Tecolote Watershed
Comprehensive Load Reduction Plan

Submitted by:

FINAL

July 20, 2012

With support provided by:

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Executive Summary

This Comprehensive Load Reduction Plan (CLRP) for the Tecolote Creek Hydrologic Area (HA) (Tecolote watershed), part of the Mission Bay watershed in the City of San Diego, represents an integrated water quality plan combining multiple permit-based and voluntary strategies and best management practices (BMPs) into a comprehensive approach for achieving compliance with the *Revised Total Maximum Daily Loads for Indicator Bacteria, Project 1 – Twenty Beaches and Creeks in the San Diego Region* (Bacteria TMDL) which was approved by the San Diego Regional Water Quality Control Board and took effect April 4, 2011. The City of San Diego and Caltrans, as the Responsible Parties (RPs) for the watershed, will use this CLRP to develop watershed implementation programs, evaluate their effectiveness, and make adjustments over the anticipated 20-year implementation period.

This document is in response to the Bacteria TMDL. This CLRP integrates information and data from multiple water quality permit requirements, studies, initiatives, and reports into a single framework. This CLRP represents the TMDL Implementation Plan required in the Bacteria TMDL, along with a schedule for attaining Waste Load Allocations (WLAs). BMPs recommended in the CLRP should be evaluated for implementation over the 20-year period from the effective date of the Bacteria TMDL through 2031, with an associated monitoring plan and periodic evaluations of the CLRP.

The RPs recognize that the program must use adaptive management to employ new information and technologies over time to achieve compliance with the TMDL in a sustainable manner that maximizes cost effectiveness and minimizes impacts to the community. The monitoring and re-evaluation components are intended to ensure that an adaptive management approach is utilized throughout the BMP Implementation Schedule to refine and adapt BMPs, based on monitoring input and other feedback, in a manner best suited to sustainably achieving compliance with the Bacteria TMDL, as well as other applicable water quality permits and standards.

In addition to addressing bacteria reduction, this CLRP specifically addresses the watershed's other regulatory drivers and impairments. Pollutants addressed in this CLRP include Clean Water Act section 303(d)-listed pollutants such as sediment (turbidity), nutrients (total nitrogen and total phosphorous), metals (cadmium, copper, lead, and zinc), selenium, and toxicity, all of which are characteristic of a highly urbanized environment. By incorporating a comprehensive approach to all of the pollutants, impairments and concerns, the CLRP framework is intended to improve the efficiency and effectiveness of BMP planning, and as a result, to reduce the overall cost of implementation and compliance monitoring.

The CLRP is structured to present the Tecolote watershed's physiography and other key characteristics; review the Clean Water Act section 303(d)-listed pollutants of concern; characterize the location, nature and extent pollutant sources and pollutant generating activities (PGAs) in the watershed; prioritize subwatersheds based on pollutant load estimates and resulting water quality composite scores; evaluate and recommend nonstructural and structural BMPs to address pollutant loads; present a schedule for implementation; and outline the order-of-magnitude estimated costs of BMP implementation to achieve compliance. A monitoring plan and specific implementation steps, notably performing modeling and optimization in a latter phase to help prioritize BMP implementation, are outlined in detail. Costs associated with recommended BMPs are addressed in an appendix to the CLRP.

The CLRP is a compliance plan that includes a suite of recommended nonstructural and structural BMPs. These BMPs were developed and selected based on their applicability to the specific pollutants, impairments and conditions addressed; the specific land use conditions and availability of land in the Tecolote watershed, particularly in areas designated as High Priority Management Areas (HPMAs) in Section 3.

All activities and BMPs in the CLRP were included in order to demonstrate a roadmap of compliance with the Bacteria TMDL. The RPs should implement activities and BMPs as resources are available in the future. The construction and implementation of BMPs and related activities will be prioritized along with all other essential jurisdictional obligations such as, but not limited to: public infrastructure rehabilitation and maintenance, compliance with other government mandated regulations, recreation, and public safety. Implementation of BMPs may require individual economic justifications relative to available funding and perceived holistic benefit to taxpayers and residents.

Nonstructural BMPs selected for the Tecolote watershed, as described in Section 4 and Appendix E, were characterized in terms of (1) potential expansions of existing BMPs to reach a greater geographic area or to achieve greater impact in the existing geographic area of the program; (2) potential enhancements or changes to existing programs that could achieve greater load reduction; and (3) new or expanded initiatives needed to address pollutant sources and load reduction goals. Nonstructural BMPs are effectives at reducing pollutant loads before they enter the storm drain system, and are recommended to begin program development in the early stages of the implementation schedule. Opportunities for **Structural BMPs** are described in Section 5 in terms of distributed structural BMPs, which are built in the landscape at the site scale, and large treatment (centralized) structural BMPs, which are regional facilities that receive flows from neighborhoods or larger areas.

The BMP Implementation Schedule in Section 7 reflects a strategic approach to prioritize BMP implementation based on environmental and cost-effectiveness. In the initial nonstructural and structural BMP planning in this CLRP, the relative cost-effectiveness of the various BMPs was key in the phasing of implementation. It is anticipated that initial program activities will focus on implementation in the HPMAs and in areas with greater numbers and concentrations of PGAs, and that geographic implementation will be further refined based on future monitoring and modeling studies.

Centralized BMPs on public land are included in the CLRP and may help facilitate compliance with the Bacteria TMDL. These BMPs will also be considered early in the scheduling of BMP implementation, particularly in the HPMAs. Distributed structural BMPs on public land are less cost effective but must be retained as an option to meet WLAs. Again, early implementation will focus on the development of distributed BMPs in HPMAs, where feasible. Overall, the implementation plan strategy reflected in the BMP Implementation Schedule is for nonstructural BMPs to be developed and implemented principally in years 0–5; planned structural BMPs on public land in years 0–10; centralized and distributed structural BMPs on public land in years 3–15; and structural BMPs on private land in years 15–20.

Once the BMP Implementation Schedule was assembled, preliminary cost estimates were developed for each of the recommended nonstructural BMPs and structural BMPs on public land. These cost estimates are intended to support future planning and securing funds for implementation. Structural BMPs on private land, which may be needed in the later phase of the BMP Implementation Schedule, were not included at this time.

The estimated present value cost in 2012 dollars of implementing the recommended nonstructural BMPs and structural BMPs on public land in the Tecolote watershed are presented in Table ES-1.

Table ES-1. Estimated present value cost of potential nonstructural and structural BMPs over 20-year timeframe

Watershed implementation categories	Present value cost[a]
Nonstructural BMPs	
Development Review Process	$811,802
Enhanced Inspections and Enforcement	$6,602,708
SUSMP and Regulatory Enhancement	$1,111,872
New/Expanded Initiatives	$2,394,533

Landscape Practices	$8,782,075
Education and Outreach	$1,835,129
MS4 Maintenance	$188,858,394
Capital Improvement Projects	$2,337,917
Subtotal	$212,734,430
Structural BMPs	
New Identified Centralized BMPs	$26,536,905
New Identified Distributed BMPs	$48,668,416
Planned/Implement Centralized BMPs	$24,823,951
Planned/Implement Distributed BMPs	$3,230,687
Subtotal	$103,259,959
Total present value cost	**$315,994,389**

Notes:

a. These are preliminary estimated costs subject to refinement and improvement as a result of further analyses and assessments performed as part of the CLRP Implementation Program. Implementation of BMPs is subject to available resources.

Establishment of CLRP Implementation Program

The RPs are committed to embarking on a CLRP Implementation Program to attain compliance with the TMDL and facilitate strategic decision-making, assessment, and adaptation of the CLRP. The RPs recognize that no plan to achieve these goals is meaningful without commitment and a mechanism for continued coordination and planning. During development of the CLRP, the RPs worked to present one watershed-based plan both to better manage pollutant loads and to serve as a foundation for decisions regarding future BMP implementation. In the coming years, lessons will be learned from projects implemented, conditions will change, new technologies will emerge, and unanticipated challenges will present themselves. Thus, implementation of the CLRP will require continued evaluation and adaptation.

Implemented over time, the recommended CLRP BMPs are expected to yield significant load reductions for the key PGAs and HPMAs. The RPs will use adaptive management to continue to refine the understanding of the optimal combination and potential need for BMP retrofits on privately owned land.

The CLRP Implementation Program will include an iterative and adaptive framework essential to ensuring that the RPs attain compliance with the Bacteria TMDL. During the periodic program reviews, findings from the activities of the CLRP Program and modifications to BMPs will be included in the BMP Implementation Schedule.

The RPs will prepare periodic Progress Reports to document progress of the CLRP in accordance with the approved schedule included in the applicable regulatory document. Progress Reports will provide status updates of BMP activities and the results of monitoring studies. These reports may also include updates to this CLRP and the BMP Implementation Schedule. The first CLRP update may replace the current Watershed Urban Management Plan for the Tecolote watershed.

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1 Introduction

To establish a comprehensive, watershed-based approach to meeting pollutant load reduction targets for the Tecolote Creek Hydrologic Area (HA) (Tecolote watershed), part of the Mission Bay watershed in the City of San Diego, the Copermittees in the San Diego Region (called the Responsible Parties or RPs) prepared a Comprehensive Load Reduction Plan (CLRP). The CLRP is a coordinated, consistent, comprehensive, and phased strategy for implementing best management practices (BMPs). It will help the Copermittees comply with the *Revised Total Maximum Daily Loads for Indicator Bacteria, Project 1 – Twenty Beaches and Creeks in the San Diego Region* (Bacteria TMDL), which became effective in April 2011.

The CLRP for the Tecolote watershed represents an integrated water quality plan combining multiple permit-based and voluntary strategies and BMPs into a comprehensive approach for achieving compliance with the Bacteria TMDL. This CLRP integrates information and data from multiple water quality permit requirements, studies, initiatives, and reports into a single framework. The two RPs in the watershed—the City of San Diego and Caltrans, will use this CLRP to develop watershed implementation programs, evaluate their effectiveness, and make adjustments over the anticipated 20-year implementation period.

The RPs recognize that the program must use adaptive management to employ new information and technologies over time to achieve compliance with the TMDL in a sustainable manner that maximizes cost effectiveness and minimizes impacts to the community. The monitoring and re-evaluation components are intended to ensure that an adaptive management approach is utilized throughout the BMP Implementation Schedule to refine and adapt BMPs, based on monitoring input and other feedback, in a manner best suited to sustainably achieving compliance with the Bacteria TMDL, as well as other applicable water quality permits and standards.

In addition to addressing bacteria reduction, this CLRP specifically addresses the watershed’s other regulatory drivers and impairments. Pollutants addressed in this CLRP include Clean Water Act section 303(d)-listed pollutants such as nutrients (nitrogen and phosphorus), metals (cadmium, copper, lead, and zinc), selenium, and toxicity. By incorporating a comprehensive approach to all of the pollutants, impairments and concerns, the CLRP framework is intended to improve the efficiency and effectiveness of BMP planning, and as a result, to reduce the overall cost of implementation and compliance monitoring.

Areas of both dense urban land use (primarily residential) and natural open space contribute to receiving waters. The Tecolote watershed (Figure 1-1) has many complex pollutants and issues to consider in comprehensive load reduction planning. Thus, this CLRP is specific to the pollutants that have caused waterbody impairments and the watershed’s unique conditions and water quality protection needs.

The coordinated planning approach in this CLRP recognizes that nonstructural and structural BMPs principally designed to reduce bacteria loading, such as storm water infiltration systems or nonstructural source reduction strategies addressing trash and animal waste, often reduce nutrients, sediment, and other loadings in addition to bacteria, making coordinated planning both practical and effective. Recognizing the efficiencies of coordinating reduction strategies for multiple pollutants, the selection of recommended BMPs and strategies in this CLRP identifies the multiple pollutant-reduction benefits of each recommended BMP, and provides a strong framework for prioritizing BMPs by type and geographic area to maximize pollutant reduction and cost-efficiency.

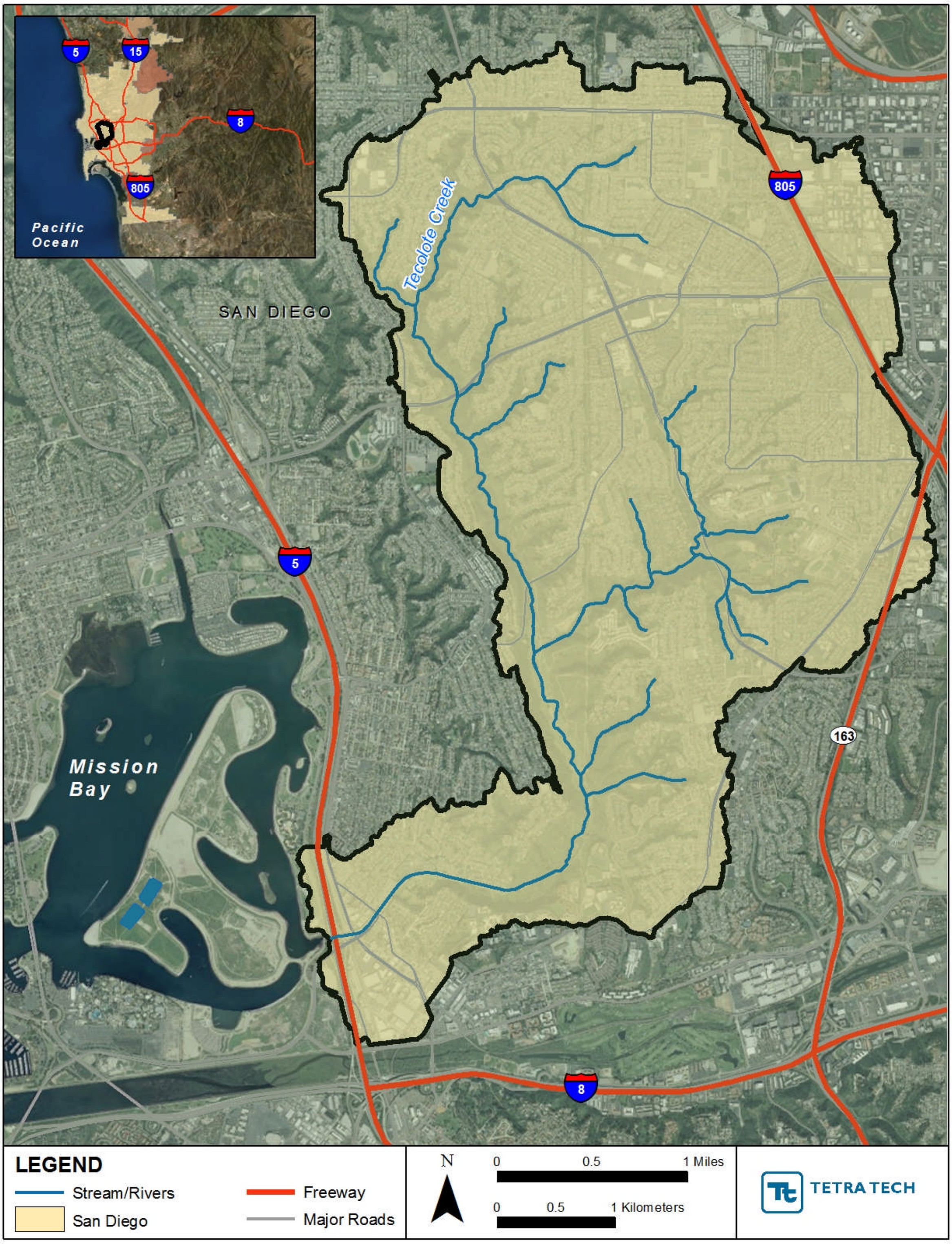

Figure 1-1. Location of the Tecolote watershed

Fundamental to the CLRP is the accompanying monitoring plan, which outlines the assessment and reporting procedures that will help the RPs assess progress toward attainment, and adapt the recommended BMPs and schedule to optimize load reduction over time. Development of the Bacteria TMDL began several years ago and focused on the 2002 303(d) impairment listings. Since then, several important monitoring and modeling studies have been conducted in the region that better characterized the extent and magnitude of bacteria impairments, existing and potential sources, and the linkage between sources and receiving water impacts. This CLRP effectively incorporates and builds on these past studies and data, current and future planning efforts, and related water resource activities to target the most cost-effective BMP implementation needs in the watershed.

The following sections discuss the geographic setting of the Tecolote watershed (Section 1.1), an overview of the impairments and priority pollutants (Section 1.2), and a discussion on the CLRP guidelines (Section 1.3). The lead CLRP watershed contact is presented in Section 1.4.

1.1 Geographic Setting

The Tecolote watershed is approximately 5 miles north of downtown San Diego, in the Mission Bay Watershed Management Area (WMA), which is one of the most densely populated WMAs in the County of San Diego. The watershed encompasses an urbanized area of approximately 9.5 square miles and is composed of residential, transportation, recreation, and commercial land uses.

An area of interest in the Tecolote watershed is Tecolote Canyon National Park. This park provides approximately 950 acres of open space, the vast majority of which (approximately 926 acres) is owned by the City of San Diego with the remainder owned by San Diego Gas and Electric. Although the park is mostly undeveloped, substantial urban development is in areas adjacent to and surrounding the park, with approximately 77 associated storm drains emptying into the park. The entire park and the watershed drain to the portion of Tecolote Creek in the park (City of San Diego 2006). As illustrated in Figure 1-1, the Tecolote watershed is entirely within the City of San Diego.

1.1.1 Hydrology and Climate

The Tecolote watershed is the southern portion of the Peñasquitos Hydrologic Unit. Natural drainage generally flows to the south and southwest along a number of small- to moderate-sized tributaries. Tecolote Creek runs north to south along the western edge of the Tecolote watershed and eventually discharges to Mission Bay. Flows in the watershed are derived from seasonal storms and landscape irrigation runoff from adjacent and upstream urban development. Because of the extensive nature of upstream urban development, most of the Tecolote Creek channel is highly incised, and flows in it are typically perennial or nearly perennial (City of San Diego 2006).

Average annual rainfall for the San Diego region ranges from 9 to 11 inches along the coast to more than 30 inches in the eastern mountains. Three distinct types of weather occur in the region. Summer dry weather occurs from late April to mid-October. During this period, almost no rain falls. The winter season (mid-October through early April) has two types of weather: (1) winter dry weather when rain has not fallen for the preceding 72 hours, and (2) wet weather consisting of storms of 0.2 inch[1] of rainfall and the 72-hour period after the storm. Of the annual rainfall, 85 to 90 percent occurs in the winter season (SDRWQCB 2010; San Diego County Department of Environmental Health 2000). Runoff from these events drains into Tecolote Creek, which eventually discharges into Mission Bay.

[1] Note that in the draft *NPDES Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4)*, 0.1 inch of rainfall are proposed for storm designation, which could affect the CLRP strategy (SDRWQCB 2012).

1.1.2 Land Cover

Land use composition of a watershed can significantly affect water quality and influence the types of pollutants in waterbodies. A breakdown of the land uses (SANDAG 2009) in the Tecolote watershed is shown in Table 1-1 and illustrated in Figure 1-2. The primary land use in the watershed is low-density residential (35 percent), followed by recreation (19 percent), and roads (17 percent). The Tecolote watershed is highly residential as the combined total of residential areas (low-density and high-density residential areas) makes up nearly 42 percent of the land uses. Low-density residential neighborhoods are throughout the watershed with higher density in the northern and eastern portions of the watershed. Transportation land uses combined (road and transportation) make up nearly 20 percent and can contribute to roadway-affiliated pollutants such as cadmium, copper, lead, zinc, sediment, and turbidity. Other land uses important to pollution generation, such as commercial and industrial make up approximately 8 percent combined. Because the majority of the watershed is developed, agriculture and areas under construction each make up less than 1 percent of the land use acreage.

The Tecolote watershed is part of the most densely populated WMA in the County of San Diego, the Mission Bay and La Jolla WMA (San Diego County 2011a). This dense population is reflected through the prevalence of low- and high-density residential areas throughout the watershed as shown in Figure 1-2.

Table 1-1. Land uses in the Tecolote watershed

Aggregate land use category	Acres	Percent
Commercial	415	6.44%
Freeway	162	2.51%
High-density residential	529	8.22%
Industrial	118	1.83%
Institutional	518	8.05%
Low-density residential	2,240	34.80%
Military	19	0.29%
Open space	60	0.92%
Recreation	1,227	19.05%
Road	1,072	16.65%
Transportation	80	1.24%
Total	6,438	100.00%

The imperviousness of the Tecolote watershed is shown in Figure 1-3. The amount of impervious cover is an indication of the degree of urbanization and the amount of storm water that can be conveyed directly to the municipal separate storm sewer system (MS4). In the Tecolote watershed, highest impervious cover is in the eastern portions or headwaters of the watershed and near the mouth of Tecolote Creek. These areas are primarily residential neighborhoods with some commercial zones. The least impervious areas are in the Tecolote Canyon Natural Park, along the western edge of the Tecolote watershed.

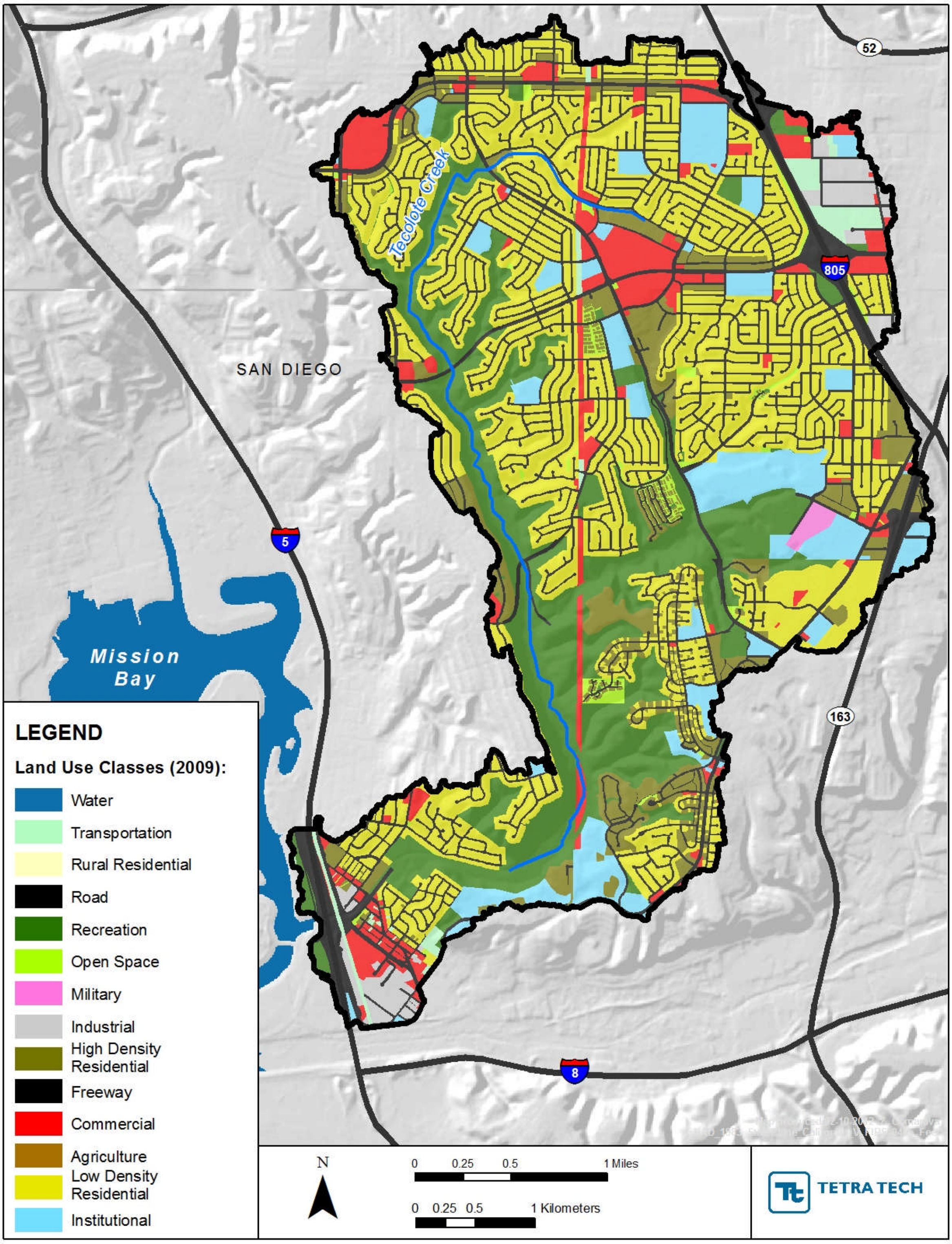

Figure 1-2. Land uses in the Tecolote watershed

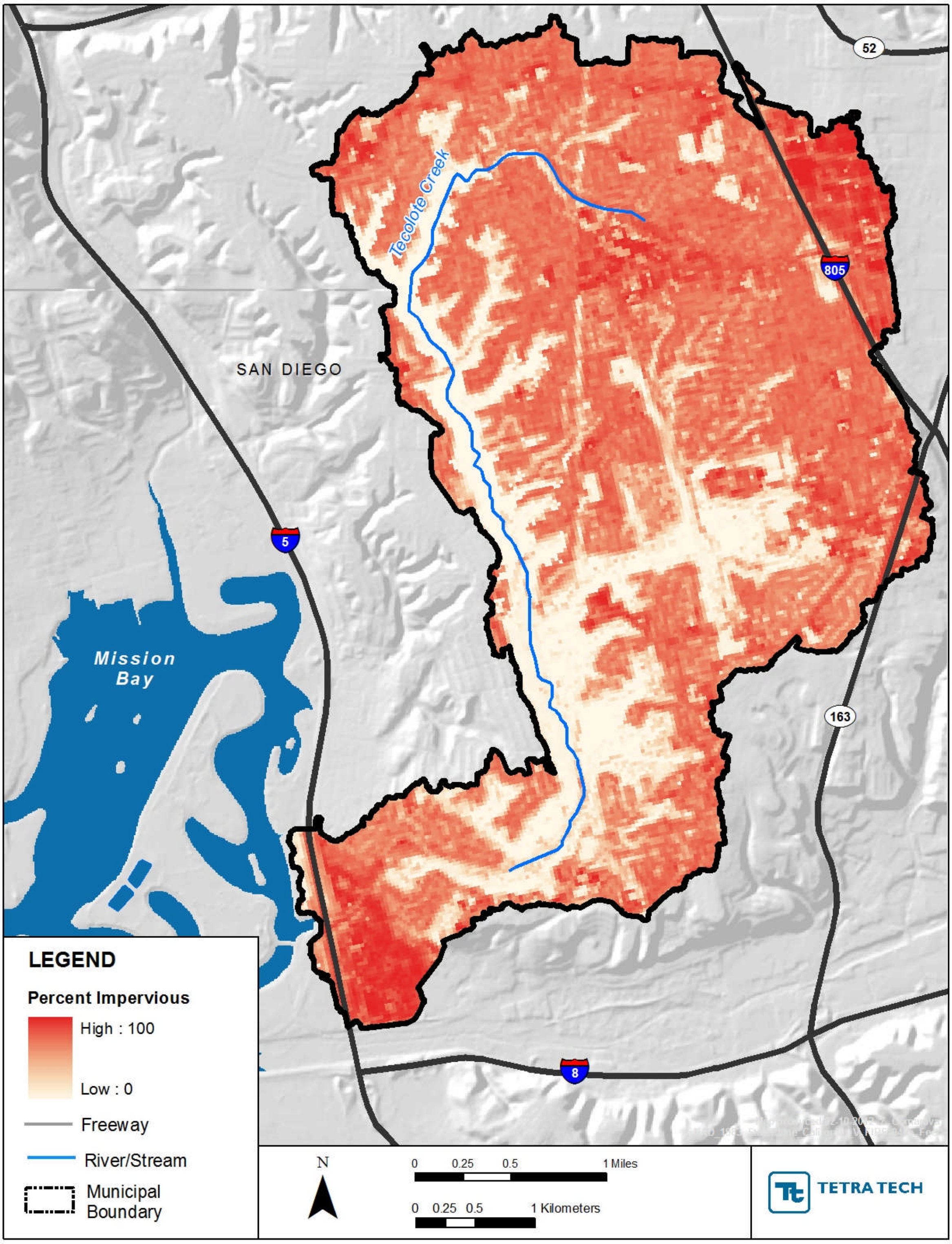

Figure 1-3. Imperviousness in the Tecolote watershed

1.2 Impairment Overview

The mainstem of Tecolote Creek is on the 2010 303(d) list as impaired for indicator bacteria (enterococci, fecal coliform, and total coliform), metals (cadmium, copper, lead, and zinc), nutrients (nitrogen and phosphorus), turbidity, toxicity, and selenium (Table 1-2 and Figure 1-4). The impaired waterbody is entirely in the jurisdiction of the City of San Diego.

Table 1-2. Impairments in the Tecolote watershed

Waterbody name	Estimated size affected (mi)	Pollutant	Jurisdiction
Tecolote Creek	7.0	Indicator bacteria (enterococci, fecal coliform, total coliform)	City of San Diego
Tecolote Creek	7.0	Cadmium	City of San Diego
Tecolote Creek	7.0	Copper	City of San Diego
Tecolote Creek	7.0	Lead	City of San Diego
Tecolote Creek	7.0	Nitrogen	City of San Diego
Tecolote Creek	7.0	Phosphorus	City of San Diego
Tecolote Creek	7.0	Zinc	City of San Diego
Tecolote Creek	7.0	Turbidity	City of San Diego
Tecolote Creek	7.0	Toxicity	City of San Diego
Tecolote Creek	7.0	Selenium	City of San Diego

Source: 2010 U.S. Environmental Protection Agency--approved 303(d) list (SWRCB 2012).

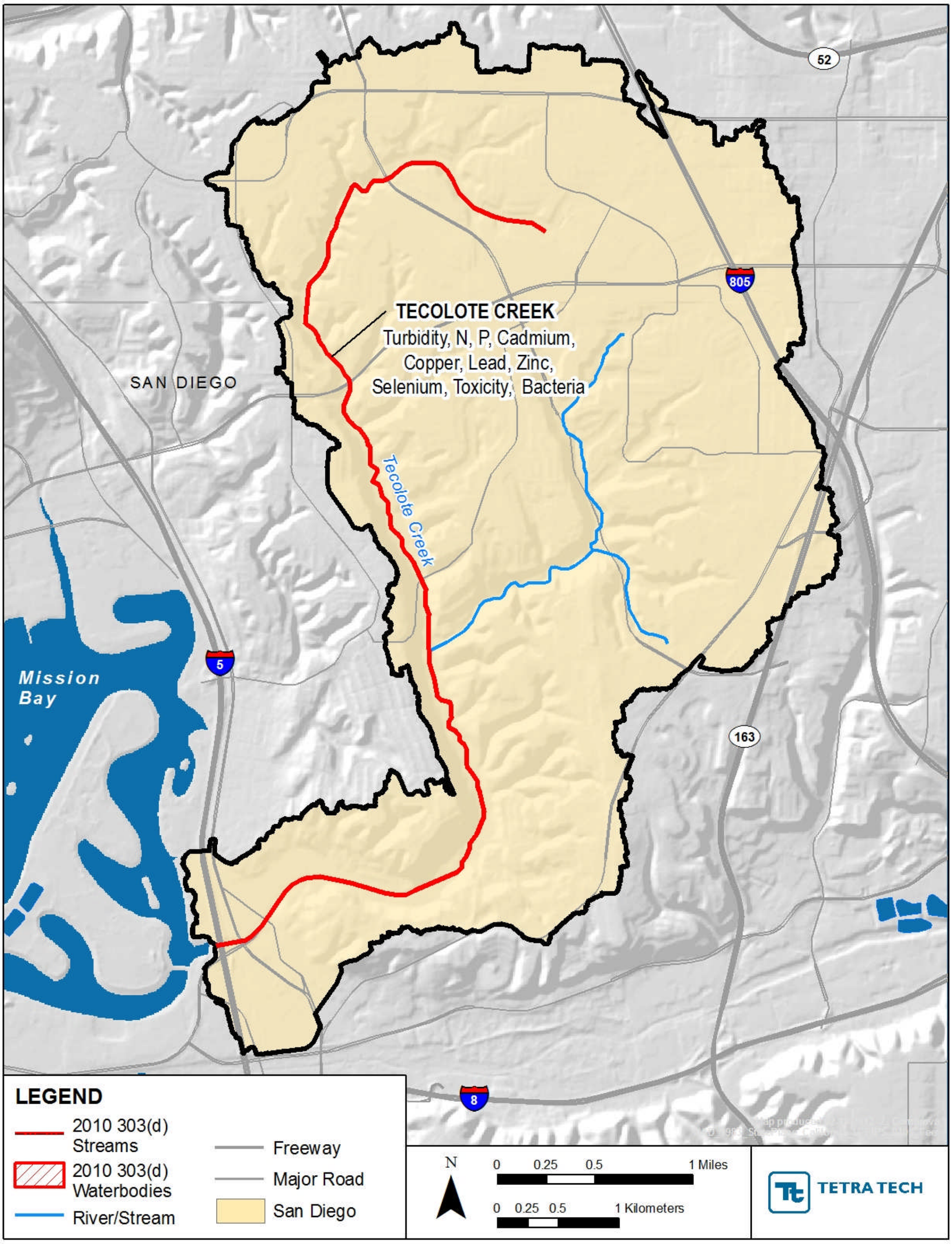

Figure 1-4. Tecolote watershed and its 303(d)-listed waterbodies

The CLRP addresses the bacteria impairments associated with the Bacteria TMDL (SDRWQCB 2010) and the other 303(d)-listed pollutants in the watershed: sediment (turbidity), nutrients (total nitrogen and total phosphorous), metals (cadmium, copper, lead, and zinc), selenium, and toxicity (SWRCB 2012). While the CLRP addresses each of these pollutants, detailed source assessment and loading estimates are only performed on a subset of pollutants that can be modeled (Sections 3.2 and 3.3). The other pollutants are represented via modeled surrogates or through management practices expected to reduce municipal storm water sources. The water quality constituents of concern in the Tecolote watershed are discussed in detail below; however, it is important to note that other pollutants not summarized below might also be of concern.

1.2.1 Bacteria (Enterococci, Fecal Coliform, and Total Coliform)

Pathogens are microbes that cause diseases. Bacteria, such as enterococci, fecal coliform, and total coliform—are used as measures or indicators of human pathogens. Various bacteria indicators have been historically used to detect the possible presence of as indicators of human pathogens within the water column because these indicators are easier and less costly to measure than the pathogens themselves (USEPA 2011a; SDRWQCB 2010). Total coliform is a group of mostly harmless bacteria that live in soil, water, and the gut of animals. The extent to which total coliforms are present in the source water can indicate the general quality of that water and the likelihood of fecal contamination. A measure of total coliform is an indicator that fecal coliform, *Escherichia coli*, and *Enterococcus* might be present. Fecal coliforms are a subset of total coliform bacteria and are a more fecal-specific in origin because they reside in the intestines of warm-blooded animals. *Enterococcus* is a more human-specific identifier of fecal origin. Similar to many pathogens, enterococci have the ability to survive in saltwater and are, therefore, a better indicator of health risk (USEPA 2011a).

Bacteria densities in waterbodies of the Tecolote watershed have historically exceeded the numeric water quality objectives (WQOs) for total coliform, fecal coliform, or enterococci indicator bacteria as defined in the SDRWQCB's *Water Quality Control Plan for the San Diego Basin* (Basin Plan; SDRWQCB 1994) or SWRCB's *Water Quality Control Plan for Ocean Waters for California* (Ocean Plan; SWRCB 2005). These exceedances threaten or impair beneficial uses such as recreational water contact (REC-1) and non-water contact (REC-2), among others. Sources of fecal contamination to surface waters include wastewater treatment plants, on-site septic systems, domestic and wild animal manure, and storm water runoff. The County of San Diego and other MS4 RPs led a source identification review of bacteria to assist with CLRP development. These sources are discussed in more detail in Section 3 and Appendix A.

1.2.2 Nutrients (Nitrogen, Phosphorus)

Nutrients such as nitrogen and phosphorus are natural elements in the environment that are essential for plant and animal growth, reproduction, and maintenance of a natural, healthy aquatic system. These nutrients contaminate and degrade waters when they are present in excessive amounts. Often as a result of human activities, elevated levels of nitrogen and phosphorus accelerate the growth of algae through a process called eutrophication. Algal blooms, as a result of eutrophication, block sunlight from reaching underwater plants and deplete oxygen in the waterbodies when they sink and decompose. Excessive amounts of nutrients from anthropogenic sources cause severe imbalances in the natural aquatic system harming fish, wildlife, and human health (USEPA 2011b).

Nutrient concentrations in waterbodies of the Tecolote watershed have exceeded the numeric and narrative WQOs as defined in the *San Diego Basin Plan*. These exceedances potentially threaten or impair recreation and aquatic life beneficial uses because of the production of algae, odor, and other secondary pollutants. Sources of nitrogen and phosphorus to surface waters include wastewater discharges, agricultural operations, atmospheric deposition, and domestic and wild animal manure. Specific sources are identified in Section 3.

1.2.3 Sediment (TSS/Turbidity)

Total suspended solids (TSS) are solid materials (organic and inorganic) that are suspended in water. Turbidity is the measure of water clarity. Both water quality parameters indicate the amount of sediment or material that is suspended in the water column. High levels of TSS and turbidity can lower water quality by absorbing light. Less light inhibits the process of photosynthesis and thereby reduces the amount of oxygen produced. The combination of less light and oxygen present in waters can affect aquatic life and plant life, thereby degrading the waters.

TSS and turbidity in several waterbodies of the Tecolote watershed have exceeded the numeric WQOs as defined in the *San Diego Basin Plan*. These exceedances threaten or impair several beneficial uses. Many potential sources influence sedimentation. Natural sources include erosion of canyon banks, bluffs, scouring in river channels, and tidal influx. The primary anthropogenic source of sediment identified is urban development from the watershed. Nonpoint sources of pollution are minimal in natural environments; however, urban development transforms the natural landscape and the rapid urbanization of the watershed directly affects the natural drainage, sediment loads and hydrologic characteristics such as peak flow rates, flow volumes, flow durations, and flow velocities (City of San Diego 2005).

In addition to pollutant loading associated with specific land use practices, urbanization changes the landscape from pervious to impervious. Research shows that impervious surfaces represent the imprint of land development on the landscape and is directly related to runoff (Burton and Pitt 2002; Schueler 1994). Furthermore, impervious cover has been identified as the *unifying theme* in stream degradation (USEPA 1999); with stream degradation occurring with as little as 10 percent imperviousness of the watershed (Schueler 1994).

The concerns associated with urban development are multifaceted. Specifically, it comes as the construction process is associated with increased erosion and runoff rates; accounting for up to 50 percent of sediment loads in urban areas (Burton and Pitt 2002). Additionally, urbanization increases imperviousness and the associated increase in runoff affects the volume, velocity, duration, and timing of runoff events. Lowered infiltration rates speeds surface runoff, which leads to increased surface erosion and gullying. Ultimately, the increased erosion destabilizes banks and washes sediment into surface waters. These sources are discussed in detail in Section 3.

1.2.4 Metals (Cadmium, Copper, Lead, and Zinc)

Several elements, including some heavy metals, are naturally occurring in surface waters. However, metals such as cadmium, copper, lead, and zinc can cause adverse effects on water quality, biological species, and human health at elevated and even slightly elevated levels. Dissolved forms of these metals can be directly taken up by bacteria, algae, plants, and planktonic and benthic organisms and can be absorbed to particulate matter (SDRWQCB 2007).

Although most metals enter surface waters via natural processes such as the erosion of natural sources and forest fires, anthropogenic sources can also contribute to their elevated presence. Industrial processes and practices and industrial wastes can serve as significant contributors of cadmium, copper, and zinc in the environment (USEPA 2007, 2012a, 2012b, 2012c; Lenntech 2011a, 2011b). Specific industrial activities that often involve these metals are smelting, mining, coal burning, and metal plating among others. Road infrastructures are contributors of certain metals because many metals are often linked to car tires, brake pads, and motor vehicle discharges and emissions. Agricultural activities such as animal feeding operations (AFOs) and certain fertilizers can also contribute trace levels of zinc and other metals. The biggest contributing source of lead, on the other hand, is the corrosion of pipes. Regardless of the source, excessive amounts of metals can cause severe imbalances in the natural aquatic system harming fish, wildlife, and human health. Sources of metals are discussed in detail in Section 3.

1.2.5 Selenium

Selenium usually occurs in the sulfide ores of heavy metals; pyrite, clausthalite, naumannite, tienammite and in selenosulfur. It can also be found as natural volcanic deposits. Although it is not a common water constituent, selenium can be in surface waters as a result of interaction with groundwater contaminated sources and, to a lesser extent, atmospheric deposition. Selenium can enter the atmosphere via the combustion of petroleum fuels and industrial smelting and refining processes. Selenium is not dangerous at low levels; however, acute and chronic exposure can lead to detrimental health effects such as hair and fingernail loss, and damage to the circulatory and nervous system and organ tissue (USEPA 2012d). Presence of selenium in natural waters at elevated levels is a threat to human health and threatens the health of the aquatic system. Selenium has exceeded the numeric criteria defined in the *San Diego Basin Plan* and is therefore included as an impairment on the 2010 303(d) list for the Tecolote watershed (Table 1-2).

1.2.6 Toxicity

As defined by the Basin Plan, toxicity is the adverse response of organisms to chemicals or physical agents. It refers to the substances and concentration of substances that are toxic to or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Toxicity in surface waters is typically measured by indicator organisms, analyses of species diversity, population density, growth anomalies, and bioassays (SDRWQCB 1994). Toxicity can be caused by a number of sources and a combination of sources. Toxicity has exceeded the narrative criteria defined by the *San Diego Basin Plan* and is therefore included as an impairment on the 2010 303(d) list for the Tecolote watershed (Table 1-2).

1.3 Guiding Principles for CLRP Development

The overarching goal and guiding principle of this multi-pollutant CLRP for the Tecolote watershed is to cost-effectively address the current Bacteria TMDL and 303(d)-listed pollutants, in addition to future potential TMDLs.

This CLRP provides implementation recommendations and information needed to begin planning for nonstructural and structural BMPs for required load reduction in the Tecolote watershed. The high-ranked BMP sites and activities in Sections 4 and 5 of this plan provide an immediate and strong foundation for each RP's CLRP program development.

The RPs will establish a CLRP Implementation Program to provide a watershed-based, adaptive framework for cost-effective implementation and process for refining the strategy over the entire implementation period. One of the first steps in the CLRP Implementation Program will be to quantify and assess the optimal balance of centralized and distributed structural BMP types and locations in light of planned nonstructural BMP load reduction activities. This task will include optimization modeling to quantify and evaluate pollutant load reductions, design sizes, and costs, to further evaluate those BMPs identified in the CLRP and determine the extent of additional BMPs necessary to attain the bacteria WLAs. Over the long term, the RPs will take an iterative and adaptive management approach to take advantage of new information or treatment technologies that could emerge in the future and result in more effective CLRP Implementation Program later phases. Further discussion of the CLRP's implementation schedule and the components of the CLRP Implementation Program is provided in Section 7.

1.4 Lead CLRP Watershed Contact

Identification of the lead CLRP watershed contact is a required CLRP component. The Tecolote watershed lead CLRP contact is the City of San Diego.

2 Objectives of a Comprehensive Load Reduction Plan

2.1 Focus of the Plan

This CLRP presents a comprehensive, watershed-based approach. It focuses on all RPs and all existing impairments and other pollutants of concern. The associated management options are within the jurisdiction of all RPs. Some of the proposed nonstructural or programmatic BMPs, such as staff training or education programs, could apply in an RP's jurisdiction in areas outside the Tecolote watershed.

The objective of the CLRP is to address the current TMDL for indicator bacteria, in addition to future potential TMDLs in the Tecolote watershed. The additional pollutants of concern include 303(d)-listed pollutants, such as metals (cadmium, copper, lead, and zinc), nutrients (nitrogen and phosphorous), sediment (turbidity), selenium, and toxicity. Source characterizations are provided in the plan for the pollutants quantified directly or indirectly (i.e., using a surrogate parameter) by the watershed model (bacteria, nutrients, sediment, and metals), while the other pollutants are addressed through identifying management activities to reduce municipal storm water loads. This information can support future initiatives for watershed and BMP planning. Existing and potential TMDLs for these impairments are discussed below.

2.1.1 Bacteria TMDL

The SDRWQCB has approved one TMDL for the Tecolote watershed. The approved Bacteria TMDL is not reflected in the 2010 303(d) list of impairments summarized in Table 1-2 because the TMDL had not been approved when data were solicited to develop the 2010 303(d) list. A summary of the TMDL, along with TMDL effective dates and implementation plan due dates, is in Table 2-1.

2.1.2 Other adopted TMDLs

As of the writing of this CLRP, the SDRWQCB has not adopted any other TMDLs in the Tecolote watershed.

2.1.3 TMDLs in Development

No other TMDLs are being developed for the Tecolote watershed; however, additional TMDLs are anticipated as the 303(d) list indicates *expected TMDL completion dates* of 2019 or 2021 for all remaining impairments.

2.1.4 Other Pollutants

In addition to the current indicator bacteria impairments, other pollutants of concern in the watershed have been identified on the 2010 303(d) list. These are metals (cadmium, copper, lead, and zinc), nutrients (nitrogen and phosphorous), sediment (turbidity), selenium, and toxicity. While no TMDLs exist or are being developed for these impairments, this CLRP is intended to address these impairments using a comprehensive, watershed-based approach that considers BMPs that can cost-effectively address multiple pollutants.

Table 2-1. Approved TMDLs for segments in the Tecolote watershed

TMDL Parameter Group	Dates	Description
Bacteria	TMDL Effective: April 4, 2011 TMDL Implementation Plan Due: October 4, 2012	Tecolote Creek of the Tecolote HA was on California's 2002 303(d) list as impaired due to exceedances of bacteria water quality standards. TMDLs were then developed for multiple bacteria indicators: fecal coliform, total coliform, and enterococci. The Beaches and Creeks TMDL (SDRWQCB 2010) for bacteria has multipart, wet weather, numeric targets based on the bacteria objectives for marine and fresh waters designated for the contact recreation (REC-1) beneficial use. Both single-sample and 30-day geometric mean limits apply to the impaired segments of the Tecolote HA for wet and dry weather, respectively. Dry-weather urban runoff and storm water, both conveyed by storm drains, are the primary sources of elevated bacterial indicator densities to the Tecolote HA during dry and wet weather, respectively. No wastewater discharges are permitted in the watershed. In addition, no agriculture-based sources exist.

2.2 Water Quality Targets

Key factors influencing the level of BMP implementation are the storm water management targets expected to be achieved. For this project, TMDLs (and associated WLAs and LAs) that address storm water runoff and potential TMDLs for other pollutants of concern must be considered a priority for developing the multi-pollutant CLRP. The following provides a summary of applicable wet- and dry-weather TMDL WLAs and LAs and implementation requirements or numeric targets (where a TMDL does not exist).

2.2.1 Bacteria

The Bacteria TMDL has multipart, wet- and dry-weather numeric targets that are based on the updated bacteria objectives for marine and fresh waters designated for contact recreation (REC-1). Both single-sample and 30-day geometric mean limits apply to the Tecolote watershed. The bacteria TMDLs are expressed in terms of both concentration and on a mass loading basis. Concentration-based TMDLs are used to determine *compliance* with the TMDLs, whereas allocations were determined using the mass-based TMDLs. Different REC-1 WQOs apply for wet and dry weather because transport mechanisms to receiving waters differ during these two conditions. Wet-weather conditions are episodic and short in duration; therefore, the single-sample maximum WQOs apply as the wet-weather numeric targets. Alternatively, the geometric mean WQOs apply during dry-weather when runoff is more uniform and slower (making die-off and amplification processes more important) than during storm flows. Full compliance with the TMDL requires that both the geometric mean and single-sample maximum WQOs are met during both wet and dry weather. Applicable bacteria objectives used in the TMDL calculations are presented in Table 2-2.

Table 2-2. WQOs for bacteria

WQOs	Numeric target (MPN/100mL)	Allowable exceedance frequency
Single-sample maximum (wet weather)		
Fecal coliform	400	22%
Enterococci	61*	22%
Total coliform	10,000	22%
Geometric mean (dry weather)		
Fecal coliform	200	0%
Enterococci	33	0%
Total coliform	1,000	0%

* More stringent WQO associated with the *designated beach* usage frequency. If the usage frequency is lowered through a Basin Plan amendment, enterococci single-sample maximum WQO of 104 MPN/100mL will apply during wet weather.

The Basin Plan provides different enterococci WQOs that are dependent on the type (freshwater or saltwater) and usage frequency (designated beach, moderately or lightly used area, or infrequently used area) of the waterbody. All waterbodies in the San Diego region designated with REC-1 beneficial use are assumed to have a *designated beach* usage frequency, which has the lowest and most stringent REC-1 WQOs. The freshwater WQOs are more stringent than the saltwater WQOs. The Tecolote Creek impairment is a freshwater listing, and it assumes that the downstream beach has a *designated beach* usage frequency; therefore, the more stringent freshwater single-sample maximum WQO applies for wet weather (Table 2-2).

If the Basin Plan is amended in the future to assign a lower usage frequency (i.e., *moderately to lightly used area*), the less stringent enterococci saltwater single-sample maximum WQO may be applied to the freshwater creek (to be protective of the downstream beach). Alternative TMDLs are included in the Bacteria TMDL and will apply only if the usage frequency is modified in the Basin Plan.

The Bacteria TMDL includes WLAs and LAs for both wet and dry weather, expressed as the number of bacteria (in billion MPN per year for wet weather and billion MPN per month for dry weather). The wet-weather allocations include a 22 percent allowable exceedance frequency of the REC-1 single-sample maximum WQOs based on the reference system and antidegradation approach (RSAA), while the dry-weather allocations include a zero percent allowable exceedance frequency of the REC-1 geometric mean WQOs.

The bacteria TMDLs are expressed in terms of both concentration and on a mass loading basis. Concentration-based TMDLs are used to determine compliance with the TMDLs, while allocations were determined using the mass-based TMDLs. These values identify the loads that need to be reduced for the concentration-based TMDLs to be met in the receiving waters. The concentration-based TMDLs are expressed as the numeric objectives and allowable exceedance frequencies (Table 2-2). These same numeric targets were used to calculate the mass-based TMDLs under critical conditions. The mass-based wet- and dry-weather WLAs and LAs are presented below.

2.2.1.1 Wet-Weather Bacteria Allocations

To implement the single-sample bacteria objectives for waters designated REC-1 and to set wet-weather allocations using the single-sample targets, TMDL targets were set equal to the WQO (Table 2-2). In addition, the RSAA was applied, which allows for a 22 percent exceedance frequency according to analyses performed on data associated with Leo Carillo Beach, just north of Los Angeles. This 22 percent exceedance frequency was applied to the number of wet days in the critical year to determine the number of allowable exceedance days. The *total allowable load* associated with the TMDL is the allowable load based on the WQOs plus the modeled load associated with the allowable exceedance days during the critical wet year. The WLAs and LAs are then parsed out of this total allowable load according to the modeled relative land use contributions in the watershed. These contributions take both land use area and land use-specific modeled bacteria loading rates into consideration, among other factors that impact the model. The resulting WLAs and LAs by source are presented in Table 2-3.

