek Bacteria TMDL Implementation Plan¹**

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 Facility-1 (NOTF)			\$10,600,000		\$1,060,000
Low Flow Treatment Facility-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 and Metals TMDL load reduction target and 8 Regional BMP facilities. See 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.

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).

**Table 6-4
Total Costs for Bacteria and Metals TMDL Implementation Plans¹**

Ballona Creek Watershed BMPs	Treated Acres ²	Capital Cost per Treated Acre	Total Capital Cost	O&M Costs per acre	Annual O&M
Additional Institutional BMPs for Metals Compliance					
Target Zinc Reduction Program					\$1,000,000
Copper Break Pad Production Replacement Program					\$100,000
Subtotal for Additional Institutional BMPs for Metals Compliance					\$1,100,000
Additional Program Management, Engineering, Administration, and Monitoring (20% of capital cost) ²					\$200,000
Additional Program Contingency (30%)					\$300,000
Total Increase for Metals TMDL Compliance					\$1,600,000
Total Cost from Bacteria TMDL Implementation Plan			\$1,260,000,000		\$34,000,000
Total Cost for Implementation of Metals and Bacteria Implementation Plans			\$1,260,000,000		\$36,000,000

¹ Included are the costs estimated to implement both the Bacteria and Metals TMDL Implementation Plans.

²The 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. 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).

6.6 Funding Availability

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

Section 7

References

- Bannerman, R.; D. Owens; R. Dodds and N. Hornewer. 1993. "Sources of Pollutants in Wisconsin Stormwater." *Water Science and Technology*. 28(3-5): 241-259.
- Brinkman, R. and Graham A. Tobin. Urban Sediment Removal: The Science, Policy, and Management of Street Sweeping. Boston: Kluwer Academic Presses. 2001.
- City of Austin. Scoop the Poop Education Campaign, Summary Report, 2008.
- City of Tacoma. Summary, Measurement, and Assessment of Education and Outreach Programs – Attachment B16, 2008.
- City of Los Angeles. Ballona Creek Treatment Facility Feasibility Study and Preliminary Design, Bureau of Engineering Report, May 1996.
- City of Los Angeles, Issuance of Task Order Solicitation No. 9 Downspout Disconnection Program.
http://www.lacitysan.org/general_info/pdfs/contracts/TOS_S9_Downspout_Disconnection.pdf. August 2008.
- City of Los Angeles, Integrated Resources Plan for the Stormwater Program (IRP). 2004.
- City of Los Angeles. Los Angeles River Bacteria Source Identification Study: Final Report. Report prepared for Cleaner Rivers through Effective Stakeholder-led TMDLs (CREST). November 2008.
- City of Los Angeles. Reference Guide for Stormwater Best Management Practices. Stormwater Management Program, Bureau of Sanitation, Department of Public Works. July 2000.
- City of Los Angeles. Water Quality Compliance Master Plan for Urban Runoff. Watershed Protection Division, Bureau of Sanitation, Department of Public Works. 2009.
- City of Palo Alto. Clean Bay Business Program,
<http://www.cityofpaloalto.org/business/news/details.asp?NewsID=526&TargetID=5>
- Clean Water Education Program (CWEP). Pre- and Post-TV Campaign Surveys of Stormwater Awareness & Behavior in the CWEP Service Area: Comparisons and Findings, North Carolina. 2008.

