City of Calabasas

Malibu Creek Watershed Monitoring Report

March, 2008

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Funding for this project has been provided in full or in part through an Agreement with the State Water Resource Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Nonpoint Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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March 4, 2008

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Subject: Malibu Creek Watershed Monitoring Program – SWRCB Agreement No. 03-128-554-2
Final Task 10.2 Report - Assessment of Data Collected

Dear Mr. Farassati:

In accordance with our professional services agreement for the subject project, Camp Dresser & McKee Inc. (CDM) has prepared the enclosed final report to fulfill the requirements of subtask 10.2 of the subject SWRCB Agreement. The report has been revised to respond to comments received on the draft report.

CDM is pleased to deliver this final report and appreciates the cooperation of and input from the staff of the various agencies involved in the Monitoring Program.

Very truly yours,

Donald J Schroeder

Donald J. Schroeder, P.E.
Vice President
Camp Dresser & McKee Inc.

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List of Acronyms

BMI	Benthic Macroinvertebrates
BMP	Best Management Practice(s)
CTR	California Toxics Rule
DEM	Digital Elevation Map
EPA	Environmental Protection Agency
IBI	Index of Biotic Integrity
LACSD	Los Angeles County Sanitation District
LVMWD	Las Virgenes Municipal Water District
MCLs	Maximum Contaminant Levels
MCW	Malibu Creek Watershed
MCW-WQMP	Malibu Creek Watershed Water Quality Monitoring Project
MCWMP	Malibu Creek Watershed Monitoring Program
NPDES	National Pollutant Discharge Elimination System
OWTS	On-site Wastewater Treatment System
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
QAPP	Quality Assurance Program Plan
RWQCB	Regional Water Quality Control Board
So.Cal. IBI	Southern California Index of Biological Integrity
SSF	Sub-surface Flow
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Loads
TMDLIP	TMDL Implementation Plan

TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WLA	Waste Load Allocation
WMA	Watershed Management Area
WMC	Watershed Management Committee
WQOs	Water Quality Objectives

Section 1
Introduction to Monitoring Program

1.1 Purpose

The cities of Calabasas, Agoura Hills, Westlake Village, and Malibu, along with the County of Los Angeles (collectively called the Watershed Management Committee (WMC) and the Las Virgenes Municipal Water District (LVMWD) developed the MCWMP to update the 1999 Draft Malibu Creek Watershed Monitoring Program. The MCWMP was selected for funding under Proposition 13 by the State Water Resources Control Board (SWRCB) to provide more comprehensive data, eliminate redundancies, and provide more comprehensive water quality information in the Malibu Creek watershed. The MCWMP is intended to provide information for the use of policy makers, regulatory agencies, and the public. Water quality in this watershed is integral to consideration of current and future public policies. The primary goal of the MCWMP is to collect data and information on pollutants and other problems that impair beneficial uses of Malibu Creek and its tributary streams. The monitored sites were chosen to represent a variety of land uses so that data collected would lead to a comprehensive understanding of how pollutants are affecting the basic watershed health and beneficial uses throughout the watershed.

This Malibu Creek Watershed Monitoring Report (Report) uses the full set of data collected under the MCWMP, as well as data compiled from several other monitoring activities within the watershed, to summarize water quality conditions for major waterbodies in the watershed during different weather conditions and seasons as discussed below. This information was then used in the selection of appropriate pollution prevention measures and BMPs within watersheds that can be used to improve water quality in waterbodies of concern as discussed in Section 4.

1.2 Malibu Creek Watershed

The Malibu Creek Watershed is a major watershed in Western Los Angeles County and southeastern Ventura County. At 109 square miles, it is the second largest watershed draining to the Santa Monica Bay. The MCW includes portions of unincorporated Los Angeles and Ventura Counties, as well as seven Cities in the two Counties. Much of the watershed is open space under the jurisdiction of the State of California State Parks, National Park Service, Conejo Parks and Recreation, Simi Recreation District, Mountain Recreation and Conservation Authority, and the Santa Monica Mountains Conservancy.

Creeks and lakes located in the upper portions of the watershed drain into Malibu Creek which then continues through the downstream portion of the watershed draining into Malibu Lagoon and ultimately into Santa Monica Bay when the Lagoon is breached. Historically, there is little flow in the summer months; much of the natural flow that does occur in the summer in the upper tributaries comes from springs and seepage areas and dry weather urban runoff sources. During this period, Malibu Lagoon is disconnected from the ocean by a sand bar. During the first rain storms of the wet season, runoff from the watershed increases flow in Malibu Creek dramatically, resulting in the Lagoon breaching the sand bar and runoff flowing out to the Bay. The natural hydrology of the watershed has been modified by the creation of several dams and man-made lakes, the importation of water to the system for human use to support region for urban growth and subsequent dry-weather urban runoff from developed areas and the presence of the Tapia Water Reclamation Facility (WRF) which provides significant dry weather flow to the system in the winter months (November 16 to April 14). In the summer months, secondary treated effluent from Tapia WRF is sprayed on fields surrounding the WRF to avoid direct discharge to Malibu Creek.