Table 2-3. Wet-weather bacteria WLAs and LAs to the impaired segments of the Tecolote watershed

WLA/LA	Associated source	Bacteria type	Allocation (billion MPN/year)	Allocation (reduction required)
WLA	Municipal MS4	Fecal coliform	126,806	20.47%
		Total coliform	5,136,598	16.51%
		Enterococci	471,211	18.15%
		Enterococci*	471,630	18.08%
WLA	Caltrans	Fecal coliform	553	0.00%
		Total coliform	27,095	0.00%
		Enterococci	1,266	0.00%
		Enterococci*	1,266	0.00%
LA	Agriculture	Fecal coliform	0	0.00%
		Total coliform	0	0.00%
		Enterococci	0	0.00%
		Enterococci*	0	0.00%
LA	Open	Fecal coliform	101,963	0.00%
		Total coliform	1,216,077	0.00%
		Enterococci	131,284	0.00%
		Enterococci*	131,284	0.00%

* Alternative wet-weather enterococci allocations calculated using the WQOs associated with m*oderately to lightly used area* usage frequency. These alternative TMDLs only apply if the Basin Plan is amended to change the usage frequency.

While the mass-based wet-weather allocations provide the loads and load reductions required to achieve the numeric targets during the TMDL critical condition, compliance is determined through comparison with the WQOs. Specifically, at the end of the TMDL compliance schedule, bacteria densities for all wet-weather days cannot exceed the single-sample maximum REC-1 WQOs more than the allowable exceedance frequency (Table 2-2). Additionally, the bacteria densities must be less than or equal to the 30-day geometric mean REC-1 WQOs 100 percent of the time (i.e., both dry- and wet-weather days in a 30-day period can be considered collectively and cannot exceed the 30-day geometric mean WQOs presented in Table 2-2 for dry weather).

2.2.1.2 Dry-Weather Bacteria Allocations

Dry-weather WLAs and LAs for the REC-1 waters are also expressed as the number of bacteria; however, the period evaluated is monthly (in billion MPN per month) without any allowable exceedance days. Specifically to implement the geometric mean bacteria objectives for waters designated REC-1 and to set dry-weather allocations, TMDL targets were set equal to the dry-weather WQO (Table 2-2). The *total allowable load* associated with the TMDL is the allowable load calculated using the WQOs for all dry days during the critical wet year. The WLAs and LAs are then parsed out of this total allowable load according to the land use contributions in the watershed. The resulting allocations by source are presented in Table 2-4.

Table 2-4. Dry-weather bacteria WLAs and LAs to the impaired segments of the Tecolote watershed

WLA/LA	Associated source	Bacteria type	Allocation (billion MPN/month)	Allocation (reduction required)
WLA	Municipal MS4	Fecal coliform	234	94.59%
		Total coliform	1,171	94.51%
		Enterococci	39	98.94%
WLA	Caltrans	Fecal coliform	0	0.00%
		Total coliform	0	0.00%
		Enterococci	0	0.00%
LA	Agriculture	Fecal coliform	0	0.00%
		Total coliform	0	0.00%
		Enterococci	0	0.00%
LA	Open	Fecal coliform	0	0.00%
		Total coliform	0	0.00%
		Enterococci	0	0.00%

Similar to the wet-weather allocations, compliance with the dry-weather TMDLs is determined through comparison with the WQOs. Specifically, at the end of the TMDL compliance schedule, bacteria densities for all dry-weather days must be less than or equal to the 30-day geometric mean REC-1 WQOs 100 percent of the time (Table 2-2). Additionally, the bacteria densities must be consistent with the single-sample maximum REC-1 WQOs (presented in Table 2-2 for wet weather).

2.2.2 Additional Pollutants of Concern

The Tecolote watershed has several other impairments included on the 2010 303(d) list (metals [cadmium, copper, lead, and zinc], nutrients [nitrogen and phosphorous], sediment [turbidity], selenium, and toxicity). All the impairments have a numeric or narrative (or both) WQO in the Basin Plan, California Toxics Rule, or Ocean Plan. The existing TMDLs do not establish targets, WLAs, or LAs for these pollutants of concern. Applicable WQOs are presented in Table 2-5 and can be used for load reduction estimations.

Table 2-5. WQOs for additional pollutants of concern

Parameter	Numeric WQO	Narrative WQO
Cadmium*	Freshwater: 2.24 ug/L	Note on freshwater numeric WQO: Based on the following calculation using an assumed hardness of 100 mg/L WER * CFC * e^ [mC(ln h)+bC]
Copper*	Freshwater: 8.96 ug/L	Note on freshwater numeric WQO: Based on the following calculation using an assumed hardness of 100 mg/L WER * CFC * e^ [mC(ln h)+bC]
Lead*	Freshwater: 2.52 ug/L	Note on freshwater numeric WQO: Based on the following calculation using an assumed hardness of 100 mg/L WER * CFC * e^ [mC(ln h)+bC]
Zinc*	Freshwater: 118.14 ug/L	Note on freshwater numeric WQO: Based on the following calculation using an assumed hardness of 100 mg/L WER * CFC * e^ [mC(ln h)+bC]
Nitrogen	N/A	Inland surface waters, bays and estuaries and coastal lagoon waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growths cause nuisance or adversely affect beneficial uses. Concentrations of nitrogen and phosphorus, by themselves or in combination with other nutrients, shall be maintained at levels below those which stimulate algae and emergent plant growth. Threshold total phosphorus (P) concentrations shall not exceed 0.05 mg/l in any stream at the point where it enters any standing body of water, nor 0.025 mg/l in any standing body of water. A desired goal in order to prevent plant nuisance in streams and other flowing water appears to be 0.1 mg/l total P. These values are not to be exceeded more than 10 percent of the time unless studies of the specific waterbody in question clearly show that water quality objective changes are permissible and changes are approved by the Regional Board. Analogous threshold values have not been set for nitrogen compounds; however, natural ratios of nitrogen to phosphorus are to be determined by surveillance and monitoring and upheld. If data are lacking, a ratio of N:P = 10:1, on a weight to weight basis shall be used (SDRWQCB, 1994).
Phosphorous	N/A	
Turbidity	20 NTU	Concentrations not to be exceeded more than 10% of the time during any one-year period.
Selenium	0.05 mg/L	Note on numeric WQO: This numeric target is based on a MUN beneficial use. There are no selenium impairments for MUN waterbodies. There are impairments for non-MUN freshwater creeks; however, no WQO has been identified. Therefore, this WQO is provided for general assessment purposes only.
Toxicity	N/A	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiochemical responses in human, plant, animal, or aquatic life.

µg/L = micrograms per liter; mg/L = milligrams per liter; NTU = nephelometric turbidity units

* Metals WQOs are provided from the California Toxics Rule. The values reported are all CCC values, associated with chronic conditions to represent a worst case scenario. The equation uses several abbreviations. These are

h = hardness (mg/L)
WER = Water-Effect Ratio (assumed to be 1)
CCF = Chronic conversion factor (to convert from the total to the dissolved fraction)
mc = slope factor for chronic criteria
bc = y intercept for chronic criteria

2.3 TMDL Implementation Schedule

Full implementation of the TMDL for indicator bacteria is to be complete within 10 years of the effective date (April 4, 2011) for both wet- and dry-weather TMDLs, unless an alternative compliance schedule is approved as a part of the CLRP.

The TMDL prioritizes impaired waters for phased compliance on the basis of three factors: level of beach (marine or freshwater) swimmer usage, frequency of exceedances of WQOs, and existing programs designed to reduce bacteria load. Short-term strategies are to achieve a 50 percent reduction in dry-weather and wet-weather exceedances within 5 years for the priority 1 waterbodies, within 6 years for priority 2 waterbodies, and within 7 years for priority 3 waterbodies. The Tecolote watershed has only priority 1 waterbodies. The default TMDL compliance schedule is summarized in Table 2-6. This schedule applies to the Bacteria TMDL unless an alternative compliance schedule is approved as part of the CLRP.

Table 2-6. WLA and LA implementation schedules for the Tecolote watershed TMDLs

TMDL	Condition	Interim Phased Implementation	Final Compliance
Bacteria	Wet weather	April 4, 2016: 50% exceedance frequency reduction	April 4, 2021: 100% exceedance frequency reduction
	Dry weather	April 4, 2016: 50% exceedance frequency reduction	April 4, 2021: 100% exceedance frequency reduction

With a plan that meets all requirements of a CLRP, RPs must achieve compliance with the WLAs and LAs by 2031 (assuming a 20-year implementation schedule is approved as part of this CLRP). With the RPs' commitment to developing a CLRP Implementation Program following CLRP development, this provides additional assurance that the CLRP will meet its intended goals over the implementation period. The proposed comprehensive implementation schedule is presented along with implementation recommendations and the CLRP Implementation Program in Section 7.

2.4 CLRP Organization

The focus of this CLRP report is to recommend a strategy to support implementation of a comprehensive and efficient plan to reduce pollutant loadings in the Tecolote watershed. Section 1 describes the Tecolote watershed, the pollutants of concern, and the guiding principles of the CLRP and Section 2 provides additional detail on the TMDL, numeric targets, and TMDL implementation schedule. The remainder of this plan presents information and analyses performed to support the implementation recommendations (Section 7). These sections are described below.

- ***Section 3—Pollutant Source Characterization and Prioritization:*** This section identifies sources of the CLRP pollutants to the Tecolote watershed on the basis of monitoring data and literature searches. Existing loads are also quantified using the Loading Simulation in C++ (LSPC) watershed model. Depending on the pollutant of interest, some constituents were modeled directly using LSPC, other constituents are represented by a modeled surrogate (i.e., sediment), and other pollutants are not represented by the watershed loading results (for additional discussion, see Section 3.3). Watershed areas are subsequently prioritized on the basis of the spatial distribution of the existing loads.

- ***Section 4—Developing Nonstructural Solutions:*** Existing and proposed nonstructural solutions that address pollutant sources are discussed in Section 4. These solutions include public information, industrial and commercial facilities control programs, and development and construction programs, among others. This section connects these solutions with pollutant-generating activities (PGAs) identified throughout the watershed.

- ***Section 5— Developing Structural Solutions:*** Structural solutions are also required to achieve significant load reductions. This section presents existing, planned, and new identified opportunities for distributed and centralized structural BMPs. The BMPs were prioritized according to a ranking scheme including high priority management areas (HPMAs), available area, and slope, among other factors.
- ***Section 6—Identifying Water Resources Plans and Other Planning Objectives:*** This section presents integrated water resources opportunities that consider multiple benefits of water storage and pollutant reduction. In addition, water resources benefits associated with the centralized and distributed BMPs are discussed.
- ***Section 7—Implementation Recommendations:*** Recommended implementation opportunities are presented and are based on a synthesis of the information presented throughout this CLRP. These recommendations include nonstructural solutions, structural BMPs, water resources opportunities, and they consider cost. This section serves as a roadmap for CLRP Implementation Program development to achieve comprehensive load reductions for all pollutants of concern in the Tecolote watershed.
- ***Section 8—Monitoring Plans:*** A monitoring plan has been developed to consider data collection needs associated with the CLRP, including compliance and effectiveness monitoring. These data will support evaluation of load reductions.

3 Pollutant Source Characterization and Prioritization

This section identifies and characterizes potential point and nonpoint pollution sources in the Tecolote watershed. Discretely characterizing pollutant sources can be a cumbersome task because of the diverse nature of pollutant source types. Existing and selected strategies for pollutant source characterization (PSC) are presented in Pollutant Source Characterization Approach (Section 3.1). For the Tecolote CLRP efforts, potential and typical pollutant sources are classified into six categories and discussed in detail in the Pollutant Source Characterization Section (Section 3.2). Watershed modeling results with wet- and dry-weather pollutant loadings are presented in the Pollutant Loading Analysis section (Section 3.3). Prioritization of water quality areas based on pollutant loadings is presented in the Water Quality Prioritization Section (Section 3.4). Understanding and characterizing pollutant sources in the watershed will be useful in assessing HPMAs and implementing structural and nonstructural solutions.

3.1 Pollutant Source Characterization Approach

Typical pollutant sources can often contribute multiple pollutants to the environment. Pollutant sources can be as discrete as a point discharge or as indiscrete as landscaping activities. This section focuses on three strategies for pollutant source characterization. The goal of Section 3 is to identify and summarize the primary sources of pollutants and activities in the watershed. Previous efforts have been focused on characterizing and prioritizing bacterial sources through the Bacteria Conceptual Model developed by the San Diego MS4 Copermittees (Appendix A). Alternatively, PGAs have been identified and classified in the *Long-Term Effectiveness Assessment (LTEA) Report* (San Diego County 2011b). For the Tecolote CLRP, pollutant sources have been compiled into six broad source categories that are subject to existing programmatic oversight. These six programmatic categories incorporate potential pollutant sources that are recognized as PGAs (Table 3-1) or have been identified in the Bacterial Conceptual Model. These six programmatic categories are National Pollutant Discharge Elimination System (NPDES) discharges, road infrastructure, atmospheric deposition, waste sites, wastewater, and agricultural operations (Section 3.2). The three strategies to characterize pollutant sources are further described below.

Bacteria Conceptual Model

To characterize bacteria sources, the San Diego MS4 Copermittees recently developed a conceptual model to identify bacteria sources and transport pathways in regional watersheds. This conceptual model considers both intermittent and continual sources of bacteria under both wet- and dry-weather conditions. The development of this model is accompanied by a literature review, which identifies and summarizes studies that quantify sources and sinks for bacterial constituents in urban watersheds internationally. Findings in the literature review were used in developing the Bacterial Conceptual Model. A prioritization process was also incorporated into the conceptual model using available information in each watershed and potential bacterial sources. The prioritization is ultimately based on five themes that have different weighting factors: human health risk, magnitude, geographical distribution, frequency and controllability. Controllability is used as a secondary factor to support source scoring (Appendix A).

Sources of bacteria presented in the conceptual model are broken into three categories to differentiate the source relationship to human activity (Appendix A). The three categories of bacterial sources are (1) human origin; (2) non-human origin: anthropogenic; and (3) non-human origin: non-anthropogenic/natural origin. Sources of human origin identify bacteria from the human body. These sources are related to sewage infrastructure, wastewater treatment plants, mobile sources, reusing wastewater and biosolids, garbage, and non-storm water discharges. Sources of anthropogenic, non-human origin identify bacteria resulting from human activities but not the human body. These sources are related to domestic animals, manure reuse (nonagricultural activities), landscaping, solid/liquid waste, agricultural activities, commercial/industrial processes, secondary wildlife (birds and rodents), reclaimed water, and biofilm/regrowth in MS4 infrastructure. Last, sources of non-anthropogenic origin identify bacteria independent of human activity and naturally occurring such as wildlife, wrackline (flies and decaying plants), plants, algae, and soil. Sources in these three main source type categories have a potential pathway into an MS4 or receiving water (creek, river, lagoon, or ocean) during both wet- and dry-weather conditions. Depictions of these three bacterial sources and further discussion on the conceptual model are presented in Appendix A.

LTEA Pollutant Generating Activities (PGAs)

PGAs are presented in the 2011 LTEA (San Diego County 2011b). PGAs are activities or land uses from which the discharge of pollutants or substances of concern to water quality can reasonably be expected because of the nature of the associated operations and actions, and that, thus, might need supplemental practices, controls, site enhancements, or other measures to prevent the discharge of pollutants. PGAs are specific in nature because they identify nearly every activity that can have a source loading potential. These specific activities are important to identify because they can be specifically targeted through the use of many nonstructural BMPs (for a more detailed discussion on PGAs and their use in the CLRP, see Section 4).

CLRP Approach

To comprehensively characterize pollutant sources in the Tecolote watershed, the PGAs were collectively assessed and categorized into the six programmatic pollutant source categories. The relationship between categorical PGAs and the six programmatic pollutant source categories is presented in Table 3-1. The PGA categories in Table 3-1 are a consolidation of the original PGA categories and include the addition of homeless encampments and equestrian properties and horse-related uses (Section 4). Specifically, for this table, the 37 predefined categories of PGAs presented in the 2011 LTEA have been consolidated where there was significant overlap of PGAs. As shown in Table 3-1, the six programmatic pollutant source categories encompass all the PGA activities and in many cases PGA activities are in several categories.

Table 3-1 also demonstrates that the three bacteria source categories founded in the Bacteria Conceptual Model (Appendix A) are in at least one of the six programmatic pollutant source categories. The six source categories used in the CLRP efforts and discussed in the following sections cover a range of PGAs, bacteria sources, and address other pollutants not necessarily generated in the watershed such as those from atmospheric deposition. These six categories present point and nonpoint sources that can be controlled under implementation measures and are subject to programmatic oversight.

Table 3-1. PSC linkages

	PSC categories					
Existing categories	NPDES sources	Road infrastructure	Atmospheric deposition	Waste sites	Wastewater sources	Agricultural operations
PGA categories						
Residential Uses	✓		✓	✓	✓	✓
Development & Redevelopment	✓		✓			
MS4	✓				✓	
Maintenance & Storage yards	✓			✓		
Park & Rec Facilities Incl. Golf Courses	✓				✓	✓
Auto body or repair shops	✓		✓	✓		
Equipment Maintenance & Repair	✓		✓	✓		

Existing categories	PSC categories					
	NPDES sources	Road infrastructure	Atmospheric deposition	Waste sites	Wastewater sources	Agricultural operations
Mobile Vehicle Washing or Repair	✓		✓	✓	✓	
Mobile Power Washing	✓		✓		✓	
Parking Lots	✓	✓	✓	✓		
Retail or Wholesale Fueling	✓		✓	✓		
Pest Control Services	✓		✓			✓
Eating & Drinking Establishments	✓			✓	✓	
Mobile Cleaning	✓		✓		✓	
General Contractors	✓		✓			
Zoos, Gardens, Nurseries & Greenhouses	✓		✓		✓	✓
Mobile Landscaping	✓		✓			✓
Marinas	✓		✓	✓	✓	
Animal Kennels & Facilities	✓				✓	
Outdoor Storage & Building Materials Facilities	✓			✓		
Equestrian properties & horse related uses	✓				✓	✓
Homeless Encampments	✓				✓	
Surface transportation System	✓	✓	✓	✓		
Bacteria conceptual model source categories						
Human origin	✓			✓	✓	
Anthropogenic, non-human origin	✓			✓		✓
Non-anthropogenic origin	✓					

3.2 Pollutant Source Characterization

For the Tecolote CLRP, the characterization of pollutant sources in the watershed is critical in assessing areas of multi-pollutant concern or HPMAs (Section 3.4). These efforts are then applied and used in identifying and prioritizing BMP efforts discussed in Sections 4 and 5. To comprehensively characterize pollutant sources in the Tecolote watershed, pollutant sources have been divided into six programmatic categories: NPDES discharges, road infrastructure, atmospheric deposition, waste sites, wastewater, and agricultural operations. The extent of these point and nonpoint sources in the Tecolote watershed is based on information gathered from several water quality monitoring programs and special studies conducted in the watershed.

For this watershed, most of the water quality monitoring is generally conducted under several countywide, regulatory monitoring programs. These monitoring programs are the MS4 monitoring program, the Coastal Storm Drain Monitoring (CSDM) Program, Stormwater Monitoring Coalition (SMC) Regional Bioassessment, Jurisdictional Dry Weather Monitoring Programs (JURMPs), and the Mass Loading Station (MLS) and Temporary Watershed Assessment Stations (TWAS) Ambient and Storm Monitoring Program. The results of these programs are presented in the *San Diego County*

Copermittees Annual Urban Runoff Monitoring Report and the *2005-2010 San Diego Stormwater Copermittees LTEA Report*. In addition, several special studies have been conducted in the Tecolote watershed to support TMDL development, especially for source assessment and land use-specific source characterizations. These studies were also helpful to characterize sources for the CLRP pollutants of concern.

Monitoring locations for many of the aforementioned programs are illustrated in Figure 3-1. Specifically for Tecolote, the monitoring stations in Figure 3-1 refer to MS4 monitoring programs (dry-weather monitoring, outfall monitoring, NPDES receiving water), special studies, and bioassessment monitoring efforts. The Tecolote watershed has one MLS monitoring site, which is along the downstream waters of Tecolote Creek. The drainage area of the MLS represents the water quality in the majority of the watershed. One TWAS station is in the watershed and is upstream of the mouth of Tecolote Creek. Water quality of this TWAS is representative of the upper west portion of the Tecolote Creek watershed. The impaired waterbody is downstream of the MLS drainage area.

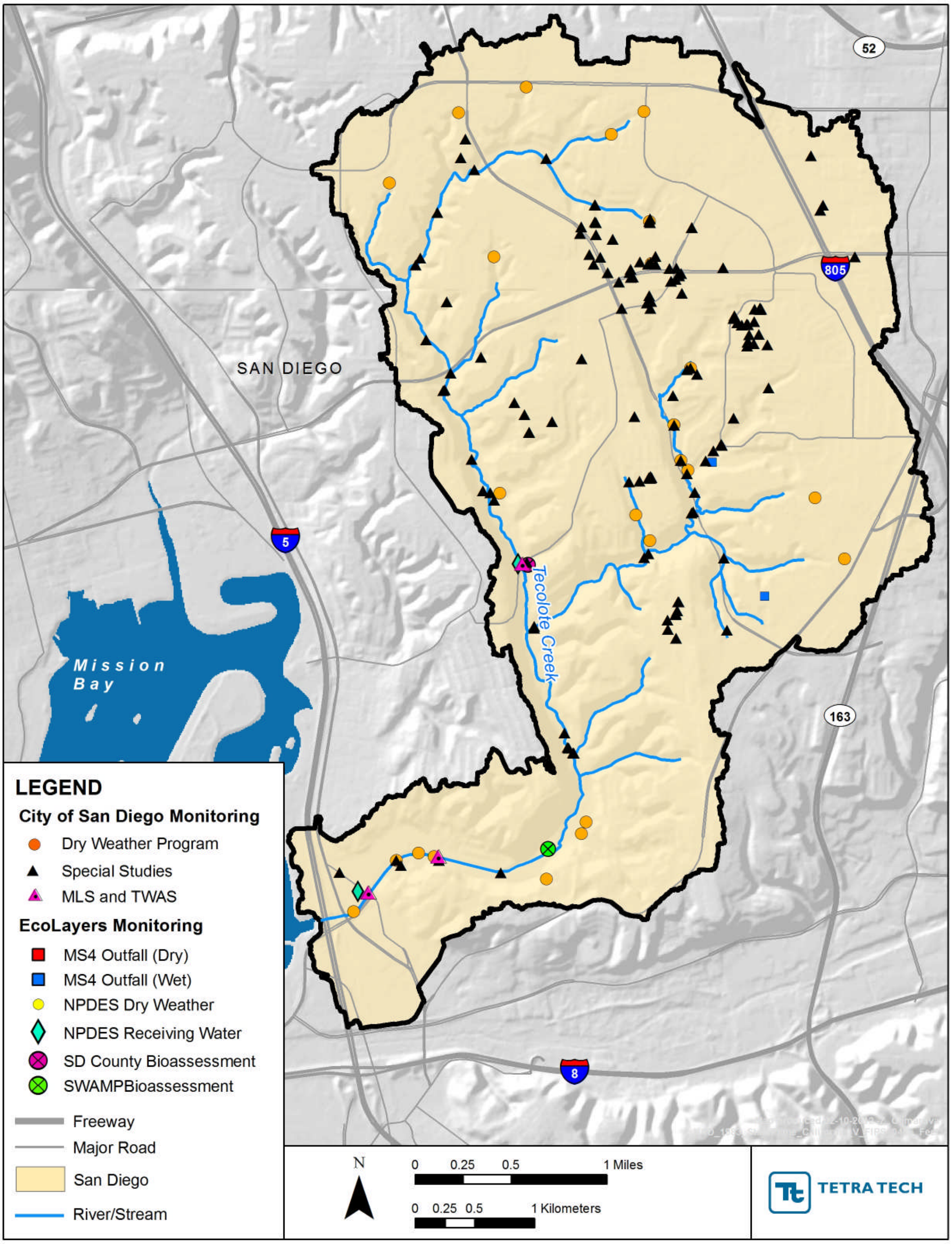

Figure 3-1. Monitoring locations in the Tecolote watershed

Storm water pollutants in the Tecolote watershed that will be quantified in the CLRP pollutant loading analysis (Section 3.3) are bacteria (enterococci, fecal coliform, and total coliform), nutrients (total nitrogen and total phosphorous), metals (copper, lead, and zinc), and sediment (TSS/turbidity). Typical sources for these pollutants (along with cadmium) are summarized in Table 3-2. Other pollutants are not modeled directly (cadmium) or are not represented by the watershed loading results (toxicity and selenium), as described in Section 3.3; however, recommended management activities to address sediment and other modeled pollutants will also likely reduce loadings associated with these pollutants. In some cases, pollutants not included in the impairment list are described in the PSC because these pollutants (i.e., organic pollutants) could be related to existing impairments such as toxicity.

Table 3-2. Typical sources of pollutants

Potential source	Pollutant				Key references
	Bacteria	Nutrients	Metals	TSS/ turbidity	
Section 3.2.1: NPDES sources					
Residential land areas	•	•		•	Regional Source Identification Monitoring Program (San Diego County 2011a); SDRWQCB 2010; City of San Diego 2009c; Gregorio and Moore 2004; LARWQCB 2002; Lattin et al. 2004
Agricultural activities (i.e., animal operations, land applications)	•	•		•	County of Los Angeles 2010; City of San Diego 2010a; USEPA 2011d; Appendix A
Metallurgical industries/activities			•		County of Los Angeles 2010; San Diego County 2011c
Construction activities			•	•	County of Los Angeles 2010; USEPA 2011d
Industrial/municipal activities	•		•		Gregorio and Moore 2004; Tiefenthaler et al. 2007, Lattin et al. 2004; Appendix A
POTW discharges			•		Sabin et al. 2004
Landscaping, fertilizers (residential and agricultural applications)		•			County of Los Angeles 2010; USEPA 2011d
Homeless encampments	•				City of San Diego 2009a; Appendix A
Pet waste	•	•			USEPA 2011d; Appendix A
Wildlife	•				County of Los Angeles 2010; LARWQCB 2002; Appendix A
Native geology		•	•		County of Los Angeles 2010; LARWQCB 2002
Land surface erosion			•	•	County of Los Angeles 2010
Detergents		•			USEPA 2011d
Car washing				•	County of Los Angeles 2010; USEPA 2011d
Section 3.2.2: Road infrastructure					
Transportation sources (i.e., copper brake pads, tire wear)			•		County of Los Angeles 2010; USEPA 2011d; Schueler and Holland 2000; Stein et al. 2006
Pavement erosion			•	•	County of Los Angeles 2010; Caltrans 2003a
Section 3.2.2.3: Atmospheric deposition					

Potential source	Pollutant: Bacteria	Nutrients	Metals	TSS/ turbidity	Key references
Metallurgical industries/activities (i.e., mining, smelting, refining, iron/steel industry)			•		County of Los Angeles 2010; San Diego County 2011c; Sabin et al. 2005, 2006a
Construction activities			•		County of Los Angeles 2010; USEPA 2011d
Roofing			•		County of Los Angeles 2010
Resuspension of historic emissions in road dusts and soil particles			•		Sabin and Schiff 2007; Sabin et al. 2005
Land surface erosion		•			Sutula et al. 2004
Section 3.2.4: Waste sites					
Land surface erosion	•		•	•	County of Los Angeles 2010; City of San Diego 1938, 2010c; Appendix A
Vermin	•				City of San Diego 1938; Appendix A
Section 3.2.5: Wastewater discharges					
Sewer Leaks, sanitary sewer overflows (SSOs), illicit discharges, septic systems	•	•		•	County of Los Angeles 2010; SDRWQCB 2010; SWRCB 2011d; Stein and Tiefenthaler 2005; Appendix A
POTW discharges		•	•		Sabin et al. 2004
Section 3.2.6: Agricultural operations					
Wildlife	•				County of Los Angeles 2010; LARWQCB 2002; Appendix A
Agricultural activities (i.e., animal operations, land applications)	•	•		•	County of Los Angeles 2010; City of San Diego 2010a; USEPA 2011d; Appendix A
Fertilizers (residential and agricultural)	•	•			County of Los Angeles 2010; USEPA 2011d; Appendix A
Land surface erosion			•	•	County of Los Angeles 2010

3.2.1 NPDES Sources

A point source, according to the regulations at title 40 of the *Code of Federal Regulations* section 122.3, is any discernible, confined, and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated AFO, landfill leachate collection system, and vessel or other floating craft from which pollutants are or can be discharged. The NPDES program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. Point sources also include storm water that is regulated through the NPDES program.

Storm water runoff in the Tecolote watershed is regulated through several types of permits including MS4 permits, a statewide storm water permit for Caltrans; a statewide Construction Activities Storm Water General Permit; and a statewide Industrial Activities Storm Water General Permit. In addition, major and minor NPDES permits are issued for industrial and manufacturing activities. Other minor permits are issued to residential and apartment communities, medical facilities, laboratories, and other various agencies. NPDES permits in the Tecolote watershed are summarized in Table 3-3 and shown in Figure 3-2.

According to the Storm Water Multiple Application and Report Tracking System (SMARTS; SWRCB 2011a, 2011b), 13 NPDES dischargers are in the Tecolote watershed (Table 3-3). This includes the Caltrans statewide storm water discharge permit, which authorizes storm water discharges from Caltrans properties and facilities, such as the state highway system, park-and-ride facilities, and maintenance yards. Most of these discharges eventually run to a city storm drain. The NPDES statewide industrial general permit regulates storm water discharges and authorized non-storm water discharges from 10 categories of industrial facilities, including manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. In the Tecolote watershed are six industrial permits. In addition, is an NPDES statewide construction permit that regulates storm water discharges from construction sites that resulted in land disturbances equal to or greater than one acre. Five construction permits are in the watershed. Note that construction permits are temporary; however, including them in this evaluation is an important component for understanding historical monitoring data (TSS for example) and serves as an indicator of the overall land disturbance that can occur in certain areas of the watershed. The permits overlap in time and space; therefore, as an aggregate, they represent a more continuous source. In addition, sediment that leaves a site can remain in the drainage system for some time.

Municipal storm water, regulated by the MS4 permit (Table 3-3), is a more general permit category because it considers loading associated with various sources and activities (i.e., generally land-use based). Locations of the NPDES permits are illustrated in Figure 3-2.

Table 3-3. NPDES permits in the Tecolote watershed

Permit type	Tecolote watershed
Publicly owned treatment works (POTWs)	0
Municipal storm water	1
Industrial storm water	6
Construction storm water	5
Caltrans storm water	1
Other NPDES discharges	0
Total NPDES Discharges	**13**

Sources: SWRCB 2011a, 2011b.

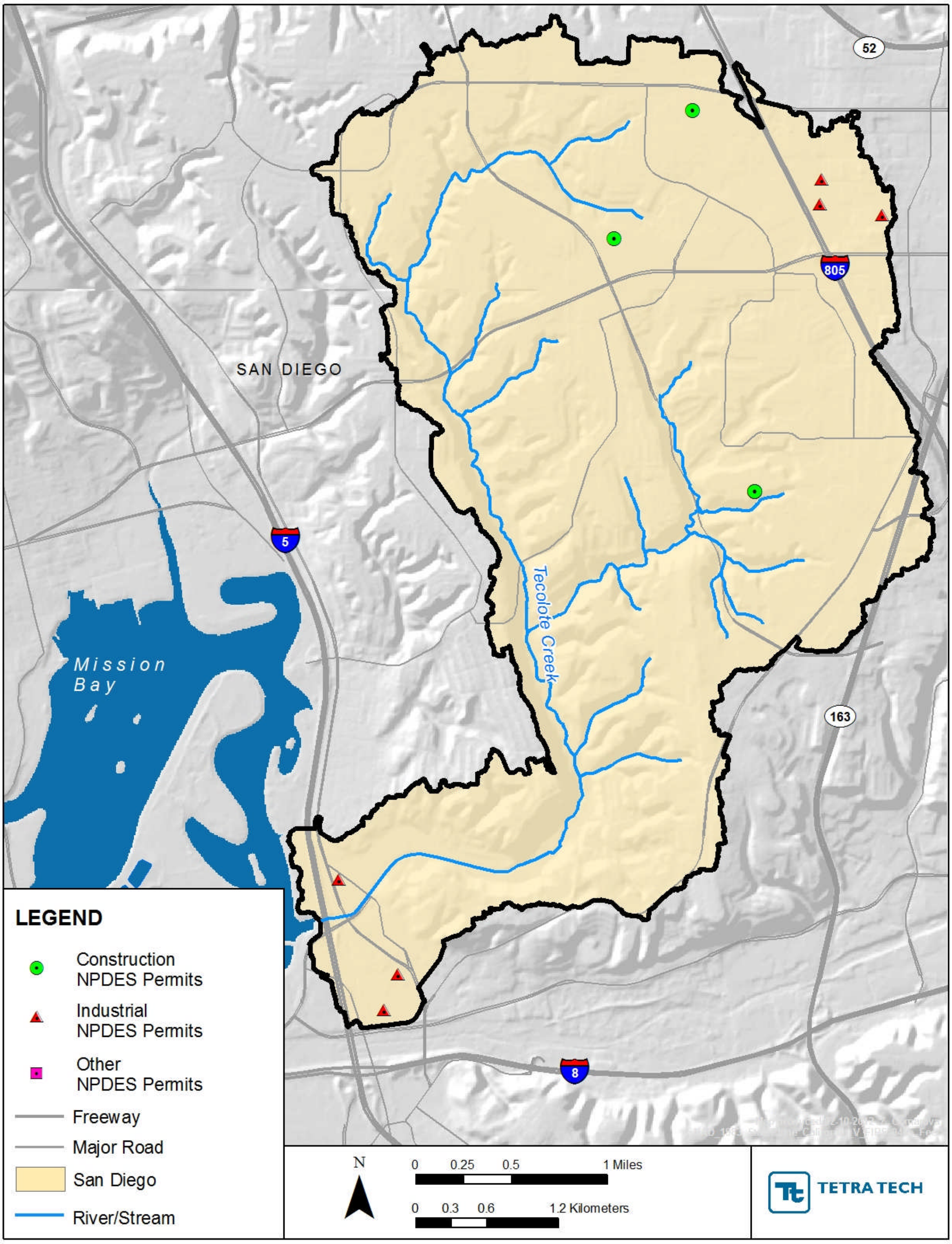

Figure 3-2. NPDES permits in the Tecolote watershed

Storm water outfalls are point sources of storm water runoff into receiving waterbodies and are regulated by the MS4 permit described above. The location and density of these outfalls can serve as a general indicator of the significance of storm water-based sources in the drainage area. The locations of storm water outfalls in the Tecolote watershed are shown in Figure 3-3. Many outfalls are throughout the entire watershed. Typically, the *first flush* of a storm discharges greater concentrations or mass in the early part of the storm event (Caltrans 2005) and therefore, understanding the drainage areas of storm water outfalls would be useful in identifying potential pollutant sources. The imperviousness of a drainage area (Figure 1-3) also provides an indication of the degree of urbanization and the amount of storm water that can be conveyed directly to the MS4 and released into receiving waters. Because the entire watershed is developed, storm drain effluent throughout the watershed will contain storm water pollutants derived from residential and transportation land use activities such as landscaping, car washing, pet waste, and vehicle wear.

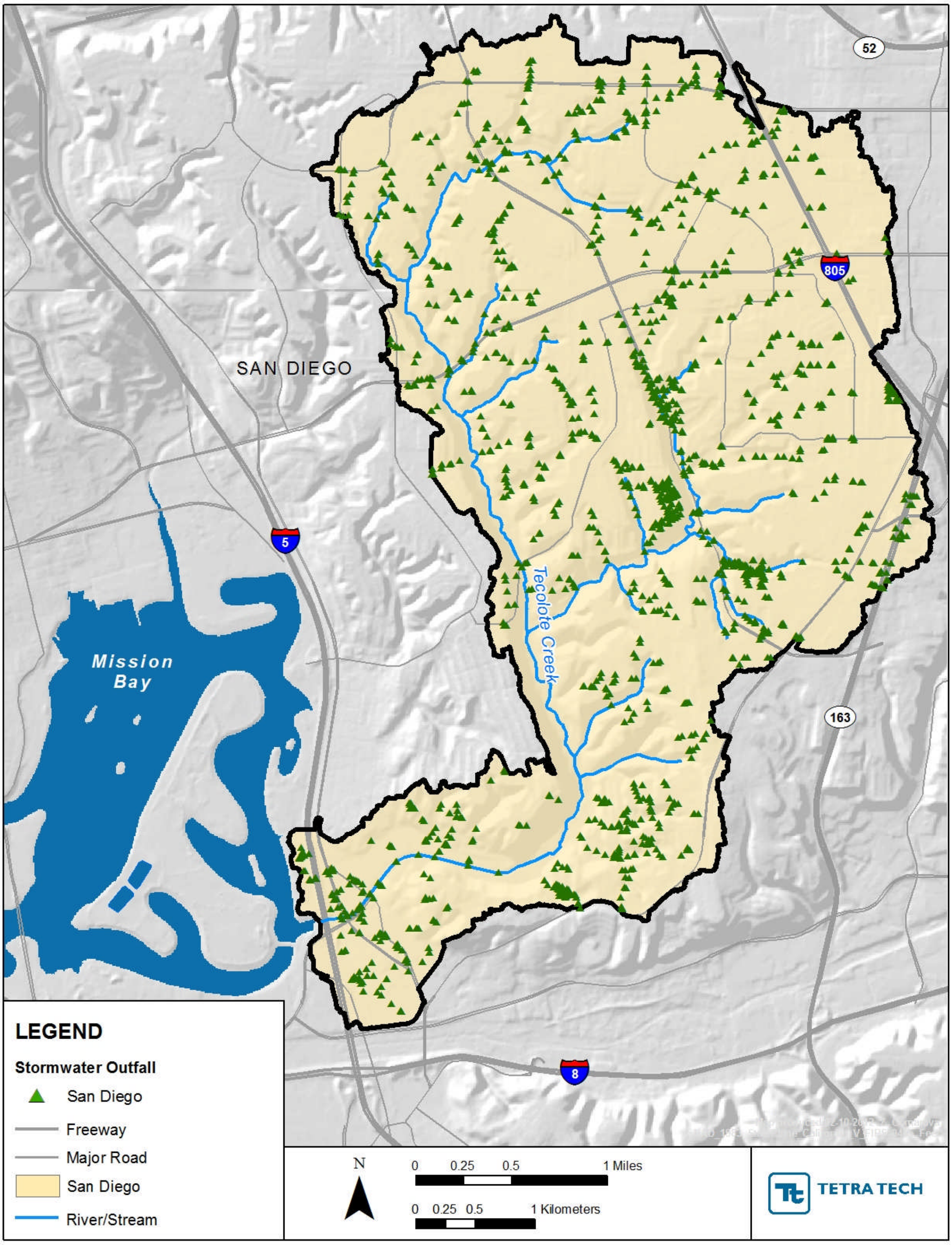

Figure 3-3. Storm water outfalls in the Tecolote watershed

Discharges from residential, commercial, transportation, and industrial areas can be a significant source of pollutant loads. The following provides additional discussion regarding the presence of pollutants in storm water runoff and other permitted discharges, their extent, and their potential sources in the Tecolote watershed. Storm water pollutants in the Tecolote watershed that will be addressed in this PSC are indicator bacteria (enterococci, fecal coliform, and total coliform), nutrients (total nitrogen and total phosphorous), metals (cadmium, copper, lead, and zinc), and sediment (TSS/turbidity).

3.2.1.1 Bacteria

Bacterial contamination is generated throughout the watershed and then transported through the storm drain system regulated under the MS4 permit (SDRWQCB 2010; Griffith and Ferguson 2011). Specific sources of bacteria are associated with all three categories (human sources, anthropogenic sources, and non-anthropogenic sources) presented in the bacteria conceptual model (Appendix A). Storm drain system discharges can have elevated levels of bacterial indicators from sanitary sewer leaks and spills; illicit connections of sanitary lines to the storm drain system; runoff from homeless encampments; pet waste; organic debris from gardens, landscaping and parks; food waste; and illegal discharges from recreational vehicle holding tanks, among others (SDRWQCB 2010; LARWQCB 2006; Stein and Tiefenthaler 2005; Stein and Yoon 2007; Gregario and Moore 2004). A bacterial source study of Mission Bay determined that bacterial loadings from storm water discharges are most significant in the San Diego region wet season (December through March) (Schiff and Kinney 2001). Dry-weather bacteria loadings from storm drains contribute substantial concentrations of bacteria and metals, which can be attributed to illicit discharges, permitted periodic discharges of industrial or construction-related effluent, and inherent variability in storm drain discharges (Stein and Tiefenthaler 2005). The bacteria indicators used to assess water quality are not specific to human sewage; therefore, natural influences of fecal matter from animals and birds can also be a source of elevated levels of bacteria (Stein and Yoon 2007; LARWQCB 2002). Additionally, vegetation and food waste can be a source of elevated levels of total coliform bacteria (LARWQCB 2006). These potential point and nonpoint sources of bacteria are summarized in Table 3-2.

According to the assessment of several monitoring programs, the Mission Bay and La Jolla *Watershed Urban Runoff Management Program* (WURMP) *Annual Report* Copermittee (City of San Diego) has determined that indicator bacteria is a high-priority water quality pollutant throughout the WMA, including the Tecolote HA (Griffith and Ferguson 2011; San Diego County 2011a, 2011b). Several monitoring programs including the MS4 Outfall monitoring program, LTEA, Jurisdictional Dry Weather Monitoring Program, and the CSDM Program have reported elevated levels of bacteria in the Tecolote watershed. The assessment and findings of these programs are discussed below.

The MS4 Outfall monitoring program is designed to characterize pollutant discharges from MS4 outfalls and to assess whether these discharges contribute to water quality problems in receiving waters. In 2009 the MS4 Outfall monitoring program indicated that bacteria are a common high-priority constituent for both wet- and dry-weather flows throughout the Tecolote watershed (San Diego County 2011a). During wet weather, fecal coliform is a high-priority constituent in both MS4 and receiving waters. Bacterial loading into Mission Bay is most significant in the wet-weather season (December through March) in the San Diego region (Schiff and Kinney 2001). In dry-weather conditions, enterococci is a high-priority pollutant in MS4 outfalls but only a priority in receiving waters in the upper-west portions of the watershed (TWAS-2 drainage area). For both wet- and dry-weather conditions, receiving water trends in the current LTEA (2005-2010) data indicate that indicator bacteria has maintained as a high-priority constituent at MLS and TWAS-2 compared to the Baseline Long-Term Effectiveness Assessment (BLTEA) conducted in 2005. A population center with low-density residential areas throughout the watershed (Figure 1-2) could be responsible for the number of bacteria exceedances recorded in the area. Residential land uses are likely contributors of fecal coliforms during wet-weather events as determined by the 2009–2010 monitoring season for the Regional Source Identification Program and other Southern California studies (San Diego County 2011a; Gregorio and Moore 2004). In addition, elevated levels of bacteria during dry weather can be attributed to nonpoint sources such as wildlife that reside in parks and open space (Stein and Yoon 2007; LARWQCB 2002).

In the 2009 JURMP, 25 stations in the Tecolote watershed sampled for *Enterococcus*, fecal coliform, and total coliform. The sampling results were compared to dry-weather action levels, which are typically higher than benchmarks to facilitate illegal connection and illicit discharges (ICID) investigations. The results of the 2009 Jurisdiction Dry Weather Monitoring indicated five exceedances for *Enterococcus*, one for fecal coliform, and six for total coliform (San Diego County 2011a) throughout the Mission Bay and La Jolla WMA. Overall, indicator bacteria had less than 10 percent exceedances. Although the results of this program cater to an area larger than the Tecolote watershed, bacteria are present during dry weather, which could be indicative of illegal sanitary line connections and discharges, irrigation runoff, wildlife, and homeless encampments (SDRWQCB 2010; City of San Diego 2009b; Stein and Tiefenthaler 2005; Stein and Yoon 2007). The 2009–2010 CSDM Program had no stations at the mouth of Tecolote Creek. The closest monitoring station was at manhole along Cudahy Creek, which experienced 6 *Enterococcus* exceedances out of 11 sampling events. Rain events in the monitoring period (October 1, 2009, through September 30, 2010) appear to be the driving force around the storm drain exceedances. Historically, however, East Mission Bay, to which Tecolote Creek discharges, has been known to have elevated bacteria. In addition to avian sources, East Mission Bay also gets very little water exchange because of the geographic location, which can contribute to the elevated bacteria levels (San Diego County 2011a).

3.2.1.2 Nutrients (Nitrogen, Phosphorous)

Potential sources of nutrients across the watershed include fertilizer used for lawns and landscaping; organic debris from gardens, landscaping, and parks; phosphorus in detergents used to wash cars or driveways; trash such as food wastes; domestic animal waste; and human waste from areas inhabited by the homeless. Nutrients from land-use activities and those that are atmospherically deposited build up, particularly on impervious surfaces, and are washed into waterways through storm drains. Nutrient loading is often associated with specific land use practices. For example, high nitrogen and phosphorus loadings are associated with urban wet-weather runoff from residential, commercial, and industrial land uses (SCCWRP 2010; LARWQCB 2003; USEPA 2003a; Sutula et al. 2004). A summary of potential point and nonpoint sources of nutrient is shown in Table 3-2.

According to the assessments from several monitoring programs, nutrients are considered a high-priority pollutant throughout the watershed during ambient conditions and a medium priority during wet conditions. In dry weather, nutrients are a high priority at the mouth of Tecolote Creek (MLS) and a medium priority upstream at TWAS-2 (San Diego County 2011b) suggesting that nutrient contribution is more likely in the downstream and lower portions of the Tecolote watershed.

Total nitrogen was a dry-weather priority constituent in both MS4 and receiving waters during the 2009–2010 monitoring season. The SMC program and the MS4 program have detected elevated total nitrogen concentrations in the MLS drainage area in receiving waters and urban runoff, which might be indicative of the residential land uses in the watershed. Upstream in the TWAS-2 drainage area, total nitrogen is not a priority in receiving waters but is a priority in runoff as indicated by the MS4 outfall results. In a recent data evaluation of 2000–2010 water quality data in Tecolote Creek, data from two sites (33 samples) indicated that 29 samples (87.9 percent) exceeded the Basin Plan WQOs for total nitrogen (City of San Diego 2010b).

Similarly, total phosphorous was a dry-weather priority constituent in both MS4 and receiving waters during the 2009-2010 monitoring seasons. The NPDES program and the MS4 program have detected elevated total phosphorous concentrations within the MLS drainage area in receiving waters and urban runoff (again, possibly because of the residential land use in the watershed). Upstream in the TWAS-2 drainage area, total phosphorous is not a priority in receiving waters but is a priority in runoff as indicated by the MS4 outfall results. In a recent data evaluation of 2000–2010 water quality data in Tecolote Creek, data from one site (35 samples) indicated that 34 samples (97.1 percent) exceeded the Basin Plan WQOs for total phosphorous (City of San Diego 2010b).

3.2.1.3 Metals (Cadmium, Copper, Lead, and Zinc)

Heavy metals including cadmium, copper, lead, and zinc are considered high-priority water quality problems in the Tecolote Creek watershed. Although naturally occurring, concentrations of these metals can be of concern in urban environments because of potential industrial and urban discharges. A variety of industrial uses could contribute to concentrations of these metals including automotive scrap yards, repair shops and recycling facilities (Tiefenthaler et al. 2007). Land use sources, including the general wear and tear of automotive parts, can be a significant source of metals in urban areas with a high density of roadway infrastructure. For example, brake wear can release copper, lead, and zinc into the environment, and tire wear can contribute to concentrations of copper and lead in urban runoff (Sansalone and Buchberger 1997). Motor oil and automotive coolants spills are another potential land use source of metals. Pesticides, algaecides, wood preservatives, galvanized metals, and paints used across the watershed can also contain these metals. In the Tecolote watershed, sources for these heavy metals have been identified as automotive repair, maintenance, fueling, cleaning and painting locations, botanical or zoological gardens and nurseries/greenhouses, metal fabrication facilities, and transportation activities and facilities (Griffith and Ferguson 2011; Tiefenthaler et al. 2007). A summary of point and nonpoint sources of metals are presented in Table 3-2.

Aerial deposition can also be a significant source of emissions of metals to the MS4 and waterbodies in the Tecolote watershed (see also Section 3.2.2.3). In 2009 an aerial deposition study in Chollas Creek found that aerial deposition of copper, lead, and zinc accounts for 100, 29 and 74 percent, respectively, of the average load discharged via storm water runoff (City of San Diego 2009c). Findings of this study indicate transportation sources and parcel-based sources play a role in metal deposition in the watershed. The study determined that copper from automotive brake pads was a major contributor of dissolved copper to San Diego waterways and that commercial and industrial land uses contributed significant amounts of copper, lead, and zinc compared to residential land uses. For instance, industrial and commercial activities with uncovered outdoor metal storage and outdoor operations were positively correlated to high levels of copper, lead, and zinc; while metal rooftops in poor condition (e.g., deteriorating or rust evident) were found to contribute significantly to total and dissolved zinc.

Tecolote Creek was listed for cadmium, copper, lead, and zinc in 2006. Listing decisions were made before 2006, and no new data were assessed in 2008. In 2010 a thorough data evaluation of all available data for Tecolote Creek took place. The data analysis results indicate that 4 of the 12 beneficial use impairments might be considered for delisting including dissolved cadmium, dissolved copper, dissolved lead, and dissolved zinc. Data used in this evaluation were collected under the Surface Ambient Water Monitoring Program (SWAMP), SMC, San Diego Regional MS4 NPDES Permit, and the City of San Diego Tecolote Phases I, II, and III. From the 2000–2010 data, dissolved cadmium (33 samples at one site), lead (51 samples from five sites), and zinc (51 samples from five sites) demonstrated no exceedances of the respective CTR criteria. Of the 51 samples collected at five sites, copper had one exceedance (2 percent). For such a sample size, eight is the maximum allowable number of exceedances for delisting.

Monitoring program activities including the ambient monitoring, SMC Regional Bioassessment, wet-weather monitoring, MS4 Outfall monitoring, Regional Source Identification Monitoring, and the CSDM program did not monitor for cadmium, copper, lead, and zinc or did not find exceedances of those in the Tecolote watershed. Dissolved cadmium, dissolved copper, dissolved lead, and dissolved zinc are monitoring under the JURMP. In the 2009–2010 Urban Runoff Monitoring Annual Report, only one exceedance of dissolved copper was found throughout the Mission Bay and La Jolla Shores WMA; no exceedances of dissolved cadmium, dissolved lead, and dissolved zinc were found.

3.2.1.4 Sediment/Turbidity

Sources of sediment are generally the same under both wet- and dry-weather conditions; however, transport mechanisms can vary significantly. For example, dry-weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn irrigation runoff. These nuisance flows pick up and transport sediment into receiving waters through the MS4. Typically, dry-weather flows carry less sediment but can contribute significantly to hydromodifications that can alter flow regimes and lead to increased stream bank erosion. Alternatively, wet-weather loading is dominated by episodic storm flows that wash off sediment that has built up on the surface of all land use types in a watershed during dry periods. Of great concern, wet-weather runoff events can lead to an increase in watershed erosion including creating gullies and increasing stream bank erosion. Urban development typically increases sediment transport rates and leads to excessive sedimentation in receiving waters. Potential effects include degradation or loss of important habitat, reduced stream channel capacity, reduced tidal mixing in estuaries and indirect impacts. A summary of point and nonpoint sources of sediment is presented in Table 3-2.