- Cleaner Rivers through Effective Stakeholder TMDLs (CREST). Implementation Strategies, Technical Memorandum for Ballona Creek Bacteria TMDL Appendix. 2005
- Dana Point, California. 2005. Street sweeping will make a clean sweep to protect the ocean. <http://secure.purposemedia.com/dpstreetcleaning/streetsearch.html>.
- Geosyntec Consultants. Los Angeles County Wide Structural BMP Prioritization Methodology, submitted by County of Los Angeles, Department of Public Works, Heal the Bay and the City of Los Angeles Bureau of Sanitation. 2008.
- Hardwick, N. Lake Sammamish Watershed Water Quality Survey. King County Water and Land Resources Division. Seattle, WA.1997.
- Herrera Environmental Consultants. Technical Memorandum: Nonstructural Stormwater BMP Assessment. Prepared for the City of Portland Bureau of Environmental Services. May 2006.
- Home and Garden Information Center (HGIC). 1996. *Residential Fertilizer Use Survey*. University of Maryland Cooperative Extension. College Park, MD. Unpublished Surveys.
- Imperial, Mark and Llyod Jones. Evaluation of the Burnt Mill Creek Outreach and Demonstration Project: Final Report, Prepared for the City of Wilmington, NC. 2005.
- Irvine Ranch Water District, Richard A. Diamond, November 2003. Project Review of the Irvine ET Controller Residential Runoff Reduction Study.
- Kildare, B., Rajal, V., Tiwari, S., Thompson, D., McSwain, B., and Wuertz, S. Draft Calleguas Creek Watershed Quantitative Microbial Source Tracking Study. Report prepared by University of California Davis and Larry Walker Associates for Calleguas Creek Watershed Organization. November 2006.
- Los Angeles County Department of Public Works (LACDPW), Water Resources Division. Hydrology Manual. January 2006. (<http://dpw.lacounty.gov>)
- Los Angeles Regional Water Quality Control Board. Attachment A to Resolution No. 06-011-015. 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.
- Los Angeles Regional Water Quality Control Board. Total Maximum Loads for Bacterial Indicator Densities in Ballona Creek, Ballona Estuary & Sepulveda

- Channel: Staff Report, Los Angeles Regional Water Quality Control Board. April 2006.
- Los Angeles Regional Water Quality Control Board. 2006. Total Maximum Loads for Bacteria in the Malibu Creek Watershed: Staff Report. Los Angeles Regional Water Quality Control Board. January 2004.
- Los Angeles Unified School District Facilities Services Division. 2001. New Construction Strategic Execution Plan.
<http://www.laschools.org/sepdocs/sep/pdf/sep-2009-web.pdf>
- McPherson, Greg, Simpson, Jim, Qingfu, Xiao and Wu, Chelsea. Los Angeles One Million Trees Canopy Cover Assessment: Final Report. Center for Urban Forest Research and University of California at Davis. March 2007.
- Minton, G.R., Lief, B. & Sutherland, R. (November 1998). High efficiency sweeping or clean a street, save a Salmon! Stormwater Treatment Northwest, Vol. 4, No. 4.
- Municipal Water District of Orange County and Irvine Ranch Water District. The Residential Runoff Reduction Study. 2004.
<http://www.irwd.com/Conservation/R3-Study-Revised11-5-04.pdf>
- Northern Virginia Planning District Commission. Nonstructural BMP Handbook. Prepared by Virginia Department of Conservation and Recreation Division of Soil and Water Conservation. December, 1996.
- Olivieri, A., Boehm, A., Sommers, C.A., Soller, J.A., Eisenber, J.N., Danielson, R. 2007. "Development of a Protocol for Risk Assessment of Microorganisms in Separate Stormwater Systems."
- Pitt, R. 2002. Emerging stormwater controls for critical source areas. In: Management of Wet-Weather Flow in the Watershed. Sullivan, D. & Field R. (Eds). Street cleaning (pp. 14-16), CRC Press, Boca Raton, FL.
- Pitt, R. and J. McLean. Toronto Area Watershed Management Strategy Study - Humber River Pilot Watershed Project. Ontario Ministry of the Environment, Toronto, Ontario, June 1986.
- Pitt, R.; Williamson, D.; Voorhees, J.; and Clark, S. "Review of Historical Street Dust and Dirt Accumulation and Washoff Data." In: Effective Modeling of Urban Water Systems, Monograph 13. W. James, K.N. Irvine, E.A McBean, and R.E. Pitt, Eds. ISBN 0-9736716-0-2. CHI. 2004.
- Rosselot, Kirsten. Copper and Solids Removed via Street Sweeping. Report prepared for the Brake Pad Partnership. March 2007.