The land use distribution in the Malibu Creek watershed is about 80% undeveloped and 20% developed. The developed land is a mixture of high density residential (13%), commercial/industrial (4%) and agricultural (3%) land uses. A significant portion (approximately 40%) of the residential development is low density.

The western part of the watershed drains the areas around Hidden Valley, Potrero Creek, Westlake and Triunfo Creek (a total area about 25,210 acres). These areas are largely undeveloped. There is limited agricultural land use, located mostly in the Hidden Valley subwatershed. Most of the residential and commercial/industrial land use is in the area around Westlake Village. Nearly all the runoff from this large watershed area is funneled to Triunfo Creek and ultimately to Malibou Lake. There is limited historical data for many waterbodies in this part of the watershed; however recent projects including this MCWMP have begun to collect data.

The eastern side of the Malibou Lake drainage area is 15,900 acres and includes the subwatersheds associated with Lindero, Medea, Palo Camodo, and Cheseboro Creeks. The land use in these subwatersheds, while still predominantly undeveloped, has a relatively higher percentage of residential and commercial land uses compared to other subwatersheds, especially in the Medea Creek and Lindero Creek subwatersheds, where developed land uses make up 34 and 43 percent, respectively.

Outflow from Malibou Lake is discharged to Malibu Creek, which also receives flow from Las Virgenes Creek and Stokes Creek. Land use at the bottom of the watershed near the Lagoon includes some residential and commercial area, from which much of the runoff is now routed to a new stormwater BMP project at the City of Malibu Civic Center. Many developments in the Malibu Lagoon subwatershed and in unincorporated areas in the less densely developed areas primarily in the middle to lower portions of the MCW are not connected to a public sewer and rely upon on-site wastewater treatment systems (OWTS).

1.3 Methodology of Monitoring Activities

1.3.1 Malibu Creek Watershed Monitoring Program

Water quality monitoring during dry and wet weather at 13 sites within the Malibu Creek watershed was conducted twice per month between February 2005 and

February 2006. Water quality parameters were chosen based on general categories of 303(d) listed pollutants, including bacteria indicators, sediment, nutrients, nutrient related impairments, and on-site recorded water quality indicators in order to establish baseline data. All chemical and bacterial samples were mid-stream grabs using lab sampling bottles provided by the project's contracted laboratory, CRG Laboratories Inc. Before all sampling events, pH and conductivity meters were calibrated at the project's laboratory located at the Las Virgenes Municipal Water District's Rancho Composting Facility. All water samples collected were retrieved by a CRG Laboratory driver at the Juan Bautista de Anza Park in Calabasas and taken to the CRG Laboratory in Torrance for analysis. The samples delivered met the six hour maximum holding time for bacteria during all sampling events. The program's Quality Assurance Project Plan (QAPP) was followed during all sampling events and water sample analysis.

The results of this first year of data are summarized in Section 2.1 and presented in detail in the 2006 Annual Baseline Report (Rinehart and Medlen, 2006). After analyzing first year baseline data, “Hot Spots” were identified for further testing in order to identify the sources of biological and ecological degradation in the watershed. These “Hot Spots” were determined by the reoccurrence of high levels of pollutants, especially bacteria and nutrients. Additional parameters were also considered in selecting hot spots, including upstream land use and area, fish tissue analysis, acute and chronic toxicity and bioassessment data (MCWMP, 2007).

The fish tissue analysis and bioassessment monitoring was conducted concurrent with the baseline water quality monitoring, but as a subset of the 13 sampling locations. Results of these analyses are summarized in Sections 2.2 and 2.3. The full methodology and results of the fish tissue and bioassessment studies were documented in two reports (Aquatic Bioassay & Consulting Laboratory, 2006; Aquatic Bioassay & Consulting Laboratory, 2007).

Per the recommendations of 2006 Annual Baseline Report and the Technical Advisory Committee, four sites (LIN2, LV2, MED2 and TRI) were tested twice during winter wet weather and seven sites (LC, LIN2, LV2, MED1, TRI-ALT, HtB-4 and RUS) were tested once during winter dry weather, for the following EPA Priority Pollutants: trace metals, asbestos, cyanide, total hardness, acid extractable compounds, base/neutral extractable compounds, chlorinated pesticides, Polychlorinated biphenyls (PCB) congeners and polynuclear aromatic hydrocarbons (PAHs). The results of this additional water quality monitoring are summarized in Section 2.1 and presented in detail in the 2007 Report on “Hot Spot” Monitoring (Rinehart, 2007).

1.3.2 Other Monitoring Activities

In addition to the MCWMP, other water quality monitoring in the MCW continues to be conducted by several agencies and by volunteers through non-profit organizations. Water quality data from several of these sources have been integrated with the results of the MCWMP monitoring to identify specific areas and pollutants of concern. The additional water quality monitoring programs referred to for this purpose are described below. Other monitoring efforts within the MCW have been conducted over the past 15 years, but were excluded from consideration in this analysis because of the generally limited number of samples collected.

- County of Los Angeles Mass Emission Station: Mass emission monitoring has been conducted by the County of Los Angeles as part of its National Pollutant Discharge Elimination System (NPDES) monitoring requirements since 1994. One mass emission monitoring location is within the Malibu Creek Watershed Management Area (WMA) and is located on Malibu Creek downstream of the confluence with Cold Creek.