In the Tecolote watershed, three types of rainfall erosion and sedimentation have been identified as occurring in the Tecolote Canyon Natural Park—streambank erosion, gullying, and overland sheet and rill erosion. Erosion in the park results in substantial sedimentation into the mouth of Tecolote Creek and Mission Bay. From 2004 field observations, one of the major areas of concern for erosion occurs in the southern portion of the Tecolote Canyon Park where runoff from a storm drain outlet associated with University of San Diego has resulted in substantial erosion of the park's main access road and the adjacent slopes of Tecolote Creek (City of San Diego 2006). Urban runoff creates a serious problem in the park as most areas have moderate or high erosion potential. For instance, bank erosion is a problem in several places along nature trails and in tributary canyons. Further, rills (small channels created by erosion) are created from point runoff in existing roads and trails, and scouring is occurring at unpaved road/trail stream crossings (City of San Diego 2006).

During wet weather, TSS and turbidity are high-priority constituents in receiving waters throughout the Tecolote Creek watershed, specifically in the MLS and TWAS-2 drainage areas (San Diego County 2011b). Comparatively, TSS and turbidity have been reported as a medium-low priority in the BLTEA conducted in 2000 to 2005 (San Diego County 2011b). In a data evaluation of 2000–2010 water quality data in Tecolote Creek, data from five sites (48 samples) indicated that 22 samples (45.8 percent) exceeded the Basin Plan WQOs for turbidity (City of San Diego 2010b).

Under ambient conditions, TSS and turbidity are not priority pollutants. Urban runoff results from the MS4 Outfall program also do not indicate TSS or turbidity to be priority constituents during wet- and dry-weather conditions (San Diego County 2011b). Elevated levels of TSS and turbidity in receiving waters but not in MS4 outfalls suggest that sediment loading can be attributed to erosion from stream banks and beds across the watershed rather than the MS4.

3.2.2 Road Infrastructure

Supporting large residential areas is often a complementary amount of roadways, freeways, and transportation land uses. Runoff from highways and roads carries a significant load of pollutants to nearby waterways. Typical contaminants associated with highways, roads, vehicles, and roadside landscapes include sediment, heavy metals, oils and grease, debris, fertilizers, and pesticides, among others (Caltrans 2003c). In general, pollutant loads generated from highways and roads are regulated under either the Caltrans or MS4 permits because most of the runoff eventually flows to a municipal storm drain. Caltrans actively implements storm water controls including sweeping, storm drain inlet maintenance, and a full suite of activities provided in its NPDES permit to address the transport of pollutants from roadway sources (Caltrans 2003a, 2003c).

Table 3-4 shows common sources of contaminants in runoff from roads and highways. For the Tecolote watershed, typical roadway pollutants of concern are sediment, metals (cadmium, copper, lead, and zinc), and nutrients, indicated by the shading in Table 3-4. Most of the contaminants in the table are associated with sediment delivered from the roadways. These contaminants from roadway runoff remain either bound to sediment or are dissolved. Cadmium, chromium, copper, lead, and zinc are generally particulate-bound, whereas higher molecular weight PAHs are generally more associated with suspended solids (Shinya et al. 2000). Road density can be used to indicate the extent of traffic volume and consequential pollutant generation. Road density is defined as the total area of the impervious road pavement. A calculation of road density percentile distribution suggests that a cutoff for road density of 20 percent could delineate high density using an inflection point in the data; low and medium road density categories were further subdivided. Therefore, the following three categories of road network density are defined:

- High Road Density: Road density is greater than 20 percent.
- Medium Road Density: Road density is between 10 and 20 percent.
- Low Road Density: Road density is less than or equal to 10 percent.

Most of the Tecolote watershed has medium and high road densities as shown in Figure 3-4. The high-density areas are primarily along the northern and eastern edges of the watershed. These areas have intense, low-density residential and commercial development. In addition, I-805 and Highway 163 intersect the watershed in this area.

Table 3-4. Common sources of roadway pollutants

Source	Cadmium	Chromium	Copper	Iron	Nickel	Lead	Zinc	PAHs	Nutrients	Synthetic organic chemicals
Gasoline	•		•			•	•			
Exhaust					•	•		•		•
Motor oil and grease				•	•	•	•	•		
Antifreeze	•	•	•	•		•	•	•		
Undercoating						•	•			
Brake linings			•	•	•	•	•			
Tires	•		•			•	•	•		
Asphalt	•		•		•		•	•		
Concrete			•		•		•			
Diesel oil	•	•				•	•			•
Engine wear				•	•	•	•			
Fertilizers, pesticides, and herbicides	•		•	•	•		•		•	•

Sources: Adapted from Nixon and Saphores 2007; Lau et al. 2009; Stein and Ackerman 2007; Davis et al. 2001; Schueler and Holland 2000

Note: Shaded cells indicate roadway pollutants of concern for this watershed.

The remainder of this section identifies roadway sources of nutrients, metals, and toxics loading to the Tecolote watershed. A summary of pollutants from road infrastructure and other sources is presented in Table 3-2.

3.2.2.1 Nutrients (Nitrogen, Phosphorous)

Roadways can be a source of total phosphorous, total Kjeldahl nitrogen, and orthophosphate because nutrients are found in fertilizers that are commonly applied on residential lands. Nutrient sources from roadway infrastructure and other sources are outlined in Table 3-2.

3.2.2.2 Metals (Cadmium, Copper, Lead, and Zinc)

The use and wear of cars is the most prevalent source of roadway pollutants. A California study found that cars are the leading source of metal loads in storm water, producing over 50 percent of the copper, cadmium, and zinc loads (Schueler and Holland 2000). Wear from brake pads, tires, and engine parts are also a significant source of metal pollutants. For example, almost 50 percent of the copper loads in roadway storm water originates from brake pads (Davis et al. 2001), and tire wear accounts for over 50 percent of the total cadmium and zinc loads delivered to the San Francisco Bay each year (Santa Clara Valley Nonpoint Source Control Program 1992).

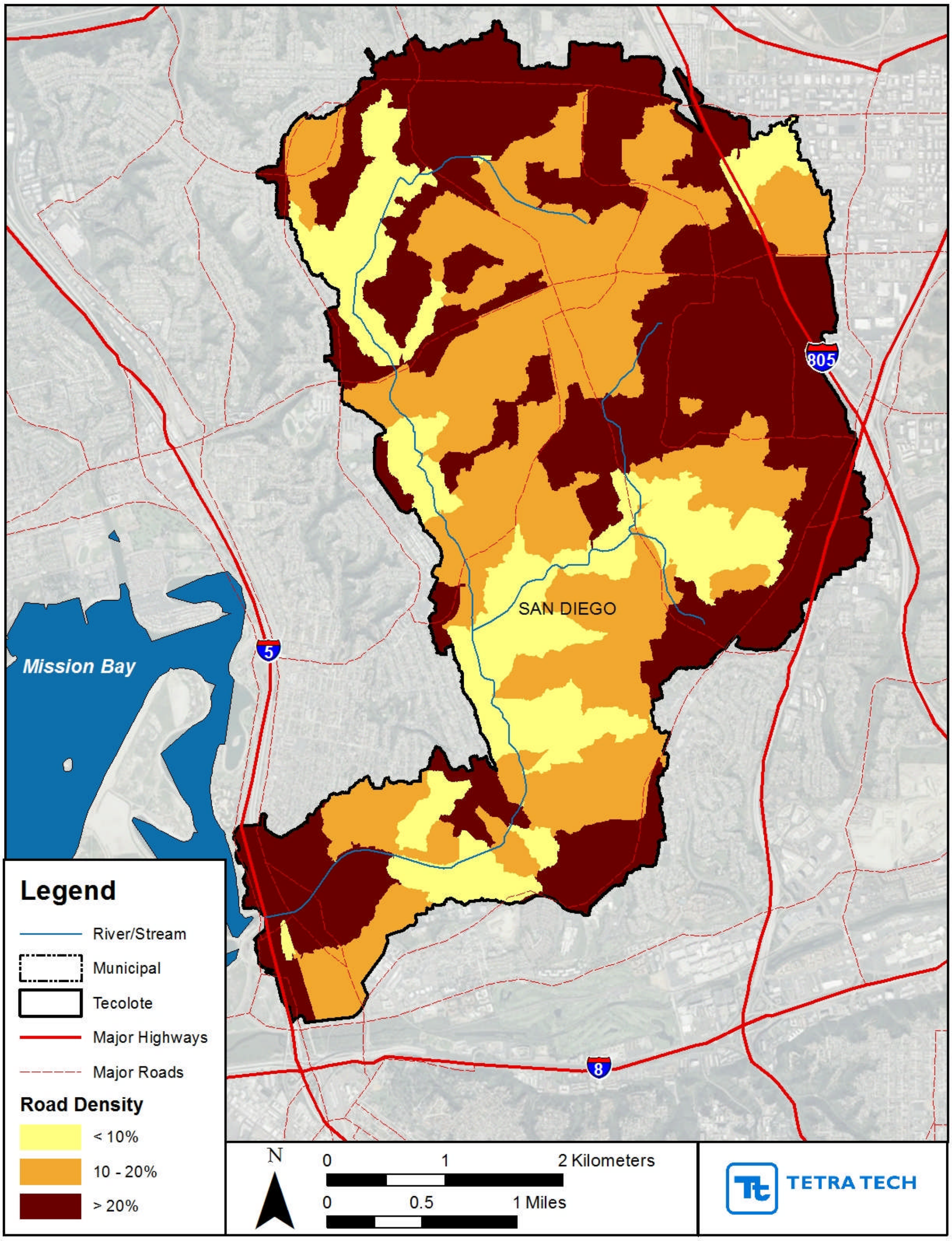

Figure 3-4. Road density in the Tecolote watershed

3.2.2.3 Sediment/Turbidity

Sediment is a common pollutant found in the runoff of roads and highways. If sediment from roadways is not controlled, road infrastructure in a watershed can contribute to elevated TSS and turbidity levels in nearby waterways (Caltrans 2003a). Compared to other land uses, runoff from highway sites in agricultural and commercial areas exhibit higher concentrations of TSS and other pollutants (Caltrans 2003c). For the Tecolote watershed, unpaved roads in rural or open areas can contribute significant sediment loading to waters. Poor compaction, high runoff velocities and volumes, and exposed soils on unpaved roads increase the potential for erosion and sediment pollution to nearby waters. Table 3-2 presents a summary of sediment sources derived from road infrastructure.

3.2.3 Atmospheric Deposition

Atmospheric deposition is the direct and indirect transfer of pollutants from the air to surface waters. Typical pollutants associated with atmospheric deposition are metals, PAHs, PCBs, and, to a lesser extent, nutrients. These pollutants enter the atmosphere from point sources (i.e., industrial emissions) and nonpoint sources (i.e., mobile and areawide emission sources). These sources are not quantified directly in the CLRP, but are implicitly included in the Pollutant Loading Analysis (Section 3.3). The discussion below provides information on potential atmospheric sources that may contribute to impairments and their relative contributions; however, additional, quantitative analyses would be required to specify loadings (and required reductions) associated with atmospheric sources.

Although toxic air contaminant emissions from stationary sources in San Diego County have been reduced by approximately 85.5 percent since 1989, large amounts of toxic compounds are still emitted into the air from a wide variety of sources including motor vehicles, industrial facilities, household products, area sources, and natural processes (San Diego County 2011c). Besides industrial emissions, the major source of atmospheric lead in California is the resuspension of lead from historic emissions that have accumulated over many years in road dust and soil particles of urban areas (Sabin and Schiff 2007; Sabin et al. 2005). Nutrients, alternatively, are atmospherically deposited during the wet season when nutrient-rich sediment is deposited. These particulate nutrients can then be remobilized as dissolved inorganic nutrients to the surface waters (Sutula et al. 2004).

Atmospheric deposition of pollutants either directly to a waterbody surface or indirectly to the watershed land surface can be a source of contamination to surface waters. Dry deposition is the fallout of pollutants from the atmosphere to the land and surface waters of the watershed. Dry deposition rates are significantly higher in areas close to urban centers and busy roadways (Sabin and Schiff 2007; Sabin et al. 2005). As much as 50–100 percent of trace metals in storm water runoff in highly impervious, urban catchments of Southern California comes from dry deposition (SCCWRP 2008). In a study to better understand the role of roadways as a source of localized metal deposition, Sabin et al. (2006b) determined that dry deposition fluxes and atmospheric concentrations of chromium, copper, lead, nickel, and zinc were highest at the site closest to freeways. These metal concentrations reduced to approximately urban background concentrations between 10 and 150 meters downwind of the freeway. Through the use of shoulders, slopes, swales, and other features, Caltrans actively implements mitigation measures to retain metal deposition within the right of way and from proceeding to adjacent waters (Caltrans 2003a, 2003b). Wet deposition is the transfer of atmospheric pollutants to the watershed via rain or snowfall. In California, wet deposition is not a significant source of pollutants in comparison to dry depositions because there are so few rain events (Lu et al. 2003; Sabin et al. 2005, 2006a).

Although the atmospheric deposition of lead has decreased over the past 30 years, atmospheric deposition of copper and zinc has increased along the coast near the San Diego Bay (SCCWRP 2008). An aerial deposition study in Santa Monica Bay indicates that zinc, followed by copper and lead, are the greatest metal pollutant loadings from aerial deposition (Stolzenbach 2006). This study also suggests that contribution of atmospheric deposition can be as high as 99 percent, in the case of lead, when compared to other sources such as sewage treatment plants, industrial sources, and power plants. A comparison of trace metal contributions from aerial deposition, sewage treatment plants, industrial activities, and power plants is shown in Table 3-5. The aerial deposition of lead was 2.3 metric tons/year (99 percent) out of the total 2.32 metric tons/year.

Table 3-5. Comparison of source annual loadings to Santa Monica Bay (metric tons/year)

Toxic air contaminant	Total load	Aerial deposition	Non-aerial sources: Sewage treatment plants	Non-aerial sources: Industrial	Non-aerial sources: Power plants
Chromium	1.26	0.5	0.6	0.02	0.14
Copper	18.84	2.8	16	0.03	0.01
Lead	2.32	2.3	< 0.01	0.02	< 0.01
Nickel	0.45	0.45	5.1	0.13	0.01
Zinc	12.1	12.1	21	0.16	2.4

Source: Stolzenbach 2006

In 2009 an aerial deposition study in Chollas Creek evaluated the source emissions of copper, lead, and zinc. Although findings from this study are most relevant to the Chollas watershed, the findings can be used to evaluate aerial deposition throughout the San Diego Region. Copper, lead, and zinc were the focus of the study because they account for 100, 29, and 74 percent, respectively, of the average annual load discharged via storm water runoff in the Chollas watershed (City of San Diego 2009b). Concentrations of these pollutants in storm water runoff were also higher in commercial and industrial land uses compared to residential land uses. This finding can be attributed to the types of activities and atmospheric emission sources that are concentrated and common in commercial and industrial land uses. The process characterized to emit the most copper and zinc was applying paints and protective coverings on surfaces of ships because some specific areas of a vessel require specifically formulated coatings. The second largest source of copper was facilities conducting abrasive activities where material is steamed against a surface to clean or prepare it. The second largest emission source of zinc are facilities where brazing is performed to join metals by heating and the use of a filler. The greatest source emissions for lead were abrasive activities and exhaust from diesel engines. These types of activities performed by industries in any watershed can contribute to atmospheric pollutant loadings and ultimately affect the water quality of a watershed. In California, these types of industries are regulated under the California Air Resources Board (CARB) to maintain and attain healthy air quality and protect the public from toxic air exposure.

In the 2010 *Air Toxics "Hot Spots" Program Report* for San Diego County, industrial source emissions were estimated for approximately 3,130 facilities in the county including 1,750 diesel engine facilities, 368 auto body shops, 683 gasoline stations, and 117 dry cleaners (San Diego County 2011c). Estimated toxic air contaminant emissions for copper, lead, and zinc are presented in Table 3-6. Also in Table 3-6, are estimates of mobile, area, and natural source emissions obtained from the CARB 2008 California Toxics Inventory (CTI) (CARB 2008). Mobile sources include on- and off-road vehicles, trains, mobile equipment, and utility equipment. Area sources include residential and commercial nonpoint sources such as fuel combustion, road dust, waste burning, solvent use, pesticide application, and construction practices. Natural sources include wildfires and windblown dust from agricultural operations and unpaved areas. Although industrial emissions of air contaminants pale in comparison to emissions from mobile, area, and natural sources, the total annual emissions are significant because they can be deposited in local watersheds in San Diego County.

Table 3-6. Estimated toxic air contaminant emissions

Toxic air contaminant	Point sources	Nonpoint sources			Total San Diego County emissions (lbs/yr)
	Emissions from industrial sources estimated for 2006–2009 (lbs/yr)	Mobile emissions from CARB (lbs/yr)	Area-wide emissions from CARB (lbs/yr)	Natural emissions from CARB (lbs/yr)	
Cadmium	29	852	1,444		2,325
Copper	3,123	11,965	17,400	201	32,690
Lead	78	7,186	34,151	466	41,880
Zinc	3,512	12,816	92,449	20,272	129,050

Source: Adapted from San Diego County 2011c

The U.S. Environmental Protection Agency's (EPA's) Toxics Release Inventory (TRI) program collects information on waste management activities and disposal of more than 650 chemicals from industrial sources nationwide. The atmospheric releases based on TRI for copper, lead, and zinc in and near the Tecolote watershed are shown in Figure 3-5 through Figure 3-7. Though no origins of the emissions are in the Tecolote watershed (although several are very close to the watershed boundary), TRI for sites outside the watershed are also relevant because atmospheric transport occurs across watershed boundaries. The TRI data show only a portion of air pollutants that could be deposited in the Tecolote watershed. Many metals and chemicals are regularly deposited hundreds of miles away from their original source (Daggupaty et al. 2006; Bozó 1991).

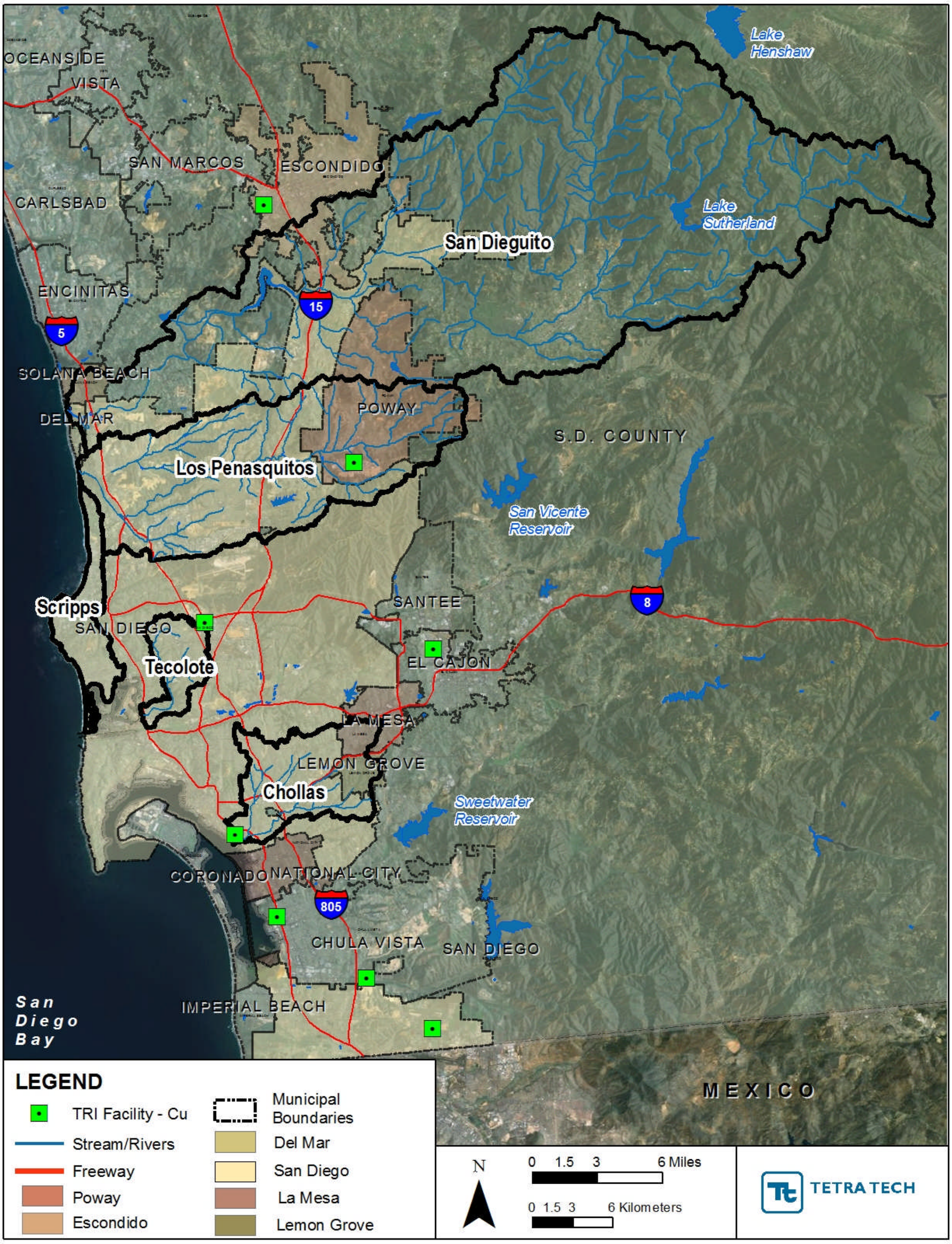

Figure 3-5. TRI atmospheric releases in the San Diego region – copper

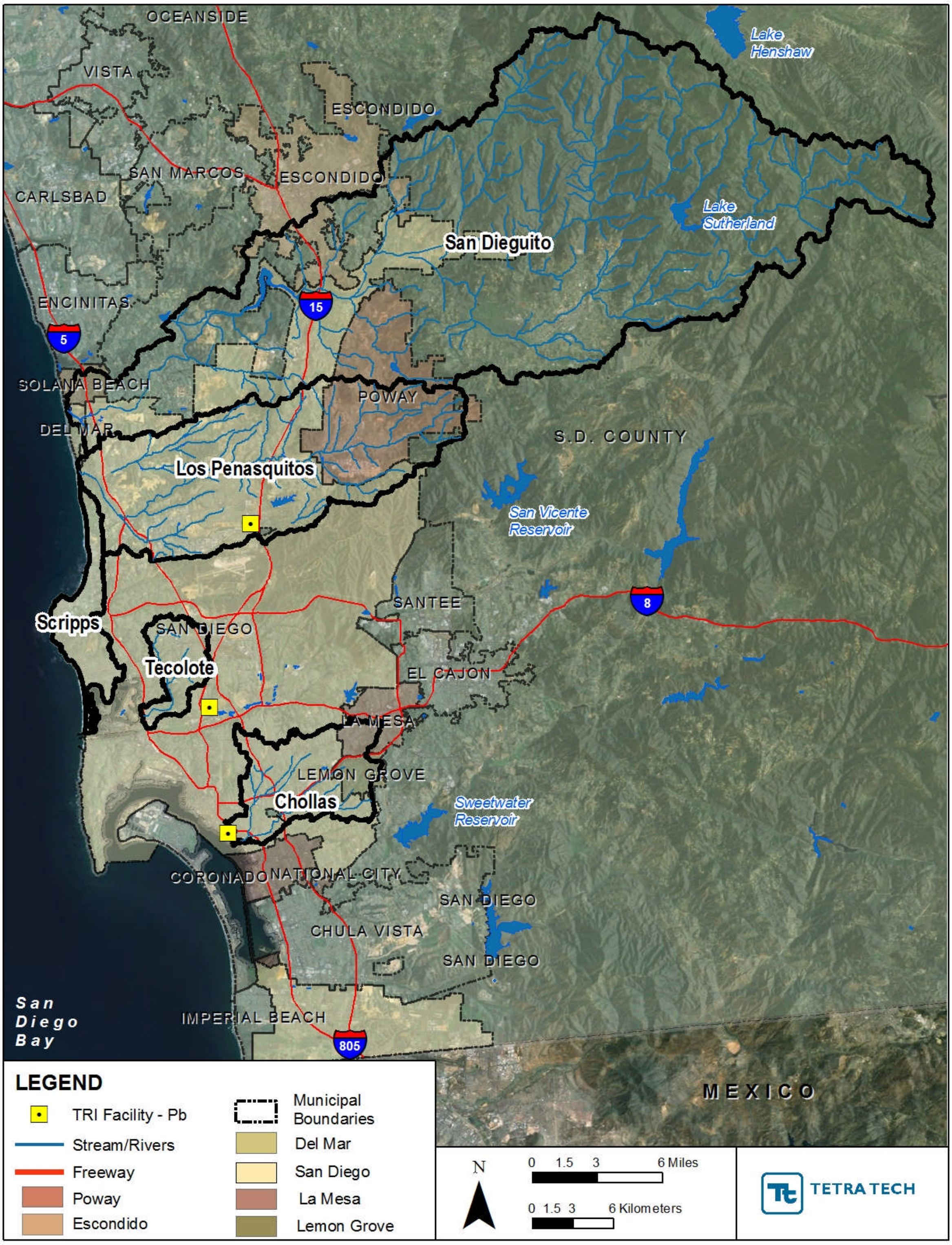

Figure 3-6. TRI atmospheric releases in the San Diego region – lead

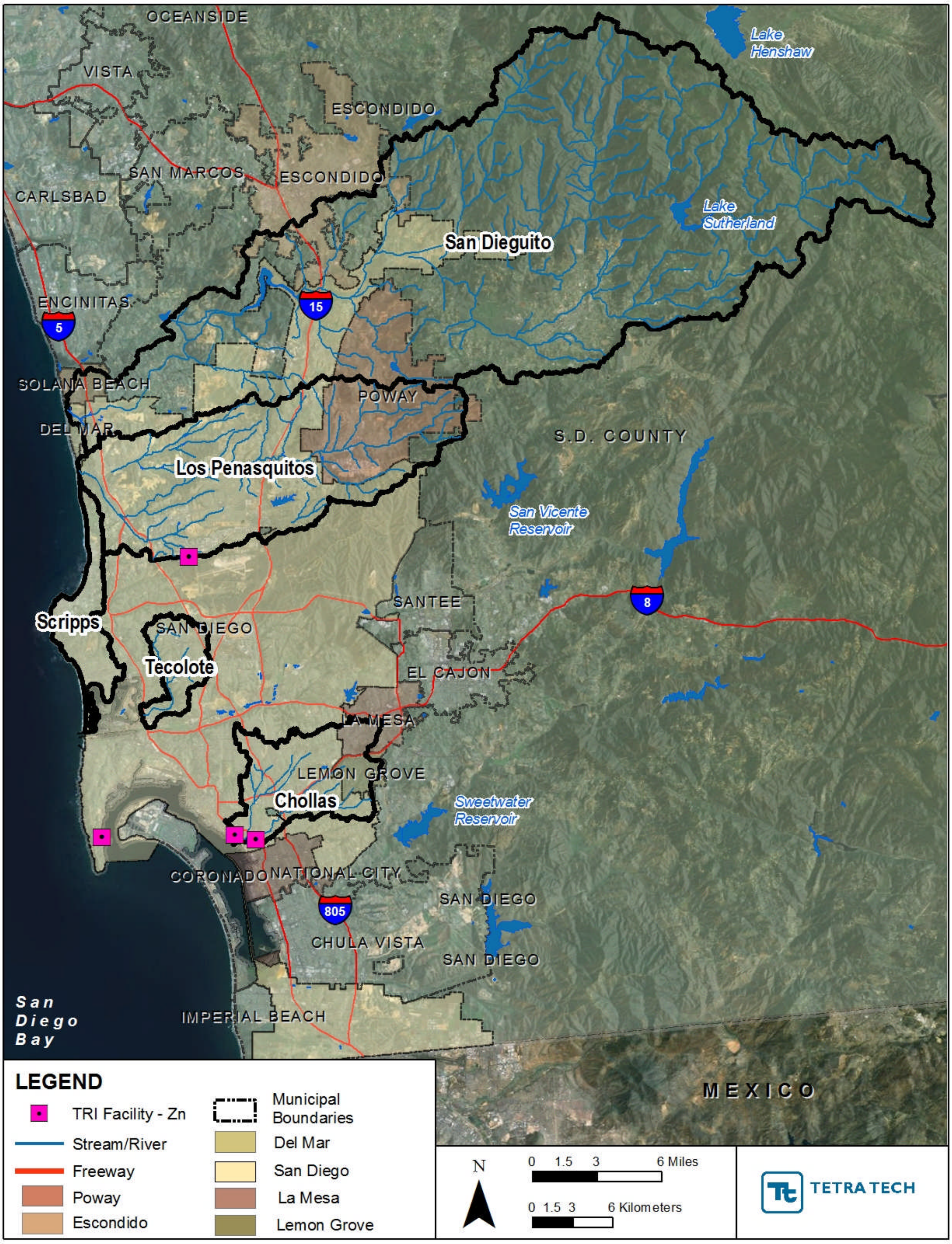

Figure 3-7. TRI atmospheric releases in the San Diego region – zinc

Atmospheric deposition is a potential source of heavy metals and organics in surface waters. Nutrients can also be in atmospheric deposition; however, ammonia and nitrate compound loading from TRI sites in San Diego County were zero; therefore, these loadings are not discussed further. For the Tecolote watershed, the pollutants of concern associated with atmospheric deposition are cadmium, copper, lead, and zinc. A summary of sources, including atmospheric deposition, for these pollutants are presented in Table 3-2.

3.2.3.1 Metals (Cadmium, Copper, Lead, and Zinc)

Potential atmospheric sources of cadmium, copper, lead, and zinc can be derived from point emission sources (i.e., industrial emissions) or from nonpoint emissions (i.e., mobile/vehicular, areawide, natural). As discussed, the *2010 Air Toxics "Hot Spots" Program Report for San Diego County* notes that nonpoint emissions of all metals outweigh point emissions (San Diego County 2011c). On the basis of these results, areawide sources that do not have specific locations and are spread out over large areas, such as consumer products and unpaved roads, contribute the most significant amount of atmospheric metals compared to mobile, natural, and industrial emissions.

3.2.4 Waste Sites

The Resource Conservation and Recovery Act (RCRA) was added to the Solid Waste Disposal Act (1965) in 1976 to regulate the disposal of municipal, industrial, and hazardous waste. It controls the generation, transportation, treatment, storage and disposal of hazardous and nonhazardous wastes. The term *RCRA site* generally refers to a site of waste storage or disposal. RCRA sets specific criteria for containment at these sites; however, a site in violation could emit pollutants into the environment (USEPA 2008).

Superfund sites, which are hazardous-waste sites that have been inactive or abandoned, are not regulated under RCRA. Such hazardous waste areas and areas of accidental pollutant release (i.e., spills) are controlled under the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Those areas are called Superfund sites because they receive federal funding to assist with removal and cleanup processes. Only severely contaminated sites qualify for Superfund and are placed on the National Priorities List to receive funding. Many data sets are generated from the Superfund site, including data to establish the site on the National Priorities List, monitor progress of cleanup efforts, and long-term monitoring to ensure success of the cleanup.

RCRA and Superfund sites in Southern California were researched using the California EnviroStor public database. For both data sets, the facility name associated with each site is provided along with the facility address, coordinates, and permit numbers. RCRA data also describe the state of the cleanup efforts (e.g., active, completed, no action required, backlog) and the type of cleanup (voluntary, hazardous waste permit, state response, school cleanup, and such).

No Superfund sites and four RCRA sites are in the Tecolote watershed. Most sites are in an *inactive cleanup* status. *Tiered permits* make up the majority of RCRA listings. A complete breakdown of cleanup types and status are shown in Table 3-7 and Table 3-8. A map of RCRA sites in the Tecolote watershed is presented in Figure 3-8.

Table 3-7. RCRA sites in the Tecolote watershed – cleanup type

Site type	Number of sites in the watershed
Corrective action	1
Tiered Permit	2
School cleanup	1
Voluntary cleanup sites	0

Table 3-8. RCRA sites in the Tecolote watershed – cleanup status

State of action	Number of sites in the watershed
Inactive	0
Certified	1
Certified with Land-use Restrictions	0
Inactive - action required	0
Inactive - needs evaluation	2
No further action	0
Referred	1

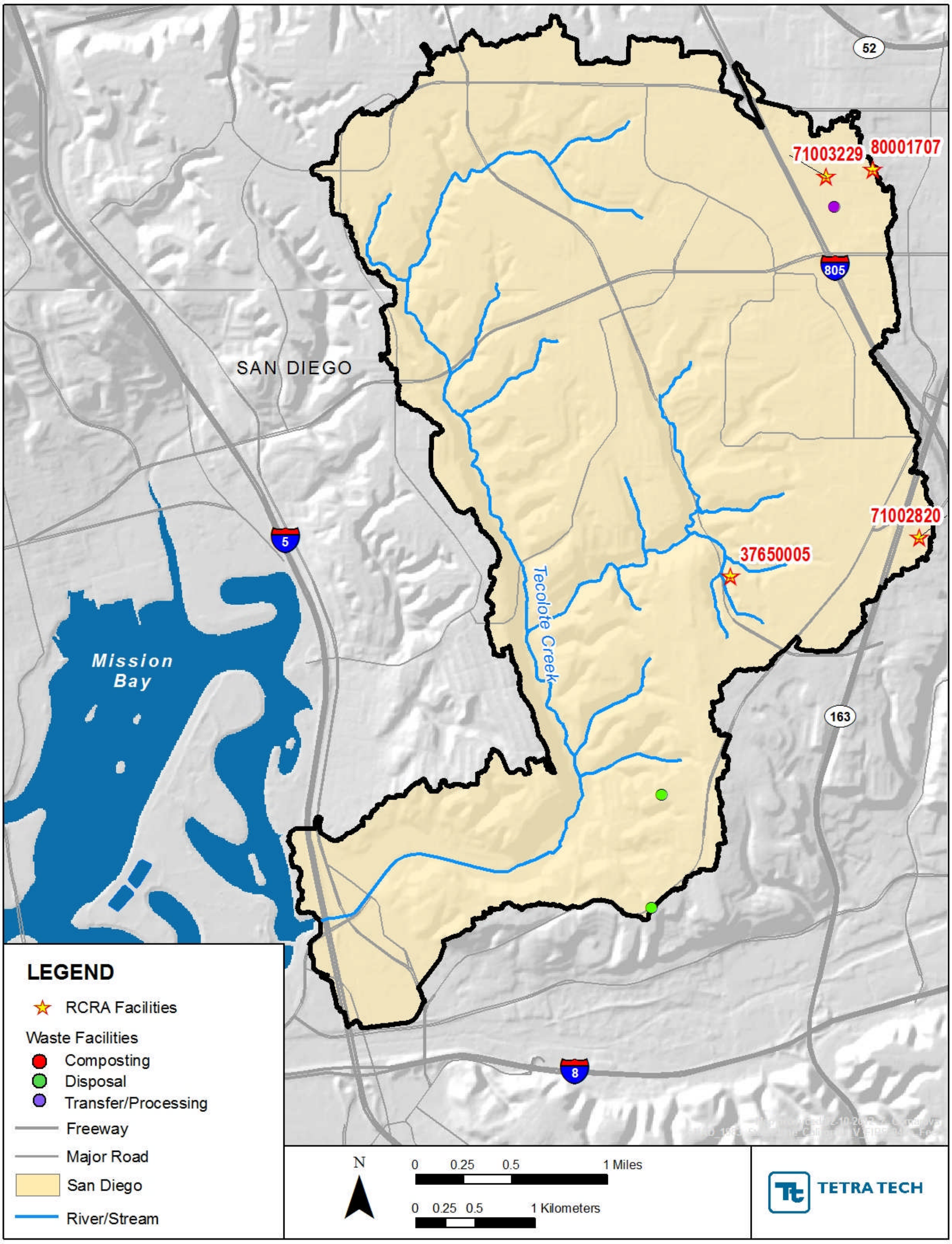

Figure 3-8. Waste sites in the Tecolote watershed

Typical contaminants that can migrate from Superfund and RCRA sites to the environment are widespread. The top 10 pollutants on CERCLA's National Priority List are arsenic, lead, mercury, vinyl chloride, PCBs, benzene, PAHs, cadmium, benzo(A)pyrene, and benzo(B)fluoranthene. Dense and light non-aqueous phase liquids—which include chlorinated solvents, petroleum components, PCBs, and PAHs—are some of the worst contaminants in hazardous-waste sites because they can travel long distances in groundwater, are slow to degrade, and are toxic at very low concentrations. Superfund and RCRA sites are potential sources of metals and organics in watersheds (Table 3-2). For the Tecolote watershed, metals are of utmost concern.

Many other waste sites (landfills, recycling areas, battery reclamation sites, incinerators, unauthorized dumping grounds) could be pollutant sources that are not listed under RCRA or CERCLA. Solid waste facilities and transfer and processing facilities in the Tecolote watershed are shown in Table 3-9 and Figure 3-8. Solid waste facilities store everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint and batteries. Typically before reaching a solid waste facility or other treatment or disposal facility, solid waste is unloaded from collection vehicles and briefly held at transfer and processing facilities while it is reloaded onto larger, long-distance transport vehicles for shipment. These facilities, particularly solid waste sites, have liner systems, surface water controls and other safeguards in place to prevent pollution of local water resources. Typical surface water impacts from solid waste sites include leachate seeps and excessive erosion (GeoSyntec Consultants 2004).

Table 3-9. Current waste sites in the Tecolote watershed

Facility name	Facility type	Facility status	Jurisdiction
Camp Kearny Mesa	Solid Waste Disposal Site	Closed	City of San Diego
Kelly Street Burnsite	Solid Waste Disposal Site	Closed	City of San Diego
Kearny Mesa LVTO	Transfer/Processing Facility	Active	City of San Diego

Source: Solid Waste Information System (SWIS) available at http://www.calrecycle.ca.gov/SWFacilities/Directory/

Historically, waste sites or *dumps* were prevalent throughout the City of San Diego in varying conditions. A 1938 City Planning Commission report identifies two types of dumps, totaling 52 dumps in the city (Note: these are throughout the City of San Diego area and might not be specifically in this watershed) (*Report on Refuse Dumps*; City of San Diego 1938). One type of dump had an attendant, who sorted through the material to be salvaged or burned. The other, more prevalent, type of dump site was the haphazard dumping of waste material such as cans, paper, boxes, wrecked automobiles, bodies, tree trimmings, spoiled food, and such. Many of the dumps identified noted the presence of vermin, dumping of automobiles, the practice of burning, and several potential fire hazards. A review of historic dumps demonstrates that the disposal of rubbish was not being handled in a manner consistent with San Diego's best interests because there were too many places in the city where refuse was being dumped, many of which were not suitable dumping grounds (City of San Diego 1938). Landfills and dumps are potential sources of bacteria, metals, and toxic compounds.

3.2.4.1 Bacteria

Landfills and dumps are known to contain vermin and various types of waste. Both the vermin and certain types of waste can be sources of bacteria in the Tecolote watershed (consistent with some of the anthropogenic, non-human sources of bacteria identified in Appendix A).

3.2.4.2 Metals (Cadmium, Copper, Lead, and Zinc)

Metals of concern in the Tecolote watershed are cadmium, copper, lead, and zinc. As indicated above, cadmium and lead are in the top 10 pollutants of the National Priority List. Actual discharges of cadmium and lead from the waste sites are unknown.

3.2.5 Wastewater Sources

Wastewater is treated either through centralized sanitary sewer systems or decentralized septic systems. Properly designed, operated, and maintained sanitary sewer systems are meant to collect and transport all the sewage that flows into them to a POTW (USEPA 2011d). Aging systems in need of repair or replacement, severe weather, improper system operation and maintenance (O&M), clogs, and root growth can contribute to sanitary sewer leaks and overflows. Sanitary sewer overflows (SSOs) are any overflow, spill, release, discharge or diversion of untreated or partially treated wastewater from a sanitary sewer system. Septic systems, on the other hand, treat wastewater on-site by collecting, treating, and dispersing wastewater from individual dwellings, businesses, or small communities (USEPA 2003b). Wastewater discharges via sanitary sewer systems or septic systems invariably release pollutants such as bacteria and nutrients to nearby waters (Table 3-2).

According to the California Integrated Water Quality System, two SSOs were reported in the Tecolote watershed in 2011 (SWRCB 2011c). As illustrated in Figure 3-9, the SSO with the largest spill volume (6,000 gallons) occurred in the middle of the watershed; the additional SSO event occurred in the upper watershed and had a smaller volume. Both watershed SSOs have likely contributed to the elevated levels of bacteria in the lower reaches of Tecolote Creek.

When sanitary sewers overflow or leak, they can release raw sewage into the environment, which can contain pollutants such as suspended solids, pathogenic organisms, toxic pollutants, nutrients, oil, and grease (SWRCB 2011d). Wastewater constituents such as bacteria and nutrients are also released into the environment through septic systems. Sanitary sewers systems and septic systems are potential sources of two contaminants of concern to the Tecolote watershed—bacteria and nutrients.

3.2.5.1 Bacteria

By nature, raw sewage and wastewater contain high concentrations of bacteria. Bacteria are released into the environment when sanitary systems leak, spill, or overflow or when illicit connections from sanitary sewers are made to the storm drain system (USEPA 2011c; SDRWQCB 2010; LARWQCB 2006). As identified in the bacterial source conceptual model (Appendix A), bacteria from wastewater sources are categorized as an anthropogenic, non-human source (Appendix A). Continuous sources of bacteria arise from septic tanks that are poorly maintained or faulty. Septic systems can back up into homes or release wastewater onto the ground surface. Untreated wastewater discharges from sanitary system leaks, SSOs and septic systems can contribute significant bacteria loadings to receiving waters and the environment. Wastewater discharge sources of bacteria and others are presented in Table 3-2 and are associated with the human sources presented in Appendix A.

3.2.5.2 Nutrients

High levels of nutrients are also in raw sewage and wastewater. Organic matter, commonly in high concentrations in wastewater, contains nutrients (nitrogen and phosphorus) in its composition. Nutrient-rich wastewater is released into the environment when sanitary systems leak, spill, or overflow or when illicit connections from sanitary sewers are made to the storm drain system (USEPA 2011c; SDRWQCB 2010; LARWQCB 2006). Septic tanks can be a continuous source of nutrients when they are poorly maintained or faulty. Septic systems can back up into homes or release wastewater onto the ground. Untreated wastewater discharges from sanitary system leaks, SSOs and septic systems can contribute significant nutrient loadings to receiving waters and the environment. Nutrients from wastewater discharge sources and others are presented in Table 3-2.

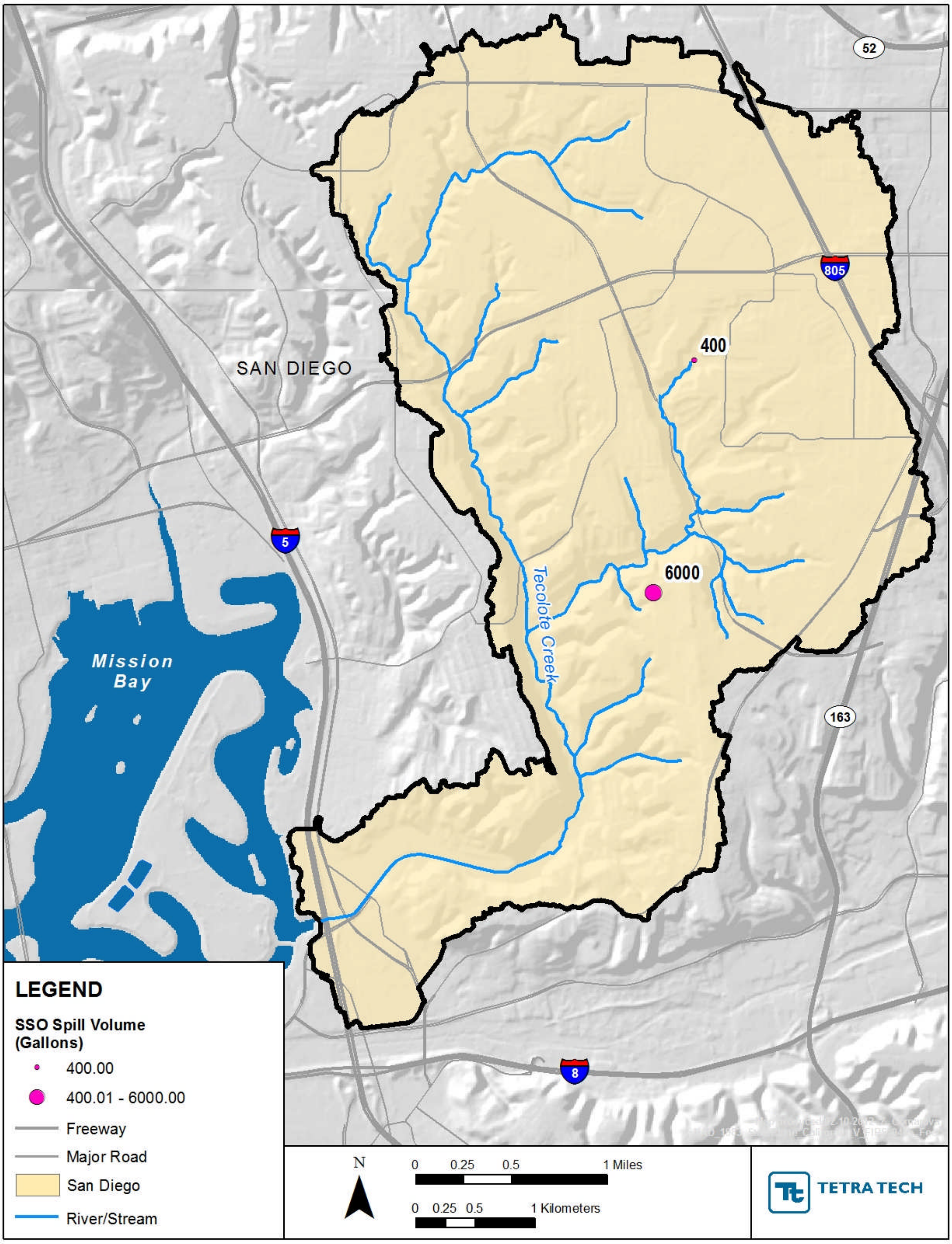

Figure 3-9. SSOs in the Tecolote watershed in 2011

3.2.6 Agricultural Operations

Agricultural operations can be either point or nonpoint sources of pollution. Typical point sources of pollution from agriculture include AFOs; animal waste storage/treatment lagoons; and the storage, handling, mixing, and cleaning areas for pesticides, fertilizers, and petroleum (City of San Diego 2010a). AFOs are agricultural operations where animals are raised in confined situations and feed is brought to the animal rather than the animals grazing in pastures. Some nonpoint sources of pollutants from agricultural operations are land application of manure wastes and grazing by livestock. Primary pollutants associated with these point and nonpoint sources of agricultural operations are nutrients, bacteria/pathogens, pesticides, organic matter, salts, solids, and volatile and odorous compounds (City of San Diego 2010a). These pollutants enter the waterways via natural infiltration or storm water runoff. A summary of pollutants from agricultural operations and other sources is presented in Table 3-2.

As shown in Figure 3-10, few agricultural lands are in the Tecolote watershed (as defined by the land use coverage); however, there are several nursery locations. Most of the active agricultural operations are in the upper portion of the Tecolote watershed. They might contribute to the elevated levels of nutrients, bacteria, and sediment.

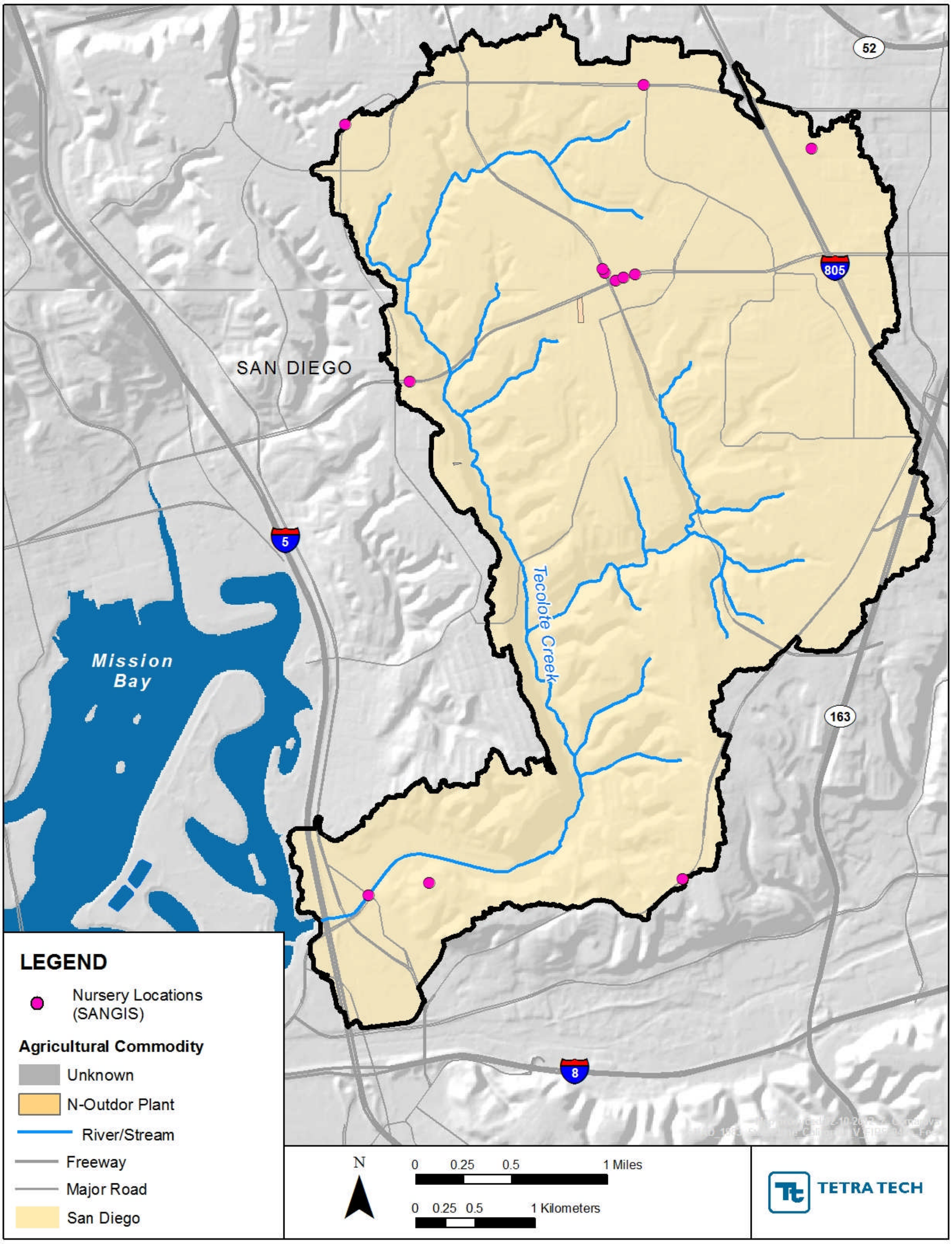

Figure 3-10. Agricultural operations in the Tecolote watershed

3.2.6.1 Bacteria

Bacteria from agricultural operations are likely because of manure application for fertilizer (associated with both anthropogenic, non-human and non-anthropogenic sources identified Appendix A) because more concentrated operations are not in the watershed. A summary of bacteria sources including those related to agricultural operations is presented in Table 3-2.