- Santa Ana Watershed Project Authority (SAWPA). Middle Santa Ana River (MSAR) Bacteria Indicator TMDL Data Analysis Report. Prepared by CDM and Risk Sciences for the MSAR TMDL Task Force. March 2009.
- Santa Monica Bay Restoration Commission. The Santa Monica Bay Restoration Plan Check-up; Implementation Progress Update 1995 - 2008. 2008
- Sartor, J.D., and Gaboury, D.R., 1984, Street sweeping as a pollution control measure – Lessons learned over the past ten years: *Science of the Total Environment*, v. 33, p. 171-183.
- Schueler, T.R. Microbes and Urban Watersheds: Concentrations, Sources, and Pathways. In, *The Practice of Watershed Protection*. Eds, T. Schueler and H. Holland. Center for Watershed Protection. Ellicott City, MD. 2000.
- Schwarze Industries. 2004. Virginia test further documents pickup of high efficiency sweepers. *American Sweeper* 8(1).
- Sinton, L.W., C.H. Hall, P.A. Lynch and R.J. Davies-Colley (2002). "Sunlight inactivation of fecal indicator bacteria and bacteriophages from waste stabilization pond effluent in fresh and saline waters." *Applied Environmental Microbiology* 68: 1122-1131.
- State Water Resources Control Board (SWRCB). Annual Summary Report for the J01P28 Interim Water Quality Improvement Package Plant BMP Agreement 01-227-55. Aliso Beach, Orange County. 2004.
- Stein, ED and LL Tiefenthaler. Characterization and source identification of dry-weather metals and bacteria in Ballona Creek, in: S.B. Weisberg and D. Elmore (eds.), *Southern California Coastal Water Research Project 2003-04 Biennial Report*. Southern California Coastal Water Research Project. Westminster, CA. pp. 179-191, 2004.
- Steuer, J., W. Selbig, N. Hornewer, and J. Prey. 1997. "Sources of Contamination in an Urban Basin in Marquette, Michigan and an Analysis of Concentrations, Loads, and Data Quality." U.S. Geological Survey, *Water-Resources Investigations Report* 97-4242.
- Surbeck S.Q., Jiang, S.C., Ahn, J.H., and S.B. Grant. 2006. Flow Fingerprinting Fecal Pollution and Suspended Solids in Stormwater Runoff from an Urban Coastal Watershed. *Environmental Science Technology* 40: 4435-4441.
- Sutherland, R. C. & Jelen, S. L. 2002. A technique for accurate urban runoff load estimation. Water Environment Federation. National TMDL Science and Policy 2002 Specialty Conference, November 13 -16, 2002. Phoenix, AZ.

- Swann, C. 1999. A Survey of Residential Nutrient Behaviors in the Chesapeake Bay. Widener-Burrows, Inc. Chesapeake Research Consortium. Center for Watershed Protection, Ellicott City, Maryland.
- Tetra Tech. Nutrient and Coliform Modeling for the Malibu Creek Watershed TMDL Studies. Prepared for USEPA Region 9 and the Los Angeles Regional Water Quality Control Board. 2002.
- Tiefenthaler, L.L., E.D. Stein, and G.S. Lyon. 2008. Fecal Indicator Bacteria Levels During Dry Weather from Southern California Reference Streams. Southern California Coastal Water Research Project (SCCWRP), Technical Report 542. January 2008.
- University of California, Los Angeles. 2001. 2002 Long Range Development Plan. http://www.capital.ucla.edu/EIR/Final_UCLA_2002_LRDP.pdf
- van der Wel, 1995. Dog Pollution. The Magazine of the Hydrological Society of South Australia.
- Los Angeles Almanac. 2000. Characteristics of the Privately Owned Dog & Cat Population & Their Owners, City of Los Angeles. Humane Society December 1999 survey. <http://www.laalmanac.com/environment/ev21.htm>