- Malibu Creek Watershed Water Quality Monitoring Project (MCW-WQMP): During 2004-2005, The County of Los Angeles contracted Weston Solutions Inc. to monitor the wet- and dry-weather water quality from seven of the inland storm drain outfalls in the Malibu Creek Watershed. Three storm events and three dry-weather days were sampled during the wet season and nine dry-weather days were sampled during the dry season.

- LVMWD’s NPDES Permit Monitoring: During certain months of the year, the Tapia WRF discharges to Malibu Creek above the confluence with the Las Virgenes River. As part of the NPDES requirements, the LVMWD has monitored a full suite of water quality parameters at seven sites along Malibu Creek upstream and downstream of the discharge. LVMWD has sampled for fecal coliform since 1997, following the requirement for tertiary treatment of effluent (NPDES Permit No.CA0053953, Order No. 97-135). This monitoring program has been reduced to include only one site above the WRF and two sites below and is currently being re-evaluated by the Regional Water Quality Control Board (RWQCB) and LVMWD based on the presence of other watershed wide monitoring programs and review of historical water quality data in Malibu Creek from the LVMWD monitoring stations. Additionally, 18 monthly samples (July 2001 - December 2002) were collected from Malibu Creek (R-1) and analyzed for volatile and semi-volatile pollutants, heavy metals, and pesticides to assess compliance with the California Toxics Rule (CTR).

- Heal the Bay Stream Team: Heal the Bay is a non-profit organization that has been active in monitoring water quality in the Santa Monica Bay and its contributing watersheds through a volunteer group called the “Stream Team.” The Stream Team has collected monthly samples since 1998 from 17 locations in the Malibu Creek Watershed.

- Surface water quality monitoring at several locations in Cheseboro Creek is required as part of the NPDES Permit for Los Angeles County Sanitation District’s (LACSD) Calabasas Landfill. Under this permit, two samples are to be collected at each stormwater monitoring location during the wet season months (October to

May). Samples are collected only when the storm produces rainfall of sufficient intensity or duration to produce runoff, and only if the runoff event has been preceded by three working days of dry weather. The runoff samples are analyzed for the constituents specified in the NPDES general permit. During the calendar year of 2006, storm water runoff samples were collected from storm events that occurred on February 27 and on March 17.

1.4 Descriptions of Sampling Sites

Sampling locations from the above mentioned water quality monitoring programs are presented in Table 1-1 and shown in Figure 1-1. The inventory documents the station name, period of record, lead agency, and a description of the waterbody for each monitoring location. Brief descriptions of the sampling sites are presented in the sections that follow (and are grouped by monitoring program/agency).

Table 1-1
Summary of Monitoring Locations

Site	Waterbody	Agency/Program	Data Collected	
CC	Cold Creek	MCW Monitoring Program	3/3/2005	5/3/2005
HV	Hidden Valley Creek	MCW Monitoring Program	3/3/2005	4/21/2005
LC	Liberty Canyon	MCW Monitoring Program	3/3/2005	5/3/2005
LV2	Las Virgenes Creek	MCW Monitoring Program	2/24/2005	5/3/2005
LIN2	Lindero Creek	MCW Monitoring Program	2/24/2005	4/21/2005
MAL	Malibu Creek	MCW Monitoring Program	3/3/2005	5/3/2005
TRI	Triunfo Creek	MCW Monitoring Program	3/3/2005	4/21/2005
LV1	Las Virgenes Creek	MCW Monitoring Program	2/24/2005	5/3/2005
LIN1	Lindero Creek	MCW Monitoring Program	2/24/2005	4/21/2005
MED1	Medea Creek	MCW Monitoring Program	3/3/2005	4/21/2005
MED2	Medea Creek	MCW Monitoring Program	3/3/2005	4/21/2005
POT	Potrero Creek	MCW Monitoring Program	3/9/2006	2/8/2007
RUS	Russell Creek	MCW Monitoring Program	3/3/2005	4/21/2005
HtB-6	Cheseboro Creek	Heal the Bay - Stream Team	11/7/1998	10/5/2003
HtB-2	Cold Creek	Heal the Bay - Stream Team	11/7/1998	10/16/2005
HtB-3	Cold Creek	Heal the Bay - Stream Team	11/7/1998	10/16/2005
HtB-11	Cold Creek	Heal the Bay - Stream Team	4/7/2002	10/5/2003
HtB-10	West Carlyle Creek	Heal the Bay - Stream Team	5/5/2001	10/5/2003
HtB-13	Las Virgenes Creek	Heal the Bay - Stream Team	4/7/2002	10/16/2005
HtB-15	Malibu Creek	Heal the Bay - Stream Team	11/10/1998	10/6/2004
HtB-7	Medea Creek	Heal the Bay - Stream Team	11/7/1998	10/16/2005
HtB-1	Malibu Creek	Heal the Bay - Stream Team	11/7/1998	10/16/2005
HtB-20	Malibu Creek	Heal the Bay - Stream Team	11/10/1998	10/6/2004
HtB-8	Palo Comado Creek	Heal the Bay - Stream Team	5/5/2001	9/12/2004
HtB-5	Las Virgenes Creek	Heal the Bay - Stream Team	11/7/1998	10/16/2005
HtB-16	Stokes Creek	Heal the Bay - Stream Team	4/8/2002	10/5/2003
HtB-17	Triunfo Creek	Heal the Bay - Stream Team	4/8/2002	10/16/2005
HtB-9	Las Virgenes Creek	Heal the Bay - Stream Team	5/5/2001	10/5/2003
HtB-4	Malibou Lake	Heal the Bay - Stream Team	11/7/1998	10/5/2003
HtB-12	Rock Pool above Tapia	Heal the Bay - Stream Team	4/8/2002	10/16/2005
HtB-19	Arroyo Sequit	Heal the Bay - Stream Team	4/8/2002	10/7/2003
S02	Mass Emission Site	LA County Public Works	10/28/2000	1/13/2004
WQMP_1	Las Virgenes Creek	LA County Public Works	1/20/2005	8/1/2005
WQMP_2	Liberty Canyon Channel	LA County Public Works	1/20/2005	8/1/2005
WQMP_5	Lindero Canyon Channel	LA County Public Works	1/20/2005	8/1/2005
WQMP_3	Cheseboro Creek	LA County Public Works	1/20/2005	8/1/2005
WQMP_4	Medea Creek	LA County Public Works	1/20/2005	8/1/2005
WQMP_6	Triunfo Channel	LA County Public Works	1/20/2005	8/1/2005
WQMP_7	Westlake	LA County Public Works	1/20/2005	8/1/2005
R-7	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-13	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-3	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-4	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-1	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-2	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-9	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
R-11	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005
SD1S, SD3, SD4	Cheseboro Creek	Calabasas Landfill	2/27/2006	3/17/2006