3.2.6.2 Nutrients

Land application of manure waste and storm water runoff from animal holding areas can contaminate surface waters with nutrient loadings. For instance, rain events pose risks to uncovered agricultural components such as stored manure, waste lagoons and storage ponds, which can introduce significant amounts of nutrients to the runoff (City of San Diego 2010a). Nutrients bounded to sediment can also be transported to nearby waters via erosion and sedimentation from agricultural lands. Table 3-2 presents a summary of nutrient sources including those related to agricultural operations.

3.2.6.3 Sediment

The agricultural operation that most significantly affects sediment water quality is grazing by livestock. Grazing is not occurring in the Tecolote watershed, so agricultural sources of sediment are likely not a problem. A summary of potential sediment sources including those related to agricultural operations is presented in Table 3-2.

3.3 Pollutant-Loading Analysis

Loadings from the pollutant sources identified in Section 3.2 have been quantified by modeling the Tecolote watershed. These loadings were subsequently analyzed to identify HPMAs throughout the watershed (Section 3.4). The Tecolote watershed was simulated using the LSPC model. This watershed model primarily uses local information representing soil characteristics, land use distribution, topography, weather data, and the stream network to simulate hydrology and pollutant transport and loading (for additional information on the modeling, see Appendix B.)

LSPC (Shen et al. 2004; USEPA 2003c; Tetra Tech and USEPA 2002) is a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) (Bicknell et al. 1997) algorithms for simulating hydrology, sediment, and general water quality on land, and a simplified stream fate and transport model. Since its original public release, LSPC has been expanded to include additional GQUAL components for sorption/desorption of selected water quality constituents with sediment, enhanced temperature simulation, and the HSPF RQUAL module for simulating dissolved oxygen, nutrients, and algae. LSPC has also been customized to address simulation of other pollutants such as indicator bacteria and metals.

The hydrologic (water budget) process in LSPC is complex and interconnected. Rain falls and lands on various constructed landscapes, vegetation, and bare soil areas in a watershed. Water flows overland and through the soil matrix. The land representation in the LSPC model environment considers three flow paths: surface, interflow, and groundwater outflow. LSPC can simulate flow, sediment, metals, nutrients, pesticides, and other conventional pollutants for pervious and impervious lands and waterbodies. The remainder of this section presents an overview of model configuration, calibration, validation, and watershed loading results for the pollutants of interest.

3.3.1 Watershed Model Development, Calibration, and Validation

The development of the LSPC model for the Tecolote watershed is consistent with the process used for other watershed models in the Southern California region. The LSPC model has been successfully applied and calibrated in Southern California for many watersheds including the Los Angeles River, San Gabriel River, San Jacinto River, Lake Mathews, Chollas Creek, Los Peñasquitos, B Street/Downtown

Anchorage, and multiple watersheds draining to impaired beaches of the San Diego Region (USEPA 2011e; City of San Diego 2010c). Modeling reports associated with these models provide detailed information regarding model configuration, calibration, and validation using the LSPC model. To support CLRP development, modeling for the Chollas watershed and companion CLRP watersheds was conducted as part of a comprehensive, uniform set of models that improves on the previous work and is calibrated using a regionalized approach, making refinements where appropriate.

The Tecolote watershed modeling effort followed a similar process using local data and information, where possible (Tetra Tech, Inc. 2011; USEPA 2011e; City of San Diego 2010c). Small modeling catchments in the watershed were delineated using available high-resolution elevation data and storm water infrastructure data.

The models rely on high-resolution spatial representation of meteorological patterns throughout the watersheds and a robust, physically based, and systematically consistent characterization of Hydrologic Response Units (HRUs). HRUs define the combination of land use, hydrologic soil group, and slope present in a watershed, facilitating a well-organized representation of landscape features that most affect hydrology and pollutant transport. The incorporation and use of HRUs in a watershed model allows for the enhanced simulation of hydrologic and contaminant transport processes in a watershed that might have diverse landscape features (County of Los Angeles 2008). In urban areas, it is important to estimate the division of land use into pervious and impervious components. Alternatively, in rural areas where vegetative cover is more important, undeveloped and agricultural land use should be well represented. For watersheds where hydrologic soil groups are not homogenous, further divisions of pervious land cover by hydrologic soil group allows better representation of infiltration processes. Furthermore, representation of slopes in watersheds where steep slopes are prevalent is critical because high slopes also influence runoff and moisture-storage processes. In addition to HRUs, the model incorporates urban irrigation for areas that rely on lawn and landscape watering.

In watershed modeling, it is essential that the hydrology of the system be accurately characterized to provide a firm foundation for simulating water quality conditions. Simulations of contaminant fate and transport processes are dependent on an accurate representation of runoff and water movement. To simulate the hydrology and contaminant transport processes in the watershed, calibration and validation of model hydrology and water quality for the current effort builds on the previous models (USEPA 2011e; City of San Diego 2010c). The primary basis for model hydrology parameterization was derived from the recent Los Peñasquitos watershed modeling to support sediment TMDL development (City of San Diego 2010c). Model hydrology was calibrated and validated for Los Peñasquitos using flow monitoring data from 1990 to 2010. The model performed well on the basis of comparisons of observed and simulated peak and base flows and the total cumulative volume.

A regionalized approach was also implemented for water quality calibration. The models simulate pollutant generation and accumulation on surfaces, and resulting pollutant runoff and delivery to receiving waterbodies. Delivery of pollutants through subsurface pathways (i.e., interflow and groundwater) is also represented. Water quality parameters were determined to adequately represent the loading generation capabilities for the different modeled HRUs for a wide range of storm intensities and base flows. Initial water quality parameterization was taken from the other models developed in the region and refined where appropriate to optimize the fit of simulated to observed concentrations and loads for all modeled pollutants.

In summary, the models used in developing the original Bacteria TMDL were significantly improved during CLRP development. These improvements provided more accurate assessment of pollutant sources and the prioritization of areas for BMP implementation in the CLRP. Notable refinements include improved spatial resolution of imperviousness/perviousness and land cover, simulation of dry-weather flows stemming from irrigation runoff (dry-weather flows were not included in the original model), recalibrated land-use-specific water quality modeling parameters on the basis of more monitoring data, and greater discretization of subwatershed boundaries for better prediction of spatially variable pollutant loadings and ability to prioritize needs for BMP implementation. A summary of these model improvements is provided in Appendix B.

3.3.2 Watershed Loading Results

The model includes flows and loading from all known sources in the watershed including NPDES permitted sources, road infrastructure, atmospheric deposition, waste sites, wastewater sources and agricultural operations, as described above in Section 3.2. Pollutant loading estimates were developed for the modeled constituents including bacteria (enterococci, fecal coliform, and total coliform), nutrients (nitrogen and phosphorus), metals (copper, lead, and zinc), and sediment. Pollutants were represented with different technical approaches depending on their mechanism for transport or availability of data for calibration. Specifically, some constituents were modeled directly using LSPC, other constituents are represented by a modeled surrogate (i.e., sediment), and other pollutants are not represented by the watershed loading results (Table 3-10).

Table 3-10. Technical approach for pollutant representation

Pollutant	Loads estimated directly from LSPC	Loads estimated from LSPC using a surrogate pollutant	Not represented by watershed model
Fecal coliform	✓		
Enterococci	✓		
Total coliform	✓		
Sediment	✓		
Nitrogen	✓		
Phosphorous	✓		
Cadmium		✓	
Copper	✓		
Lead	✓		
Zinc	✓		
Selenium			✓
Toxicity			✓

The model results, presented as long-term, average annual loads (in number, tons, or pounds) per acre, quantify loading from upland areas. Loads associated with wet and dry conditions are shown separately for each modeled pollutant and are apportioned according to wet and dry days. Specifically, annual loading from wet conditions are represented by the sum of the loading for all wet days in a year, and then results for all modeled years were averaged. Wet days were defined as days with 0.2 inch of rainfall or more and the following 3 days. All other days were designated as dry days and were used to calculate average annual dry-weather loads. Irrigation return flow serves as an important source contributing to dry-weather loads. Other potential sources could be leaking sewer lines (and septic systems where applicable), illicit storm water discharges, and natural background sources from groundwater. Modeled loading results for each pollutant and seasonal condition are described throughout the remainder of this section.

3.3.2.1 Bacteria (Enterococci, Fecal, and Total Coliform)

Bacteria loading in the Tecolote watershed was modeled for enterococci, fecal coliform, and total coliform bacteria. Wet- and dry-weather loading of enterococci bacteria are presented in Figure 3-11 and Figure 3-12, respectively, the wet- and dry-weather results are presented for fecal coliform and total coliform in Figure 3-13 through Figure 3-16. As expected, the dry-weather bacteria loading rates are several orders of magnitude below the wet-weather loading rates in the same subwatershed for all bacteria types. In addition, dry-weather loading is reasonably constant throughout the Tecolote watershed. In the enterococci wet-weather loading maps, the subwatershed with the highest loading rate is in the lower watershed. These are areas with large pockets of low-density residential land uses. Total and fecal coliform loadings were high throughout the watershed.

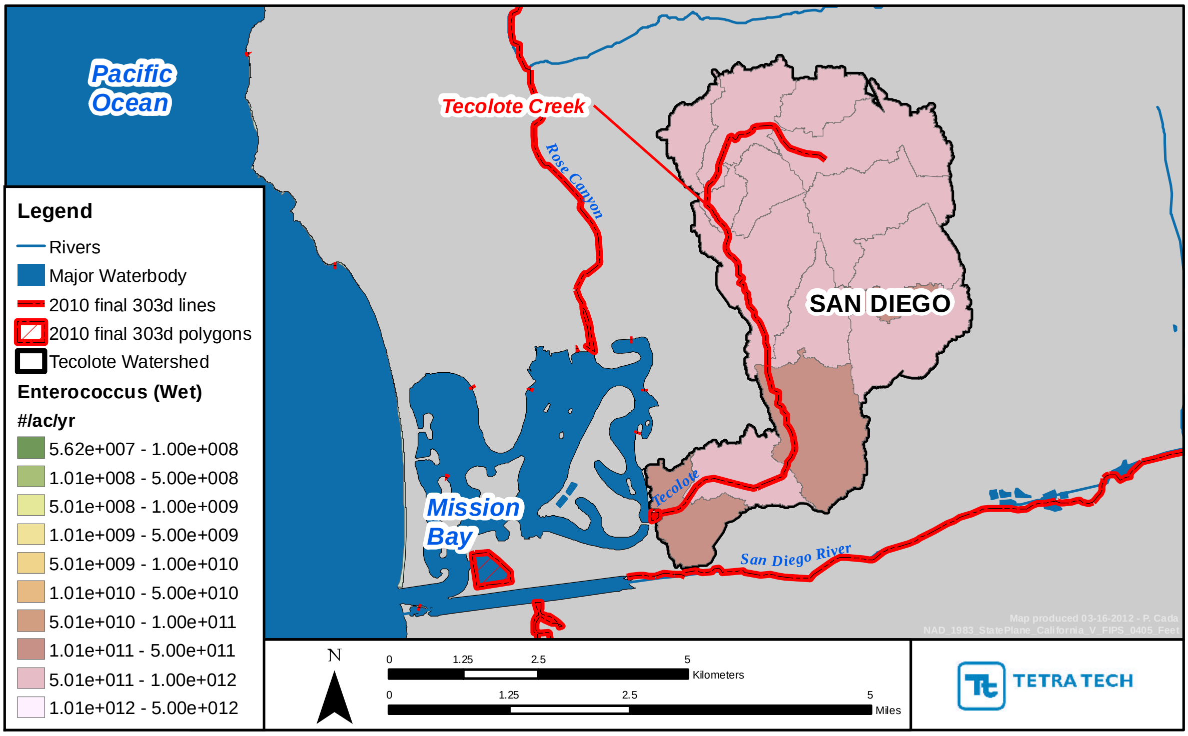

Figure 3-11. Wet-weather enterococci bacteria loading in the Tecolote watershed

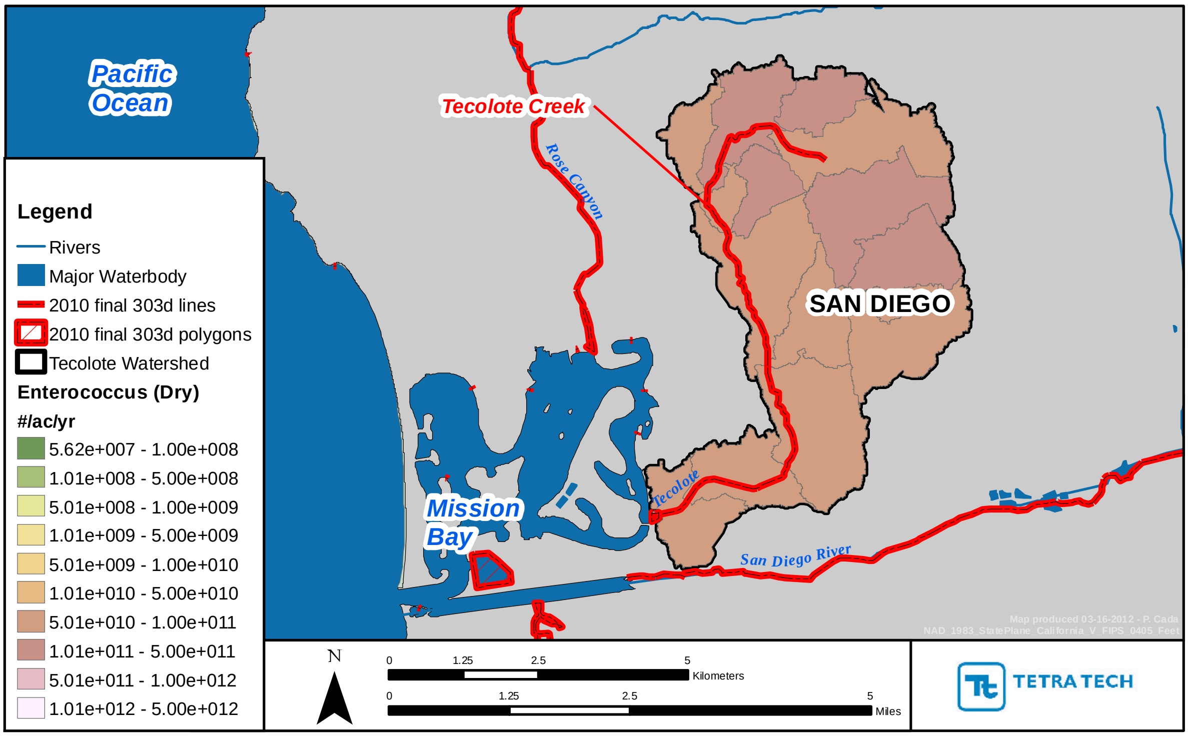

Figure 3-12. Dry-weather enterococci bacteria loading in the Tecolote watershed

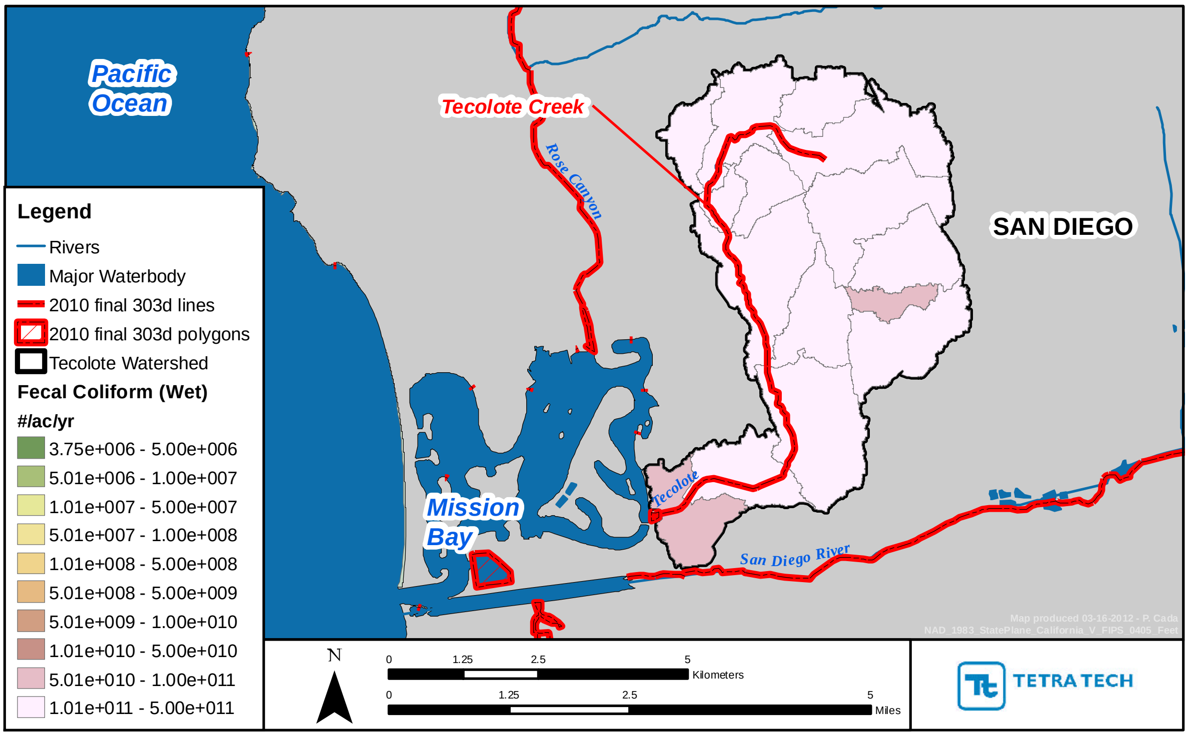

Figure 3-13. Wet-weather fecal coliform bacteria loading in the Tecolote watershed

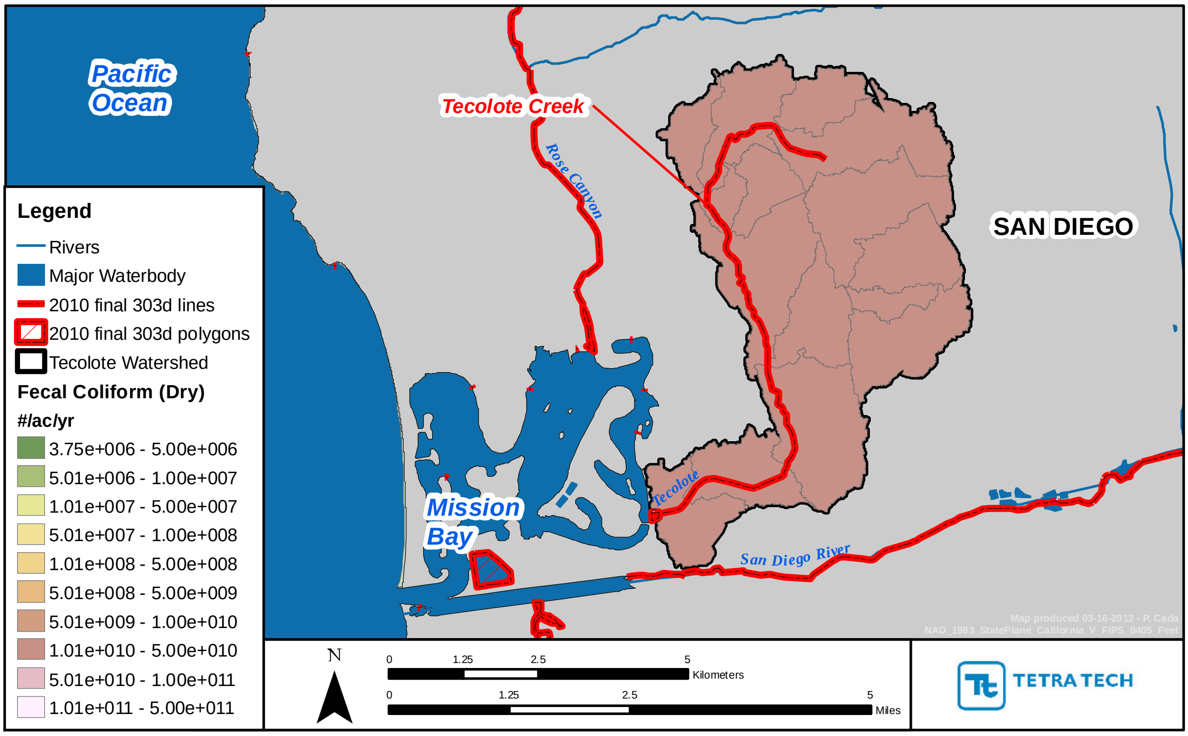

Figure 3-14. Dry-weather fecal coliform bacteria loading in the Tecolote watershed

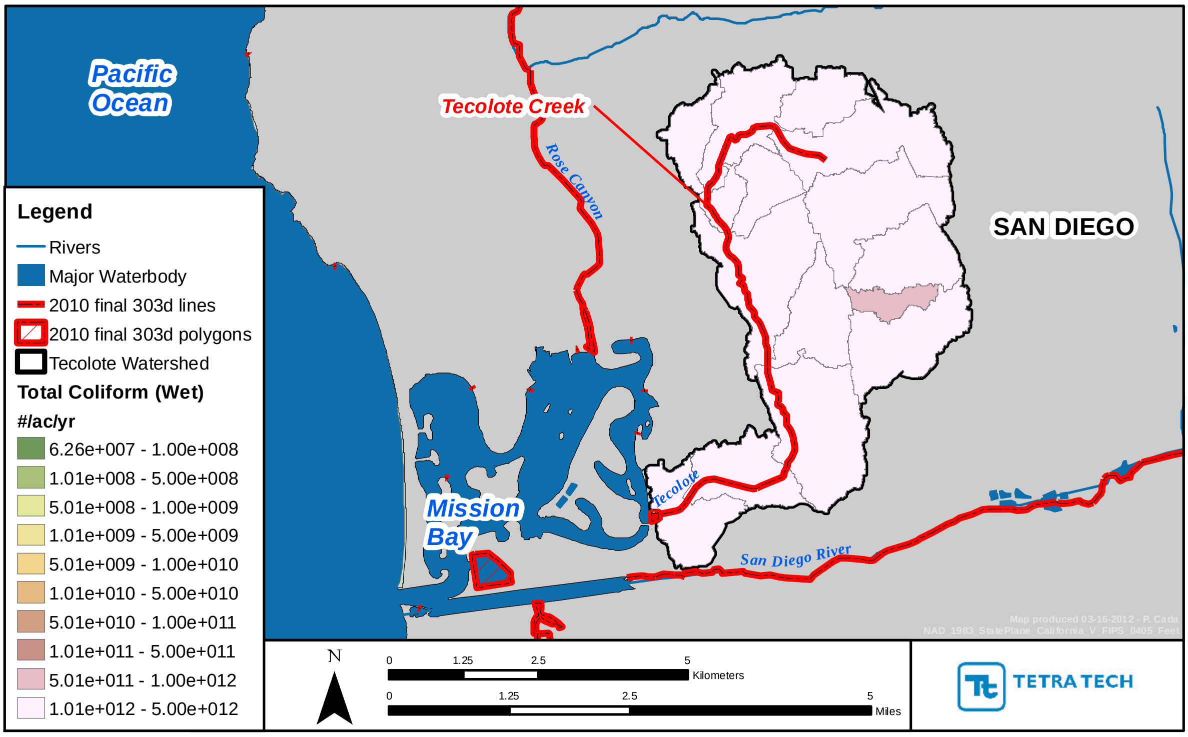

Figure 3-15. Wet-weather total coliform bacteria loading in the Tecolote watershed

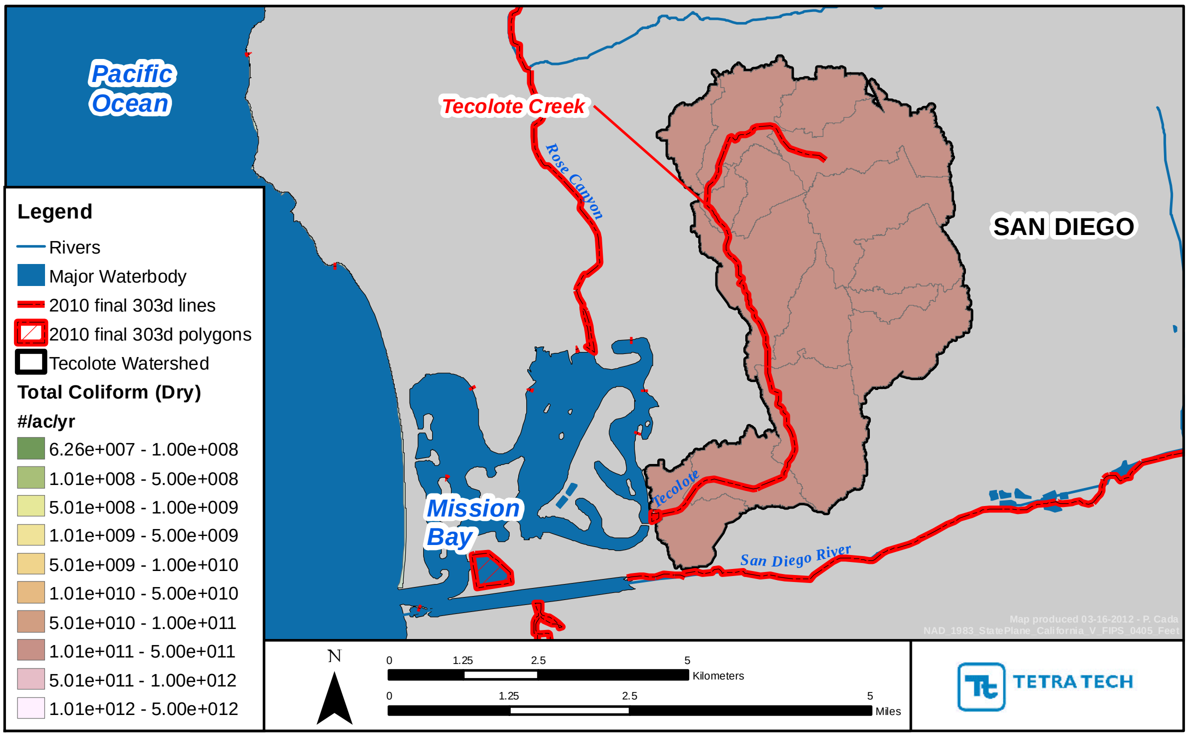

Figure 3-16. Dry-weather total coliform bacteria loading in the Tecolote watershed

3.3.2.2 Nutrients (Nitrogen and Phosphorus)

Total nitrogen and total phosphorous were simulated to represent nutrient loading in the Tecolote watershed. Figure 3-17 and Figure 3-18 illustrate the wet-weather and dry-weather loading of nitrogen, respectively; the wet-weather and dry-weather phosphorus loading are presented in Figure 3-19 and Figure 3-20, respectively. For both nutrient species, the dry-weather loading is significantly less than the wet-weather load (approximately 50 percent less). The highest wet-weather loadings are near the headwaters of the watershed, but another area of high loading is near the mouth of Tecolote Creek. The areas with the highest wet-weather loadings are predominantly low-density residential, institutional, transportation, and commercial land uses.

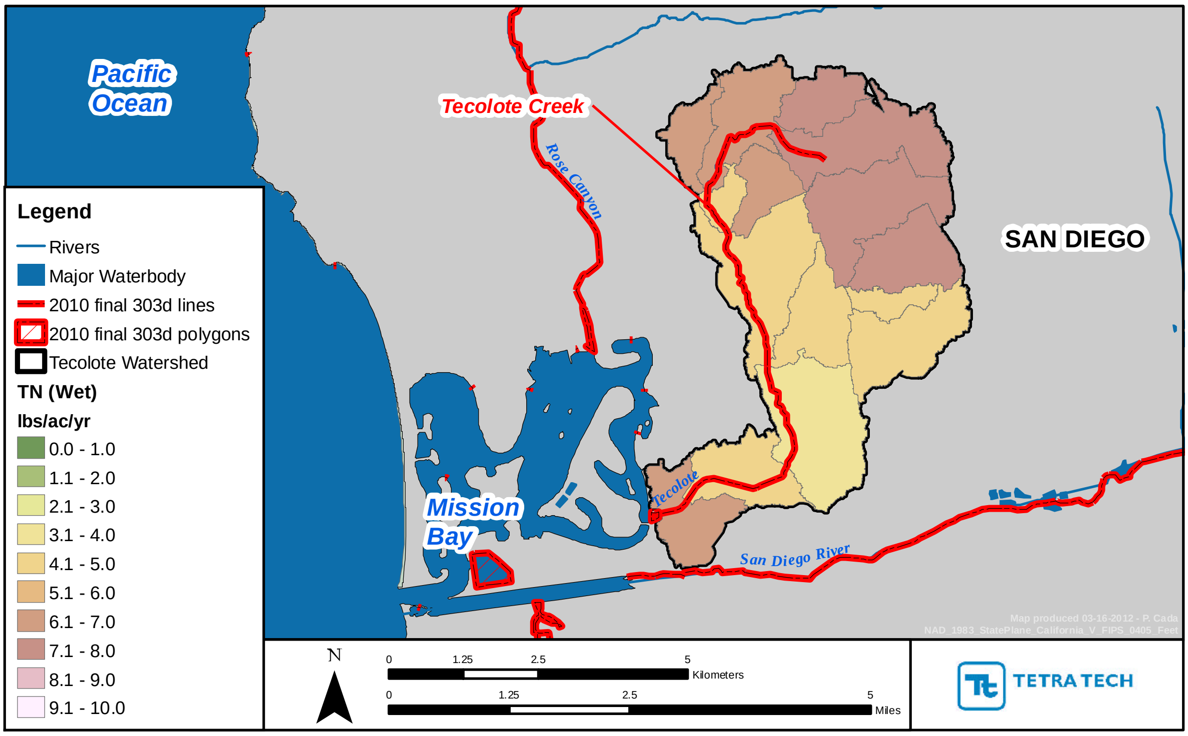

Figure 3-17. Wet-weather nitrogen loading in the Tecolote watershed

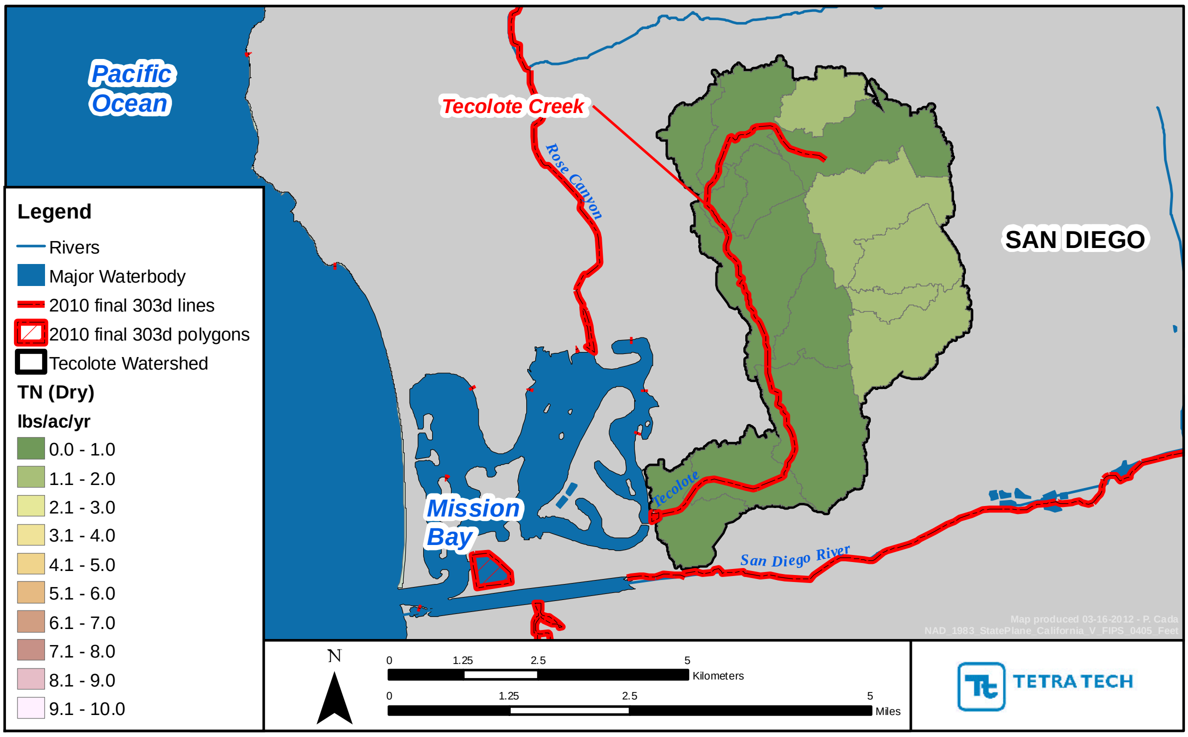

Figure 3-18. Dry-weather nitrogen loading in the Tecolote watershed

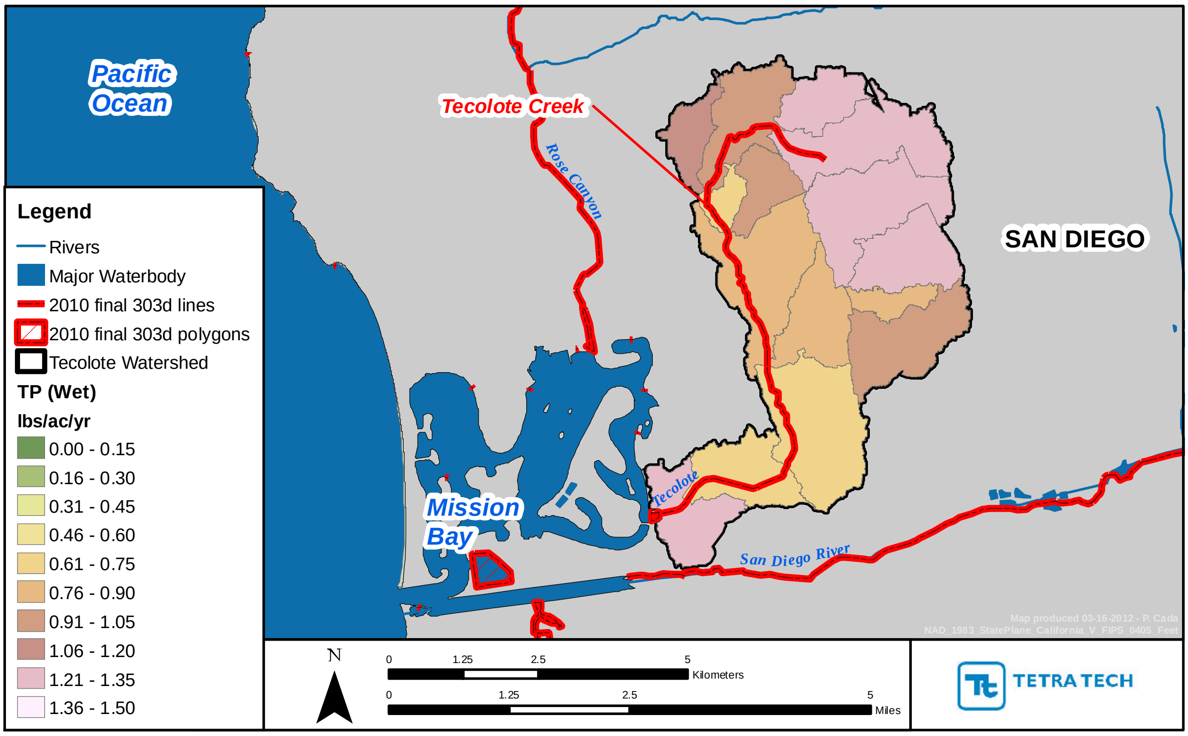

Figure 3-19. Wet-weather phosphorus loading in the Tecolote watershed

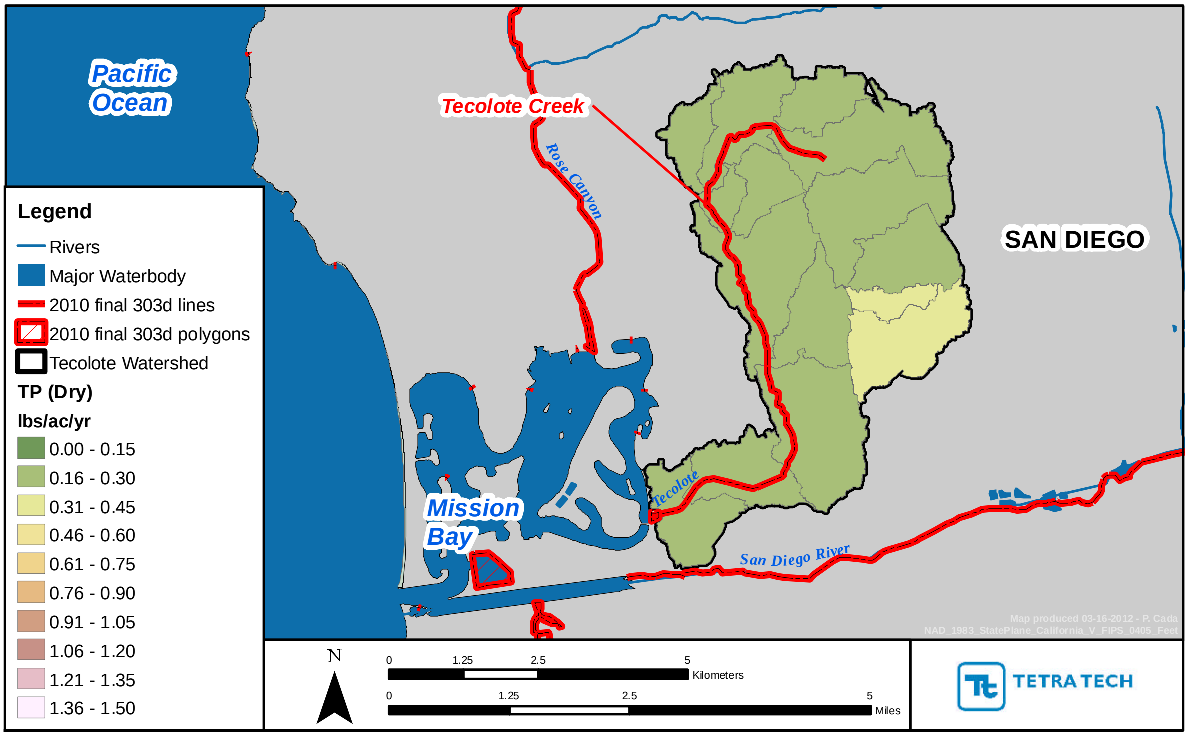

Figure 3-20. Dry-weather phosphorus loading in the Tecolote watershed

3.3.2.3 Metals (Copper, Lead, and Zinc)

Metals loading in the Tecolote watershed were quantified for copper, lead, and zinc. Wet-weather and dry-weather loading of the three metals are presented below in Figure 3-21 through Figure 3-26. The watershed also has impairments for cadmium, which was not simulated by the LSPC model. Cadmium loading likely follows a similar spatial pattern to the other metals; however, its magnitude likely differs. Loading results for copper, lead, and zinc generally have the same spatial distribution during wet weather, with the highest loading in the headwaters and near the mouth of Tecolote Creek. The headwaters area with the highest copper and zinc loading are near I-805 (and other transportation land uses) and low-density residential housing and commercial areas. Similar to the results previously presented, the dry-weather results are significantly lower than wet-weather results (although generally less than 50 percent lower).

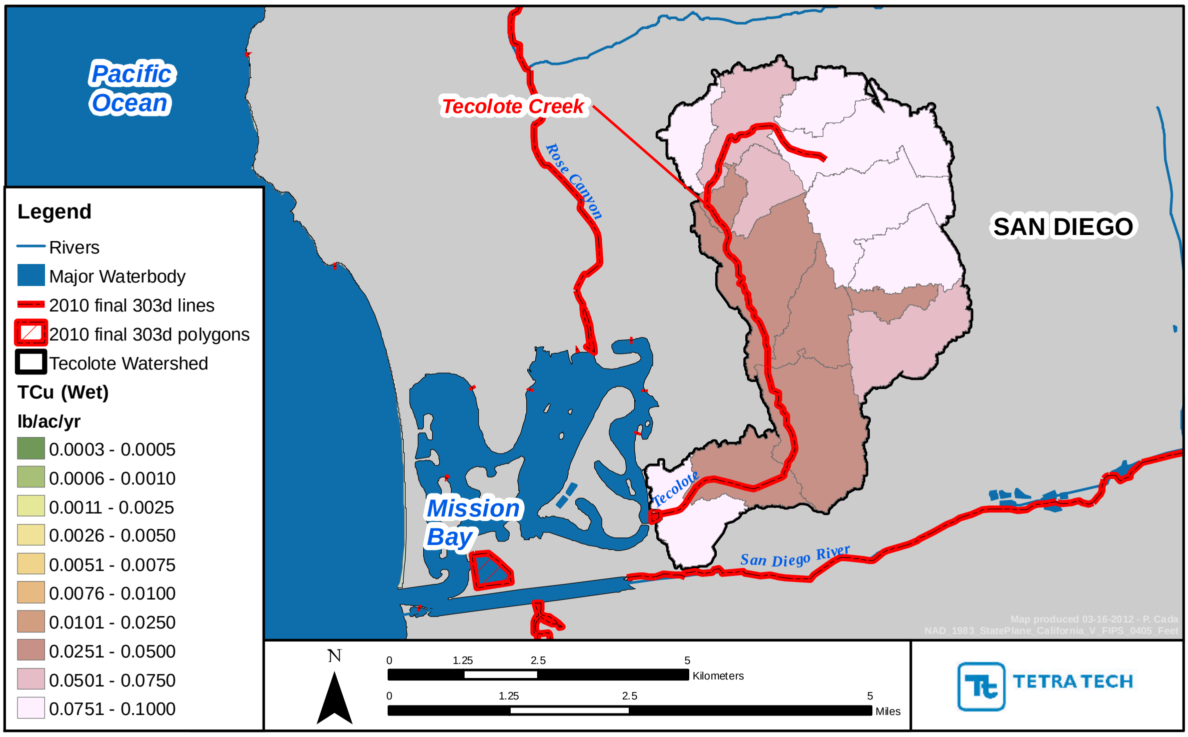

Figure 3-21. Wet-weather copper loading in the Tecolote watershed

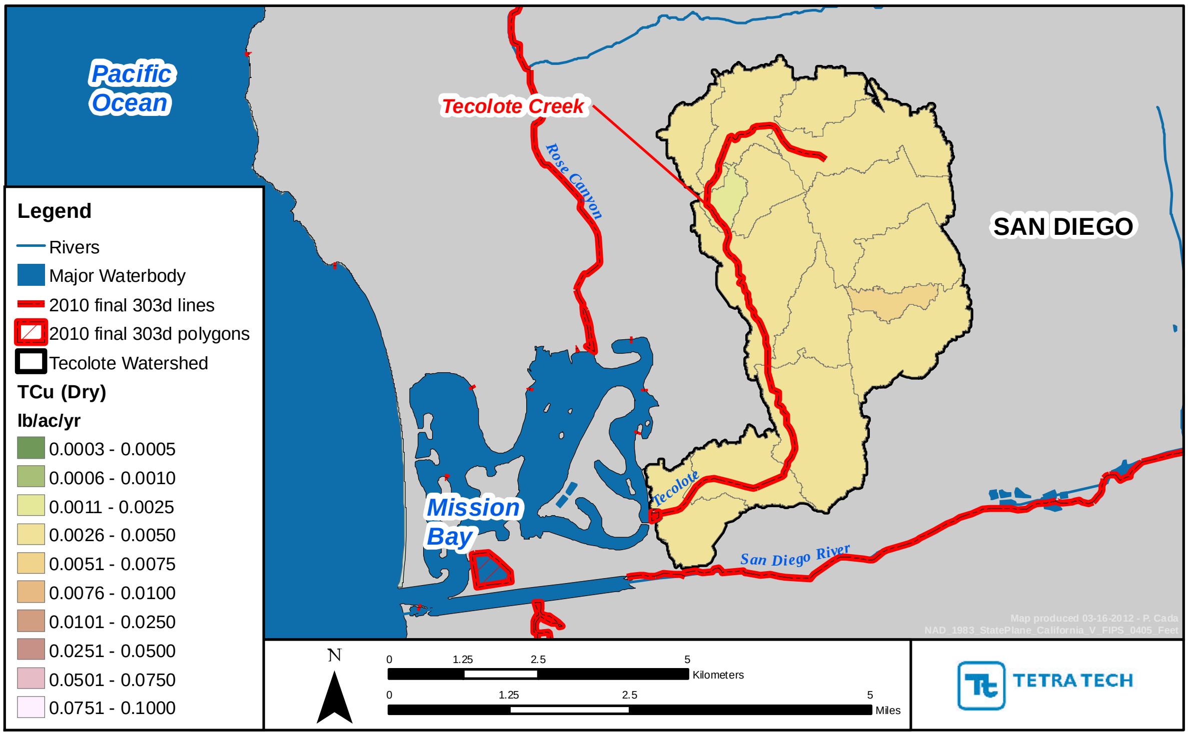

Figure 3-22. Dry-weather copper loading in the Tecolote watershed

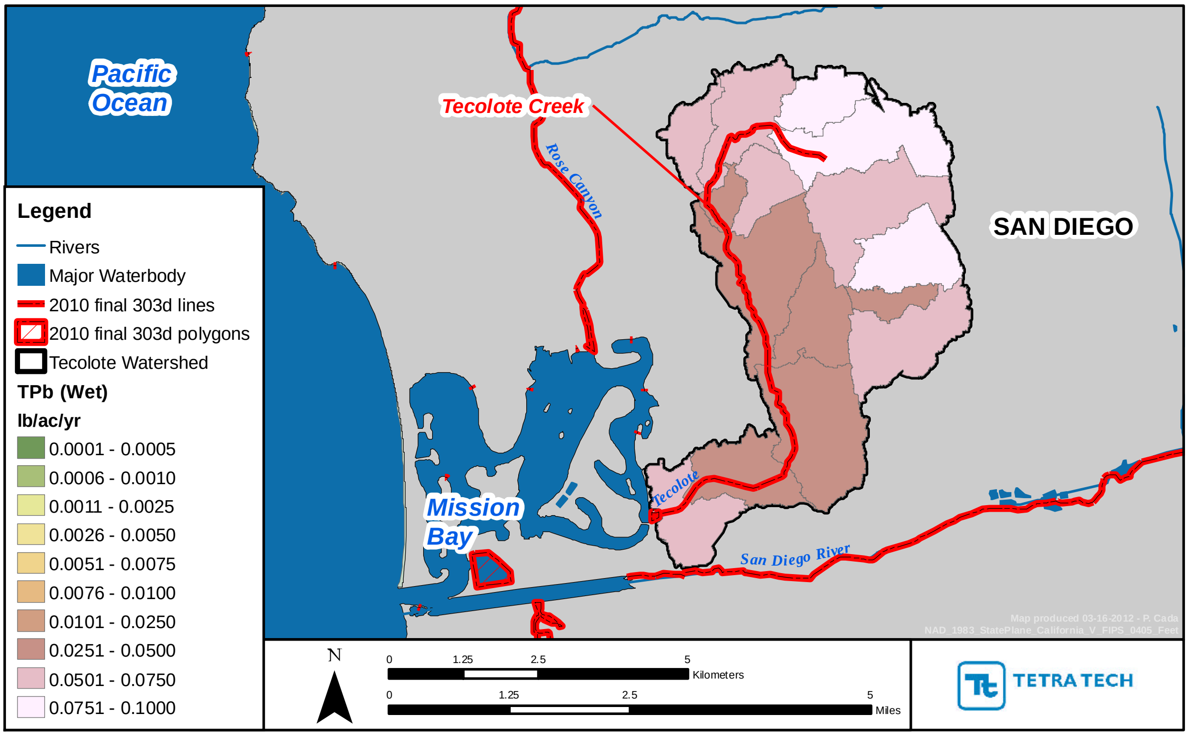

Figure 3-23. Wet-weather lead loading in the Tecolote watershed

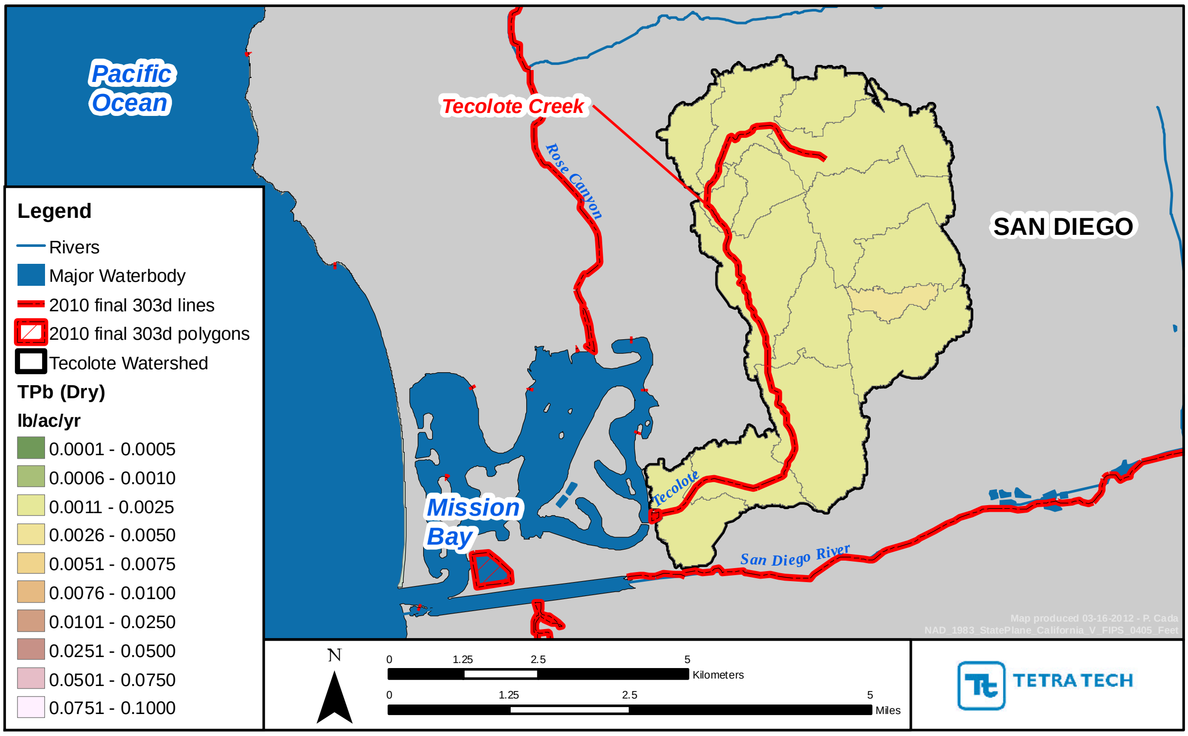

Figure 3-24. Dry-weather lead loading in the Tecolote watershed

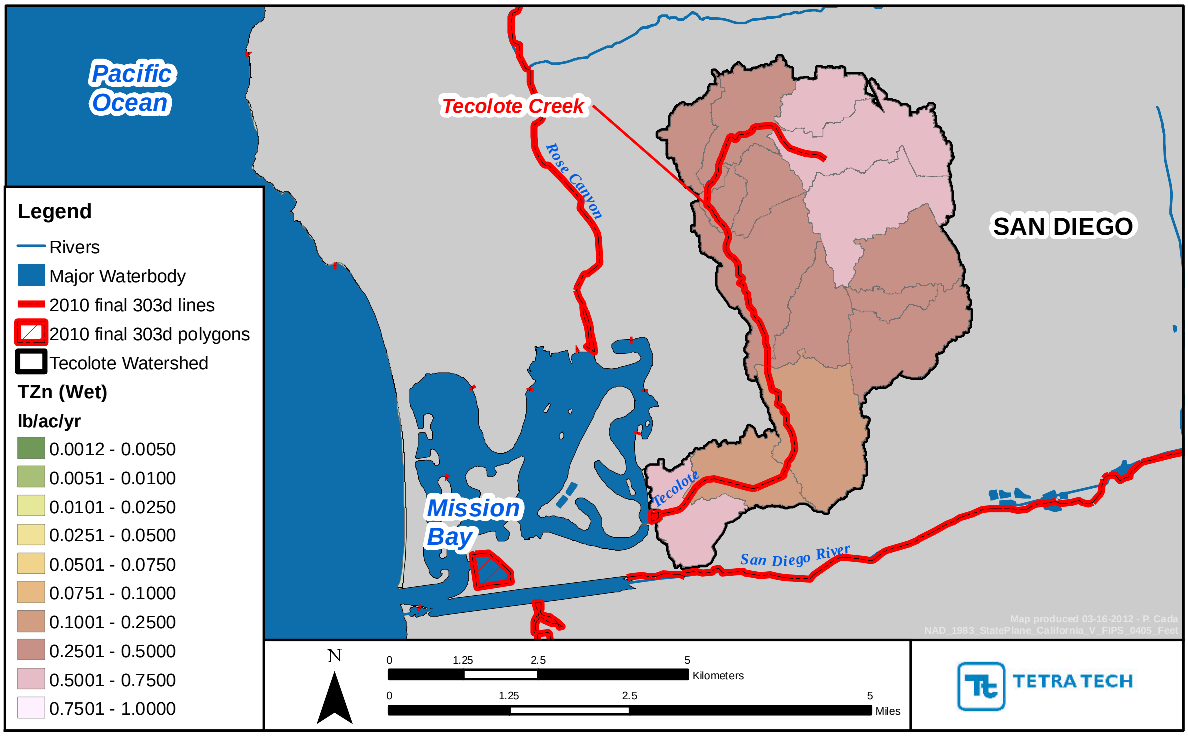

Figure 3-25. Wet-weather zinc loading in the Tecolote watershed

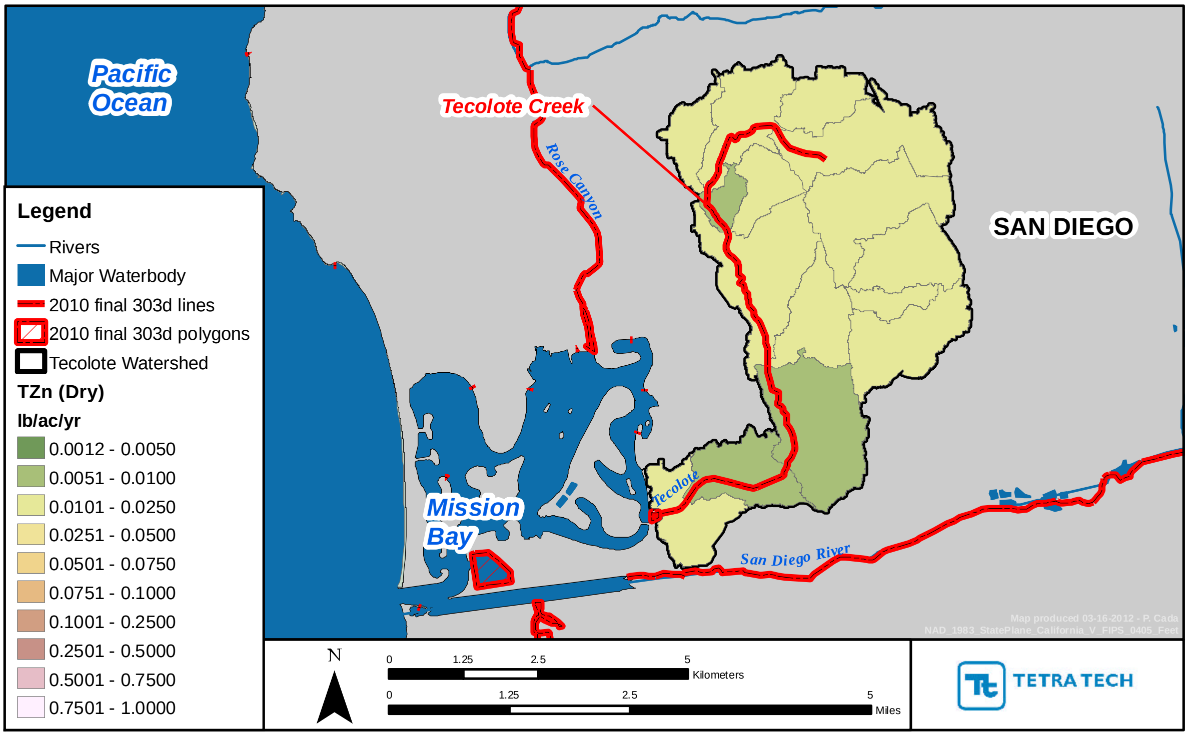

Figure 3-26. Dry-weather zinc loading in the Tecolote watershed

3.3.2.4 Sediment (TSS)

In addition to bacteria, nutrients, and metals, waterbodies in the Tecolote watershed are impaired by sediment (TSS and turbidity). The LSPC watershed model simulated sediment loads as TSS. Wet- and dry-weather sediment loads are presented in Figure 3-27 and Figure 3-28, respectively. As expected, the sediment load during dry weather is minimal when compared to the wet-weather results. The areas of highest sediment loading are in the headwaters of the watershed, which contain large areas of low-density residential and commercial land uses, other areas of moderate loading are sporadic throughout the drainage area.

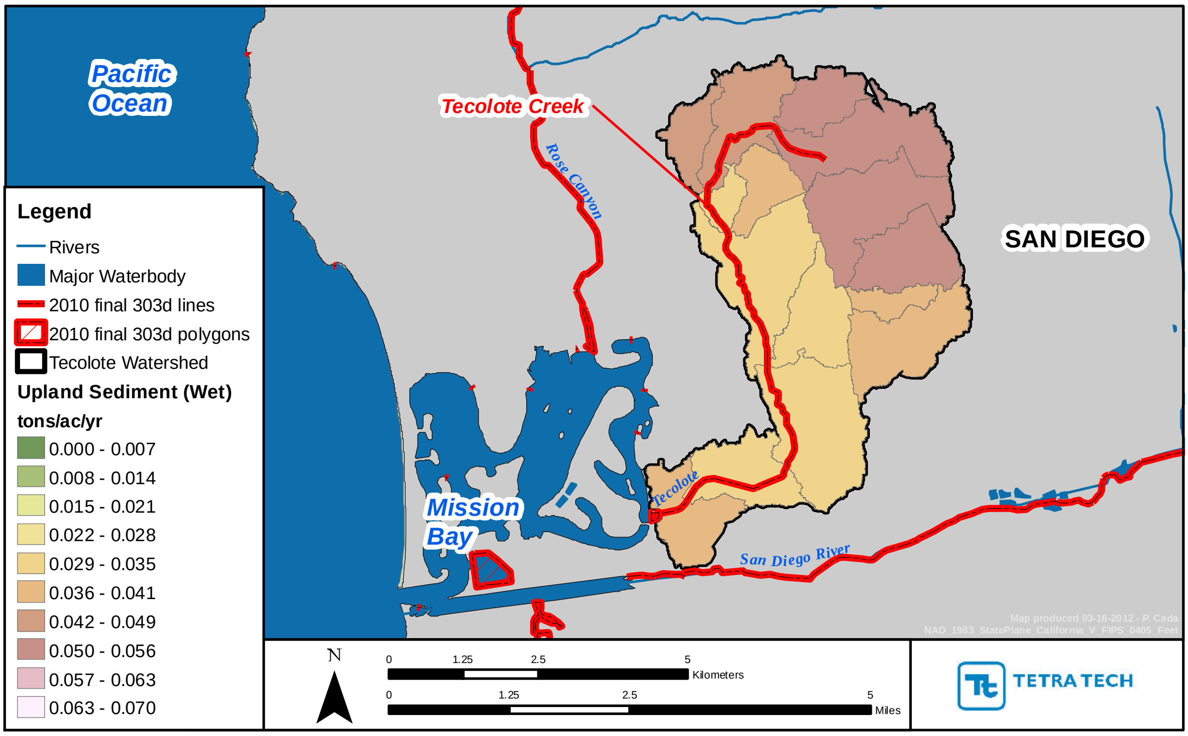

Figure 3-27. Wet-weather sediment loading in the Tecolote watershed

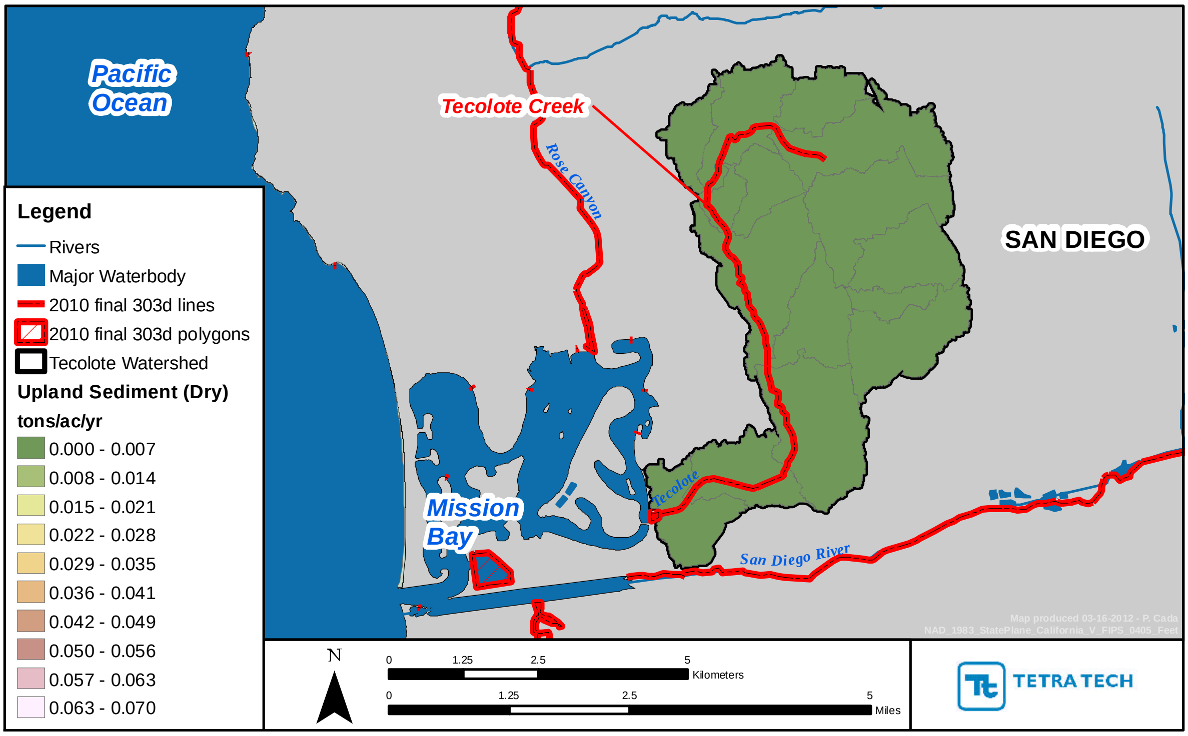

Figure 3-28. Dry-weather sediment loading in the Tecolote watershed

3.3.2.5 Additional Impairments (Selenium and Toxicity)

In addition to bacteria, nutrients, and metals, several waterbodies in the Tecolote watershed are impaired by the following non-modeled pollutants: selenium and toxicity. Toxicity cannot be modeled directly; rather, loadings associated with pollutants that cause toxicity can be estimated. Such pollutants often include metals and organic compounds, such as pesticides, which generally have a high affinity to soil and sediment particles (Shinya et al. 2000; USEPA 2002; ATSDR 2004). Because these hydrophyllic contaminants are likely to be in storm water runoff adsorbed to eroded sediment particles, their loadings are relatively proportional to sediment loadings in the Tecolote watershed. Wet- and dry-weather sediment loads are presented in Figure 3-27 and Figure 3-28, respectively, and are discussed above. Management practices to reduce sediment are likely to reduce toxicity, if the specific pollutants causing the impairments are sediment-associated. Selenium is the other non-modeled pollutant in the Tecolote watershed. The primary source of selenium is likely groundwater, and the watershed pathways are often complex. Storm water is not expected to be a significant source of selenium; however, if opportunities to reduce selenium are identified, they will be considered in the overall watershed implementation recommendations.

3.4 Pollutant Source Prioritization

3.4.1 Prioritization Methodology

To prioritize the model subwatersheds on the basis of water quality and to guide BMP recommendations, each modeled pollutant loading for every subwatershed was classified into quintiles. Bacteria was selected as the focus because of the priority in addressing the Bacteria TMDL loadings, recognizing that other pollutants will also benefit by implementing most of these BMPs. Because the critical conditions for the Bacteria TMDL include both wet and dry conditions, bacteria loading estimates were used to calculate the score for each condition.

A score of 5 indicates that the subwatershed pollutant loading was in the top 20th percentile (high pollutant loading); whereas a score of 1 represents a subwatershed loading in the bottom 20th percentile (low pollutant loading). Quintiles were established for each subwatershed and were given to each pollutant for both wet-weather and dry-weather analyses. For bacteria, the individual quintiles scores (1–5) for enterococci, fecal coliform, and total coliform were averaged for a dry composite bacteria score and for a wet composite bacteria score.

For each subwatershed, the dry composite score is the dry composite bacteria score or the average of the individual quintiles scores (1–5) for enterococci, fecal coliform, and total coliform. The wet composite score is the average of the wet composite bacteria score. The overall composite water quality score is the sum of the dry composite and wet composite scores. This scoring methodology is summarized in Table 3-11. To prioritize the subwatershed on a wet-weather or dry-weather approach, the wet-weather quintile scores (1–5) were averaged for an overall wet-weather score; the dry-weather quintile scores for bacteria were averaged for an overall dry-weather score.

Table 3-11. Water quality prioritization for the Tecolote watershed

TMDL pollutant	Dry composite score (1-5)*	Wet Composite score (1-5)*	Composite water quality score
Bacteria, Sediment, Metals (Cu, Pb, Zn)	Bacteria $_{dry**}$	Bacteria $_{wet**}$	Dry Composite Score + Wet Composite Score

* The 1–5 score represents the area loading's quintile as determined by the modeling results. A score of 5 indicates that the areal loading was in the top 20 percent; whereas, a score of 1 represents an area loading in the bottom 20 percent. Quintiles were established for each watershed.

**Bacteria$_{dry/wet}$ is the average of the dry enterococci, fecal coliform and total coliform scores.

3.4.2 Prioritization Results

The dry-weather composite scores and the wet-weather composite scores for each subwatershed are illustrated in Figure 3-29 and Figure 3-30, respectively. The overall water quality composite scores are illustrated in Figure 3-31. The water quality prioritization results demonstrate that the highest loadings take place in the upper-portion or headwaters of the Tecolote watershed. Subwatersheds 13 and 15 have a composite water quality score of 10, indicating that pollutant loadings there are the greatest under both wet- and dry-weather conditions (Appendix C). Areas that have a composite water quality score of 9 or 10 are considered HPMAs because they have the highest pollutant loadings in both weather conditions. As shown in Figure 3-31, these areas are in the headwaters of the Tecolote watershed (Appendix C provides additional detail on the water quality composite scores). The pollutant loading ranges for quintile scores for bacteria is shown in Table 3-12.

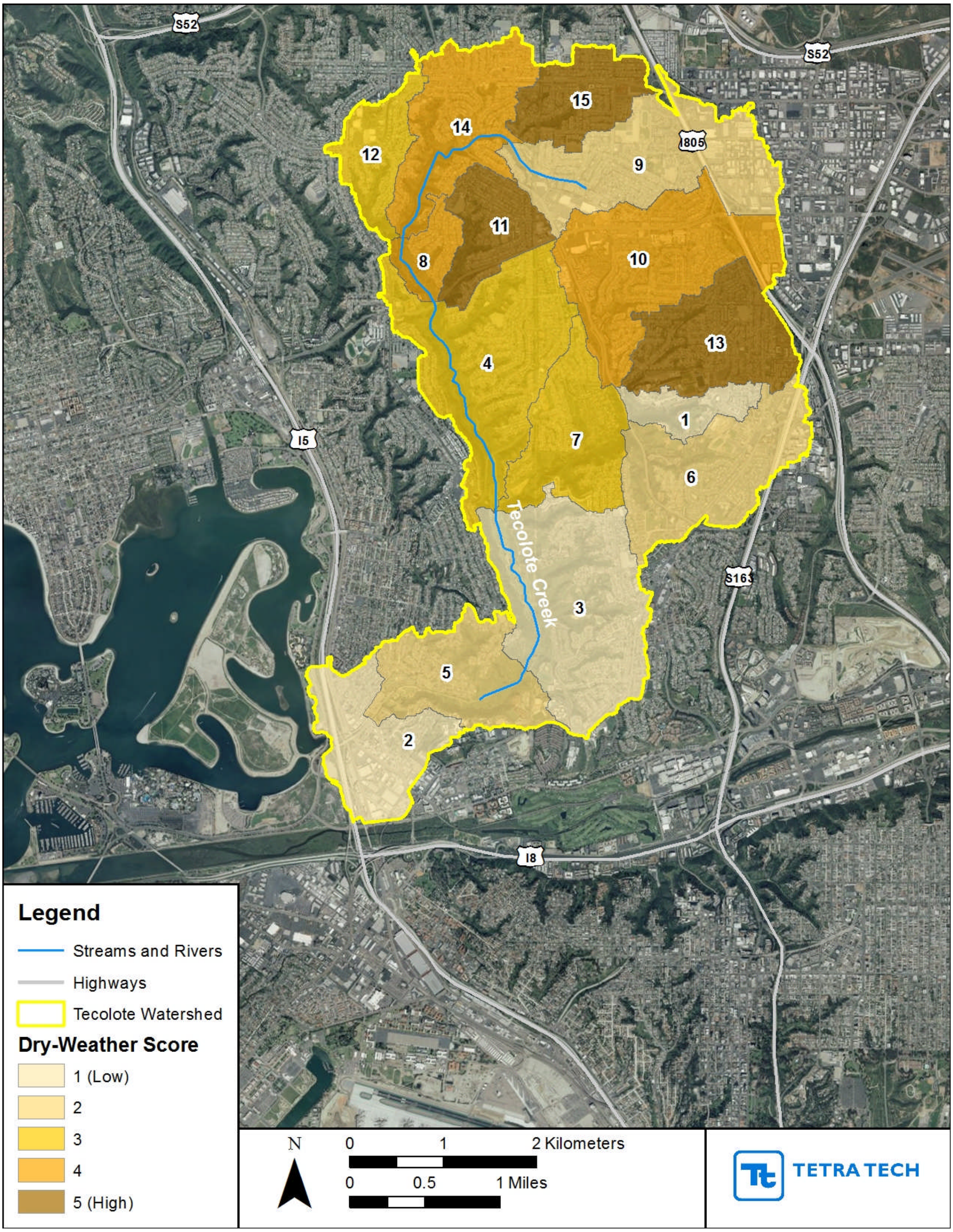

Figure 3-29. Dry-weather composite score (bacteria)

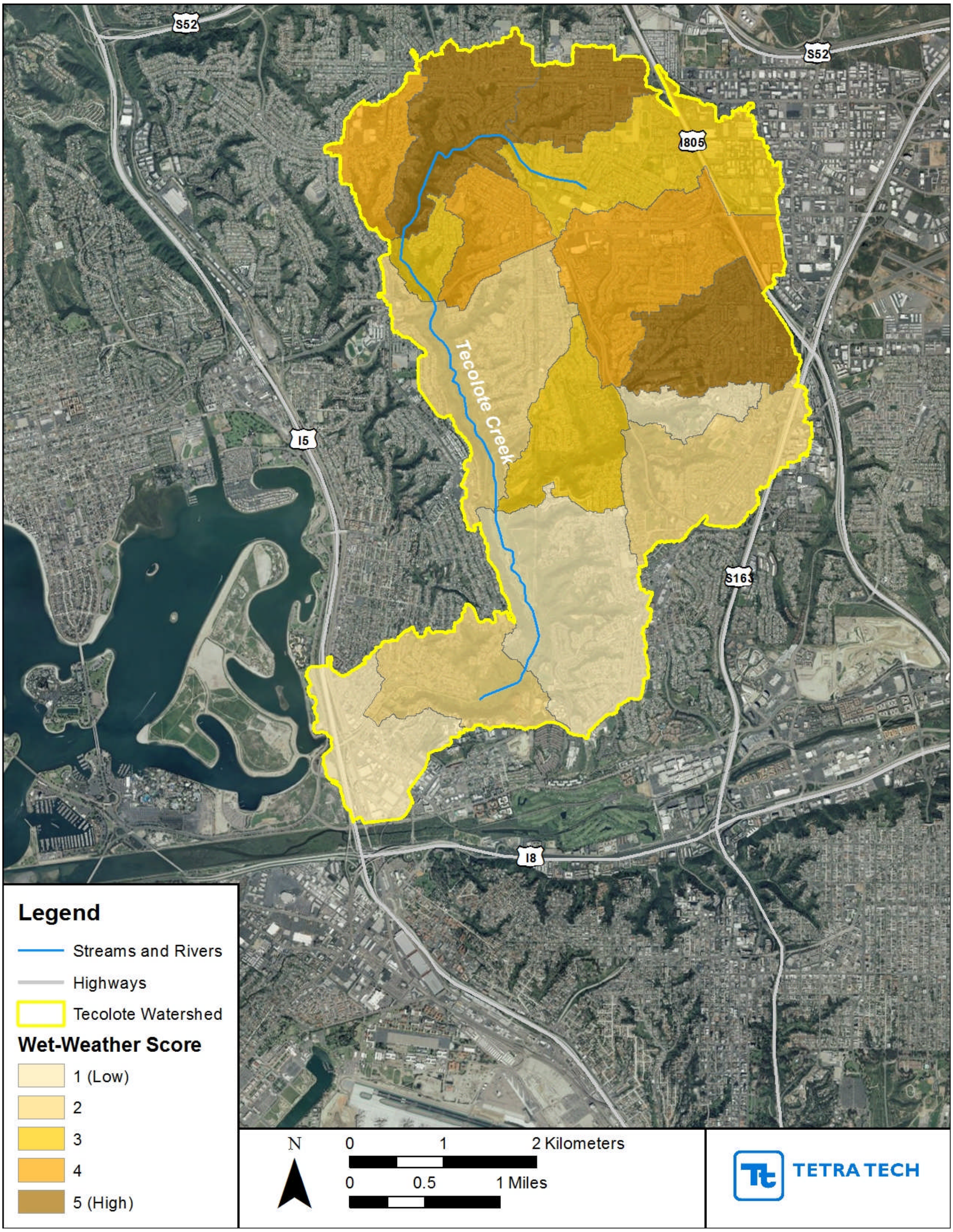

Figure 3-30. Wet-weather composite score (bacteria)

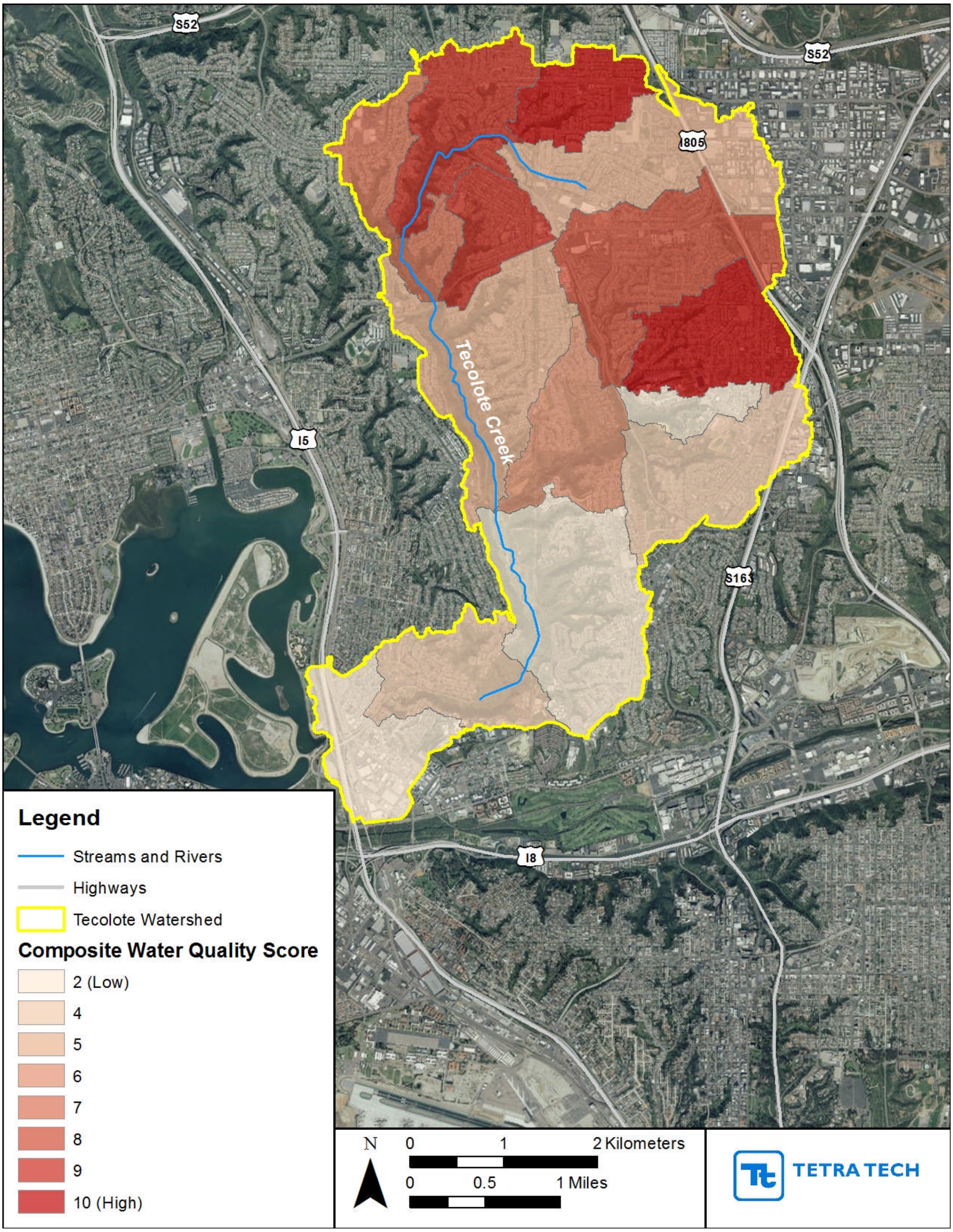

Figure 3-31. Water quality composite score (bacteria)

Table 3-12. Pollutant loading scores and associated ranges for bacteria

Water quality score	Bacteria range (billions/ac/yr)					
	Fecal coliform wet	Fecal coliform dry	Total coliform wet	Total coliform dry	Enterococci wet	Enterococci dry
1	0–133	0–18	0–1,282	0–204	0–519	0–82
2	133–156	18–20	1,282–1,551	204–218	519–594	82¯89
3	156–167	20–23	1,551–1,610	218–252	594–635	89–95
4	167–205	23–26	1,610–1,981	252–278	635–769	95–107
5	205 +	26 +	1,981 +	278 +	769 +	107 +

4 Developing Nonstructural Solutions

4.1 Introduction and Approach

To be fully comprehensive, a CLRP must identify nonstructural program opportunities and solutions that complement proposed structural solutions to achieve overall attainment of WLAs. This section describes strategies and opportunities for achieving load reduction targets in the Tecolote watershed by applying nonstructural BMPs identified by the two RPs for this watershed, Caltrans and the City of San Diego.

This section first presents a review of the actions the RPs have already taken to reduce pollutant loads, as reported in the Caltrans Statewide Stormwater Management Program Annual Report (Caltrans 2012), the City's JURMP Annual Report (City of San Diego 2010d; Caltrans 2012) and the WURMP for Mission Bay and La Jolla, which covers the Tecolote watershed (City of San Diego 2008). Second, this section discusses options for enhancements and expansions of existing and selected new, nonstructural BMPs, programs and activities that could result in reduced pollutant loads. Finally, this CLRP presents recommended BMPs that are planned, scheduled, and budgeted for each jurisdiction for each RPs but that can be prioritized and applied in the Tecolote watershed to address the specific PGAs, land use sources, and conditions in the watershed, using the mapping and HPMA designations. Each BMP is associated with a prospective 5-year implementation and phasing schedule, with cost estimates for each year, and associated budgeting according to the level of staff effort or materials and outside services estimated to be required to implement the BMP, as discussed in Section 7.

4.1.1 Approach

The sheer number of actions that the RPs perform in the course of their regular operations that can be considered *nonstructural BMPs* makes it especially challenging to organize them according to which ones, under what circumstances, and in what locations, could lead to the measurable load reductions required in the watershed. Thus, the CLRP focuses on three priorities:

1. Establishing a baseline for existing nonstructural actions relative to existing loads, principally on the basis of JURMP- and WURMP-reported activities as required in the MS4 permit
2. Identifying additional load reductions from planned, programmed, or ongoing activities that exceed basic permit requirements, or from enhancements or expansion of existing programs (e.g., the City of San Diego's rainwater harvesting rebate, Caltrans' Don't Trash California and Adopt-a-Highway programs)
3. Identifying potential changes to existing programs, including adopting best practices from other jurisdictions or watersheds that are transferable to the Tecolote watershed, and new actions or initiatives that would result in additional load reductions

After identifying the list of potential nonstructural BMPs, many of which were recommended as future BMPs in the WURMP, the CLRP analysis must determine where these BMPs might be applied to be most effective, the amount of pollutant load reduction that could be reasonably expected, and the potential costs of implementing the BMPs.

4.1.2 Defining Nonstructural BMPs

In contrast to the engineering practices of designing and building structural treatment and control facilities to improve water quality, both water resources-based and nonstructural BMPs can involve a wide range of actions. For example, some nonstructural BMPs include adopting laws or regulations banning the use of pollutants, and conducting general public outreach and education.

In many cases, a single nonstructural program or Watershed Activity will incorporate several components, such as enforcement, education, and pollution-preventing retrofits such as covering outdoor trash enclosures. For these reasons, it is important to define the universe of practices that will be included in the CLRP as *nonstructural* BMPs.

For purposes of this CLRP, nonstructural reduction strategies are defined as ***those actions and activities intended to reduce storm water pollution that do not involve construction of a physical component or structure to filter and treat storm water***. Non-structural reduction strategies also may include erosion repairs, stream buffer plantings and enhancement, constructing water resource mitigation sites in conjunction with capital projects (particularly transportation system projects that affect wetland areas), and implementing landscape-based measures such as turf conversion that involve construction and earth moving, but whose constructed functions are not exclusively limited to storm water filtration or treatment.

With a clear understanding of the scope of nonstructural BMPs, it is possible to characterize and define the types of BMPs in place or potentially available to the RPs. To do so, existing nonstructural BMPs were identified, and then three options were evaluated for additional load reduction: (1) potential expansions of existing BMPs to reach a greater geographic area or to achieve greater effect in the existing geographic area of the program; (2) potential enhancements or changes to existing programs that could achieve greater load reduction; and (3) new or expanded initiatives needed to address PGAs or sources identified. These are organized into eight categories listed in Table 4-1. The categories provide an organizational structure for discussion of BMP types, pollutant removal effectiveness, and additional load-reduction strategies.

In an effort to provide consistency in nonstructural BMP categorization between this CLRP and other regional efforts, Table 4-1 shows the relationship between the BMP descriptions used in this CLRP, and the BMP "families" described in a set of fact sheets developed separately and used in other regional efforts (Appendix D). This Table is intended to provide continuity and a cross-reference for the two approaches to describing BMPs.

Table 4-1. BMP terminology

Tecolote CLRP	BMP fact sheet *families*
Development review process SUSMP and regulatory enhancement	Policy development
Enhanced inspections and enforcement	Code enforcement
	Inspections
Enhanced inspections and enforcement SUSMP and regulatory enhancement	Trash management
	Animal waste management
MS4 maintenance	MS4 cleaning
	Street sweeping
	Channel and slope stabilization
New/expanded practices or capital improvement projects	Sanitary sewerage management
Capital improvement projects	Elimination of groundwater inflow
Landscape practices	*Smart gardening*
Education and outreach	Education and outreach

4.2 Methodology

To determine which of the many BMP options could be expected to be most effective at reducing pollutant loads, several factors must be considered:

- The pollutants and conditions of concern in the Tecolote watershed
- Locations and land use types in subwatersheds with the highest *water quality composite* scores, as illustrated in Figure 3-31
- The extent to which existing nonstructural solutions address each pollutant or condition of concern as reported in the JURMP and WURMP reports
- The extent to which each new or enhanced BMP option addresses gaps or weaknesses in the RPs' nonstructural program in the most targeted and cost-effective manner possible

The combination of existing efforts and recommended efforts determine the final, expected load reduction (Figure 4-1). Fundamentally, BMPs were chosen on the basis of their expected effectiveness at reducing pollutant sources and targeting PGAs of concern in the Tecolote watershed and their suitability for and potential to be implemented by the RPs. Selected BMPs were then assigned ranking criteria to help prioritize among various options, as addressed in Section 7.

Figure 4-1. Determining total load reduction from nonstructural practices

4.3 Nonstructural BMP Development

An evaluation was performed covering all aspects of the RPs' nonstructural BMP programs, which provided the necessary background on existing nonstructural solutions and suggested areas where enhanced or restructured activities might be more successful. The information obtained during these evaluations, along with independent research on pollutant sources, potential reduction strategies, and local conditions, formed the basis for the nonstructural BMP recommendations in this section.. More specifically, the BMP selection process followed the steps outlined below.

1. Review and characterize existing nonstructural programs for their reported effectiveness, and identify opportunities for enhancement or expansion, using the RPs' JURMP reports, applicable portions of the WURMP report, other relevant planning documents and development standards, and, as applicable, TMDL implementation plans and other plans (Section 4.3.1)
2. Identify new nonstructural programs for implementation, including best practices that are implemented elsewhere (Section 4.3.2)
3. Evaluate reduction effectiveness by examining the relationships among available nonstructural BMPs, pollutant sources, and PGAs to identify BMPs that address the pollutants, loads, and sources in the Tecolote watershed (Section 4.4.1)
4. Summarize potential BMPs (Section 4.5)

The potential BMPs were then prioritized for implementation, as discussed in Section 7.

4.3.1 Review and Characterization of Existing Nonstructural Programs

The City of San Diego and Caltrans are and have been implementing a variety of nonstructural programs designed to address pollutants and conditions of concern in the Tecolote watershed. These existing programs have been documented in the JURMP and WURMP reports. With respect to development review, the City's *Storm Water Standards Manual* (City of San Diego 2012) and zoning ordinances (City of San Diego Municipal Code Chapters 11 through 15) detail provisions relating to BMPs required for new development and redevelopment, and any retrofits required in the watershed. These sources combine to provide a baseline for existing nonstructural program activities.

4.3.1.1 Caltrans and JURMP-Reported Nonstructural Activities

The first component of the existing, baseline level of reduction comes from the nonstructural activities reported in the FY2010 JURMP for the City of San Diego (City of San Diego 2010d) and the Caltrans Statewide Stormwater Management Program Annual Report for FY2011-2012 (Caltrans 2012). Table 4-2 and Table 4-3 summarize the nonstructural program data. It is important to note that the JURMP reports present data by jurisdiction, rather than for the watershed; watershed-specific data are presented in Table 4-4.

Table 4-2. JURMP-reported nonstructural program data

Inspection activities	Tecolote watershed RP City of San Diego (FY 2010)
Construction	
Violations cited	23
MS4 cleaning	
Total number of catch basin inlets	31,997 and 3,055 storm drain facilities
Number inspected	33,189 and 12,000 storm drains
Number cleaned	15,092
Material removed[1]	6,236 tons and 444 tons from storm drain facilities
Distance of pipes	901 mi
Distance inspected	Not formally tracked
Distance cleaned	2.55 mi
Material removed	6,674 tons
Miles of open channels	50 mi
Length inspected	100 mi - inspected twice
Length cleaned	8 mi
Material removed	20,591 tons and 40,500 tons removed from Tijuana River and Smuggler's Gulch Channels
Street Sweeping	
Length of high-material streets	1,384 mi
Length of medium-material streets	313 mi and 5 operation yards
Length of low-volume streets	3,540 mi and 390 municipal parking lots
Total miles swept	101,048 mi
Number of municipal parking lots swept	

Inspection activities	Tecolote watershed RP City of San Diego (FY 2010)
Sweeping frequency	High volume - weekly, medium volume - monthly, low volume - every other month, 5 operation yards - once a month, parking lots - once a year
Materials collected	6,668 tons
Sites requiring inspection	127
Number inspected	124
Frequency	
Violations	0
Industrial and Commercial	
Number of commercial facilities requiring inspection	15,742
Number of commercial facilities inspected	5,306 site visits - 3,137 required full inspections
Number of industrial facilities requiring inspection	3,488
Number of industrial facilities inspected[2]	1,087 site visits and 582 required full inspections
Additional inspections	3,159- City's Food Establishment Wastewater Discharge Program 48- Industrial Wastewater Control Program
Total Inspections	6,926 full inspections
Citations issued	17
Violations issued	57
Verbal warnings issued	
Mobile businesses	1,915
Mobile business investigations	22
Citations issued[3]	5
Notice of violation issued	9
Residential	
Pounds/tons of household hazardous waste collected	464 tons
Number of investigations[4]	640
NOVs issued	171
Citations issued	119
Verbal warnings issued[5]	See comment

[1] *City of San Diego*- This number includes removal from catch basins, inlets, cleanouts, and the MS4 (not calculated separately).
[2] *City of San Diego*- The Pollution Prevention Division conducted the 1087 site visits. Of these, 582 were found to need full inspections, and 505 of those were found to have moved, be duplicates, or incorrectly classified. One industrial facility was found to be a mobile business.
[3] *City of San Diego*- Two Civil Penalties, and education provided for 5.
[4] *City of San Diego*- Investigations due to Storm Water Hotline and observations by code enforcement.
[5] *City of San Diego*- Totals: 1 civil penalty, 91 educational materials, 93 letters, 15 referrals to another department, and 5 TBD. Others were blank data, exempt, no action taken, or not visited.

Table 4-3. Caltrans FY2011-12 nonstructural program data

Activities	Caltrans- District 11 (Fiscal Year 2010- 2011)
Progress on Work Plan (percent completed)[1]	
General Management Practices	
Monitoring activities	100%
Public education and participation	100%
Municipal coordination	83%
Cooperative agreements with local agencies	100%
Construction Stormwater Program	
Pre-construction meetings	46
Active construction sites	92
Active construction sites with a SWPPP[3]	55
Active construction sites with a WPCP[3]	37
Response to enforcement actions	2
Maintenance Stormwater Program	
Drains and Culverts	
Drains-culverts inspections (each)	8,412
Drains-culverts cleaned (each)	6,188
Ditches and channels inspected and cleaned (miles)	7
Total number of drain inlets	24,158
Number of drain inlets/culverts inspected	7,391
Number of drain inlets/culverts cleaned	5,163
Enhanced Drain Inlet Inspection and Cleaning Program	
Total Number of drain inlets	8,104
Number of drain inlets inspected	2,707
Number of drain inlets cleaned	311
Herbicide Usage Summary	
Total pounds applied	20,824.26
Acres treated	3,712.30
Slope Inspection - District Maintenance Stormwater Coordinators [4]	
Total shoulder miles	3,085
Shoulder miles inspected	569.89
Minor repair needs found	1
Major repair needs found	2
Stormwater Slope Inspections and Erosion Control Activities- Division of Maintenance Field Crews [4]	
Storm Patrol Inspection miles	94,133
Minor Slope repairs	145
Minor slide/slipout work orders	33
Minor bare slopes repair work orders	2
Route sites cleared due to storms	183

Activities	Caltrans- District 11 (Fiscal Year 2010- 2011)
Major storm work orders	1
Storm related public complaint investigations	1
Illicit Connections/Illegal Discharge Summary	
Incidents	40
Resolved from prior fiscal years	13
Resolved during fiscal year 2010-2011	16
Regional Board referrals	5
Training	
Division of Planning and Design Employer Training Activities[5]	728
Division of Construction Employee Training Activities[6]	2,930
Maintenance Stormwater BMP Tailgate Meetings	897
Public Education	
Adopt-A-Highway Program	
Total Shoulder Miles	1,975
Miles Adopted	944
Materials removed (cubic yards)	942
Public Education Efforts	
"Don't trash California" - anti-litter campaign	x
Adopt- a highway program - anti-litter campaign	see details above
County Fairs	x
School events, activities, festivals	x

[1] The District completed a majority of the planned TMDL activities, and coordinated with TMDL stakeholders to achieve the percentage completed.
[2] Planned TMDL work for the fiscal year was completed and includes; water quality monitoring, municipal/stakeholder coordination, modeling, TMDL implementation, and structural and non-structural BMP implementation.
[3] A SWPPP and WPCP (Stormwater Pollution Protection Plan and Water Pollution Control Plan) were implemented at all construction sites when required.
[4] District Maintenance Stormwater Coordinators lead effort for storm damage repairs under the SWMP mandated program. In addition, Division of Maintenance conducts storm patrols, which assess needed erosion control/storm damage repairs for slopes.
[5] Training courses included: Design-Erosion prediction, Stormwater, Construction Site Water Pollution Control, Water Quality Sampling and Analysis, SWPPP/WPCP Review, Storm Water Data Report Workshop, and Advanced Concepts in Sustainable Erosion Control.
[6] Training courses included: Water Quality Sampling and Analysis, Construction Stormwater Refresher, Key Concepts of Sustainable Erosion Control, Reporting Requirement Training, 4-Hour SWPPP Crash Course, Spill Identification and Emergency Response, SWPPP New General Construction Permit, New Construction General Permit (CGP), Lake Tahoe Stormwater Training, Stormwater Data Report Workshop, Construction Stormwater NPDES Meetings, Registered Engineer Meeting Stormwater Update and Regional Board Presentation, Stormwater Management New Employee Training, and Stormwater Management Refresher Training.

4.3.1.2 WURMP-Reported Activities

The second component of the existing, baseline level of reduction comes from the nonstructural activities reported in the FY2010 WURMP annual report for the Mission Bay and La Jolla watersheds, which covers the Tecolote watershed (City of San Diego 2011a). Table 4-4 summarizes the nonstructural program data for the RPs in aggregate. It is important to note that as with JURMP reported data, the WURMP reports present data for the entire Mission Bay watershed, which includes the Tecolote watershed. The data presented in Table 4-4 have been selected to eliminate those WURMP activities that are not applicable to the Tecolote watershed.

As part of developing the recommended nonstructural solutions in the CLRP, the WURMP-reported activities were evaluated carefully and discussed with the RPs to evaluate the level of effort being applied, and to identify those Watershed Activities and maintenance operations that are most likely to achieve greater load reductions, if the activity were either expanded in its current format, or enhanced or modified to better target pollutants. The column at the right in Table 4-4 indicates whether the activity is recommended, in the CLRP, to be continued in its present form, expanded (i.e., more resources and greater geographic coverage) in its present form, or modified/enhanced at similar or slightly expanded resource levels to accomplish greater load reduction. The decision-making process for this column is described in detail in Section 4.3.1.4.

Table 4-4. WURMP-reported nonstructural program data

Watershed activity reported	Comparable BMP within Tecolote watershed CLRP (Table 4-6)	CLRP recommended action: continue current, enhance, or expand
City of San Diego		
MB1002 I Love a Clean San Diego Trash Cleanup Sponsorship MB1003 Coastal Cleanup Day Sponsorship	Education & Outreach: (27) Enhanced and expanded trash cleanup programs	Enhance
MB1005 Mission Bay Targeted Automotive Facility Inspections MB1006 Geographically Based Business Property & Facility Inspections	Enhanced Inspections & Enforcement: (7) Property-Based Inspections	Enhance & Expand
MB1010 Aggressive Street Sweeping MB1024 Median Sweeping Pilot Study	MS4 Maintenance: (36) Optimized/increased sweeping frequency or routes; (37) Sweeping medians on high-volume segments; (38) Upgraded sweeping equipment; (39) Require sweeping of private roads and parking lots	Enhance & Expand
MB1011 Municipal Rain Barrel Installation and Downspout Disconnection Project	Landscape Practices: Rebates/incentives for (22) Residential properties; (23) HOAs/common lands; (24) non-residential properties	Enhanced & expand
MB-1022 Lindbergh Park Limited Low Flow Storm Drain Inlet MultiPollutant Treatment	MS4 Maintenance: (33) Optimized/enhanced catch basin inlet cleaning and management	Enhance & expand
MB1025 Pet Waste Bag Dispenser Program	Education & Outreach: (32) Refocused education initiatives targeted to specific audiences/issues	Enhance & expand
MB1026 Source Control of Copper Water Pollutants, Senate Bill 346: Motor Vehicle Brake Friction Materials	New/Expanded Initiatives: (20) Support for Brake Pad Partnership	Continue existing
MB-2009 Mission Bay Focused Outreach	(32) Refocused or enhanced education and outreach to target audiences	Enhance & expand

4.3.1.3 Review of Development and Redevelopment Provisions

In the City of San Diego's jurisdiction, provisions related to BMPs required for new development or redevelopment and retrofits required in the watershed are in the zoning ordinances and applicable SUSMP documents. For the Tecolote watershed, the SUSMP for the City of San Diego (City of San Diego 2012), the City of San Diego Municipal Code (City of San Diego Municipal Code, Chapters 11 through 15) were reviewed to identify existing BMP requirements. In FY2011, the City of San Diego conducted an extensive evaluation of code and ordinance-based barriers to low impact development (LID) implementation (City of San Diego 2011b) and identified opportunities to improve source control through amendments and enhancements to codes and ordinances. The most notable findings relevant to the Tecolote watershed concerned opportunities to increase the use of landscaped areas for LID storm water controls, opportunities to improve site design requirements for high-risk uses such as auto- or animal-related uses, and opportunities to require supplemental measures through the SUSMP requirements, notably related to trash enclosures.

4.3.1.4 Internal Program Evaluations

The degree of actual load reduction achieved by any BMP, whether structural or nonstructural, is a function of the BMP's design, the level of effort and resources applied, and the extent of its application (whether geographic, directed to a specific PGA or pollutant-generating land use, or to a target audience). Evaluating the potential reduction value of different BMPs, thus, requires (1) an assessment of pollutant removal expectations on the basis of engineering and scientific data, and (2) of the timing, extent, and level of effort that reasonably could be applied, all of which can be determined by the RPs as programs are implemented.

To address this, the RPs conducted a series of evaluations to assess current programs and possible changes, and identify BMPs that may address identified load reduction opportunities. These evaluations were held for different aspects of watershed management, storm water pollution prevention, maintenance, and planning. This process provided essential information on the depth, focus, and practical impact of nonstructural programs that are not fully captured in the WURMP and JURMP reports. Moreover, data collected during the evaluations informed the identification of possible new nonstructural BMPs and best practices.

Evaluations primarily focused on areas or practices that could represent greater load reduction if existing programs were either expanded, enhanced, or the resources refocused toward a specific objective or to incorporate improved practices. Most pilot programs, such as rebates for landscape changes or the rain barrel and street sweeping pilot evaluations conducted by the City of San Diego in the Tecolote watershed and reported in the WURMP, are obvious candidates for expansion, but the feasibility of any program expansion depends on the availability of financial, staff, and equipment resources.

However, in some cases (such as shifting from required commercial and industrial inspections to a property-based approach focused on PGAs) and in some jurisdictions, it appears that there are opportunities for greater load reduction by refocusing the existing level of effort on the most likely pollution sources and practices. In cases such as this, where feasible, refocusing the existing program (and in some cases expanding the available resources) is recommended. Street sweeping, catch basin cleaning, and the industrial and commercial inspection program, represent approaches where enhancement and optimization changes to the existing programs—not simple expansion or increase—may be recommended to achieve greater load reductions over the current baseline.

Evaluations also identified current programs that are successful and believed to be resulting in load reductions, but the extent to which expansion or additional resources would achieve additional load reduction is subject to further study and could represent diminishing or no returns. As an example, the City of San Diego has achieved a high level of program development and geographic and target audience coverage with programs such as the regional education partnership, providing opportunities for household hazardous-waste reduction, special event permitting, installing pet waste bag dispensers in parks and public areas, illicit discharge detection and elimination, municipal site management, municipal staff training, and dealing with non-firefighting flows. These areas are assumed to continue roughly at current program levels reported in the JURMP or WURMP, or as represented in applicable ordinances, standards, and requirements.

Finally, best practices received special attention in developing recommended new initiatives for the RPs to consider. Best practices refer to model or innovative nonstructural efforts in place in one or more of the neighboring jurisdictions in the San Diego region that, if transferred and adopted by the RPs, could reduce pollutant loading without major new initiatives or expenditures. Many of these best practices (e.g., Del Mar's door hangers for over-irrigation (Kelly Barker, Mikhail Ogawa Engineering, personal communication, November 7, 2011), and Escondido's mobile business training during licensing (Cheryl Filar, City of Escondido, personal communication, November 17, 2011) operate within regular, existing municipal program activities and can represent readily adapted strategies for load reductions if the RPs begin adopting these management practices.

4.3.1.5 Existing Programs Recommended for Enhancement, Expansion, or Restructuring

Combining information from the JURMP- and WURMP-reported activities with the RPs' internal program evaluations and information obtained from additional research yields a list of existing programs that, if enhanced, expanded, or restructured, could improve BMP efficacy. Table 4-5 presents the list of BMPs recommended for enhancement or expansion, along with a reference to the existing program with best practices noted in red, a qualitative description of the potential load reduction anticipated from implementation, and the political actions (e.g., ordinance adoption or amendment, appropriation of resources) required for implementation. The anticipated costs for each BMP are unique to each RP and are reflected in the cost estimates in Section 7.