Figure 1-1
Water Quality Monitoring Locations in the Malibu Creek Watershed

1.4.1 MCW Monitoring Program Sampling Sites

Site descriptions came from the Malibu Creek Watershed Monitoring Program, 2006 Annual Baseline Report (May 2006).

CC Cold Creek

Cold Creek is the Malibu Creek Watershed Monitoring Project's reference site. The creek is a small, spring-fed tributary to the main Cold Creek and is located on State Land managed by the University of California Natural Reserve System within the Lower Malibu Creek subwatershed. The creek drains an area of roughly 5,221 acres of 100% open space considered natural habitat with near pristine conditions. The creek is near the intersection between Mulholland Highway and Stunt Road, at the University of California Natural Reserve System gate.

HV Hidden Valley Creek

The Hidden Valley Wash is located in Ventura County in the Hidden Valley Creek subwatershed. The creek drains an area of approximately 10,792 acres comprised of cropland and pasture, residential and open space land uses. The site is accessible from the intersection of Stafford Street and Potrero Road, on Ventura Farms property. Due to a low flow, accessibility issues and the fact that the site converges with Lake Sherwood, very little true "creek" data was obtained from the site.

LC Liberty Canyon

Liberty Canyon Creek is located North of the 101 Freeway at the Liberty Canyon Road exit within the City of Agoura Hills. The drainage basin is located within the Lower Las Virgenes Creek subwatershed and drains and area of roughly 4,886 acres. Subwatershed land use is comprised open space and residential land uses. The sampling site at Liberty Canyon Creek is a small concrete channel that flows through residential areas. Due to channeling of the creek there is little or no vegetation growing on the banks or within the creek. There is however some growth of vegetation between cracks in the concrete channel. The stream bottom is usually thinly coated with algae.

LV2 Las Virgenes Creek

Las Virgenes Creek 2 is located in the City of Calabasas within the Lower Las Virgenes Creek subwatershed. The creek drains and area of roughly 4,886 acres and is comprised of residential, commercial, urban and open space land uses. The site is accessible from De Anza Park at the intersection of Lost Hills Road and Las Virgenes Road. The stream is a natural low gradient stream with a sandy rock gravel substrate. The stream contains some undercutting and shallow gravel beds with a canopy cover. Aquatic invertebrates were found to be abundant at this sampling site. Trash was found on the banks on all sampling events.

LIN2 Lindero Creek

Lindero Creek Site 2 flows from a concrete spillway .at the Lake Lindero Dam, which continues into a concrete lined channel. The creek eventually flows into an underground tunnel where it meets Medea Creek. The site is accessible from the intersection of Canwood Street and Lake Lindero Road, just beneath the bridge on the west side of Lake Lindero Road. The creek is lacking in vegetation due to concrete channeling of the creek system. There is some vegetation growing in sedimentation, but the channel bottom is covered mostly with algae.

MAL Malibu Creek

Malibu Creek is located within the Lower Malibu Creek subwatershed within the Malibu Creek State Park property. The creek drains approximately 69,000 acres comprised of open space and residential land uses. The site can be reached by trail at the intersection between Serra Road and Cross Creek Road.

Malibu Creek is the catch point of all drainage in the watershed, including effluent discharge from the Tapia Water Reclamation Plant. The creek contains a good mixture of sand, gravel, large rocks, and boulders. The stream bank is heavily vegetated with willows, cottonwoods, and exotic species.

TRI Triunfo Creek

Triunfo Creek is a modestly sized creek that receives water from the outfall of the dam at Westlake Lake. The site is accessible from the intersection of Lindero Canyon Road and Ridgeford Drive in Westlake Village. A trail on the south side of Ridgeford Drive leads to the creek. The creek bed appears natural but is actually boulder and concrete lined and covered with natural rocky substrate. Triunfo Creek and its banks contain diverse plant and animal species which include native and exotic invasives. Native and non-native trees also line the creek, providing abundant shade, cooling and bank stability.

LV1 Las Virgenes Creek

Las Virgenes Creek 1 is located in the Upper Las Virgenes Creek subwatershed in the City of Calabasas. The creek drains an area of roughly 7,618 acres comprised of open space and residential land uses. The sampling site is accessible from the north end of Las Virgenes Road.

The Las Virgenes Creek 1 site is located where natural riparian and stream substrate transition into concrete channeling. The stream substrate typically contains high levels of algae covered sediment and silt. Poor bank stabilization surrounds the immediate sampling location.

LIN1 Lindero Creek

Lindero Creek Site 1 is a small creek that runs through property owned and managed by the Lindero Country Club. The site is accessible from the Thousand Oaks Blvd, just northwest of the intersection between Thousand Oaks Blvd and Lake Lindero Road. Portions of the creek along the golf course are concrete lined, which eventually changes to soft bottom just before reaching the sampling site. The creek's upper reach runs through residential areas. The creek continues south through the golf course located across the street and eventually flows into Lake Lindero. Stream side and in-stream vegetation consist of Cattails and Willows. During dryer months the stream may not be visible due to overgrowth of vegetation.

MED1 Medea Creek

Medea Creek Site 1 is located in the City of Agoura Hills in the Upper Medea Creek subwatershed. The drainage basin drains 3,948 acres of open space and residential land uses. The site is accessible from the intersection of Kanan Road and Conifer Street, on the left hand side of Conifer Street and Medea Creek Park.

The sample site of Medea Creek is a concrete channel. A majority of the creek is unlined but portions of stream (areas that flow under road bridges) are concrete lined. Portions of the creek banks are left natural but some walls of the creek have been reinforced with large rock and concrete. The banks contain natural and introduced plant species. Cattails and Willows can be found growing along the stream bank. Algae can be found in abundance floating on the surface of the stream, on submerged rocks, and on the substrate. Trash lines the bank of the streams at and around the sampling area.

MED2 Medea Creek

Medea Creek Site 2 is located within the Santa Monica Mountain National Recreation Area and the Lower Medea Creek subwatershed. It is accessible from the Paramount Ranch area, north of the intersection between Kanan Road and Cornell Road. The sampling location is beneath the bridge west of the ranger's station. The creek drains an area of approximately 15,500 acres comprised of open space and residential land uses.

Medea Creek 2 is a moderately sized stream that flows into the Malibou Lake. The stream has a natural low gradient with sand, rock gravel mix and large rocks. The stream also contains undercutting, good canopy cover, good variation of runs, riffles and pools, and shallow gravel beds, making it near pristine in condition for aquatic invertebrates which are found in abundance at the site.

POT Potrero Creek

Potrero Creek is located in the City of Thousand Oaks within the Westlake subwatershed.

The creek drains an area comprised of mostly residential areas and open space land uses with some commercial and light industry use. The site is accessible from the intersection of Triunfo Canyon Road and Glastonbury Road on the west side of the bridge.

Potrero Creek is a concrete lined and boulder lined channel that drains into the Westlake Lake.

RUS Russell Creek

Russell Creek is located parallel to Lindero Canyon Road on the south side of the 101 Freeway. The site can be accessed from a gate located on the southeastern corner of the intersection between Lindero Canyon Road and Agoura Road. Russell Creek is a small concrete channel that flows through residential areas. Due to concrete channeling of the creek, there is little or no vegetation growing on the banks or in the creek. The stream bottom is covered or matted in algae and trash is found in stream and along the upper banks.

1.4.2 Heal the Bay - Stream Team Sampling Sites

Site descriptions for the Heal the Bay sites came from their website at: http://www.healthebay.org/streamteam/chem/

HtB-6 Cheseboro Creek

The Agoura Hills Reference is located on Cheseboro Creek within the Santa Monica Mountains National Recreation Area. This site is minimally impacted by upstream development. HtB-6 is located near the Lost Hills Landfill, which is used to dispose of solid waste for the surrounding communities.

HtB-2 Cold Creek

The Cold Creek Outlet is located at the outlet of Cold Creek just prior to draining into Malibu Creek. This site receives runoff from residential properties and horse facilities built near the creek. The homes in this area use septic systems to treat wastewater. HtB-3 and HtB-11 are located upstream from this monitoring station.

HtB-3 Cold Creek

The Cold Creek Reference is located near the top of Cold Creek and is nearly pristine. This monitoring site is not impacted by upstream development.

HtB-11 Cold Creek

Site 11 is located between HtB-2 and HtB-3 near the middle of Cold Creek. At this location Cold Creek is a third order stream that drains a small number of rural residential homes. Some of these residences house horses and all of the wastewater in this area is treated using septic systems.