Table 4-5. Existing programs with recommendations for expansion or enhancement

BMP category/RP	Existing program	Potential load reduction impact of expansion/enhancement	Action required for expansion/enhancement
Development Review Process			
Caltrans	n/a – not responsible for development review		
City of San Diego	Current codes and ordinances	Improved implementation of LID, greater source control in new development and redevelopment	Legislative and policy adoption, implementation, enforcement
Enhanced Inspections and Enforcement			
Caltrans	Current IC/ID program	Enhanced effectiveness through supplemental staff training on IC/ID	Resources for development and implementation of enhanced training
City of San Diego	Current inspection and enforcement program	Greater effectiveness preventing and reducing pollutant discharges from high-risk PGAs and sites through adoption of property-based inspection program	Code adoption, regulatory support for modified programs, funding for additional staff for enforcement
SUSMP and Regulatory Enhancement			
Caltrans	n/a – not responsible for development review		
City of San Diego	Current SUSMP/Storm Water Standards	Retrofit of PGAs; and prevention pollutant loading from new development and redevelopment	Adopting amended standards, funding for additional staff for enforcement

BMP category/RP	Existing program	Potential load reduction impact of expansion/enhancement	Action required for expansion/enhancement
Landscape Practices			
Caltrans	Existing programs to reduce irrigation and pesticide use in ROW	Continued dry weather flow and pesticide runoff reductions & expanded geographic coverage	Continued funding for program to support additional irrigation retrofits & staff training
City of San Diego	Recently adopted San Diego Public Utilities rebate programs; MWD programs; enhanced enforcement of over-irrigation pursuant to City ordinances	Greater geographic coverage and greater number of sites using LID and water-conserving landscape practices reducing dry-weather flows and wet-weather pollutant loads; greater connection and support with MWD rebate programs	Funding for additional rebates; funding for additional enforcement staff on over-irrigation
Education and Outreach			
Caltrans	Don't Trash California and Adopt-A-Highway programs	Expanded schools coverage through Don't Trash California and expanded geographic coverage through additional Adopt-A-Highway sponsorships	Funding for staff for Don't Trash California; private sponsorship sign-ups for expanded Adopt-A-Highway
City of San Diego	Current ThinkBlue and regional watershed education programs; existing website	Improved targeting to audiences by watershed and specific high-risk behaviors; improved public education on regulations and enforcement	Reworking existing programs and website; funding for enhanced programs
MS4 Maintenance and Repair			
Caltrans[2]	Current JURMP-reported maintenance, slope & erosion stabilization, and capital upgrade programs	Continued retrofits to improve MS4, additional slope stabilization preventing sediment loads	Continued funding for operation/maintenance and storm water upgrades associated with capital projects
City of San Diego	Current JURMP-reported system maintenance	Proactive maintenance and replacement of MS4 components; enhanced and optimized cleaning and street sweeping	Reworking and optimizing current cleaning and sweeping programs; funding for additional and expanded maintenance, replacement

4.3.2 Identifying New Nonstructural BMPs and Best Practices

In addition to identifying opportunities for improving or expanding existing programs, the CLRP analysis must identify new nonstructural BMPs that could effectively reduce pollutant loads in the Tecolote watershed if implemented. New nonstructural BMPs may be developed where there are gaps in the present level of program implementation or to address sources or land uses that have not been the focus of existing programs.

Substantial research and evaluations were conducted to assess activities underway in the watershed that the RPs have not initiated, funded or managed, but that could provide opportunities for the RPs to engage in partnerships that provide load reduction. Information and options for partnerships were especially important in developing some of the BMPs that deal with pollutant sources, such as homeless or migrant

[2] Caltrans is adding LID features and additional source control over and above the permit as part of capital projects, and these are captured under Caltrans BMP #34 (proactive MS4 repair and replacement) and #45 (mitigation and conservation initiatives) in Table 4-6.

camps or multifamily residential complexes, whose management purview lies well beyond the authority of storm water and public works departments.

The CLRP also identifies strategies not underway in the watershed but that address an area not emphasized in the WURMP and JURMP that could provide additional load reduction. These actions might require the RPs' individual or regional collective actions, community partnerships, or support for other organizations and providers. In several cases, prospective BMPs could be initiated through support or partnership with another agency, service provider, or nonprofit organization rather than requiring a new action or activity by the RPs. Strategies for dealing with homelessness are an example of focus for the CLRP.

Finally, there are instances where a new initiative, partnership or investment would address a pollutant load pathway. New initiatives could range from studies and assessments to pilot programs, to financial support for regional activities, to entirely new Watershed Activities. Initiating any new activity would be subject to the availability of resources, whether for funds, approval to direct additional staff resources to an issue, or approval of a partnership agreement with an outside organization.

4.4 Potential Nonstructural BMPs

The final list of potential nonstructural BMPs consists of the existing JURMP- and WURMP-reported initiatives, the programs identified for enhancement, expansion, or restructuring, and the possible new initiatives. This consolidated list of potential BMPs addresses the pollutants and conditions of concern, and the specific PSC land uses and PGAs in the Tecolote watershed. This section describes how the BMPs on the final consolidated list relate to the PGAs, PSC land uses, and conditions and pollutants of concern. Appendix E presents more detailed descriptions of the BMPs in the Table.

The specific timing and focus of each BMP will be tailored to address the pollutants of concern, PGAs and PSC land uses, as described below. The specific implementation by the RPs could take a number of different forms as programs are developed in detail; however, the analysis in the CLRP has informed the selection of BMPs and initial planning for resource allocation and phasing over the implementation period. Required levels of effort, phasing, and costs for the selected nonstructural BMPs are addressed in Section 7.

Table 4-6 summarizes all recommended initiatives for the watershed by RP. Appendix E describes each BMP, including discussion of any model program(s) on which the initiative is based and the resources and decision making required for implementation. The pollutants, land uses, and PGAs in the watershed that are addressed by the BMPs are described in Table 4-7 through Table 4-5. Table 4-6 indicates with an X where the RP would address load reduction through an enhanced or expanded version of an existing BMP, as described in Table 4-5 above, or through participation in or developing a new or expanded BMP either on its own, or through a regional initiative, as is determined to be most cost-effective and efficient as the specific program is developed. The costs of those BMPs are the basis for the nonstructural program costs in Section 7.

It is important to note that the absence of a symbol in a cell does not necessarily indicate that the RP has not addressed the issue of concern. The absence of a symbol indicates that after consideration of its program development process and local conditions, the RP has not included the BMP in its strategy for load reduction during the CLRP implementation period. In some cases, aggressive efforts are in place already and the effort would not, if expanded, lead to further reductions. In other cases, the RPs have determined that new actions or investments are not warranted. Finally, a "C" in the cell indicates that the RP has undertaken and completed the applicable BMP and further action is not deemed necessary.

Table 4-6. Recommended nonstructural BMPs[3]

<table>
<tr><th colspan="2" rowspan="2">BMP</th><th colspan="2">RP</th></tr>
<tr><th>Caltrans</th><th>City of San Diego</th></tr>
<tr><td colspan="4">Development Review Process</td></tr>
<tr><td>1</td><td>Amend zoning and other development regulations to facilitate LID implementation</td><td rowspan="2">n/a</td><td>X</td></tr>
<tr><td>3</td><td>Train staff and boards to facilitate LID implementation and source control</td><td>X</td></tr>
<tr><td colspan="4">Enhanced Inspections and Enforcement</td></tr>
<tr><td>4</td><td>Training or certification requirements for mobile businesses</td><td rowspan="2">n/a</td><td>X</td></tr>
<tr><td>5</td><td>Inspection/enforcement of power washing discharges</td><td>X</td></tr>
<tr><td>6</td><td>Enhanced IC/ID reporting and enforcement</td><td>X</td><td>n/a Caltrans-specific</td></tr>
<tr><td>7</td><td>Property-based inspections</td><td>n/a</td><td>X</td></tr>
<tr><td colspan="4">SUSMP and Regulatory Enhancement</td></tr>
<tr><td colspan="4">Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:</td></tr>
<tr><td>9</td><td>Trash enclosure and storage areas</td><td rowspan="5">n/a</td><td>X</td></tr>
<tr><td>10</td><td>Animal-related facilities</td><td>X</td></tr>
<tr><td>12</td><td>Nurseries and garden centers</td><td>X</td></tr>
<tr><td>13</td><td>Auto-related uses</td><td>X</td></tr>
<tr><td>15</td><td>Update minimum BMPs</td><td>X</td></tr>
<tr><td colspan="4">New/Expanded Initiatives</td></tr>
<tr><td>16</td><td>Partnerships to address bacteria and trash impacts of homelessness</td><td>X[4]</td><td>X</td></tr>
<tr><td>17</td><td>Pilot projects disconnecting impervious surfaces from the MS4 (e.g., rain barrels, downspout disconnection)</td><td>□ra[5]</td><td>X</td></tr>
<tr><td>20</td><td>Support for Brake Pad Partnership</td><td>X</td><td>X</td></tr>
<tr><td colspan="4">Landscape Practices</td></tr>
</table>

[3] The numbering of BMPs is, in some cases, not sequential. The San Diego Region Copermittees have prepared five city-led CLRPs in FY2012, and for management and planning purposes, have created a common, merged list of all BMPs recommended in all city-led CLRPs. The numbering from this master merged list has been used in each of the CLRPs. Where a BMP from the master list has not been recommended or is not applicable to the Tecolote watershed, that BMP is missing and the list has not been renumbered.

[4] Caltrans conducts and documents encampment removal from its right of way.

[5] Caltrans is actively seeking to implement new treatment BMPs such as porous pavement and modified infiltration trenches as pilot programs to monitor effectiveness and potential for implementation as an approved treatment BMP. Because of the unique nature of Caltrans as an RP, these measures are reflected in BMP #34 and BMP #45.

BMP		RP Caltrans	RP City of San Diego
Landscape BMP incentives, rebates, and training:			
22	Residential properties	n/a	X
23	Homeowners' associations/property managers		X
24	Nonresidential properties		X
25	Reducing over-irrigation		X
26	Xeriscaping, turf conversion and other irrigation, pesticide and fertilizer reduction (jurisdiction-specific program)	X	**n/a Caltrans specific**
Education and Outreach			
27	Enhanced and expanded trash cleanup programs	X	X
28	Improved Web resources promoting reporting of enforceable discharges		X
Refocused or enhanced education and outreach to target audiences:			
29	Equestrian community	n/a	X
32	General/other		X
MS4 Maintenance			
33	Optimized or enhanced catch basin inlet cleaning and management		X
34	Proactive MS4 repair and replacement	X	X
35	Increased channel cleaning and scour pond repair to improve MS4 function	X	X
Street sweeping enhancements and expansion:			
36	Increased sweeping frequency or routes		X
37	Sweeping medians on high-volume segments		X
38	Upgraded sweeping equipment	X	X
39	Sweeping of private roads and parking lots		X
Erosion repair and slope stabilization:			
40	Public property and right of way	X	X
41	Enforcement on private properties	n/a	X
Capital Improvement Projects			
42	Dry-weather flow separation		X
45	Mitigation and conservation initiatives	X	

4.4.1 Expected Load Reductions of Pollutants

The purpose of identifying nonstructural BMPs in the CLRP is to identify and develop a list of recommended BMPs that target the pollutants of concern in the Tecolote watershed and that, when implemented, would effectively reduce pollutant loads or address a condition of concern in the Tecolote watershed. For example, requiring closed-top trash receptacles at restaurants can prevent wildlife from entering trash areas, prevent storm water from coming into contact with trash and trash areas, and prevent trash from becoming wind- or water-borne, and thereby reduce bacteria loads by preventing pollutants from entering the MS4.

Table 4-7 presents the BMPs recommended for implementation in the Tecolote watershed and their primary and secondary pollutant reduction effectiveness relative to the pollutants of concern. The table shows the BMPs' *primary*, *secondary*, and *no* reduction values, which are based on literature review and the RPs' internal program evaluation in 2011, considering the typical design approach, typical land use setting, and common geographic extent of application for the specific BMP. In Table 4-7, the closed circle (●) indicates that the BMP provides primary reduction for the pollutant; the half circle (◗) indicates secondary/incidental reduction; and the open circle (○) indicates that the BMP does not address the pollutant. BMPs have been recommended that have a primary reduction impact (●) on each of the watershed impairments.

Table 4-7. Effectiveness of nonstructural BMP types[6]

BMP		Impairment										
		Bacteria	Metals	Organics	Sediment	Pesticides	Nutrients	Oil and grease	Dissolved minerals	Trash	Flow	Volume reduction
Development Review Process												
1	Amend zoning and other development regulations to facilitate LID implementation	●	◗	◗	●	◗	●	○	◗	●	●	●
3	Train staff and boards to facilitate LID implementation and source control	◗	◗	○	◗	◗	◗	○	◗	◗	◗	◗
Enhanced Inspections and Enforcement												
4	Training or certification requirements for mobile businesses	●	○	●	○	◗	○	●	○	◗	○	○
5	Inspection/enforcement of power washing discharges	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗
6	Enhanced IC/ID reporting and enforcement	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗
7	Property-based inspections	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗

[6] The numbering of BMPs is, in some cases, not sequential. The San Diego Region Copermittees have prepared five city-led CLRPs in FY2012, and for management and planning purposes, have created a common, merged list of all BMPs recommended in all city-led CLRPs. The numbering from this master merged list has been used in each of the CLRPs. Where a BMP from the master list has not been recommended or is not applicable to the Tecolote watershed, this BMP is missing and the list has not been renumbered.

		Impairment										
BMP		**Bacteria**	**Metals**	**Organics**	**Sediment**	**Pesticides**	**Nutrients**	**Oil and grease**	**Dissolved minerals**	**Trash**	**Flow**	**Volume reduction**
SUSMP and Regulatory Enhancement												
Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:												
9	Trash enclosure and storage areas	●	◗	○	○	○	○	◗	○	●	○	○
10	Animal-related facilities	●	○	○	●	●	●	○	○	○	◗	◗
12	Nurseries and garden centers	◗	○	●	●	●	●	○	○	○	◗	◗
13	Auto-related uses	○	●	◗	○	○	○	●	○	◗	◗	◗
15	Update minimum BMPs	*Varies by SUSMP and Regulatory Enhancement*										
New/Expanded Initiatives												
16	Partnerships to address bacteria and trash impacts of homelessness	●	○	○	○	○	◗	○	○	●	○	○
17	Pilot projects disconnecting impervious surfaces from the MS4 (e.g., rain barrels, downspout disconnection)	◗	◗	◗	◗	◗	◗	○	◗	○	●	●
20	Support for Brake Pad Partnership	○	●	○	○	○	○	○	○	○	○	○
Landscape Practices												
Landscape BMP incentives, rebates, and training:												
22	Residential properties	○	○	○	◗	●	◗	○	○	○	◗	◗
23	Homeowners' associations/property managers	○	○	○	◗	●	◗	○	○	○	◗	◗
24	Nonresidential properties	○	○	○	◗	●	◗	○	○	○	◗	◗
25	Reducing over-irrigation	○	○	○	◗	●	◗	○	○	○	●	●
26	Xeriscaping, turf conversion and other irrigation, pesticide and fertilizer reduction	●	◗	◗	●	●	●	○	◗	○	●	●
Education and Outreach												
27	Enhanced and expanded trash cleanup programs	◗	◗	◗	○	◗	○	◗	●	◗	○	○
28	Improved Web resources promoting reporting of enforceable discharges	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗	◗
Refocused or enhanced education and outreach to target audiences:												
29	Equestrian community	●	○	○	◗	○	◗	○	○	○	○	○
32	General/other	*Varies by focus*										
MS4 Maintenance												

BMP		Impairment										
		Bacteria	Metals	Organics	Sediment	Pesticides	Nutrients	Oil and grease	Dissolved minerals	Trash	Flow	Volume reduction
33	Optimized or enhanced catch basin inlet cleaning and management	◗	●	○	●	○	◗	○	○	○	○	○
34	Proactive MS4 repair and replacement	◗	●	○	●	○	◗	○	○	○	○	○
35	Increased channel cleaning and scour pond repair to improve MS4 function	◗	●	○	●	○	◗	○	○	○	○	○
Street sweeping enhancements and expansion:												
36	Increased sweeping frequency or routes	◗	●	◗	●	○	●	○	◗	●	○	○
37	Sweeping medians on high-volume segments	◗	●	◗	●	○	●	○	◗	●	○	○
38	Upgraded sweeping equipment	◗	●	◗	●	○	●	○	◗	●	○	○
39	Sweeping of private roads and parking lots	◗	●	◗	●	○	●	○	◗	●	○	○
Erosion repair and slope stabilization:												
40	Public property and right of way	◗	○	○	●	○	◗	○	◗	○	○	○
41	Enforcement on private properties	◗	○	○	●	○	◗	○	◗	○	○	○
Capital Improvement Projects												
42	Dry-weather flow separation	●	◗	○	○	○	◗	◗	○	○	●	●
45	Mitigation and conservation initiatives	◗	○	○	●	◗	◗	○	○	○	○	○

● - provides primary pollutant reduction ◗ - provides secondary pollutant reduction ○ - does not address the pollutant

4.4.2 Pollutant Sources and Pollutant-Generating Activities

In addition to the pollutants of concern in the watershed, BMPs can be identified that address the specific types of pollutant sources (PSC land uses) expected to generate those pollutants, and the specific PGAs in the watershed. Appendix F presents the complete menu of BMPs recommended, and the specific targeted PSC land uses and PGAs in the watershed.

To ensure some cross-referencing capacity between the PSC in this CLRP and the 2011 LTEA (San Diego County 2011b), Appendix F relates the expected PGAs with PSC land uses, the full menu of BMPs to PSC land uses to which they apply, and to the PGAs to which they apply. Table 4-8 and Table 4-9 present the extent of land uses and the types and numbers of PGAs in the Tecolote watershed, and the specific BMPs proposed for the watershed (using the numbers in Table 4-6 above) that have been selected on the basis of their applicability to the land use category.

Table 4-8. PSC land uses in the Tecolote watershed

Aggregate land use category	Land use components	Acres	Percent	Recommended BMPs
Commercial	Arterial Commercial Automobile Dealership Communications and Utilities Community Shopping Center Hotel/Motel (Low-Rise) Neighborhood Shopping Center Office (Low-Rise) Other Retail Trade and Strip Post Office Religious Facility Service Station	414.828	6.44%	1, 2, 3, 5, 6, 7, 9, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 33, 34, 35, 39, 41
Freeway	Freeway	161.645	2.51%	6, 13, 20, 26, 27, 32, 33, 34, 35, 36, 37, 38, 40
High Density Residential	Dormitory Mobile Home Park Multi-Family Residential Multi-Family Residential Without Units Other Group Quarters Facility Single Family Multiple-Units	529.221	8.22%	1, 2, 3, 5, 6, 7, 9, 14, 17, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 39, 41
Industrial	Industrial Park Light Industry - General Public Storage Warehousing	117.502	1.83%	5, 6, 9, 14, 28, 41
Institutional	Elementary School Fire/Police Station Government Office/Civic Center Hospital - General Junior College Junior High School or Middle School Library Other Health Care Other Public Services Other School Other University or College School District Office Senior High School	518.118	8.05%	1, 2, 3, 5, 6, 7, 9, 10, 17, 24, 25, 26, 27, 28, 33, 34, 35, 39, 41
Low Density Residential	Single Family Detached Single Family Residential Without Units	2,240.161	34.80%	1, 2, 3, 6, 12, 13, 14, 17, 19, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 41
Military	Military Use	18.588	0.29%	6, 10, 13, 14, 24, 25, 26, 27, 33, 34, 35, 39
Open Space	Landscape Open Space Vacant and Undeveloped Land	59.510	0.92%	9, 11, 18, 19, 25, 26, 27, 28, 29, 31, 40

Aggregate land use category	Land use components	Acres	Percent	Recommended BMPs
Recreation	Golf Course Golf Course Clubhouse Open Space Park or Preserve Other Recreation - High Park - Active Residential Recreation	1,226.500	19.05%	1, 2, 3, 5, 6, 7, 9, 11, 19, 24, 25, 26, 27, 28, 29, 33, 34, 35, 39, 40
Road	Road Right of Way	1,072.026	16.65%	2, 3, 6, 13, 20, 26, 27, 28, 32, 33, 34, 35, 36, 37, 38, 40
Transportation	Other Transportation Parking Lot - Structure Parking Lot - Surface Rail Station/Transit Center Railroad Right of Way	79.936	1.24%	1, 2, 6, 13, 14, 20, 26, 27, 28, 32, 33, 34, 35, 36, 37, 38, 40
Total		6,438.035	100.00%	

Table 4-9. PGAs in the Tecolote watershed

PGAs	Number	Recommended BMPs
AWM Fueling	18	5, 6
Animals	27	1, 2, 3, 5, 6, 7, 9, 10, 11, 18, 22, 23, 24, 25, 26, 27, 28, 29, 31
Auto Body Paint	8	1, 3, 5, 6, 9, 13, 14, 28, 39, 41
Auto Repair	120	1, 3, 4, 5, 6, 9, 13, 14, 20, 22, 23, 25, 28, 39
Boat Repair	6	1, 3, 5, 6, 9, 14, 28, 39
Food Facilities	2,020	1, 2, 3, 5, 6, 7, 9, 23, 24, 25, 27, 28, 39
Golf Courses	11	1, 2, 3, 5, 6, 9, 23, 24, 25, 26, 27, 28, 39, 41
Industrial Facilities	1,044	1, 2, 3, 5, 6, 7, 9, 14, 23, 24, 25, 26, 27, 28, 39
Municipal Landfills	15	6, 9, 14, 40
Nurseries	16	1, 2, 3, 4, 5, 6, 7, 9, 12, 14, 25, 26, 27, 28, 39, 40

The locations of the PSC land uses and PGAs becomes especially important when trying to evaluate the need for specific BMPs. To evaluate these contributing factors, maps showing the land uses from the PSC, PGAs from the LTEA, and HPMAs were prepared. Knowledge of the spatial distribution of each of these contributors allows designing (where practicable) nonstructural programs that address the appropriate PGAs and land uses, and, if resources are limited and program design allows, also enables the city to target uses and PGAs in the HPMAs for the first and most intensive implementation. Furthermore, mapping the PGAs, land uses, and HPMAs allows visualization of the spatial extent to which nonstructural practices, if applied on a watershed-wide, programmatic basis by the RPs, can be expected to address the land use-based pollutant sources and PGAs in the watershed. Figure 4-2 portrays the pollutant sources (land uses) and PGAs in the Tecolote watershed.

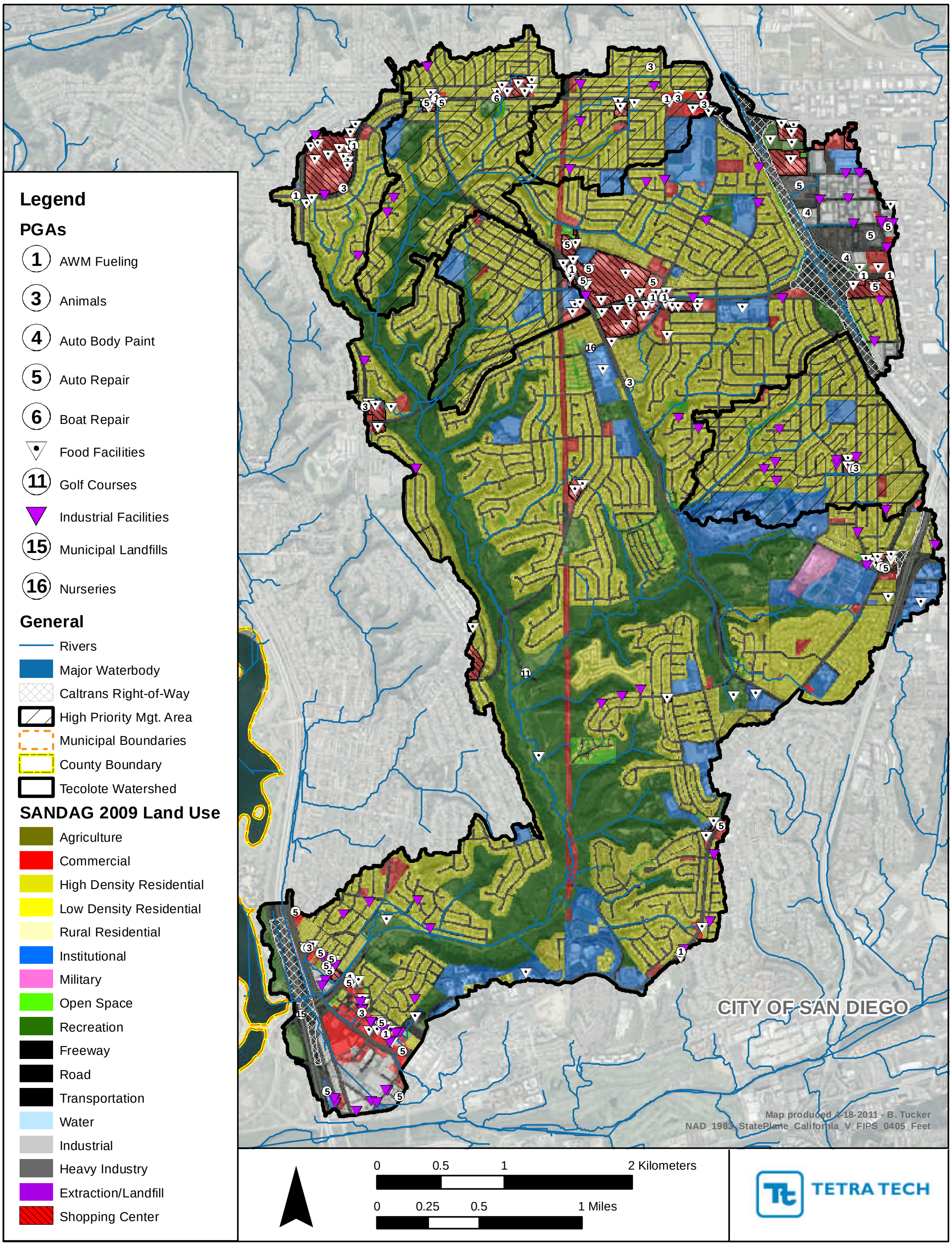

Figure 4-2. PGAs and land uses in the Tecolote watershed

Figure 4-2 also offers a method of further understanding the spatial distribution of potential pollutant sources in each watershed, particularly according to the presence of PGAs in the HPMAs. Where PGAs coincide with an HPMA, some nonstructural BMPs can be prioritized to first address areas with the greatest potential for pollutant loading, improving the cost and environmental effectiveness of nonstructural programs.

However, not all pollutant sources can be represented spatially as specific geographic points or even as land use categories. Some identified pollutant sources, such as trash and bacteria contributions from homeless persons in the watershed, are documented in the Tecolote watershed but cannot be assigned to a specific location. Others, such as runoff from over-irrigation or atmospheric deposition of copper from automobile brake pads, certainly are associated with specific land use or land cover types but cannot be located with the certainty of, for example, an animal-related facility or a community shopping center's trash area. Therefore, Figure 4-2 provides essential information relevant to final BMP selection, program design, and priority, but it cannot be used without considering the potential effects on PGAs that cannot reliably be mapped.

After assessing the prevalence and spatial distribution of PSC land uses and PGAs, BMPs were assessed relative to the impact of specific land uses and PGAs in the watershed. To ensure some cross-referencing capacity between the PSC for this CLRP and the 2011 LTEA report, Appendix F presents the expected relationship between land uses and PGAs or, in other words, the land uses in which the PGA, such as mobile carpet cleaning or pesticide use, reasonably might be expected to occur. Table 4-4 presents the expected relationships between BMP types and PSC land uses for the Tecolote watershed. It lists the PSC land uses identified on Figure 4-2 as columns, with the BMPs as rows. The BMPs that might reasonably be applied to reduce pollutant loads generated by the PSC land are indicated by a water drop in the associated cell.

Table 4-4. Nonstructural BMP types and PSC land uses

BMP		Land Use																
		Agriculture	Commercial	HD residential	LD residential	Rural residential	Institutional	Military	Open space	Recreation	Freeway	Road	Transportation	Water	Industrial	Heavy industry	Extraction/landfill	Shopping center
Development Review Process																		
1	Amend zoning and other development regulations to facilitate LID implementation		💧	💧	💧	💧	💧			💧			💧		💧			💧
3	Train staff and boards to facilitate LID implementation and source control		💧	💧	💧	💧	💧			💧		💧			💧			💧
Enhanced Inspections and Enforcement																		
4	Training or certification requirements for mobile businesses	*Varies, not tied to a specific land use*																
5	Inspection/enforcement of power washing		💧	💧			💧			💧					💧	💧	💧	

BMP		Agriculture	Commercial	HD residential	LD residential	Rural residential	Institutional	Military	Open space	Recreation	Freeway	Road	Transportation	Water	Industrial	Heavy industry	Extraction/landfill	Shopping center
	discharges																	
6	Enhanced IC/ID reporting and enforcement		●	●	●	●	●	●		●	●	●	●		●	●	●	●
7	Property-based inspections		●	●			●			●					●			●
SUSMP and Regulatory Enhancement																		
Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:																		
9	Trash enclosure and storage areas		●	●			●		●	●					●	●		●
10	Animal-related facilities	●	●			●	●	●										●
12	Nurseries and garden centers		●		●													●
13	Auto-related uses		●		●			●			●	●	●		●			●
15	Update minimum BMPs	*Varies by SUSMP and Regulatory Enhancement*																
New/Expanded Initiatives																		
16	Partnerships to address bacteria and trash impacts of homelessness	*Not tied to a specific land use*																
17	Pilot projects disconnecting impervious surfaces from the MS4 (e.g., rain barrels, downspout disconnection)		●	●	●		●								●			●
20	Support for Brake Pad Partnership										●	●	●					
Landscape Practices																		
Landscape BMP incentives, rebates, and training:																		
22	Residential properties			●	●	●												
23	Homeowners' associations/property managers			●	●													
24	Nonresidential properties		●				●	●		●					●			●
25	Reducing over-irrigation		●	●	●	●	●	●	●	●					●			●

BMP		Agriculture	Commercial	HD residential	LD residential	Rural residential	Institutional	Military	Open space	Recreation	Freeway	Road	Transportation	Water	Industrial	Heavy industry	Extraction/landfill	Shopping center
		Land Use																
26	Xeriscaping, turf conversion and other irrigation, pesticide and fertilizer reduction	●	●	●	●	●	●	●	●	●	●	●	●		●			●
Education and Outreach																		
27	Enhanced and expanded trash cleanup programs	●	●	●	●	●	●	●	●	●	●	●	●		●			●
28	Improved Web resources promoting reporting of enforceable discharges	●	●	●	●	●	●		●	●		●	●		●	●		●
Refocused or enhanced education and outreach to target audiences:																		
29	Equestrian community	●				●			●	●								
32	General/other	*Varies by focus area*																
MS4 Maintenance																		
33	Optimized or enhanced catch basin inlet cleaning and management		●	●	●		●	●		●	●	●	●		●			●
34	Proactive MS4 repair and replacement		●	●	●		●	●		●	●	●	●		●			●
35	Increased channel cleaning and scour pond repair to improve MS4 function		●	●	●		●	●		●	●	●	●		●			●
Street sweeping enhancements and expansion:																		
36	Increased sweeping frequency or routes										●	●	●					
37	Sweeping medians on high-volume segments										●	●	●					
38	Upgraded sweeping equipment										●	●	●					
39	Sweeping of private roads and parking lots		●	●			●	●		●					●			●
Erosion repair and slope stabilization:																		
40	Public property and right of way								●	●	●	●	●					
41	Enforcement on private properties	●	●	●	●	●	●								●	●	●	
Capital Improvement Projects																		

BMP		Land Use																
		Agriculture	Commercial	HD residential	LD residential	Rural residential	Institutional	Military	Open space	Recreation	Freeway	Road	Transportation	Water	Industrial	Heavy industry	Extraction/landfill	Shopping center
42	Dry-weather flow separation	*Capital improvement project; not tied to land use setting*																
45	Mitigation and conservation initiatives	*Capital improvement project; not tied to land use setting*																

Table 4-5 presents the expected relationships between BMP types and PGAs. Table 4-5 lists the PGAs identified on Figure 4-2 as columns, with the BMPs as rows. The BMPs that might reasonably be applied to reduce pollutant loads generated by the PGAs are indicated by a water drop in the associated cell.

Table 4-5. Nonstructural BMP types and PGAs

BMP		PGAs									
		AWM fueling	Animals	Auto body paint	Auto repair	Boat repair	Food facilities	Golf courses	Industrial facilities	Municipal landfills	Nurseries
Development Review Process											
1	Amend zoning and other development regulations to facilitate LID implementation		💧	💧	💧	💧	💧	💧	💧		💧
3	Train staff and boards to facilitate LID implementation and source control		💧	💧	💧	💧	💧	💧	💧		💧
Enhanced Inspections and Enforcement											
4	Training or certification requirements for mobile businesses				💧						💧
5	Inspection/enforcement of power washing discharges	💧	💧	💧	💧	💧	💧	💧	💧		💧
6	Enhanced IC/ID reporting and enforcement	💧	💧	💧	💧	💧	💧	💧	💧	💧	💧
7	Property-based inspections		💧				💧		💧		💧
SUSMP and Regulatory Enhancement											
Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:											
9	Trash enclosure and storage areas		💧	💧	💧	💧	💧	💧	💧	💧	💧
10	Animal-related facilities		💧								
12	Nurseries and garden centers										💧
13	Auto-related uses			💧	💧						

BMP		**PGAs**									
		AWM fueling	**Animals**	**Auto body paint**	**Auto repair**	**Boat repair**	**Food facilities**	**Golf courses**	**Industrial facilities**	**Municipal landfills**	**Nurseries**
15	Update minimum BMPs	*Varies by SUSMP and Regulatory Enhancement*									
New/Expanded Initiatives											
16	Partnerships to address bacteria and trash impacts of homelessness	*Not related to PGAs*									
17	Pilot projects disconnecting impervious surfaces from the MS4 (e.g., rain barrels, downspout disconnection)	*Relates to structures and applies to multiple settings*									
20	Support for Brake Pad Partnership				♦						
Landscape Practices											
Landscape BMP incentives, rebates, and training:											
22	Residential properties		♦		♦						
23	Homeowners' associations/property managers		♦		♦		♦	♦	♦		
24	Nonresidential properties		♦				♦	♦	♦		
25	Reducing over-irrigation		♦		♦		♦	♦	♦		♦
26	Xeriscaping, turf conversion and other irrigation, pesticide and fertilizer reduction		♦					♦	♦		♦
Education and Outreach											
27	Enhanced and expanded trash cleanup programs		♦				♦	♦	♦		♦
28	Improved Web resources promoting reporting of enforceable discharges		♦	♦	♦	♦	♦	♦	♦		♦
Refocused or enhanced education and outreach to target audiences:											
29	Equestrian community		♦								
32	General/other	*Varies by focus area*									
MS4 Maintenance											
33	Optimized or enhanced catch basin inlet cleaning and management	*N/A, BMPs address public MS4*									
34	Proactive MS4 repair & replacement	*N/A, BMPs address public MS4*									
35	Increased channel cleaning and scour pond repair to improve MS4 function	*N/A, BMPs address public MS4*									
Street sweeping enhancements and expansion:											
36	Increased sweeping frequency or routes	*Not related to PGAs*									
37	Sweeping medians on high-volume segments	*Not related to PGAs*									
38	Upgraded sweeping equipment	*Not related to PGAs*									
39	Sweeping of private roads and parking lots			♦	♦	♦	♦	♦	♦		♦

BMP		PGAs									
		AWM fueling	Animals	Auto body paint	Auto repair	Boat repair	Food facilities	Golf courses	Industrial facilities	Municipal landfills	Nurseries
Erosion repair and slope stabilization:											
40	Public property and right of way									♦	♦
41	Enforcement on private properties			♦				♦			
Capital Improvement Projects											
42	Dry-weather flow separation	*N/A, BMPs address public MS4*									
45	Mitigation and conservation initiatives	*N/A, BMPs address public MS4*									

4.5 Summary of Nonstructural BMP Recommendations

In the Tecolote watershed, nonstructural BMPs have been proposed that address the PGAs, PSC land uses, and other loading sources identified for the watershed. These nonstructural BMPs may be implemented over time (principally within an initial five-year period) as resources, funding, and authority become available. A prospective schedule of nonstructural BMP implementation is incorporated in Section y7, recognizing that program initiation and scope will depend significantly on the availability of resources and funding. Therefore, these BMPs are intended as a general guide to the initiatives or efforts the RPs believe may be most effective in expanding or enhancing their nonstructural BMP programs, given the extent and nature of PGAs and land uses in the watershed, the reduction effectiveness of the BMPs, and the physical distribution of the PGAs and sources addressed in the watershed.

The nonstructural BMPs recommended suggested in the CLRP and their respective schedules for implementation may be integrated with the RPs' existing programs and thus have a high potential for implementation over the 20-year period of the CLRP. The cost estimates, while adjusted in Section 7 for future potential implementation reflect realistic levels of staff and financial resources needed to carry out the work involved. The RPs can use this information in program and budget development. Section 7 of the CLRP provides an initial schedule for nonstructural BMP implementation based on feasibility and potential for funding. The CLRP provides a framework for decision making by the RPs, in consultation with the applicable watershed work groups, on the timing, level, and extent of implementing nonstructural programs. A prospective schedule of nonstructural BMP implementation is incorporated in Section 7, recognizing that any number of factors could affect the timing of implementation.

5 Developing Structural Solutions

Compliance with existing and future TMDL WLAs will require a combination of nonstructural and structural BMPs. For structural BMPs, it is important to carefully evaluate the effectiveness and the feasibility of implementing different types of practices, particularly because these types of BMPs will be the largest focus of *quantified* load reduction in the CLRP watersheds.

A critical consideration in selecting and evaluating structural BMPs is scale. On-site (called *distributed*) structural BMPs are built in the landscape at the site-scale. Examples of distributed structural BMPs include bioretention areas incorporated in landscaping and permeable pavement parking lots. Alternatively, large treatment (centralized) structural BMPs are regional facilities that receive flows from neighborhoods or larger areas, and often serve dual purposes for flood control or groundwater recharge. These BMPs are often in public spaces and can be co-located in parks or green spaces. Both distributed and centralized BMPs serve important purposes and should be considered in combination to determine their optimal level of implementation to meet the WLAs.

This section provides an assessment of opportunities for distributed and centralized BMPs in the Tecolote watershed. It outlines the methods used to determine good candidate BMP locations, the RPs' existing and planned BMPs, and newly identified BMP opportunity sites. The top-ranked sites identified for centralized BMPs have a more detailed site evaluation and description, including fact sheets that can be used for implementation planning.

The structural solutions analysis yielded information needed to begin the planning of distributed and centralized BMPs and information essential for developing and evaluating load reduction alternatives. Section 7, Implementation Recommendations, includes a range of costs associated with implementing these structural BMPs. A more detailed quantification of the pollutant load reductions, design sizes, and costs will be developed in the initial phase of CLRP Implementation Program, including optimization modeling and assessment.

5.1 Structural Solution Screening Methodology

To develop the structural solution analysis, the RPs collected and summarized available information regarding their existing, proposed, or planned structural BMPs that could contribute to future load reduction. At the outset of the task, the RPs were instrumental in developing a screening methodology for identifying new BMP opportunity sites, and a menu of preferred structural BMPs types to evaluate in more detail.

In researching new distributed and centralized BMP opportunities, a site screening was performed according to land ownership of parcels and site characteristics such as soil type, slope, and impervious area. HPMAs were identified on the basis of pollutant loading analyses and parcels in these areas received a higher weight because of their potential to make the most difference in comprehensive load reduction. Potential centralized BMP sites were further screened and prioritized by parcel ownership (i.e., public parcels were favored), field investigations of site characteristics that can affect or prevent BMP design or construction, and an evaluation of potential multiuse or multi-benefit features. Additional sites in canyon areas were screened for potential location of centralized BMPs. The screening methodologies for distributed and centralized BMP locations are discussed in detail in Appendix H, and the preferred structural BMP types is described in Appendix I.

Once potential centralized parcels were evaluated using the prioritization methodology and review of aerial photography, candidate retrofit projects were then subject to a more detailed evaluation and site investigation. Implementation requirements were developed and assessed for each of these sites (including the needed for detailed plans, design, land acquisition, permitting, construction, and preliminary cost estimates), and each site was ranked for implementation feasibility. Appendix J provides the Detailed Evaluation of Centralized BMP sites, and Appendix K provides BMP Fact Sheets from this analysis.

Finally, it is important to note that it would be impractical to identify, map, and size BMPs for each potential BMP site in the Tecolote watershed, particularly for the distributed BMPs, because of the varying goals and requirements for implementation and the sheer number of potential distributed BMP retrofits. The CLRP screening process identified key potential BMP projects that can be quantified for load reduction benefits and considered for CLRP Implementation Program. A key first step in the CLRP Implementation Program will be an optimization analysis of thousands of potential implementation sites to determine the degree to which distributed and centralized BMPs will be needed to meet the WLAs. Although the CLRP structural solutions assessment has focused implementation on public parcels as being most cost-effective, the program's future optimization analysis will also evaluate the need for BMP retrofits on private parcels. A complete description of the CLRP Implementation Program and associated recommended analyses is in Section 7.

5.2 Identification of Opportunities for Distributed, On-Site BMPs

This section briefly highlights the menu of preferred distributed BMP s that can help address the multiple parameters of concern in the Tecolote watershed. It includes maps of distributed BMP projects implemented, planned, or proposed by the RPs in the watershed. Additionally, the screening and scoring system detailed in Appendix H was used to screen 502 parcels. The top new potential sites are listed and mapped along with the HPMAs. The screening prioritized public parcels for BMP retrofit opportunities. These high-ranked potential public BMP projects can be quantified for load reduction benefits and considered for CLRP implementation planning. Clearly, there is additional opportunity for implementing distributed BMPs on parcels beyond those identified in this section.

5.2.1 Menu of Preferred Distributed BMPs

The RPs identified different types of distributed BMPs that can help address the multiple parameters of concern in the Tecolote watershed and link the load reduction projects to the region's broader water resource management goals (for more information on how the CLRP recommended BMPs link to larger community goals, see Section 6). The RPs' menu of preferred distributed BMPs included 12 BMP types: bioretention areas and rain gardens, infiltration trenches, bioswales, planter boxes, permeable pavement, sand filters, vegetated swales, vegetated filter strips, water harvesting, green roofs, trash segregation, and proprietary BMPs. As was done in Table 4-6 above, Table 5-1 lists the proposed types of distributed BMPs and summarizes the effectiveness of the potential BMP projects in addressing the different causes of impairment and TMDL parameters of concern.

In Table 5-1, the closed circle (●) indicates that the BMP provides primary reduction for the pollutant; the half circle (◗) indicates secondary/incidental reduction; and the open circle (○) indicates that the BMP does not address the pollutant. Pollutant reduction assumptions represent best professional judgment based on the typical design approach, typical land use setting, and common geographic extent of application for the type of BMP. They are also based on literature review and internal RP evaluation in 2011, developed in conjunction with the RPs. Appendix I provides a brief description of each of these BMPs.

BMPs that have volume reduction (and infiltration) as a primary design component and function should be a priority for distributed BMP implementation because they provide the greatest potential for pollutant reduction. The BMPs listed as having secondary volume reduction potential also typically provide some reduction through soil storage and evapotranspiration. Many of the distributed BMPs provide filtration and exposure to sunlight providing a primary reduction in bacteria.

For infiltration practices listed below, the BMP processes and the potential to remove pollutants through soil filtration will depend on a site's soil type. In the early phase of the CLRP Implementation Program, BMPs recommended for the Tecolote watershed can be assigned infiltration rates on the basis of the parcel soil type, and the BMP processes can be predicted using model applications, thereby providing necessary information for appropriate design recommendations (e.g., the need for an underdrain). This assessment will help optimize the location of distributed BMPs by performance and cost.

Table 5-1. Effectiveness of distributed BMP types in addressing causes of impairment

BMP	Impairment										
	Bacteria	Metals	Organics	Sediment	Pesticides	Nutrients	Oil and grease	Dissolved minerals	Trash	Flow	Volume reduction
Distributed structural BMPs											
Rain gardens	●	◗	◗	●	◗	●	◗	◗	●	●	●
Bioretention area	●	◗	◗	●	◗	●	◗	◗	●	●	●
Infiltration trenches	●	◗	◗	●	◗	●	◗	◗	●	●	●
Bioswales	●	◗	◗	●	◗	●	◗	◗	●	●	●
Planter boxes	●	◗	◗	●	◗	●	◗	◗	●	◗	◗
Permeable pavement	●	◗	◗	●	◗	●	○	◗	○	●	●
Sand filter	●	◗	◗	●	◗	◗	●	○	●	◗	◗
Vegetated swales	◗	◗	◗	●	◗	◗	◗	◗	●	◗	◗
Vegetated filter strips	◗	◗	◗	●	◗	◗	◗	◗	●	◗	◗
Water harvesting	◗	◗	◗	●	◗	◗	◗	◗	◗	●	●
Green roof	◗	◗	○	●	○	○	○	◗	○	●	◗
Trash segregation	◗	◗	○	○	○	○	◗	○	●	○	○
Proprietary BMPs	Dependent on proprietary BMP selected										

● provides primary pollutant reduction
◗ provides secondary pollutant reduction
○ does not address the pollutant

5.2.2 Existing, Planned and Proposed Distributed BMPs

The RPs have proposed and implemented two distributed BMP projects in the Tecolote watershed that together can contribute to load reduction. These proposed or planned projects provide a head start in CLRP implementation planning. A map and table of the existing and planned and implemented distributed BMPs are provided below (Table 5-2 and Figure 5-1). Note that this CLRP does not list all the BMPs that were developed to address SUSMP requirements because those BMPs are required to meet existing regulatory requirements. The CLRP focuses on BMP projects that provide additional water quality improvement above the SUSMP requirements.

Table 5-2. Planned/implemented distributed BMPs

Planned distributed BMP ID	Location/ jurisdiction	Owner	Description	Phase
1	City of San Diego	City of San Diego	Sewer interceptor system upgrades are proposed to be installed along Mission Bay and coastal beaches.	Implemented
2	City of San Diego	City of San Diego	In Lindberg Park, limited low-flow storm drain inlets are proposed to serve as multi-pollutant treatment.	Planned
3	City of San Diego	City of San Diego	A green street infiltration BMP is proposed for the area around Bannock Avenue and Gennessee Avenue.	Planned

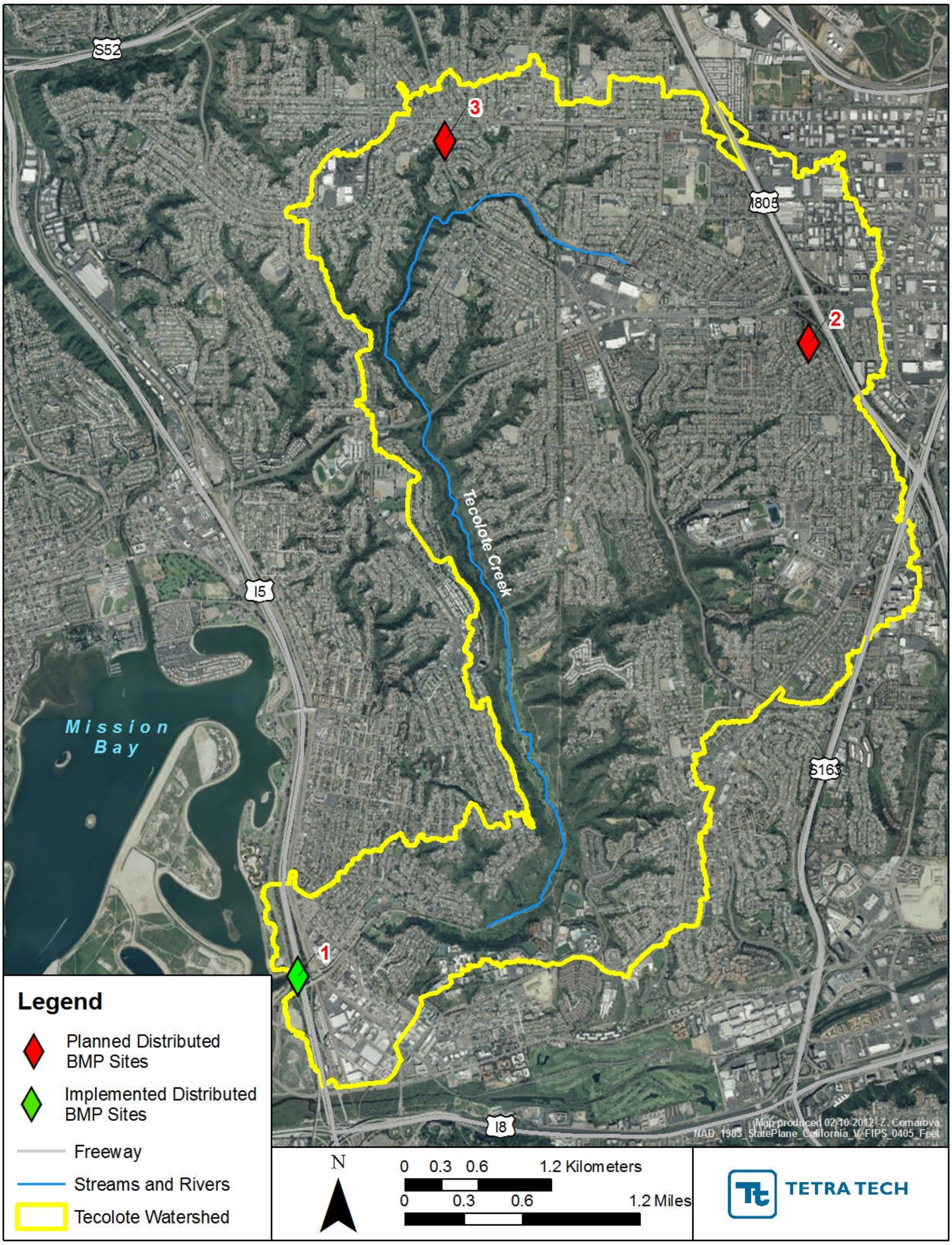

Figure 5-1. Planned and implemented distributed BMP sites

5.2.3 New Identified Opportunities for Distributed BMP Retrofits

Using the screening methodology discussed in Appendix H, opportunities for additional sites for distributed BMPs were identified, including alternatives for implementation on publicly and privately owned parcels. Approximately 502 parcels were screened for suitability. The sections below list and map the new, high-ranked potential retrofit sites on public parcels. The maps show the HPMAs along with the high-ranked areas identified for potential BMP retrofits (Figure 5-2). The blue circles indicate the top-ranked public parcels for potential distributed BMPs. Planned distributed BMPs are included in the map (red diamonds) to provide an overview of the potential for locating distributed BMPs in the Tecolote watershed. A final series of tables lists the top-ranked sites for each RP, and indicates whether the sites are in an HPMA (see Section 3.4).

Note that the tables indicate *watershed rank* and *watershed score* (Table 5-3 to **Error! Reference source not found.**). The high-ranked public parcels are mostly in the HPMAs. Some of the recommended parcels are n Multiple Species Conservation Program (MSCP) or Multi-Habitat Planning Area (MHPA) boundaries where implementation might be limited. The level of implementation permitted should be coordinated before developing conceptual designs. In the CLRP Implementation Program, the RPs will use the Tecolote watershed parcel prioritization methodology and optimization analysis to determine the degree to which these private parcels will need to be retrofitted with structural BMPs to meet the WLAs.