HtB-10 West Carlyle Creek

The West Carlisle Creek Reference station is located in the western-most portion of the watershed. This site is impacted by upstream low density development and an exotic animal farm.

HtB-13 Las Virgenes Creek

This site is located approximately in the middle of Las Virgenes Creek. HtB-13 is located above the influence of the Rancho Compost Facility, which is where the solids from the Tapia wastewater treatment plant are composted. This site receives runoff from a portion of the City of Calabasas and livestock (cattle and sheep) that graze upstream from this station.

HtB-15 Malibu Creek

The Los Angeles County stream gauge is sampled monthly by the Las Virgenes Municipal Water District as part of their National Pollutant Discharge Elimination System (NPDES)permit requirements. NPDES permits are required to allow the discharge of treated waste water into Malibu Creek. Site 15 (R-13)receives runoff from the cities of Agoura Hills, Westlake Village, and portions of Calabasas as well as discharge from the Tapia Wastewater Treatment Plant.

HtB-7 Medea Creek

The Agoura Hills Outlet is located on Medea Creek prior to where it empties into Malibou Lake (HtB-4). This site receives runoff from Lake Lindero and the entire city of Agoura Hills.

HtB-1 Malibu Creek

The Malibu Creek Outlet is the lowest monitoring site in the watershed. It is located approximately 1 mile north of Malibu Lagoon and Surfrider Beach. HtB-1 receives runoff from the cities of Agoura Hills, Westlake Village, and portions of Calabasas and Malibu as well as discharge from the Tapia Wastewater Treatment Plant.

HtB-20 Malibu Creek

The Malibu Lagoon site is sampled monthly by the Las Virgenes Municipal Water District as part of their National Pollutant Discharge Elimination System (NPDES)permit requirements. NPDES permits are required to allow the discharge of treated waste water into Malibu Creek. Site 20(R-11) is the lowest monitoring site in the watershed and is influenced by Pacific Ocean tides. It is located in Malibu Lagoon State Park just downstream of the Pacific Coast Highway bridge. This site receives runoff from the cities of Agoura Hills, Westlake Village, and portions of Calabasas and Malibu as well as discharge from the Tapia Wastewater Treatment Plant.

HtB-8 Palo Comado Creek

The Palo Comado Creek Reference station is located within the Santa Monica Mountains National Recreation Area. This site is fed by a spring/seep and does not flow except during winter rain events.

HtB-5 Las Virgenes Creek

The Las Virgenes Creek Outlet is located at the outlet of Las Virgenes Creek just prior to draining into Malibu Creek. Site 5 is located downstream of the Rancho Compost Facility, which is where the solids from the Tapia wastewater treatment plant are composted. This site receives runoff from a portion of the City of Calabasas and livestock (cattle and sheep) that graze upstream from this station.

HtB-16 Stokes Creek

Site 16 is located in Malibu Creek State Park. The monitoring station receives drainage from a rural residential neighborhood in Stokes Canyon. This site receives runoff from residential properties and horse facilities built near the creek. The homes in this area use septic systems to treat wastewater. This area is also used by Tapia WRF for spraying treated wastewater during the dry season.

HtB-17 Triunfo Creek

Site 17 is located at just upstream of the Kanan Rd. Triunfo Creek bridge. The monitoring station receives drainage from rural residential neighborhoods in Triunfo and Lobo Canyons, and the City of Westlake Village. HtB-17 receives runoff from personal and commercial horse facilities built near the creek and from Westlake and Lake Sherwood.

HtB-9 Las Virgenes Creek

The Las Virgenes Creek Reference station is located on block of property recently purchased by the State of California and managed by the Santa Monica Mountains Conservancy. This site is minimally impacted by upstream development and may receive runoff from equestrian users. HtB-9 is located near the Lost Hills Landfill, which is used to dispose of solid waste for the surrounding communities.

HtB-4 Malibou Lake

The Malibou Lake Outlet is located just below the dam that was erected to create Malibou Lake. This site receives runoff from four man-made lakes (Westlake, Lake Sherwood, Lake Eleanor and Lake Lindero) and from the cities of Westlake Village and Agoura Hills.

HtB-12 Rock Pool above Tapia

The Rock Pool is located in Malibu Creek State Park above the confluence of Las Virgenes and Cold Creeks. This site is downstream of Malibou Lake and receives runoff from the entire Triunfo and Medea Creek watersheds. The Rock Pool is a popular swimming hole used by thousands of visitors every summer.

1.4.3 LA County Public Works Sampling Sites

Site descriptions come from the Wet and Dry Weather Comprehensive Report for Malibu Creek Watershed Water Quality Monitoring Project, Draft Report (October 2005).

S02 Mass Emission Site

The mass emission monitoring station is located on Malibu Creek directly below the confluence with Cold Creek. The site is approximately 4 miles inland from the coast.

WQMP_1 Las Virgenes Creek

The Las Virgenes Creek Site is located just downstream of the intersection of Las Virgenes Road and Lost Hills Road. This site receives water from residential properties and businesses within the City of Calabasas and from De Anza Park immediately upstream. At the monitoring Site, the streambed is well vegetated and is natural.

WQMP_2 Liberty Canyon Channel

The Liberty Canyon Channel Site is located south of Agoura Road on Liberty Canyon Road. At the point of sampling, Liberty Canyon Channel is a manmade concrete conveyance but tunnels underground just downstream of the sampling site.

WQMP_5 Lindero Canyon Channel

The Lindero Canyon Channel Site is located downstream of Lake Lindero at the end of an underground concrete culvert on the south side of Agoura Road west of Kanan Road. Discharge flows into a scour pond of concrete riprap which then flows into a natural channel.

WQMP_3 Cheseboro Creek

The Chesebro Creek Site is located upstream of the confluence with Medea Creek south of Kanan Road on Agoura Road. This portion of Chesebro Creek is an open concrete channel without a riparian zone. The creek runs underground upstream of the Site.

WQMP_4 Medea Creek

The Medea Creek Site is located upstream of the confluence with Chesebro Creek south of Kanan Road on Agoura Road. The creek at the sampling location is an open concrete channel without a riparian zone.

WQMP_6 Triunfo Channel

The Triunfo Channel Site is located near the intersection of Foxfield Drive and West Lindero Canyon Road, upstream of Westlake Lake. This open concrete channel runs parallel to West Lindero Canyon Road and the Site is upstream of where the channel goes under Foxfield Drive. The channel's slope flattens out considerably at this location, so careful site selection was taken to insure that there would be no interference from Westlake's surface water.

WQMP_7 Westlake

The Westlake Site captures drainage into an all residential west side of Westlake Lake. The sampling site is a concrete storm drain accessed by a manhole off of Triunfo Canyon Road at the end of Timberridge Court.

Section 2
Monitoring Results

2.1 Water Quality and Hot Spots Monitoring Results

The following sections present monitoring results for bacteria, nutrients, metals, and EPA priority toxic pollutants. These data are related to specific water quality targets, which differ in the basis for their regulatory targets. For bacteria and nutrients, the adopted TMDL for bacteria and a draft TMDL for nutrients are used as a basis for water quality targets used in this report. These TMDLs include seasonally varying targets and flow based conditions (bacteria TMDL only), therefore the results are presented for each season and or flow condition. Metals and other EPA priority toxic pollutants were evaluated against EPA Priority Toxic Pollutant Levels, when applicable, and EPA secondary maximum contaminant levels (MCLs).

2.1.1 Bacteria

Indicator bacteria data was collected at 45 sampling locations throughout the Malibu Creek Watershed (see Section 1.4 for site descriptions). The types of bacteria indicators monitored at each location varied primarily by the monitoring program collecting the water samples, but generally include E. coli, Enterococcus, Fecal Coliform, and/or Total Coliform. This report focuses on a fresh water analysis for Malibu Creek Watershed, therefore the fresh water indicator bacteria, *E. coli* and Fecal Coliform will be further evaluated. The number of samples collected at various locations within the MCW for these two indicator bacteria is shown in Table 2-1.

The MCW bacteria TMDL uses water quality targets based on body contact recreational use water quality standards set in Water Quality Control Plan, Los Angeles Region (Basin Plan). These include water quality objectives (WQOs) for *E. coli* and fecal coliform bacteria in inland surface waterbodies. The WQOs for *E. coli* and fecal coliform include:

- Single sample limit of 235 MPN/100ml *E. coli* not to be exceeded in more than 10% of samples during a 30-day period
- Geometric mean limit of 126 MPN/100ml *E. coli* for any 30-day period with greater than 5 samples collected.
- Single sample limit of 400 MPN/100ml fecal coliform not to be exceeded in more than 10% of samples during a 30-day period
- Geometric mean limit of 200 MPN/100ml for any 30-day period with greater than 5 samples collected.

For this evaluation of water quality in the MCW, only the single sample WQO was evaluated, because there were limited instances of five samples collected from any one site within a 30-day period. The TMDL target is based on a number of days of allowable exceedences of WQOs, which is different for wet-weather, winter dry, and summer dry weather conditions. Therefore, the collected bacteria indicator data was stratified by season and flow conditions for evaluation; wet weather (days with at least 0.1 inches of rain and the three days following), winter dry weather (November 1 through March 31), and summer dry weather (April 1 and October 31).