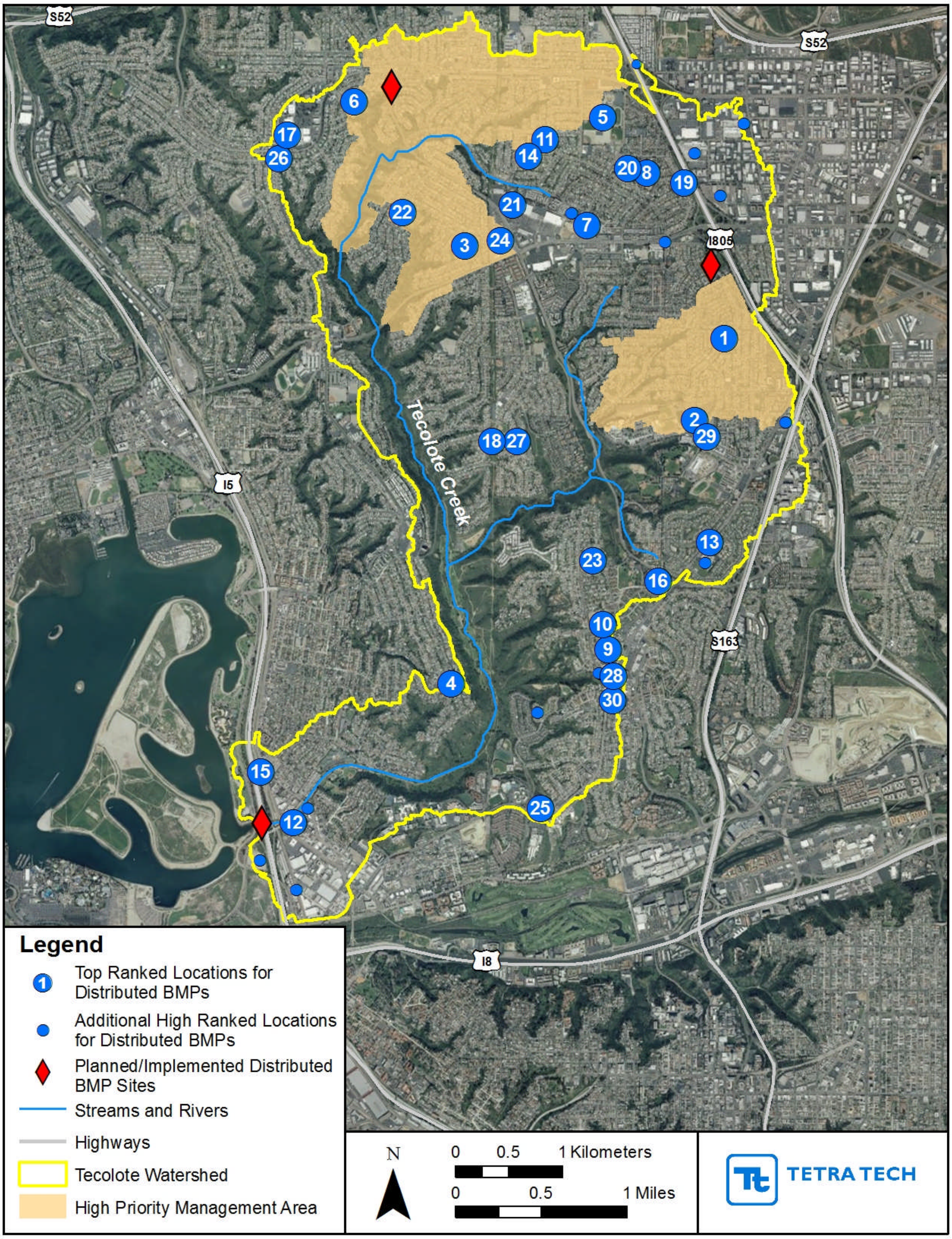

Figure 5-2. High-ranked Tecolote watershed locations for distributed BMPs

Table 5-3. Top 30 potential distributed BMP sites in the Tecolote watershed

Public parcel rank #	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Parcel owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
1	1	39	Yes	No	4202803600	San Diego Unified School District	9.85	64	D
2	2	39	Yes	No	4270202300	San Diego Community College District	8.33	72	D
3	3	38	Yes	No	4190200100	San Diego Unified School District	9.67	68	D
4	4	35	No	No	4302902000	San Diego Unified School District	6.33	72	C
5	5	35	Yes	No	3620106900	San Diego Unified School District	47.57	48	D
6	6	34	Yes	No	3602200200	San Diego Unified School District	10.51	45	D
7	7	34	No	No	3612611600	City of San Diego	3.40	70	D
8	8	34	No	No	3625700200	San Diego Unified School District	12.36	63	D
9	9	33	No	No	4312303000 4312303200	City of San Diego	3.44	62	D
10	10	33	No	No	4312303100	San Diego Unified School District	13.12	66	D
11	13	33	Yes	No	3615430100 3615342400	San Diego Unified School District	11.14	55	D
12	14	33	No	No	4360303000	City of San Diego	0.79	68	D
13	15	33	No	No	4272540300 4272740400 4272630400 4273240900 4273310300 4273700600 4273800300	United States of America	56.22	62	D
14	17	32	Yes	No	3616210700	San Diego Unified School District	0.02	72	D
15	18	32	No	No	4360200200	San Diego Metropolitan Transit Development Board	4.72	60	D
16	19	32	No	No	4312600800 4321601200 4275606400	Northern S D H C F N M A L L C	2.03	60	D
17	21	32	No	No	3602821600 3602821500	City of San Diego	0.28	77	D
18	22	32	No	No	4260600200	City of San Diego	8.65	20	D

Public parcel rank #	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Parcel owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
19	23	32	No	No	3624402400	City of San Diego	3.52	58	D
20	24	32	No	No	3625700100	City of San Diego(Olive Grove Community Park)	9.18	18	D
21	27	32	No	No	3612612600	State of California	3.41	63	D
22	28	32	Yes	No	3612900400	San Diego Unified School District	10.21	39	D
23	29	32	No	No	4316800100	San Diego Unified School District	8.83	71	D
24	31	31	Yes	No	3616611200	County of San Diego	4.05	86	D
25	36	31	No	No	4370101800	San Diego Unified School District	7.69	62	C
26	44	30	No	No	3602821700	City of San Diego	0.16	78	D
27	47	30	No	No	4264102500	City of San Diego	0.02	67	D
28	50	29	No	No	4314300800 4313201500	City of San Diego	0.92	74	D
29	54	29	No	No	4270203000	San Diego Unified School District	0.84	87	D
30	62	29	No	No	4314301100	United States Postal Service	3.89	78	D

Table 5-4. City of San Diego top-ranked potential distributed BMP sites

Jurisdictional Rank (Public parcel rank #)	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
1 (1)	1	39	Yes	No	4202803600	San Diego Unified School District	9.85	64	D
2 (2)	2	39	Yes	No	4270202300	San Diego Community College District	8.33	72	D
3 (3)	3	38	Yes	No	4190200100	San Diego Unified School District	9.67	68	D
4 (4)	4	35	No	No	4302902000	San Diego Unified School District	6.33	72	C

Jurisdictional Rank (Public parcel rank #)	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
5 (5)	5	35	Yes	No	3620106900	San Diego Unified School District	47.57	48	D
6 (6)	6	34	Yes	No	3602200200	San Diego Unified School District	10.51	45	D
7 (7)	7	34	No	No	3612611600	City of San Diego	3.40	70	D
8 (8)	8	34	No	No	3625700200	San Diego Unified School District	12.36	63	D
9 (9)	9	33	No	No	4312303000 4312303200	City of San Diego	3.44	62	D
10 (10)	10	33	No	No	4312303100	San Diego Unified School District	13.12	66	D
11 (11)	13	33	Yes	No	3615430100 3615342400	San Diego Unified School District	11.14	55	D
12 (12)	14	33	No	No	4360303000	City of San Diego	0.79	68	D
13 (13)	15	33	No	No	4272540300 4272740400 4272630400 4273240900 4273310300 4273700600 4273800300	United States of America	56.22	62	D
14 (14)	17	32	Yes	No	3616210700	San Diego Unified School District	0.02	72	D
15 (15)	18	32	No	No	4360200200	San Diego Metropolitan Transit Development Board	4.72	60	D
16 (16)	19	32	No	No	4312600800 4321601200 4275606400	Northern S D H C F N M A L L C	2.03	60	D
17 (17)	21	32	No	No	3602821600 3602821500	City of San Diego	0.28	77	D
18 (18)	22	32	No	No	4260600200	City of San Diego	8.65	20	D
19 (19)	23	32	No	No	3624402400	City of San Diego	3.52	58	D
20 (20)	24	32	No	No	3625700100	City of San Diego(Olive Grove Community Park)	9.18	18	D
21 (21)	27	32	No	No	3612612600	State of California	3.41	63	D
22 (22)	28	32	Yes	No	3612900400	San Diego Unified School District	10.21	39	D

Jurisdictional Rank (Public parcel rank #)	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
23 (23)	29	32	No	No	4316800100	San Diego Unified School District	8.83	71	D
24 (25)	36	31	No	No	4370101800	San Diego Unified School District	7.69	62	C
25 (26)	44	30	No	No	3602821700	City of San Diego	0.16	78	D
26 (27)	47	30	No	No	4264102500	City of San Diego	0.02	67	D
27 (28)	50	29	No	No	4314300800 4313201500	City of San Diego	0.92	74	D
28 (29)	54	29	No	No	4270203000	San Diego Unified School District	0.84	87	D
29 (30)	62	29	No	No	4314301100	United States Postal Service	3.89	78	D
30 (31)	66	29	No	No	4273320800	San Diego Unified School District	8.64	57	D

Table 5-5. San Diego County top-ranked potential distributed BMP sites

Jurisdictional Rank (Public parcel rank #)	Watershed rank #	Watershed score	Within HPMA (Y/N)	Within MHPA or MSCP area (Y/N)	APN	Owner	Total parcel acreage	Percent impervious cover (%)	Hydrologic soil group
1 (24)	31	31	Yes	No	3616611200	County of San Diego	4.05	86	D

5.2.4 Distributed BMP Strategies for TMDL Implementation

The overarching strategy for implementing the distributed BMPs in the Tecolote watershed is to first target and treat on-site runoff for the publicly owned parcels listed and mapped in this section, particularly those in the HPMAs. It is anticipated that RPs will begin implementation on those sites that are already planned and newly identified sites that are ranked highest for their jurisdiction. For high-ranked parcels owned and operated by public agencies other than the RPs (such as school districts), partnerships will need to be established. A secondary benefit of first locating distributed BMPs on public land is public education. This is especially true for parks, libraries, schools, and the like, that have frequent use. As the public learns more regarding the functional and aesthetic value of these BMPs, they can be encouraged to implement similar practices on private property. Outreach will need to be conducted and partnerships formed with private owners of high-ranked parcels. Indeed, more widespread implementation of distributed BMPs on private property might be critical to meeting the WLAs. Initial actions of the CLRP Implementation Program will assess the optimal balance of distributed BMP types and locations.

5.3 Assessment of Opportunities for Large, Centralized Structural BMPs

This section highlights the centralized BMP types selected to meet the multiple parameters of concern in the Tecolote watershed. Three existing and proposed centralized BMPs are highlighted, and five new opportunity sites are identified and evaluated in detail. General cost estimates are provided in Section 7 for implementing the BMPs at each site. Canyon areas were also screened as potential options where characteristics of the undeveloped land would not compromise the functionality of a centralized BMP.

5.3.1 Menu of Preferred Centralized BMPs

The RPs' menu of preferred centralized BMPs has six BMP types: surface infiltration basins, subsurface detention systems, subsurface infiltration galleries, dry extended detention basins, subsurface flow wetland systems, and constructed and pocket wetland systems. Table 5-6 lists the proposed centralized BMPs and indicates the effectiveness of the potential BMP projects in addressing the different causes of impairment and TMDL parameters of concern. The performance of the infiltration practices in removing pollutants through soil filtrations will depend on the soil type. As discussed above, at the outset of CLRP Implementation Program, the Tecolote CLRP model will assign infiltration rates on the basis of the parcel soil type and will adjust the simulation of BMP process and design accordingly. Appendix I provides a brief description of each of the preferred centralized practices. The preferred centralized BMP configuration includes surface BMPs designed for infiltration, particularly infiltration basins and dry extended detention basins. However, given the constraints of a site, this configuration might not always be feasible. Therefore, multiple BMP options are provided to meet the multiple potential site needs and constraints.

Table 5-6. Effectiveness of centralized BMP types in addressing causes of impairment

	Impairment										
BMP	**Bacteria**	**Metals**	**Organics**	**Sediment**	**Pesticides**	**Nutrients**	**Oil and grease**	**Dissolved minerals**	**Trash**	**Volume reduction**	**Flow**
Centralized Structural BMPs											
Surface Infiltration Basins	●	◗	◗	●	◗	●	●	◗	●	●	●
Subsurface Infiltration Galleries	●	◗	◗	●	◗	●	●	◗	○	●	●
Dry Extended Detention Basins	●	◗	◗	●	◗	●	●	◗	●	●	●
Subsurface Detention Galleries	●	◗	◗	●	◗	●	●	◗	○	●	●
Subsurface Flow Wetland Systems	●	◗	◗	●	◗	●	●	●	○	◗	●
Constructed and Pocket Wetland Systems	●	◗	◗	●	◗	●	●	●	○	◗	●

● provides primary pollutant reduction
◗ provides secondary pollutant reduction
○ does not address the pollutant

5.3.2 Existing, Planned, and Proposed Centralized BMPs

The RPs have recently implemented one centralized BMPs in the Tecolote watershed that should receive credit for comprehensive load reduction. Moreover, the RPs have proposed or planned to two centralized BMP projects in the watershed that should be prioritized in CLRP implementation planning. A table and map of the existing and planned centralized BMPs are provided below (Table 5-7 and Figure 5-3).

Table 5-7. Existing and planned centralized BMP projects in the Tecolote watershed

Planned Centralized BMP ID	Jurisdiction	Owner	Description	Phase
1	City of San Diego	City of San Diego	Bioinfiltration and biofiltration basins will be installed at Mt Abernathy to capture the first 0.25 inch of rain over the entire 18-acre drainage area and filter the water through plant material and layers of soil and base rock that will serve as the treatment. The three types of basins differ in the way the treated water is released. In one type, the treated water enters a perforated pipe that leads to the storm drain. In the second type, the treated water is collected in an underground storage tank and slowly allowed to infiltrate. In the third type of basin, the water is allowed to infiltrate directly from the basin.	Planned
2	City of San Diego	City of San Diego	A hydrodynamic separator (Baffle Box) was installed in Mt Ashmun Dr	Implemented
3	City of San Diego	City of San Diego	A hydrodynamic separator (Baffle Box) is proposed to be installed in Mt Ariane Dr	Planned

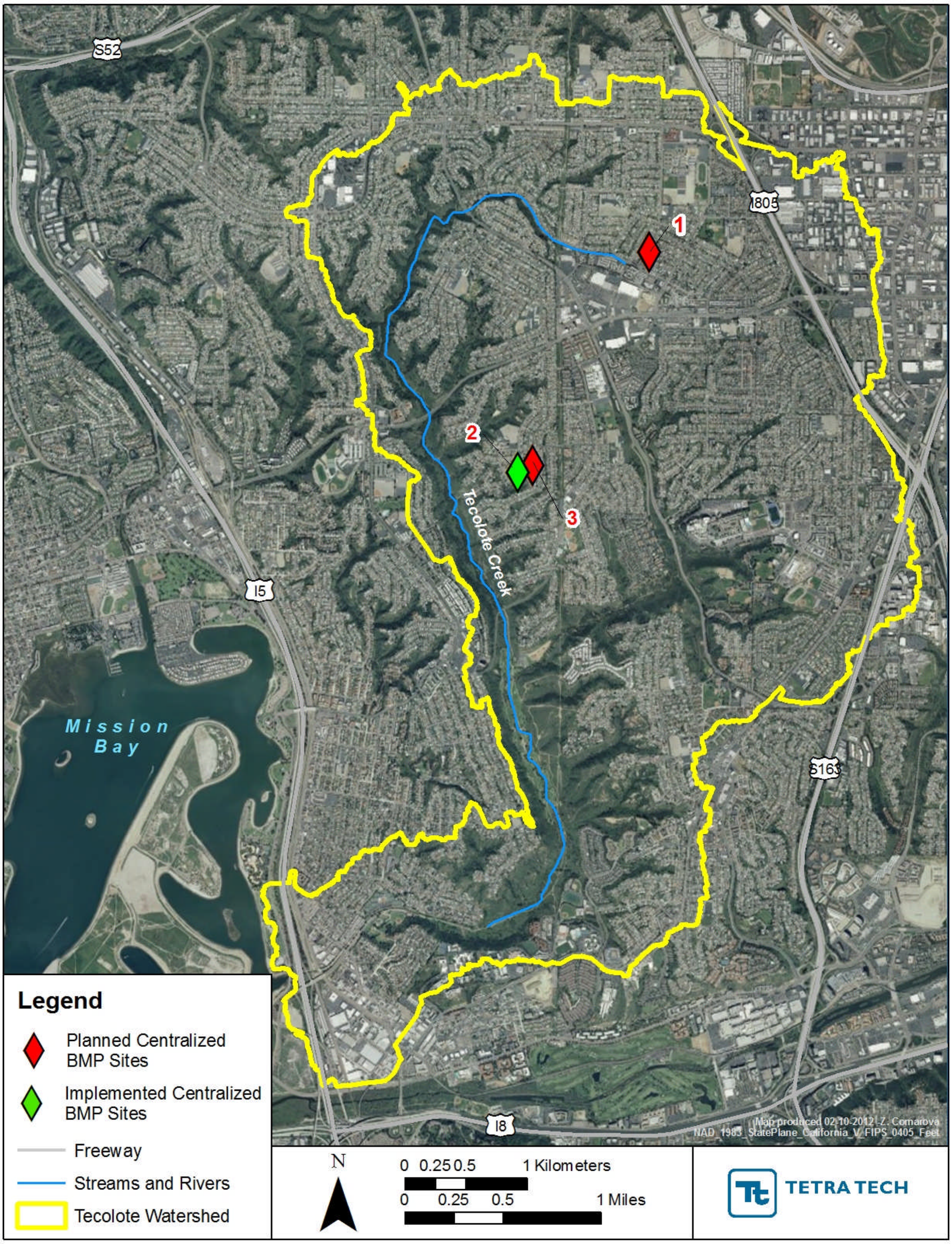

Figure 5-3. Existing and planned centralized BMP sites in the Tecolote watershed

5.3.3 New Identified Opportunities for Centralized BMPs

Using the screening methodology discussed in Appendix H, 16 new opportunities for centralized BMPs were identified and prioritized in the Tecolote watershed. Using aerial imagery, the list of new opportunities was reduced from 16 to 5 because of the location of the site and size of the watershed (Table 5-8 and Figure 5-6). A more detailed field investigation was performed at the 5 remaining sites. On the basis of observation made during the field visits and ownership, all 5 potential sites were identified as feasible for centralized BMP implementation.

Each of the sites was ranked by whether it is in an HPMA, results of the field investigations, and implementation feasibility. High, medium, and low rankings were assigned to each site accordingly. Sites in an HPMA are given a feasibility rank of high regardless of the watershed size or the necessity of pumping. Sites with a small catchment area that require pumping were given a low ranking. Below are descriptions of the high- and medium-ranked sites identified, including level of priority, location, size of catchment area, and current land use. All public sites considered feasible (even those receiving a low rank) are listed and mapped along with the HPMAs. Existing and planned centralized BMP sites are included in the map to provide the larger picture of existing and potential centralized BMP locations in the watershed (Figure 5-6).

1. John Muir School and Mount Etna Neighborhood Park

Priority: High

The 72-acre catchment is in the City of San Diego in the northern portion of the Tecolote watershed approximately one-half mile north of Balboa Avenue and west of Genesee Avenue. The catchment includes the John Muir School, adjacent Mount Etna Neighborhood Park, and a predominantly single-family residential area with smaller than 1/8-acre lots. The catchment is largely impervious. The only green space is the small residential yards. The catchment is approximately 63 percent impervious.

Figure 5-4. Athletic field at John Muir and Anderson School

2. James Madison High School

Priority: Low – because of the potential need to pump stormwater to the BMP and the small catchment area.
The 97-acre catchment is in the upper northeast portion of the Tecolote watershed, in the City of San Diego south and west of the juncture of I-805 and Clairemont Mesa Boulevard. The catchment is a mixture of single-family residential with smaller than 1/8-acre lots, James Madison High School, a miniature golf course and go-kart track, a church, a fitness center, and a shopping plaza. The area is largely impervious. The only green space is the athletic fields at the high school and the small residential yards. The catchment is approximately 60 percent impervious

3. Mt. Everest Academy Elementary School

Priority: High

The 21-acre catchment is in the City of San Diego in the northern portion of the Tecolote watershed just north of Balboa Avenue and west of Genesee Avenue. The catchment consists of a shopping plaza and the Mt. Everest Academy Elementary School campus, which has school buildings, basketball courts, paved parking, and a bare earth athletic field. The school parcel is in an urban, highly impervious, single-family residential area on 1/8-acre lots. The catchment is approximately 74 percent impervious.

4. Sam Snead All American Golf Course

Priority: High

The 5,642-acre catchment is in the City of San Diego in the southwest portion of the Tecolote watershed. It is bordered by State Road 52 on the north, I-5 on the west, I-805 on the east, and culminates at Sam Snead All American Golf Course to the south. The catchment is predominantly single-family residential with smaller than 1/8-acre lots. Also included are educational institutions, parks, open space, business districts, and shopping plazas. Green space in the catchment includes the open space, residential yards, and numerous athletic fields. The catchment is approximately 55 percent impervious.

5. Tecolote Canyon Park

Priority: High

The 6,032-acre catchment is in the City of San Diego in the southwest portion of the Tecolote watershed. It is bordered by State Road 52 on the north, I-5 on the west, I-805 on the east, and culminates at the Tecolote Canyon Park. Note that this catchment is much the same as the catchment delineated for the Sam Snead All American Golf Course. Tecolote Canyon Park is downstream of the golf course, so it includes the drainage area below the golf course. The catchment is predominantly single-family residential with smaller than 1/8-acre lots. It also includes educational institutions, parks, open space, and businesses.

Figure 5-5. Waterway adjacent to Tecolote Canyon Park

Table 5-8. 5 new potential centralized sites in the Tecolote watershed

Site ID #	Rank	APN	Name	Jurisdiction
1	High	3612900400	John Muir School/Anderson School	City of San Diego
2	Low	3620106900	James Madison High School	City of San Diego
3	High	4190200100	Mt. Everest Academy Elementary School	City of San Diego
4	High	4310700600	Sam Snead All American Golf Course	City of San Diego
5	High	4362612100	Tecolote Canyon Park	City of San Diego

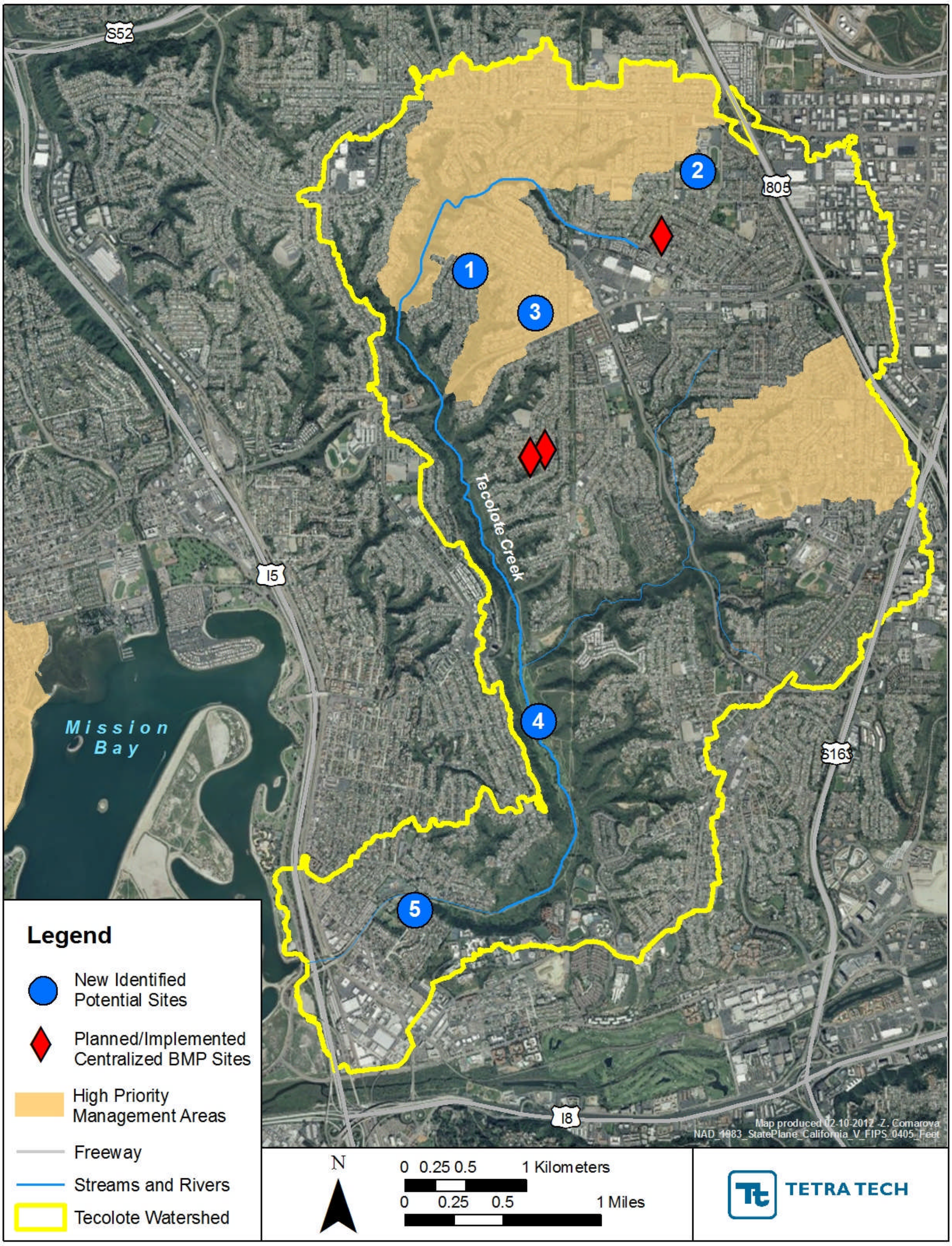

Figure 5-6. Locations for centralized BMPs in the Tecolote watershed

To broaden opportunities for centralized BMP implementation, potential sites were identified specifically in canyon areas using the methodology discussed in Appendix H. Although the use of canyon areas for storm water treatment allows for treating larger drainage areas in *unoccupied* areas, the feasibility of this space is restricted by several key factors: the steep slopes and limited level space; slope instability; and distance from public utilities. The table and map below show the top 10 sites for potentially locating centralized BMPs in canyon areas (Table 5-9 and Figure 5-7).

Table 5-9. Top 10 potential canyon area locations for centralized BMPs

Rank	APN	Owner	Jurisdiction	Total parcel acreage	Parcel acreage <15% slope	Canyon score
1	3602200100	City of San Diego (North Clairemont Community Park)	City of San Diego	14.50	4.41	41
2	4361600100	City of San Diego	City of San Diego	46.83	21.72	41
3	4317310300	City of San Diego	City of San Diego	6.55	1.80	40
4	4263101000	City of San Diego	City of San Diego	83.29	18.13	39
5	4310700600	City of San Diego	City of San Diego	73.59	18.85	39
6	4311500600	City of San Diego	City of San Diego	85.68	10.24	38
7	4270102400	City of San Diego Open Space Park Facilities District No 1	City of San Diego	45.60	12.67	38
8	4270102700	City of San Diego	City of San Diego	14.66	2.48	38
9	4192100600	City of San Diego	City of San Diego	25.73	2.32	38
10	4265400500	City of San Diego	City of San Diego	38.55	5.10	38

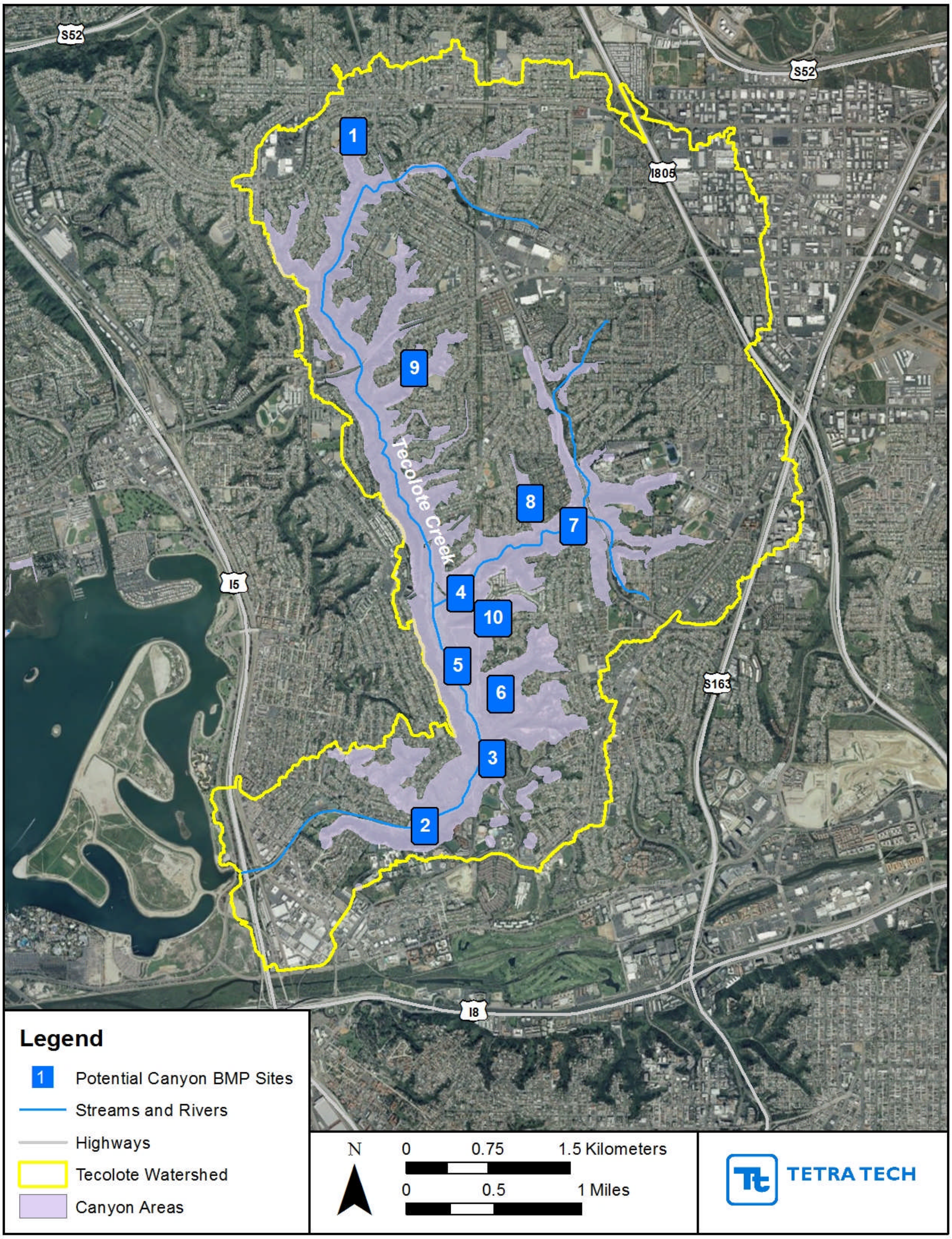

Figure 5-7. Potential canyon area locations for centralized BMPs in the Tecolote watershed

Appendix J provides more detailed information for each newly identified site (excluding potential canyon locations), including potential sources of pollution, soil and drainage characteristics, BMP options and constructability, implementation requirements, estimated costs, and potential multiuse benefits. Detailed site maps are also provided. Estimated cost and load reduction benefits for each site will be developed in more detail in the early stage of the CLRP Implementation Program.

5.3.4 Centralized BMP Strategies for TMDL Implementation

The overarching strategy for implementing the centralized BMPs in the Tecolote watershed is to first target and treat on-site runoff for the publicly owned parcels listed and mapped in this section, particularly those in the HPMAs. As with the potential distributed BMP sites, is anticipated that RPs will begin implementation on those sites that are already planned and newly identified sites that are ranked highest for their jurisdiction.

The preferred centralized BMP configuration includes surface BMPs designed for infiltration, particularly infiltration basins and dry extended detention basins. However, given the constraints of a given site, this configuration may not always be feasible. Therefore, multiple BMP options and configurations are provided to meet the multiple potential site needs and constraints.

5.4 Summary of Structural Solutions

The assessment of opportunities for distributed and centralized BMPs in the Tecolote watershed revealed that the RPs have already planned or proposed a number of structural BMP retrofits in the study area that can significantly support comprehensive load reduction. Moreover, the screening analysis revealed many other potential sites for locating distributed or centralized BMP. Through review of numerous local studies and GIS analysis of more than 502 parcels in the watershed, the assessment identified significant structural opportunities including

- 3 distributed BMP projects planned by the RPs or other agencies in the watersheds
- 33 new high-ranked potential distributed BMP sites on public parcels
- 3 centralized BMP projects planned by the RPs or other agencies
- 5 new potential public parcels for potentially locating centralized BMPs
- 10 new potential centralized BMP sites in canyon areas

The costs for implementing BMPs at each of the newly identified sites will vary widely, depending on site conditions and BMPs selected. Section 7 provides a range of general, planning level cost estimates for implementing the distributed and centralized BMPs. This range of costs is provided for general planning purposes only, a more refined cost estimate will be provided at the outset of program implementation. A more detailed cost analysis should be performed during the conceptual design phase of each project before implementation.

The analysis of structural solutions yielded information needed to begin planning for distributed and centralized BMPs. The high-ranked BMP sites in this section provide an immediate and strong foundation for each RP’s CLRP program development.

6 Identifying Water Resources Plans and Other Planning Objectives

6.1 Water Resources Planning Overview

The purpose of this section is to identify opportunities to achieve co-benefits between water resource and storm water management strategies, groundwater and surface water storage, water reclamation and reuse, and conservation. Many of the strategies used to manage the region's water supply, such as conservation measures, water retention/detention and storage, groundwater infiltration, serve both water supply and storm water management purposes by managing storm volumes, providing treatment of runoff, and reducing dry-weather or *nuisance* flows that carry pollutants into and through the storm drain system. At the same time, many storm water treatment measures, particularly regional retention/detention facilities, constructed wetlands, and systems that infiltrate storm flows into groundwater, can augment water supply and improve water resource quality. The information in this section is also in Appendix L in more detail**.**

This section examines the region's existing beneficial uses, water supply, use and reuse strategies, plans for enhancing regional water supplies, and the potential impact or benefit of those practices on water quality. It also highlights how the types of nonstructural and structural BMP projects discussed in Sections 4 and 5 meet the required California Water Plan strategies and support multiple regional water resources objectives.

To develop this analysis, the City of San Diego, the County of San Diego, and the San Diego County Water Authority (SDCWA) collaborated to collect and summarize available information on the region's water supply system and any existing or potential benefits realized from storm water storage or use or both. Studies used in analysis are in Appendix L.

Just as planned water supply projects can provide water quality benefits, structural solutions for load reduction can have benefits for water reuse and groundwater recharge. Integral to this task were targeted interviews with key staff from the RPs and regional entities whose policies and investments most affect water resource policy and program environment. These interviews included the SDCWA, the City of San Diego Public Utilities Department, San Diego Association of Governments, and local government conservation contacts. On the basis of input received, additional targeted interviews were conducted. Through this interactive approach, regional water resource management planning was coordinated with the screening of nonstructural and structural solutions discussed in Sections 4 and 5.

Detailed review of available documentation identified a large number of water resource programs and projects in the San Diego region but left some uncertainty regarding the degree to which they are being implemented in the CLRP watersheds. Most projects were reported by jurisdiction or by a larger watershed area or groundwater basin area, rather than by individual location. Existing or planned enhancements to local water supplies, recycled water projects and groundwater projects reviewed were included if they appeared to be in or near the study area. Water conservation programs were reported by jurisdiction. The SDCWA provides information on potable water efficiency and conservation targets needed to meet state requirements in the coming decades; however, estimates were reported for the region using an aggregate regional water efficiency target. To translate the regional targets to watershed specific targets, additional information will be needed such as specific water efficiency targets in gallons per capita per day (GPCPD) for each jurisdiction/water purveyor, specific and verifiable recycled water use in the study area, and estimates of population per watershed. Therefore, water efficiency and conservation targets noted below are based on a more regional perspective. In the early stages of CLRP program implementation, the RPs may consider translating the regional targets into watershed-specific targets and potentially tracking water supply and conservation efforts in the watershed to account for load reduction and other water resources benefits.

6.2 Water Resource Management Setting

This section discusses existing regional water resources goals and management objectives that significantly frame the water resources management setting in the region and that complement comprehensive load reduction efforts. It also shows how the recommended CLRP BMPs support required regional and state water plan strategies.

6.2.1 Regional Water Resource Plans and Objectives

In 2005 the City of San Diego, San Diego County, and the SDCWA committed to guiding and managing development of an IRWM Plan. A 32-member Regional Advisory Committee was established with members representing water suppliers, wastewater agencies, environmental groups, flood managers, farm and business interests, tribes, and other parties key to integrated water resources planning. The plan was prepared in accordance with statewide IRWM Program Guidelines, which were established by the State Water Resources Control Board in 2004 and updated in 2007, and prepared pursuant to the California Water Plan Update 2005. The Regional Advisory Committee adopted IRWM Plan Goals and Objectives to both guide their plan and to use as a basis for tracking progress.

In 2009 California experienced its third consecutive year of drought conditions. Effects of the drought were compounded by reduced water supplies and a growing population. Climate change has reduced snowpack storage (and thus water supply reliability), and increased the frequency and intensity of floods. These trends contributed to the continued decline of ecosystems and impairment of waterbodies. The state recognized the importance of these trends for water resources planning in its *Water Plan Update 2009*, giving new consideration to uncertainty, risks, and resource sustainability; integrated flood management and drought contingency planning; and climate change adaptation and mitigation strategies (CADWR 2009a, 2009b). The plan articulates a number of objectives, some overlapping with the goals and objectives in the IRWMP.

Additionally, the California legislature has enacted several water conservation and water reliability laws , with recent ones pertinent to water supply planning and the CLRPs. Senate Bill 7 enacted in 2009, referred to as SBX7-7, sets a goal of 20 percent statewide reduction in urban per capita water use by December 31, 2020 (with a 2015 interim target), and requires each urban retail water supplier to develop urban water use targets to meet the goal. SB 610 and SB 221 amended the state water code to improve the link between information on water supply reliability and local land use decisions.

On the basis of SBX7-7, SDCWA and its member agencies in the region have established water use efficiency targets through 2035, and projected the amount of additional conservation required after subtracting water cycling projects that can also help meet the target. To meet the SBX7-7 20 percent reduction target, conservation efforts must decrease annual water use by 46,951 acre-feet by 2020. Although SBX7-7 does not require targets beyond 2020, for planning purposes, the SDCWA set year 2025–2035 GPCPD demand on the basis of the member agencies' 2020 GPCPD targets. To meet the 2030 targets, water conservation measures must lead to a reduction in annual water use of 117,528 acre-feet in the region.

These regional and state water resources goals and objectives may significantly shape comprehensive load reduction efforts. A merged listing of these regional goals and objectives is provided in Table 6-1. These may be used throughout the CLRP program development and implementation to screen and evaluate the selection of BMP types; screen and evaluate the design and location of BMP projects; and evaluate CLRP management scenarios combining different BMP options. While load reduction is the primary goal, the BMPs and strategies may also be evaluated according to how well they support multiple regional goals and objectives.

Table 6-1. Water resources goals and objectives supporting comprehensive load reduction

Overarching goals
Optimize water supply reliability
Protect and enhance water quality
Provide stewardship of our natural resources
Coordinate and integrate water resource management
Integrated water resources management objectives supporting load reduction
Develop and maintain a diverse mix of water resources
Construct, operate, and maintain a reliable infrastructure system
Reduce the negative effects on waterways and watershed health caused by hydromodification and flooding
Effectively reduce sources of pollutants and environmental stressors
Use and reuse water more efficiently; meet water conservation requirements of SBX7-7
Expand conjunctive management of multiple supplies
Reduce energy consumption of water use systems and use
Ensure equitable distribution of benefits
Invest in new water technology
Protect, restore, and maintain habitat and open space

6.2.2 CLRP Structural and Nonstructural BMPs that Support Required Water Resource Management Strategies

IRWM Program Guidelines (CADWR 2004, 2007) established criteria for Proposition 50 funding and listed 11 water management strategies that must be addressed in IRWM Plans: water supply reliability, groundwater management, water quality protection and improvement, water recycling, water conservation, storm water capture and management, flood management, recreation and public access, ecosystem restoration, wetlands enhancement and creation, and environmental and habitat protection and improvement.

The California Water Plan Updates for 2005 and 2009 provide 27 strategies that must be considered in IRWM plans, and the 2007 San Diego IRWMP developed recommended actions/projects using this more detailed list. Of the 27 strategies listed in the Update 2009 Implementation Plan, the following are most relevant to the CLRP's load reduction analyses:

1. Urban runoff management
2. Urban water use efficiency
3. Pollution prevention
4. Ecosystem restoration
5. Conjunctive management and groundwater storage
6. Matching quality to use
7. Flood risk management
8. Economic incentives

9. Agricultural water use efficiency
10. Agricultural lands stewardship
11. Forest management
12. Land use planning/management

Drawing from the strategies above, the RPs developed a list of structural and nonstructural BMPs that can help address the multiple parameters of concern as discussed in Sections 4 and 5. Table 6-2 lists these BMPs and how they support the 12 required California Plan strategies identified above.

Table 6-2. Structural and nonstructural BMPs supporting required California Water Plan strategies

Type of BMP	Required California Water Plan strategies
Structural BMPs	
Rain gardens	Urban runoff management; Urban water use efficiency; Economic incentives
Bioretention area	Urban runoff management; Urban water use efficiency; Conjunctive management/groundwater recharge
Infiltration trenches	Urban runoff management; Conjunctive management/groundwater recharge
Bioswales	Urban runoff management; Conjunctive management/groundwater recharge
Planter boxes	Urban runoff management
Permeable pavement	Urban runoff management
Sand filter	Urban runoff management
Vegetated swales	Urban runoff management
Vegetated filter strips	Urban runoff management
Water harvesting	Urban runoff management; Urban water use efficiency; Conjunctive management/groundwater recharge Economic incentives; Matching quality to use
Green roof	Urban runoff management
Trash segregation	Urban runoff management
Surface infiltration basins	Urban runoff management; Conjunctive management/groundwater recharge; Flood risk management
Subsurface infiltration galleries	Urban runoff management; Conjunctive management/groundwater recharge; Flood risk management
Dry extended detention basins	Urban runoff management; Conjunctive management/groundwater recharge; Flood risk management
Subsurface detention galleries	Urban runoff management; Conjunctive management/groundwater recharge; Flood risk management
Subsurface flow wetland systems	Urban runoff management; Conjunctive management/groundwater recharge;
Constructed and pocket wetland systems	Urban runoff management; Conjunctive management/groundwater recharge;

Type of BMP	Required California Water Plan strategies
Nonstructural BMPs	
Development review process	Urban runoff management; Urban water use efficiency; Economic incentives; Pollution prevention; Conjunctive management/groundwater storage; Matching quality to use; Flood risk management; Land use planning/management
Enhanced inspections and enforcement	Urban runoff management; Pollution prevention; Urban water use efficiency;
SUSMP and regulatory enhancement	Urban runoff management; Urban water use efficiency; Pollution prevention
New/expanded initiatives	Urban runoff management; Urban water use efficiency; Pollution prevention; Agricultural water use efficiency
Landscape practices	Urban runoff management; Urban water use efficiency; Pollution prevention; Conjunctive management/groundwater storage; Matching quality to use; Flood risk management;
Education and outreach	Urban runoff management; Urban water use efficiency; Economic incentives; Pollution prevention; Conjunctive management/groundwater storage; Matching quality to use; Flood risk management; Land use planning/management; Agricultural water use efficiency; Forest management
MS4 maintenance	Urban runoff management; pollution prevention
Capital improvement projects	Urban runoff management; Ecosystem restoration; Water use efficiency; Pollution prevention

6.3 Water Supply, Water Conservation Programs and Associated Load Reductions

The following sections summarize water supplies in the region and conservation efforts throughout the watershed. They discuss potential load reduction benefits associated with the water supply and conservation programs.

6.3.1 Water Supplies

SDCWA purchases water from the Metropolitan Water District of Southern California (MWD). In turn, SDCWA's 24 member agencies purchase the imported water for retail distribution in their individual service areas. The City of San Diego is the SDCWA's largest member agency, both in terms of land area (22 percent of the service area) and in normal year water demand (42 percent of the demand in 2010) (SDCWA 2011).

SDCWA's imported supply comes from two suppliers: the State Water Project, diverting water from Northern California to Southern California through a 444-mile-long aqueduct; and the Colorado River, via a 242-mile-long aqueduct bringing Colorado River water from Lake Havasu to the MWD service area. The Colorado River makes up 50 percent of the imported water supply. MWD blends Colorado River water and State Water Plan water at a facility in Riverside County, and then transfers it to the water treatment plants in the San Diego region. Because of the increasing cost and potential vulnerabilities of these two systems, local resources developed by SDCWA's member agencies have become increasingly critical in developing a more diverse and reliable water supply for the region.

The Tecolote watershed overlies the Mission Valley groundwater basin. Although groundwater basins within the region generally have stable groundwater levels and none are in overdraft (CADWR 2004), groundwater supplies and production are more limited in the San Diego region than in other regions of California (SDCWA 2011). Constraints on using the regional groundwater basins are the following:

- Small geographic extent of the more productive sand and gravel (alluvial) aquifers
- The shallowness of most of the alluvial aquifers
- Limited yield and storage in the sedimentary deposits
- Lack of rainfall and groundwater recharge
- Affected water quality from human activities, requiring treatment before domestic or agricultural uses

Despite these constraints, the SDCWA and its member agencies believe that the undeveloped, brackish groundwater could meet a larger portion of the region's future water demand than is projected. The 2007 IRWMP established a target of increasing groundwater supply in the Water Authority Service Area from about 14,960 acre-feet per year (AFY) in 2006 to 28,580 AFY by 2010 and to 31,180 AFY by 2030. According to the August 2011 IRWMP Report Card, groundwater supplies from the SDCWA member agencies were 20,833 AFY in 2010 and are projected to be more than 48,000 AFY by 2030. Appendix M includes more details regarding surface and groundwater resources.

In late 2011 the City of San Diego began a multiyear project to further investigate, evaluate, and develop its groundwater assets (City of San Diego 2010e). Some elements of the project include preparing aquifer storage and recovery plans, seawater intrusion and control plans, nutrient and salinity management plans, and groundwater-specific designs. Although no centralized storm water capture and groundwater recharge facilities are planned in the study watershed areas, such facilities could be effective at reducing pollutant loads and should be considered from a multi-benefit perspective. Moreover, many of the structural BMPs being evaluated for the CLRP and conservation measures such as rainwater harvesting and permeable landscapes, if implemented on a widespread basis in the watershed, have potential for significant storm water and rainwater infiltration and selective groundwater recharge.

6.3.1.1 Potential Load Reduction Benefits Associated with Water Supplies

In recent years, the cost of imported water has doubled and is projected to double again in the next 10 years. This increased cost with drought and water supply reliability issues have spurred efforts to develop a more diverse mix of water resources in the region.

The clear trends for enhancing regional water supply systems are increasing the production and use of recycled water and brackish groundwater. Increased recycled water use does not appear to have storm water load reduction benefits. Indeed, recycled water used for irrigation could increase storm water loading of nutrients and salts from elevated concentrations of TDS, which characterize the region's recycled water. RPs must be careful to mitigate this potential effect as recycled water use is expanded. If properly managed, recycled water can yield reductions in wastewater discharge loading and provide other beneficial uses such as providing nutrients for agricultural and landscaping/nursery areas and enhancing environmental features such as wetlands.

A number of structural storm water BMPs and conservation measures under evaluation provide load reduction and increased infiltration. The degree to which these distributed and centralized BMPs are implemented will determine the cumulative potential for groundwater recharge benefits in the study area watersheds.

Although there are no plans for storm water capture and recharge of groundwater, or plans for storm water capture and treatment, such projects could also play a role in comprehensive load reduction and increased local water supplies, and should be considered from a triple bottom line perspective. In the future, an overarching strategy in evaluating and selecting among these various options will be, "the right water supply for the right use."

6.3.2 Water Conservation Programs

The 2007 IRWMP set a target of increasing water conservation savings in the region from about 51,000 AFY in 2006 to at least 79,960 AFY by 2010 and 108,400 AFY by 2030. According to the August 2011 *IRWMP Report Card*, SDCWA and member agencies reduced per capita water use by 27 percent between 2007 and 2010. The SDCWA and its member agencies have committed to an aggregate efficiency target of 167 GPCPD by 2020. This includes all water uses except those for agriculture. (Note that communities have each established their own efficiency target. By way of comparison, the City of San Diego has established a 2020 goal of 142 GPCPD.) The region has now set a more aggressive target of water conservation savings of 138,400 acre-feet annually by 2030.

As noted, when verifiable recycled water projects are subtracted from water use efficiency targets for the region, significant additional conservation is required to meet the state's 20 percent reduction goal by 2020 (Table 6-3). The 2020 conservation target for the region (46,951 acre-feet) more than doubles by 2035 if the region is to maintain the 2020 per capita water use efficiency. Note that some jurisdictions and water agencies have met or are making significant progress in meeting the 2020 target.

Table 6-3. Regional conservation requirements to meet and sustain SBX7-7 targets

Targets to sustain SBX7-7 (acre-feet)	2015	2020	2025	2030	2035
Additional conservation required	6,737	46,951	72,234	97,280	117,528

This section discusses storm water-related water conservation programs in the watershed that are ongoing or are being explored, and evaluates the potential for these BMPs to help meet the long-term water conservation and load reduction targets. It focuses particularly on those local programs related to rainwater harvesting, downspout redirection, permeable landscapes, whole-site functional landscapes, and urban irrigation reduction.

6.3.2.1 Types and Purposes of Programs

Water conservation has been a part of the outreach throughout San Diego County. Rainwater harvesting or rain barrels, lawn and garden practices, *good housekeeping* for outdoor projects, and pet waste management are typical residential BMPs promoted by regulated municipalities across the country. California's recent droughts and population growth have added new layers of urgency and regulations, requiring even stronger conservation measures. The most prevalent types of water conservation, recharge, and turf conversion programs related to storm water load reduction can be generally characterized as

- **Rainwater harvesting**: Initiatives promoting the use of rainwater catchment systems (i.e., rain barrels and cisterns) that intercept wet-weather or storm event runoff in a storage unit, enabling use of the retained water for non-potable purposes.
- **Downspout redirection**: Modifying structural rainwater collection systems (i.e., gutters, downspouts and drains) to intentionally direct storm event runoff into storage systems or permeable areas of a site, reducing direct discharge of storm water to constructed storm drainage systems or across impervious surfaces.
- **Permeable landscapes**: Using landscape materials and techniques, including turf conversion, xeriscaping, grading, soil amendment, or removal of impervious surfaces, intended to reduce irrigation demand; increase the area of a site that performs natural hydrologic functions such as rainwater storage, groundwater infiltration, and evapotranspiration; and reduce the volume of storm water reaching constructed drainage systems or impervious surfaces.

- **Whole-Site Functional Landscapes:** Combines rainwater harvesting, downspout redirection, and permeable landscapes on a site scale to replicate a natural landscape and have a neutral hydrological impact from development.

In arid and semi-arid climates such as Southern California, urban irrigation reduction and water-efficient irrigation device incentives are common components of local water department conservation programs. Through reducing over-irrigation, these incentive programs can particularly reduce dry-weather runoff. More details about these water conservation and water efficiency approaches are in Appendix L.

Despite their increasing prevalence and available financial incentives, these types of residential BMP programs generally have not been deployed as a strategy to yield measurable, quantifiable pollutant reduction, either in an NPDES permitting or TMDL context. In most urbanized watersheds, modeling and assessments consistently indicate that residential properties represent a substantial source of pollutant loading and storm water runoff volume. However, the nature and scale of these residential BMPs, and of nonpoint source pollution reduction efforts in general, makes it difficult to assess the effective pollutant reduction that can be obtained.

While rainwater harvesting systems generally are not used as primary treatment for water quality and pollutant removal, there is increasing evidence that rain barrels and cisterns can be successful at reducing pollutant loads when used in a *treatment train* that discharges water to other BMPs, such as bioretention areas or rain gardens.

Almost all the local governments in the region and a number of other water agencies are implementing water conservation incentives and educational programs to some degree. These mostly include rebates for water efficient irrigation devices and some form of permeable landscape assistance, typically free advice from a landscaper or in the case of the City of San Diego, rebates for landscape conversion. The county has an ongoing rain barrel incentive program. These and other incentive programs being explored in the watershed are discussed more fully below. Note that in addition to these incentive programs, the City of San Diego has water conservation in landscaping ordinances requiring water efficient landscaping for new development.

6.3.2.2 City of San Diego Water Conservation Program Activities

The City of San Diego is evaluating development of an ongoing rainwater harvesting program to provide rain barrels at a discount from retail costs. The rain barrel program began in January 2012. The purpose of the program would be to promote water conservation and reuse, runoff reduction, and redirection of collected rainwater to permeable surfaces and landscaping.

In 2009 the city’s Transportation and Storm Water Department, Storm Water Division implemented Phase II Rain Barrel Downspout Disconnect (RBDD) Best Management Practices Effectiveness Monitoring and Operations Program. The study included the installation and assessment of 24 rain barrels at seven facilities in the city. The project was intended to evaluate the potential for RBDD as a cost-effective BMP that reduces storm water runoff and improves water quality. The project monitored the effectiveness of storm water flow reduction and pollutant load reduction from rooftop runoff. In addition, the program has potential applicability for TMDL implementation programs in reducing heavy metals, pesticides, nutrients, bacteria, and sediment in the local watershed.

The RBDD systems were designed to reduce the volume of storm water runoff from rooftop drainage areas and use existing landscaped vegetated areas or planter boxes to infiltrate and treat the runoff. The RBDD configuration for each facility was based on existing site constraints. Where feasible, the rooftop runoff was discharged into the existing landscape. For sites with insufficient existing landscape or where soils had low infiltration rates, a raised planter bed (planter box) was constructed to provide treatment and filtration.

The study evaluated three different RBDD configurations:

- Gravity-flow system that discharges to existing landscape. This system continuously captures and discharges the runoff throughout the storm event.
- Automated storage system that captures and stores runoff for use once the storm event has passed.
- Planter-barrel system that discharges to raised planters. This configuration was designed to accommodate both gravity-flow and automated discharge.

The city conducted water quality and volume monitoring and found a significant reduction in water volume but no significant change in water quality. Pre- and post-installation monitoring took place at five of the seven sites. The gravity-flow system was ranked the highest for flow reduction, pollutant load reduction and ease of O&M. In certain configurations, the gravity-flow system was able to reduce the rooftop runoff by 6.5 times the actual volume of the rain barrel. When the gravity-flow system was discharged to areas of existing vegetation, 100 percent of the flow was attenuated (assumed but not measured). The automated system is limited to capturing the volume of the barrel (because of pump failure) and therefore has lower flow attenuation and pollutant load reduction. In the automated systems, capacity was often exceeded because of electrical or mechanical problems with the drainage pumps. Overflow volumes from RBDD systems were not monitored.

The gravity-flow planter-barrel system was found to have insufficient infiltration area for the larger roof drainage areas. In these situations, infiltration can be increased through a series of infiltration strategies (e.g., overflowing into an area of permeable paving).

Pollutant load reductions were calculated for metals, TSS, and bacteria. Facilities with copper or galvanized metal roofing materials had higher measurable concentrations of copper and zinc. The gravity-flow system was able to provide the greatest load reduction for all constituents because of flows reaching porous landscapes. The planter-barrel system was able to provide metal load reductions at sites that had metal roofing materials, but had an increase in TSS concentrations and indicator bacteria. This was likely because of the lack of fully established vegetation. The increase in bacteria could also be associated with the underdrain and environmental bacteria in the soil. It is presumed that planters with increased heights will provide greater treatment, but no qualitative results are available. It is suggested that the planter-barrel system be flushed at least annually to prevent buildup of bacteria and sediment. The automated storage systems provided the least pollutant load reduction.

The City of San Diego Public Utilities Department has a turf conversion rebate program that provides $1.25 per square foot converted. Applicants must convert at least 400 square feet of existing turfgrass to more drought-tolerant vegetation. The maximum area covered by the rebate is 1,600 square feet, and the maximum rebate per household or participant is $2,000.

The City of San Diego Public Utilities Department also has a rebate program, which was initiated as an incentive to improve irrigation systems and shift residential customers to more water-efficient irrigation, particularly *smart controllers* that adjust watering schedule according to weather and season, and reduce watering when not required. The city's existing rebate of $1.25 per square foot of turf converted to sustainable landscaping, or $1.50 if professionally designed plans are submitted, is above the median rebate amount of $1 per square foot among the programs surveyed (Table 6-4). Single-family, commercial and multifamily properties are eligible for micro-irrigation rebates. These rebates ($0.20 per square foot, up to $1,000) are funded through a California grant on a first-come first-served basis. City of San Diego residents can also participate in the rebate program sponsored by the MWD.

The city also offers residential and commercial surveys that include an assessment of the irrigation system and irrigation scheduling.

Table 6-4. City of San Diego Public Utilities Department rebate programs use as of 5/10/11

Total residential and commercial combined	Total rebate applications received	Total rebate checks sent
Smart irrigation controller rebate	18	7
Micro irrigation rebate	55	13
Sustainable landscape – turf replacement	83	10
Total	156	30

The city does not have an active downspout redirect program, but it is exploring incentives for such a program, as noted above.

6.3.2.3 Potential Load Reduction Benefits associated with Water Conservation Programs

Most local governments in the region are implementing conservation incentive and educational programs to some degree, the most typical being incentives for water efficient irrigation devices and free professional advice upon request regarding landscape conversion. Stronger programs for rainwater harvest, downspout disconnection, permeable landscapes, and urban irrigation reduction offer significant potential for comprehensive load reduction and groundwater recharge, and have become increasingly important in light of the state's water efficiency targets for 2020 and the region's MS4 permit requirements for reductions in effective impervious area.

Despite the increasing prevalence of conservation BMPs, their load reduction benefits have not been systematically measured and quantified. A few studies exist with site-scale observed performance monitoring data, but extrapolating site-scale benefits to the watershed cannot be done readily because performance is influenced by degree of implementation, available lot space, timing of rainfall and pollutant transport, and many other factors. However, the CLRP program has modeling tools that can be used to simulate and estimate benefits from these BMPs. For example, urban irrigation can be simulated in the LSPC model using a program module that calculates evapotranspiration demand on the basis of soil moisture condition and allows for demand-based irrigation to be specified. Irrigation can also be disabled for a user-specified period after a rainfall event. Irrigation technologies of varying efficiencies can be incorporated, and irrigation can be applied to varying fractions of urban pervious land cover. Land cover representing xeriscaping and water harvesting can also be developed. Studies indicate that California could reduce outdoor residential water use by 25 to 40 percent through improved landscape management practices and better application of available technology (Gleick et al. 2003). In a recent model application in Los Angeles County evaluating dry-weather runoff, an assumption of 25 percent reduction in urban irrigation was used as a conservative estimate of what is achievable, which resulted in an average dry-weather flow and load reduction of 43 percent. Rainwater harvesting practices can be simulated directly in SUSTAIN or on a unit-area basis in LSPC, accounting for variations in storage volume, water use, and time-varying precipitation.

This leads to another key finding: it is easy and common to overestimate the benefits of conservation BMPs. The RPs (and contractors) will be careful to develop conservative and realistic assumptions for model simulation inputs, including the realistic participation rates by residential, commercial, and other properties in the study watersheds.

6.4 Water Quality Project Opportunities with Multiple Water Resources Benefits

As discussed above, the *types* of BMPs being evaluated for load reduction were specifically selected because they support multiple water resources goals and objectives, including improved water quality; water conservation and efficiency; groundwater recharge; open space and habitat; water supply diversity and reliability; and investment in new, and where possible, more energy-efficient technologies (Table 6-5). On the basis of studies and experience in other arid and semi-arid climates, several of these BMPs offer the broadest water resource opportunities: infiltration basins, extended detention, rain gardens, bioretention areas, and water harvesting.

Table 6-5. BMP project types supporting multiple regional water resources objectives

BMP	Water quality	Water conservation/efficiency	Selective groundwater recharge	Improve open space & habitat	Hydromodification & flooding	Reliability/diversity of supply	New technology/energy efficiency
Centralized structural BMPs							
Surface infiltration basins	✓	✓	✓		✓	✓	
Subsurface infiltration basins	✓	✓	✓		✓	✓	
Dry extended detention basins	✓	✓	✓		✓	✓	
Subsurface detention systems	✓	✓	✓		✓	✓	
Constructed and pocket wetland systems	✓	✓	✓	✓	✓	✓	
Subsurface flow wetland systems	✓	✓	✓	✓	✓	✓	
Distributed structural BMPs							
Rain gardens	✓	✓	✓	✓	✓	✓	
Bioretention area	✓	✓	✓	✓	✓	✓	
Infiltration trenches	✓	✓	✓				
Bioswales	✓	✓	✓				
Planter boxes	✓		✓				
Permeable pavement	✓		✓				
Vegetated swales	✓		✓				
Vegetated filter strips	✓		✓				
Water harvesting	✓	✓	✓	✓			✓
Green roofs	✓						✓
Trash segregation	✓						
Nonstructural BMPs							
Development review process	✓	✓		✓	✓		✓
Enhanced inspections and enforcement	✓						✓

BMP	Water quality	Water conservation/efficiency	Selective groundwater recharge	Improve open space & habitat	Hydromodification & flooding	Reliability/diversity of supply	New technology\energy efficiency
SUSMP and regulatory enhancement	✓	✓			✓		✓
New/expanded initiatives	✓	✓		✓	✓	✓	✓
Landscape practices	✓	✓	✓	✓	✓	✓	✓
Education and outreach	✓	✓		✓			
MS4 maintenance	✓			✓	✓		
Capital improvement projects	✓		✓	✓			✓

7 Implementation Recommendations

This section provides a summary of the CLRP implementation recommendations for the Tecolote watershed. These recommendations form the basis of a *CLRP Implementation Program* which together with the CLRP itself represents the initiation of an ongoing implementation process. This program will facilitate the RPs' continued BMP analyses, planning, assessment, and optimizing adjustments. It will also be used to explore joint funding opportunities, conduct future water quality monitoring evaluations and periodic program review, and identify needed modifications and improvements to the CLRP over the implementation period.

Included in this section is a BMP Implementation Schedule that lists the potential future actions of the CLRP Implementation Program and nonstructural and structural BMP opportunities. These recommendations serve as the foundation for future decisions for comprehensive load reduction planning in the watershed. Given the iterative and adaptive framework for the CLRP Implementation Program, these recommendations are subject to change depending on future assessments, BMP optimization, available funding, and other essential RP obligations.

7.1 CLRP Implementation Program

The RPs are committed to embarking on a CLRP Implementation Program to attain compliance with the TMDL and facilitate strategic decision making, assessment, and adaptation of the CLRP. The RPs recognize that no plan is meaningful without commitment and a mechanism for continued coordination and planning. During development of the CLRP, the RPs worked to present one watershed-based plan both to better manage pollutant loads and to serve as a foundation for decisions regarding future BMP implementation. In the coming years, lessons will be learned from projects implemented, conditions will change, new technologies will emerge, and unanticipated challenges will present themselves. Thus, implementation of the CLRP will require continued evaluation and adaptation. The following discusses key management actions planned for the CLRP Implementation Program.

7.1.1 Establishment of CLRP Implementation Program

A CLRP Implementation Program will be established, incorporating an adaptive management approach. The program will allow the RPs to continue coordinating on selecting and implementing cost-effective BMPs over the implementation period. The program will allow for refinements of the implementation recommendations over time as new information is obtained regarding cost-effectiveness and to achieve compliance with the Bacteria TMDL and other applicable water quality permits and standards. Importantly, it will assess the optimal balance of centralized and distributed BMP types and locations in light of planned nonstructural BMP load reduction activities. Quantification of the pollutant load reductions, design sizes, and costs will be developed in the early phase of the program. The program will also assess the degree to which centralized and distributed BMPs may need to be implemented on private land, in addition to those specified in this CLRP, to meet required load reductions.

The CLRP recommendations provide the information needed to begin planning for nonstructural and structural BMPs that may be implemented. The high-ranked BMP sites and activities in Sections 4 and 5 of this plan provide an immediate and strong foundation for each RP's CLRP program development.

7.1.2 Initial Structural and Nonstructural BMP Analysis

Although a number of nonstructural and structural BMPs have been recommended for comprehensive load reduction in the Tecolote watershed, additional analysis is needed regarding their sufficiency and cost-effectiveness in meeting the WLAs. Section 4 identifies a potential list of new nonstructural BMPs or enhancements of existing nonstructural BMPs that are anticipated to yield significant load reductions for the key PGAs and HPMAs. Section 5 identifies distributed and centralized structural BMPs that RPs can implement on publicly owned land to further reduce pollutant loads, particularly in HPMAs. The RPs will use adaptive management to continue to refine the understanding of the optimal combination of these recommended BMPs and the potential need for BMP retrofits on privately owned land.

In the CLRP's nonstructural and structural BMP planning, the relative cost-effectiveness of the various BMPs was key in the phasing of implementation. Nonstructural BMPs are effective at reducing pollutant loads before they enter the storm drain and are recommended to begin in the early stages of implementation. Initial program activities will focus on the PGAs and HPMAs, which will be further refined on the basis of future monitoring and modeling studies. Centralized BMPs on public land are included in the CLRP and may help facilitate compliance with the Bacteria TMDL. These BMPs will also be considered early in the scheduling of BMP implementation, particularly in the HPMAs. Again, early implementation will focus on the development of distributed BMPs in HPMAs, where feasible. BMPs implemented on public land outside the PGAs and HPMAs would further reduce loading; however, the cost per load reduced could be greater.

Table 7-1presents a conceptual cost-effectiveness curve that can form the basis for future analyses. With a modeling tool capable of providing comparative BMP performance results, such a cost-optimization curve can be developed for the watershed by selecting those BMPs that provide the greatest load reduction relative to cost early in the planning process (represented by the steep slope at the beginning of the curve), followed by the addition of less cost-effective BMPs (represented by the reduced slope at the end of the curve). Essentially, the combination of those BMPs that are most cost effective can be selected for implementation early in the planning period (e.g., nonstructural BMPs and structural BMPs on public land); the less cost-effective BMPs (e.g., structural BMPs on private land requiring land acquisition) are scheduled for later in the planning period. This strategy allows more time for evaluation of alternatives, acquiring funding, and verifying load reductions achieved by BMPs implemented earlier in the schedule.

The initial structural and nonstructural BMP analysis will yield an improved understanding of the cost-effectiveness and benefits of the alternative strategies and their combinations. These results will better inform the remaining CLRP Implementation Program and provide a basis for adapting the CLRP to maximize its likelihood of successfully attaining the WLAs in the watershed based on available funding and other RP priorities and responsibilities.

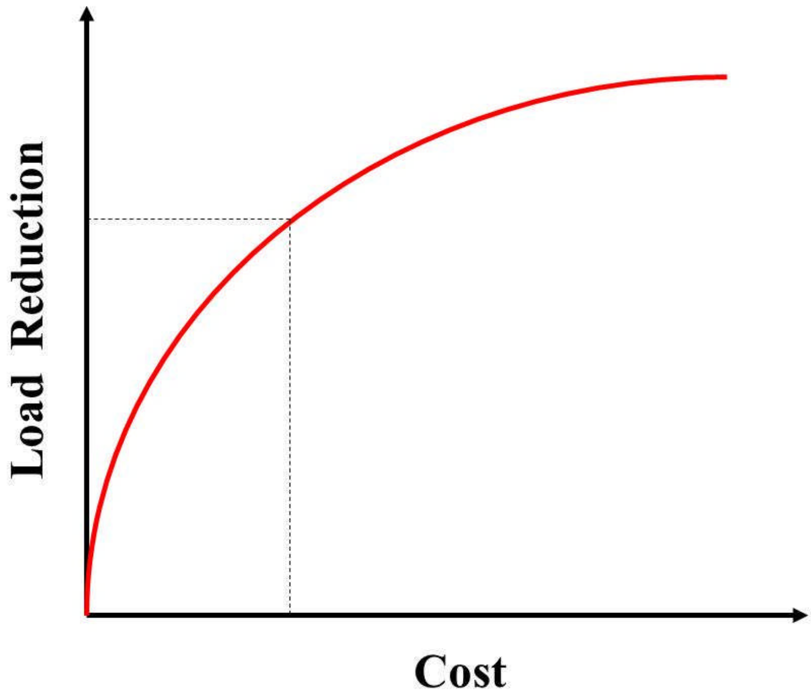

Figure 7-1. Example cost-effectiveness curve for structural and nonstructural BMP analysis

7.1.3 CLRP Modifications and Improvements

An iterative and adaptive framework is essential to ensuring that the RPs attain compliance with the Bacteria TMDL. During the periodic program reviews, findings from the activities of the CLRP Implementation Program and modifications to the BMPs will be included in the BMP Implementation Schedule. Activities that will support justification for CLRP revisions and inform alternative strategies for BMP implementation and the BMP Implementation Schedule include, for example, the following:

- Initial structural and nonstructural BMP analysis (Section 7.1.2)
- Periodic BMP assessment and optimization adjustments (Section 7.1.4)
- CLRP reporting (Section 7.1.5)
- Monitoring (Chapter 8)

The overlapping schedules for these activities are presented in the BMP Implementation Schedule in Section 7.2.

7.1.4 Periodic BMP Assessment and Optimization Adjustments

As both structural and nonstructural BMPs are implemented, their effectiveness will be tracked in parallel efforts for CLRP reporting (Section 7.1.5) and continuous monitoring (Section 8). BMP assessments will be periodically performed to provide meaningful information for needed CLRP revisions or adjustments to the nonstructural and structural BMPs that may be implemented in the future.

For nonstructural BMP assessment, the information collected varies significantly depending on the activities undertaken. Moreover, the methods for assessing effectiveness vary tremendously from one BMP to another. Through past experience in WURMP reporting, and internal methods for ensuring cost-effective program implementation, the RPs have developed various procedures for assessing nonstructural

BMP effectiveness which can be shared with all RPs in the watershed as part of the CLRP Implementation Program.

As structural BMPs are implemented, their effectiveness is more straightforward to assess. Methods that can be employed include pre- and post-construction monitoring, and tracking of the costs for planning, permitting, design, construction, operation, and maintenance. Likewise, it will be important to track the specific characteristics of each BMP to build a local database that ties these characteristics to effectiveness measures. Such characteristics could include the size of the area treated by the BMP (distributed or centralized), the type of BMP (e.g., bioretention, detention, porous pavement, or combination or various types), soil characteristics, infiltration rates, land use, and the like. With such a database in place, research can be focused to better inform the overall CLRP Implementation Program and guide specific studies and resources to those BMP characteristics for which their effectiveness is less understood. As a result, not every structural BMP would require monitoring. Rather, as the effectiveness of certain BMP characteristics is well understood, those results can be extrapolated to all other BMPs sharing those same characteristics. Also, these results can be incorporated into future modeling studies, as discussed in Section 7.1.2, thereby providing an improved prediction of future load reductions and costs for implementing structural BMPs in the BMP Implementation Schedule. With this ability to prioritize research needs on those BMP characteristics least understood, the CLRP program will optimize the overall cost for BMP assessment.

Initially, BMP assessment will focus primarily on information compiled and reported in WURMPs , and results of monitoring studies as discussed in Chapter 8. BMP-specific studies may be recommended to focus future BMP assessments and optimization adjustments to support program refinements in subsequent years.

7.1.5 CLRP Reporting

The RPs will prepare periodic Progress Reports to document progress of the CLRP in accordance with the approved schedule included in the applicable regulatory document. Progress Reports will provide status updates of BMP activities and the results of monitoring studies. These reports may also include updates to this CLRP and the BMP Implementation Schedule. The first CLRP update may replace the current Watershed Urban Management Plan (WURMP) for the Tecolote watershed.

7.1.6 Continued Coordination

The RPs will meet regularly throughout the duration of the BMP Implementation Schedule to continue collaboration and coordination. These meetings will include status updates from each RP on BMP implementation and strategizing of ongoing activities in the CLRP Implementation Program.

7.2 Comprehensive Compliance Schedule – BMP Planning and Scheduling

The Bacteria TMDL Basin Plan Amendment was approved in April 2011, which represents the start date for complying with the WLAs and other TMDL requirements. This CLRP incorporates a 20-year compliance schedule and recognizes BMP development and planning efforts that have been completed to date, including development of the CLRP itself. A BMP Implementation Schedule was developed to focus on the BMP and monitoring actions that may be implemented in future years according to the following overarching strategy: nonstructural BMPs are scheduled to be implemented in years 0–5; currently planned structural BMPs on public land in years 0–10, centralized and distributed structural BMPs on public land in years 3–15, and structural BMPs on private land in years 15–20.

Table 7-1 provides the BMP Implementation Schedule to meet the TMDL compliance milestones. For each nonstructural BMP category, the BMP Implementation Schedule designates the anticipated timeline for BMP implementation and O&M, which corresponds to cost estimates reported in Section 7.3. Likewise, for each structural BMP, the BMP Implementation Schedule designates expected timelines for planning, design, construction, and O&M, also incorporated in developing cost estimates in Section 7.3. Implementation of BMPs may be subject to funding availability and other considerations.

Most of the planned or newly identified BMP opportunities are not funded, and the time frame to secure the necessary funding for each BMP is not incorporated in the implementation schedules. With the state of the economy, the availability of financial resources is extremely limited, and the lack of funding could delay the implementation start and end dates. These challenges will be continually re-evaluated and addressed through an adaptive management process throughout the implementation period.

BMP implementation is subject to further evaluation of funding opportunities and other considerations. For example, Caltrans funds are subject to legislative appropriation and availability given the constraints in California law (Streets and Highway Code Section 114 & 130) and the California Constitution (Article XVI, Section 7). Additional factors related to the order of phasing will be considered during periodic program reviews and optimization adjustments. The prioritization of projects in Section 5 can be a preliminary aid to project selection when implementing the BMP Implementation Schedule.

Table 7-1. BMP Implementation Schedule

	Implementation
	O&M

Management actions	RP		Implementation year																		
	CSD	CTRANS	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CLRP IMPLEMENTATION PROGRAM ACTIONS																					
Initial structural and nonstructural BMP analysis	✓	✓																			
CLRP modifications and improvements	✓	✓																			
CLRP reporting	✓	✓																			
NONSTRUCTURAL																					
DEVELOPMENT REVIEW PROCESS																					
Amend regulations to facilitate LID implementation	✓																				
Train staff and boards	✓																				
ENHANCED INSPECTIONS and ENFORCEMENT																					
Mobile business training requirements	✓																				
Power washing discharges inspection/enforcement	✓																				
Enhanced IC/ID reporting and enforcement		✓																			
Property-based inspections	✓	✓																			

Management actions	RP		Implementation year																		
	CSD	CTRANS	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
SUSMP and REGULATORY ENHANCEMENT[7]																					
Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:																					
Trash enclosure & storage areas	✓																				
Animal-related facilities	✓																				
Nurseries and garden centers	✓																				
Auto-related uses	✓																				
Update minimum BMPs	✓																				
NEW/EXPANDED INITIATIVES																					
Address bacteria & trash impacts of homelessness	✓																				
Pilot projects to disconnecting impervious surfaces	✓																				
Support for Brake Pad Partnership	✓	✓																			
LANDSCAPE PRACTICES																					
Landscape BMP incentives, rebates, and training:																					
Residential properties	✓																				
Homeowners' associations/property managers	✓																				
Nonresidential properties	✓																				
Reduction of over-irrigation	✓																				
Irrigation, pesticide & fertilizer reduction		✓																			
EDUCATION AND OUTREACH																					
Enhanced and expanded trash cleanup programs	✓	✓																			

7

Management actions	RP		Implementation year																		
	CSD	CTRANS	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Improve web resources on reporting	✓																				
Refocused or enhanced education and outreach to target audiences:																					
Equestrian community	✓																				
General/Other	✓																				
MS4 MAINTENANCE																					
Optimized or enhanced catch basin inlet mgmt.,	✓																				
Proactive MS4 repair & replacement	✓	✓																			
Increased channel cleaning & scour pond repair	✓	✓																			
Street sweeping enhancements & expansion:																					
Increased/optimized sweeping	✓																				
Sweeping medians on high-volume segments	✓																				
Upgraded sweeping equipment	✓	✓																			
Sweeping of private surfaces in targeted areas	✓																				
Erosion repair and slope stabilization:																					
Public property & right of way	✓	✓																			
Enforcement on private properties	✓																				
CAPITAL IMPROVEMENT PROJECTS																					
Dry-weather flow separation	✓																				
Mitigation and conservation initiatives		✓																			

Management actions	RP		Implementation year																		
	CSD	CTRANS	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
STRUCTURAL[8]																					
STRUCTURAL: PLANNED AND IMPLEMENTED																					
PLANNED AND IMPLEMENTED BMPS: CENTRALIZED																					
Planned - Centralized 1-2	✓																				
Implemented - Centralized 3	✓																				
Planned - Centralized 4	✓																				
PLANNED AND IMPLEMENTED BMPS: DISTRIBUTED																					
Planned - Distributed 1	✓																				
Planned - Distributed 2	✓																				
STRUCTURAL: NEW BMPS ON PUBLIC PARCELS																					
NEW BMPS: Centralized																					
Centralized - BMP 1	✓																				
Centralized - BMP 2	✓																				
Centralized - BMP 3	✓																				
Centralized - BMP 4	✓																				
Centralized - BMP 5	✓																				
NEW BMPS: DISTRIBUTED																					
Distributed - BMP 1-3	✓																				
Distributed - BMP 4-6	✓																				

Implementation phases for structural BMPs includes periods for planning, design, and construction, with each period considered and included in cost estimates presented in Section 7.2.

Management actions	RP		Implementation year																		
	CSD	CTRANS	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Distributed - BMP 7-9	✓																				
Distributed - BMP 10-13	✓																				
Distributed - BMP 14-17	✓																				
Distributed - BMP 18-21	✓																				
Distributed - BMP 22-25	✓																				
Distributed - BMP 26-29	✓																				
Distributed - BMP 30-33	✓																				
Distributed - BMP 34-37	✓																				
Distributed - BMP 38-40	✓																				
Distributed - BMP 41-43	✓																				
Distributed - BMP 44-46	✓																				
STRUCTURAL: NEW BMPS ON PRIVATE PARCELS																					
NEW BMPS: CENTRALIZED																					
Planning through O&M																					
NEW BMPS: DISTRIBUTED																					
Planning through O&M																					

7.3 Economic Justification

For each of the nonstructural BMPs and structural BMPs on public land included in the BMP Implementation Schedule, preliminary cost estimates were developed to support future planning and securing funds for implementation. This excludes the potential need for structural BMPs on private land that might be needed in the later phase of the schedule. As noted, the initial structural and nonstructural BMP analysis and periodic BMP assessment and optimization adjustments will continue to assess the degree to which centralized and distributed BMPs would need to be implemented on private land to meet required load reductions. On the basis of optimization modeling performed for these activities, cost estimates will be adjusted, and the timeline of implementing specific BMP projects will be refined.

Implementation actions and cost estimates for recommended nonstructural and structural BMPs are presented in **Table 7-2**. Detailed descriptions of the methods for estimating BMP costs are provided in Appendix M.

Table 7-2. Estimated present value cost of recommended nonstructural and structural BMPs over a 20 year timeframe

Watershed Implementation categories	Present value cost[a]
Nonstructural BMPs	
Development Review Process	$811,802
Enhanced Inspections and Enforcement	$6,602,708
SUSMP and Regulatory Enhancement	$1,111,872
New/Expanded Initiatives	$2,394,533
Landscape Practices	$8,782,075
Education and Outreach	$1,835,129
MS4 Maintenance	$188,858,394
Capital Improvement Projects	$2,337,917
Subtotal	$212,734,430
Structural BMPs	
New Identified Centralized BMPs	$26,536,905
New Identified Distributed BMPs	$48,668,416
Planned/Implement Centralized BMPs	$24,823,951
Planned/Implement Distributed BMPs	$3,230,687
Subtotal	$103,259,959
Total present value cost	**$315,994,389**

Note:

a. These are preliminary estimated costs subject to refinement and improvements as a result of further analyses and assessments performed as part of the CLRP Implementation Program. Implementation of BMPs is subject to availability of resources

8 Monitoring Plans

A monitoring plan was developed to outline a CLRP Monitoring Program designed to fulfill the monitoring requirements of the approved TMDLs and generate data to support the Tecolote watershed CLRP Implementation Program as detailed in Section 7 (see Appendix N). The CLRP Monitoring Program will collect data to evaluate the approved TMDL pollutants, draft TMDL pollutants, and other 303(d) constituents. The CLRP Monitoring Program's goals are the following:

- To assess progress toward meeting the approved TMDL numeric targets and WLAs
- To characterize potential sources of approved TMDL pollutants, draft TMDL pollutants, and other 303(d) constituents
- To support the selection and evaluation of potential BMPs

Four principal types of monitoring can be conducted to address the CLRP Monitoring Program goals.

- ***Compliance Monitoring*** is required by the Bacteria TMDL to demonstrate progress toward meeting TMDL requirements including numeric targets and WLAs.
- ***Optional Monitoring*** is not required by the TMDL; however, if sufficient funds are available, the RPs can implement it to better understand water quality conditions in the receiving water, support management decisions, and demonstrate progress toward meeting TMDL WLA requirements.
- ***Follow-up Monitoring*** will be implemented to characterize the source, magnitude, and duration of exceedances of bacteria WQOs in the receiving water.
- ***Special Studies*** will be implemented on the basis of the available data, resources, and funding to address management questions regarding adopted TMDLs, and 303(d)-listed pollutants.

The monitoring plan includes a quality assurance project plan (QAPP) to provide the methodology and data requirements to meet the CLRP Monitoring Program goals and address specific monitoring requirements of the Compliance Monitoring and Optional Monitoring components scheduled to be implemented during fiscal year 2012–2013. Each year of implementation, the monitoring plan and QAPP will be reviewed and revised as necessary to generate the quality of data needed to meet the CLRP Monitoring Program goals.

An Annual CLRP Monitoring Summary will be included in the WURMP Annual Report as an appendix. The summary will describe the sample collection methods, sampling events, and present key findings of the analytical results. The summary will assess TMDL compliance, identify constituent concentrations above water quality criteria, and present trend information for TMDL and other pollutants, if possible. Any deviations from protocols listed in the Monitoring Plan or QAPP and the implications of those deviations from the data interpretation will be included in the report.

9 References

Bicknell, B.R., J.C. Imhoff, J.L. Kittle Jr., A.S. Donigian Jr., and R.C. Johanson. 1997. *Hydrological Simulation Program–FORTRAN, Users Manual*, version 11. EPA/600/R-97/080. U.S. Environmental Protection Agency, National Exposure Research Laboratory. Athens, GA.

Bozó, L., J. Alcarno, J. Bartnicki, and K. Olendrzyriski. 1991. *Heavy Metals Contamination in Eastern Europe: Background Load from the Atmosphere*. International Institute for Applied Systems Analysis, Laxenburg, Austria. WP-91-46.

Burton, A., and R. Pitt. 2002. *Stormwater effects handbook: a toolbox for watershed managers, scientists, and engineers*. Lewis Publishers, New York, NY.

CADWR (California Department of Water Resources). 2004. *California Groundwater Bulletin 118*. California Department of Water Resources, Sacramento, CA.

CADWR (California Department of Water Resources). 2007. *Integrated Regional Water Management Program Guidelines*. California Department of Water Resources, Sacramento, CA.

CADWR (California Department of Water Resources). 2009a. *California Water Plan Highlights Update 2009*. California Department of Water Resources, Sacramento, CA.

CADWR (California Department of Water Resources). 2009b. *California Water Plan Highlights Update 2009. Implementation Plan*. California Department of Water Resources, Sacramento, CA.

Caltrans (California Department of Transportation). 2003a. *A Review of the Contaminants and Toxicity Associated with Particles in Stormwater runoff*. August 2003. Accessed December 5, 2011. http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-03-059.pdf.

Caltrans (California Department of Transportation). 2003b. *Statewide Storm Water Management Plan*. CTSW-RT-02-008. May 2003. California Department of Transportation, Sacramento, CA.

Caltrans (California Department of Transportation). 2003c. *Discharge characterization study report*. CTSW-RT-03-065.51.41. November 2003. California Department of Transportation, Sacramento, CA.

Caltrans (California Department of Transportation). 2005. *First Flush Phenomenon Characterization*. CTSW-RT-05-73-02.6. California Department of Transportation, Sacramento, CA.

Caltrans (California Department of Transportation). 2012. *Caltrans Stormwater Management Program Annual Report Fiscal Yar 2010-2011*. Report No. CTSW-RT-12-286.11.1. California Department of Transportation, Sacramento, CA.

CARB (California Air Resources Board). 2008. *California Toxics Inventory*. Accessed November 2, 2011. http://www.arb.ca.gov/toxics/cti/cti.htm.

City of San Diego. 1938. *Report of Refuse Dumps*. City Planning Commission, San Diego, CA.

City of San Diego. 2005. *Los Peñasquitos Watershed Management Plan.* San Diego, CA.

City of San Diego. 2006. *Tecolote Canyon Natural Park. Natural Resource Management Plan*. Prepared for the City of San Diego, Park and Recreation Department, Open Space Division, by HELIX Environmental Planning, Inc. March 2006.

City of San Diego. 2008. *Mission Bay & La Jolla Watershed Urban Runoff Management Plan.*

City of San Diego. 2009a. *Tecolote Creek Microbial Source Tracking Study*. Phase II. Final. June 30, 2009. San Diego, CA.

City of San Diego. 2009b. *Dry weather bacterial source identification study in the Mouth of Chollas Creek*. Final Report. Prepared by: Weston Solutions, Inc. June 2009.

City of San Diego. 2009c. *Aerial Deposition Study, Phase III*. Source Evaluation of TMDL Metals in the Chollas Creek Watershed. Final Report. San Diego, CA.

City of San Diego. 2010a. Watershed Sanitary Survey. http://www.sandiego.gov/water/operations/environment/wssurvey.shtml

City of San Diego. 2010b. *Tecolote Creek Data Evaluation for City of San Diego 2000-2010*. San Diego, CA.

City of San Diego. 2010c. *Los Peñasquitos Lagoon Sediment TMDL Modeling Final Report*. Prepared by: Tetra Tech, Inc. April 2010. San Diego, CA.

City of San Diego. 2010d. *The City of San Diego Jurisdictional Urban Runoff Management Program. FY2010 Annual Report*. San Diego, CA.

City of San Diego. 2010e. *2010 Urban Water Management Plan*. City of San Diego Public Utilities Department, San Diego, CA.

City of San Diego. 2011a. *Mission Bay and La Jolla Watershed Urban Runoff Management Program*. Fiscal Year 2010 Annual Report. Accessed November 18, 2011. http://www.projectcleanwater.org/html/wurmp_mission_bay.html.

City of San Diego. 2011b. *Assessing Regulatory Barriers and Solutions for Low Impact Development within the City of San Diego*. June 2011. San Diego, CA.

City of San Diego. 2012. *Storm Water Standards*. San Diego, CA.

County of Los Angeles. 2008. *Evaluation of Existing Watershed Models for the County of Los Angeles*. Prepared by: Tetra Tech, Inc. October, 2008. County of Los Angeles, Los Angeles, CA.

County of Los Angeles. 2010. *Multi-pollutant TMDL Implementation Plan for the Unincorporated County Area of Los Angeles River Watershed*. County of Los Angeles, Los Angeles, CA.

Daggupaty, S.M., C.M. Banic, P. Cheung, and J. Ma. 2006. Numerical simulation of air concentration and deposition of particulate metals around a copper smelter in northern Québec, Canada. *Geochemistry: Exploration, Environment, Analysis* 6(2–3):139–146.

Davis A.P., M. Shokouhian, and S. Ni. 2001. Loading estimates of lead, copper, cadmium, and zinc in urban runoff from specific sources. *Chemosphere* 44:997–1009.

GeoSyntec Consultants. 2004. *Landfill Facility Compliance Study Task 8 Report – Summary of Findings and Comprehensive Recommendations*. Accessed April 9, 2012. http://www.calrecycle.ca.gov/Publications/default.asp?pubid=1082 .

Gleick, P.H., D. Haasz, C. Henges-Jeck, V. Srinivasan, G. Wolff, K.K. Cushing, and A. Mann. 2003. *Waste Not, Want Not: The Potential for Urban Water Conservation in California*. ISBN No. 1-893790-09-6. Pacific Institute for Studies in Development, Environment, and Security, Oakland, CA.

Gregorio, D., and S.L. Moore, 2004. *Discharge into state water quality protection areas in southern California*. http://www.sccwrp.org/Homepage/RecentPublications.aspx

Griffith, J.F., and D.M. Ferguson. 2011. *Enterococcal Sources and Growth Related to Two Storm Drains in San Diego County*. Southern California Coastal Water Research Project. Draft Final Report. June 11, 2011. SCCWRP, Costa Mesa, CA.

LARWQCB (Los Angeles Regional Water Quality Control Board). 2002. *Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches During Wet Weather*. California Regional Water Quality Control Board, Los Angeles Region, Los Angeles, CA.

LARWQCB (Los Angeles Regional Water Quality Control Board). 2003. *Total maximum daily load for nitrogen compounds and related effects in the Los Angeles River and its Tributaries*. Accessed October 28, 2011. http://www.epa.gov/waters/tmdldocs/11061_LARIVER-NITROGEN-ALL.pdf.

LARWQCB (Los Angeles Regional Water Quality Control Board). 2006. *Total Maximum Daily Loads for Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, & Sepulveda Channel*. California Regional Water Quality Control Board-Los Angeles Region, Los Angeles, CA.

Lattin, G.L., C.J. Moore, A.F. Zelkers, S.L. Moore, S.B. Weisberg. 2004. A Comparison of Neustonic Plastic and Zooplankton at Different Depths near the Southern California Shore. *Marine Pollution Bulletin*, 49: 291-294.

Lau, S.-L., Y. Han, J.-H. Kang, M. Kayhanian, and M.K. Stenstrom. 2009. Characteristics of highway stormwater runoff in Los Angeles: Metals and polycyclic aromatic hydrocarbons. *Water Environment Research* 81(3):308–318.

Lenntech. 2011a. *Nickel and water*. Accessed April 18, 2012. http://www.lenntech.com/periodic/water/nickel/nickel-and-water.htm.

Lenntech. 2011b. *Zinc (Zn) and water*. Accessed April 18, 2011. http://www.lenntech.com/periodic/water/zinc/zinc-and-water.htm.

Lu, R., R.P. Turco, K.D. Stolzenbach, S.K. Freidlander, C. Xiong, K. Schiff, L.L. Tiefenthaler, and G. Wang. 2003. Dry deposition of airborne trace metals on the Los Angeles Basin and adjacent coastal waters. *Journal of Geophysical Research* 108:4074.

Nixon, H., and J.D. Saphores. 2007. Impacts of motor vehicle operation on water quality: Clean-up costs and policies. Transportation Research Part D. *Transport and Environment* 12(8):564–576.

Sabin, L. and K. Schiff. 2007. *Metal Dry Deposition Rates along a Coastal Transect in Southern California*. Technical Report #509. Southern California Coastal Research Project, Costa Mesa, CA. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

Sabin, L.D., J. Hee Lim, K.D. Stolzenbach, K.C. Schiff. 2005. Contribution of trace metals from atmospheric deposition to stormwater runoff in a small impervious urban catchment. *Water Research* 39:3929–3937.

Sabin, L.D., J. Hee Lim, K.D. Stolzenbach, K.C. Schiff. 2006a. Atmospheric Dry Deposition of Trace Metals in the Coastal Region of Los Angeles, California, USA. *Environmental Toxicology and Chemistry* 25(9): 2334-2341.

Sabin, L.D., J.H. Lee, M.T. Venezia, A.M. Winer, K.C. Schiff, and K.D. Stolzenbach. 2006b. *Dry deposition and re-suspension of particle-associated metals near a freeway in Los Angeles*. SCCWRP #537. SCCWRP, Costa Mesa, CA.

Sabin, L.D., K.C. Schiff, J. Hee Lim, and K.D. Stolzenback. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region*. Southern California Coastal Research Project, Costa Mesa, CA. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

SANDAG (San Diego Association of Governments). 2009. 2009 Land Use GIS data. http://www.sandag.org/resources/maps_and_gis/gis_downloads/land.asp

San Diego County Department of Environmental Health. 2000. *County of San Diego—Ocean Illness Survey Results (August 1997–December 1999)*. San Diego County Department of Environmental Health, San Diego, CA.

San Diego County. 2011a. 2009-2010 *Urban Runoff Monitoring Annual Report*. January 2011. http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=168:2009-10-urban-runoff-monitoring-annual-report-&catid=17:tool-box

San Diego County. 2011b. *Long Term Effectiveness Assessment Water Quality Report*. Prepared by Weston Solutions for the San Diego County Copermittees. http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=185:2011-ltea-water-quality-report&catid=16.

San Diego County. 2011c. *2010 Air Toxics “Hot Spots” Program Report for San Diego County*. San Diego County, San Diego, CA

Sansalone, J.J., and S.G. Buchberger. 1997. Partitioning and First Flush of Metals in Urban Roadway Storm Water. *Journal of Environmental Engineering* 123(2):134-143.

Santa Clara Valley Nonpoint Source Control Program. 1992. Source Identification and Control Report. Woodward Clyde Consultants, Oakland, CA.

Schiff, K.C., and P. Kinney. 2001. *Tracking sources of bacterial contamination in stormwater discharges from Mission Bay, California*. Southern California Coastal Research Project, Costa Mesa, CA. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

Schueler, T. 1994. The importance of imperviousness. *Watershed Protection Techniques*1(3):100–111.

Schueler, T., and H.K. Holland. 2000. *The Practice of Watershed Protection*. Center for Watershed Protection, Ellicott City, MD.

SDCWA (San Diego County Water Authority). 2011. *2010 Urban Water Management Plan*. San Diego County Water Authority, San Diego, CA.

SDRWQCB (San Diego Regional Water Quality Control Board). 1994. *Water Quality Control Plan for the San Diego Basin (9)*. California Regional Water Quality Control Board, San Diego Region, San Diego, CA.

SDRWQCB (San Diego Regional Water Quality Control Board). 2007. *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay*. California Regional Water Quality Control Board, San Diego Region, San Diego, CA.

SDRWQCB (San Diego Regional Water Quality Control Board). 2010. *Revised TMDL for Indicator Bacteria, Project I - Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek)*. Resolution No. R9-2010-0001. Approved February 10, 2010. http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/bacteria.shtml.

SDRWQCB (San Diego Regional Water Quality Control Board). 2012. N*PDES Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4)*. San Diego Regional Water Quality Control Board, San Diego, CA.

Shen, J., A. Parker, and J. Riverson. 2004. *A New Approach for a Windows-based Watershed Modeling System Based on a Database-supporting Architecture. Environmental Modeling and Software*, July 2004.

Shinya, M., T. Tsuchinaga, M. Kitano, Y. Yamada, and M. Ishikawa. 2000. Characterization of heavy metals and polycyclic aromatic hydrocarbons in urban highway runoff. *Water Science and Technology* 42 (7–8):201–208.

SCCWRP (Southern California Coastal Water Research Project). 2008. Atmospheric deposition of trace metals. Accessed November 1, 2011. http://www.sccwrp.org/ResearchAreas/Contaminants/AtmosphericDeposition.aspx

SCCWRP (Southern California Coastal Water Research Project). 2010. Where do nutrients come from? Accessed October 28, 2010. http://sccwrp.org/ResearchAreas/Nutrients/IdentificationOfNutrientSources/BackgroundWhereDoNutrientsComeFrom.aspx.

SWRCB (State Water Resources Control Board). 2005. *Water Quality Control Plan for Ocean Waters of California*. State Water Resources Control Board, Sacramento, CA.

SWRCB (State Water Resources Control Board). 2011a. *California Integrated Water Quality System Project (CIWQS)*. Spill Public Report –Summary Page. Accessed November 4, 2011. https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/PublicReportSSOServlet?reportAction=criteria&reportId=sso_main.

SWRCB (State Water Resources Control Board). 2011b. *Sanitary Sewer Overflow (SSO) Reduction Program*. Accessed December 2, 2011. http://www.waterboards.ca.gov/water_issues/programs/sso/.

SWRCB (State Water Resources Control Board). 2011c. *Storm Water Multiple Application and Report Tracking System (SMARTS)*. Accessed in November 4, 2011. https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp.

SWRCB (State Water Resources Control Board). 2011d. NPDES Permits (including Storm Water). Excel spreadsheet download. Accessed December 6, 2011. http://www.waterboards.ca.gov/water_issues/programs/ciwqs/publicreports.shtml#facilities.

SWRCB (State Water Resources Control Board). 2012. *California 2010 303(d) list*. Excel Spreadsheet Download. Accessed April 18, 2012. http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

Stein, E.D., and L.L. Tiefenthaler. 2005. *Dry-weather metals and bacteria loading in an arid urban watershed: Ballona Creek, California*. Technical Report #457. Southern California Coastal Research Project, Costa Mesa, CA. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

Stein, E.D., and V.K. Yoon. 2007. *Dry-weather flow contributions of metals, nutrients, and solids from natural catchments*. Southern California Coastal Research Project, Costa Mesa, CA. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

Stein, E.D., and D. Ackerman. 2007. Dry weather water quality loadings in arid, urban watersheds of the Los Angeles Basin, California, USA. *Journal of the American Water Resources Association* 43(2):398–413.

Stein, E.D., L.L. Tiefenthaler, and K. Schiff. 2006. Watershed-based Sources of Polycyclic Aromatic Hydrocarbons in Urban Storm Water. *Environmental Toxicology and Chemistry* 25(2):373–385.

Stolzenbach, K.D. 2006. Atmospheric Deposition Grades B+ to C-. Southern California Environmental Report Card 2006. University of California, Los Angeles, Institute of the Environment, Los Angeles, CA. Accessed November 2, 2011. http://www.environment.ucla.edu/reportcard/article.asp?parentid=1497.

Sutula, M., K. Kamer, and J. Cable. 2004. *Sediment as a nonpoint source of nutrients to Malibu Lagoon, California*. Southern California Coastal Research Project. Technical Report 441. http://www.sccwrp.org/Homepage/RecentPublications.aspx.

Tetra Tech and USEPA (U.S. Environmental Protection Agency). 2002. *The Loading Simulation Program in C++ (LSPC) Watershed Modeling System – User's Manual*.

Tetra Tech, Inc. 2011. *Data Summary Report*. Prepared for CLRP Responsible Parties, by Tetra Tech, San Diego, CA. November 2011.

Tiefenthaler, L.L., E.D. Stein, and K.C. Schiff. 2007. Watershed and land use-based sources of trace metals in urban storm water. *Environmental Toxicology and Chem*istry 27(2):277–287.

USEPA (U.S. Environmental Protection Agency). 1999. *Preliminary data summary of urban storm water best management practices*. Office of Water. EPA-821-R-99-012. http://epa.gov/guide/stormwater/files/usw_a.pdf.

USEPA (U.S. Environmental Protection Agency). 2003a. *Total Maximum Daily Loads for Nutrients in the Malibu Creek Watershed*. U.S. Environmental Protection Agency, Region 9, San Francisco, CA.

USEPA (U.S. Environmental Protection Agency). 2003b. *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*. EPA 832-B-03-001. March 2003. Accessed December 5, 2011. http://www.epa.gov/owm/septic/pubs/septic_guidelines.pdf.

USEPA (U.S. Environmental Protection Agency). 2003c. *Fact Sheet: Loading Simulation Program in C++*. U.S. Environmental Protection Agency, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. http://www.epa.gov/athens/wwqtsc/LSPC.pdf.

USEPA (U.S. Environmental Protection Agency). 2007. *2007 Update of Ambient Water Quality Criteria for Copper*. Accessed April 18, 2012. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/pollutants/copper/fs-2007.cfm.

USEPA (U.S. Environmental Protection Agency). 2008. *Summary of the Resource Conservation and Recovery Act*. U.S. Environmental Protection Agency, Washington, DC. Accessed July 2009. www.epa.gov/lawsregs/laws/rcra.html.

USEPA (U.S. Environmental Protection Agency). 2011a. *Fecal Bacteria*. Accessed December 2, 2011. http://water.epa.gov/type/rsl/monitoring/vms511.cfm.

USEPA (U.S. Environmental Protection Agency). 2011b. *Water: Nutrients*. Accessed December 2, 2011. http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/problem.cfm.

USEPA (U.S. Environmental Protection Agency). 2011c. *Water: After the Storm – Weather*. Accessed December 5, 2011. http://water.epa.gov/action/weatherchannel/stormwater.cfm.

USEPA (U.S. Environmental Protection Agency). 2011d. *Sanitary sewer overflows and peak flows*. Accessed November 1, 2011. http://cfpub.epa.gov/npdes/home.cfm?program_id=4.

USEPA (U.S. Environmental Protection Agency). 2011e. *Watershed Modeling for Downtown Anchorage Watersheds for Simulation of Loadings to San Diego Bay*. Prepared by: Tetra Tech, Inc. May 2011.

USEPA (U.S. Environmental Protection Agency). 2012a. *Cadmium EPA Factsheet*. Accessed April 18, 2012. http://www.epa.gov/wastes/hazard/wastemin/minimize/factshts/cadmium.pdf.

USEPA (U.S. Environmental Protection Agency). 2012b. *Lead in Drinking Water*. Accessed April 18, 2012. http://water.epa.gov/drink/info/lead/index.cfm.

USEPA (U.S. Environmental Protection Agency). 2012c. *Basin Information on the Arsenic Rule*. Accessed April 18, 2012. http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/basic-information.cfm.

USEPA (U.S. Environmental Protection Agency). 2012d. *Selenium Factsheet*. Accessed April 30, 2012. http://water.epa.gov/drink/contaminants/basicinformation/historical/upload/Archived-Technical-Fact-Sheet-on-Selenium.pdf..

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