Table 2-1
Number of Bacteria Indicator Samples Per Site

Site	Subwatershed	*E. coli*	Fecal Coliform
HtB-6	Cheseboro Creek	14	0
WQMP_3	Cheseboro Creek	15	15
CC	Cold Creek	27	27
HtB-2	Cold Creek	38	0
HtB-3	Cold Creek	45	0
HtB-11	Cold Creek	15	0
HtB-10	Hidden Valley Creek	14	0
HV	Hidden Valley Creek	10	10
HtB-13	Lower Las Virgenes Creek	45	0
LC	Lower Las Virgenes Creek	33	33
LV2	Lower Las Virgenes Creek	36	36
WQMP_1	Lower Las Virgenes Creek	15	15
WQMP_2	Lower Las Virgenes Creek	15	15
LIN2	Lower Lindero Creek	33	33
WQMP_5	Lower Lindero Creek	15	15
HtB-15	Lower Malibu Creek	71	0
MAL	Lower Malibu Creek	34	34
R-13	Lower Malibu Creek	161	161
S02	Lower Malibu Creek	19	19
HtB-7	Lower Medea Creek	45	0
MED2	Lower Medea Creek	34	34
HtB-1	Malibu Lagoon	43	0
HtB-20	Malibu Lagoon	71	0
R-3	Malibu Lagoon	155	155
R-4	Malibu Lagoon	132	132
R-11	Malibu Lagoon	158	158
R-1	Middle Malibu Creek	157	157
R-2	Middle Malibu Creek	154	154
R-9	Middle Malibu Creek	128	128
HtB-8	Palo Comado Creek	8	0
POT	Potrero Creek	5	5
HtB-5	Stokes Creek	45	0
HtB-16	Stokes Creek	15	0
HtB-17	Triunfo Creek	37	0
TRI	Triunfo Creek	34	34
WQMP_6	Triunfo Creek	15	15
HtB-9	Upper Las Virgenes Creek	21	0
LV1	Upper Las Virgenes Creek	34	34
LIN1	Upper Lindero Creek	32	32
HtB-4	Upper Malibu Creek	22	0
HtB-12	Upper Malibu Creek	45	0
MED1	Upper Medea Creek	33	33
WQMP_4	Upper Medea Creek	15	15
WQMP_7	Westlake	15	14
RUS	Westlake	32	32

Table 2-2.
Percent of Bacteria Samples Exceeding TMDL Targets

Subwatershed	**Site**	***E. coli.***			**Fecal Coliform**		
		Wet	**Winter**	**Summer**	**Wet**	**Winter**	**Summer**
Cheseboro Creek	HtB-6	n/a	0	14	n/a	n/a	n/a
Cheseboro Creek	WQMP-3	100	0	75	100	33	87
Cold Creek	CC	0	0	0	0	8	7
Cold Creek	HtB-11	n/a	45	26	n/a	71	83
Cold Creek	HtB-2	16	9	38	n/a	n/a	n/a
Cold Creek	HtB-3	16	0	3	n/a	n/a	n/a
Hidden Valley Creek	HtB-10	100	6	13	100	40	37
Hidden Valley Creek	HV	50	16	0	50	66	50
Lower Las Virgenes Creek	HtB-13	50	33	44	n/a	n/a	n/a
Lower Las Virgenes Creek	LC	100	85	100	100	85	94
Lower Las Virgenes Creek	LV2	80	38	77	80	61	94
Lower Las Virgenes Creek	WQMP-1	100	33	75	100	66	87
Lower Las Virgenes Creek	WQMP-2	100	66	100	100	66	100
Lower Lindero Creek	LIN2	83	15	21	66	38	78
Lower Lindero Creek	WQMP-5	100	33	100	100	100	100
Lower Malibu Creek	HtB-15	45	10	7	n/a	n/a	n/a
Lower Malibu Creek	MAL	50	7	0	50	14	11
Lower Malibu Creek	R-13	44	8	8	42	8	9
Lower Malibu Creek	S02	92	50	66	92	50	66
Lower Medea Creek	HtB-7	66	33	55	n/a	n/a	n/a
Lower Medea Creek	MED2	63	42	52	40	53	56
Malibu Lagoon	HtB-1	33	0	4	n/a	n/a	n/a
Malibu Lagoon	HtB-20	54	40	32	n/a	n/a	n/a
Malibu Lagoon	R-11	68	40	34	68	39	34
Malibu Lagoon	R-3	50	10	6	50	9	6
Malibu Lagoon	R-4	57	2	13	57	2	13
Middle Malibu Creek	R-1	66	11	15	66	11	15
Middle Malibu Creek	R-2	55	8	6	55	8	6
Middle Malibu Creek	R-9	58	5	11	61	5	11
Palo Comado Creek	HtB-8	n/a	0	0	n/a	n/a	n/a
Potrero Creek	POT	0	0	100	0	50	100
Stokes Creek	HtB-16	n/a	0	33	n/a	n/a	n/a
Stokes Creek	HtB-5	50	8	18	n/a	n/a	n/a
Triunfo Creek	HtB-17	33	0	8	n/a	n/a	n/a
Triunfo Creek	TRI	50	32	9	83	50	50
Triunfo Creek	WQMP-6	75	0	75	75	33	75
Upper Las Virgenes Creek	HtB-9	n/a	0	0	n/a	n/a	n/a
Upper Las Virgenes Creek	LV1	33	0	16	33	23	22
Upper Lindero Creek	LIN1	80	30	71	60	61	78
Upper Malibu Creek	HtB-12	0	0	3	n/a	n/a	n/a
Upper Malibu Creek	HtB-4	n/a	12	7	n/a	n/a	n/a
Upper Medea Creek	MED1	100	46	80	100	60	80
Upper Medea Creek	WQMP-4	100	100	75	100	33	75
Westlake	RUS	50	26	23	75	26	69
Westlake	WQMP-7	100	66	100	100	33	100

The range of bacteria data and mean sample value during each weather condition are shown in Figures 2-1 and 2-2. The bold red line shows the single sample water quality objective for the constituent presented in each figure.

Figure 2-1
Range of E. coli Data and Mean Concentrations
for Wet Weather, Winter Dry Weather, and Summer Dry Weather

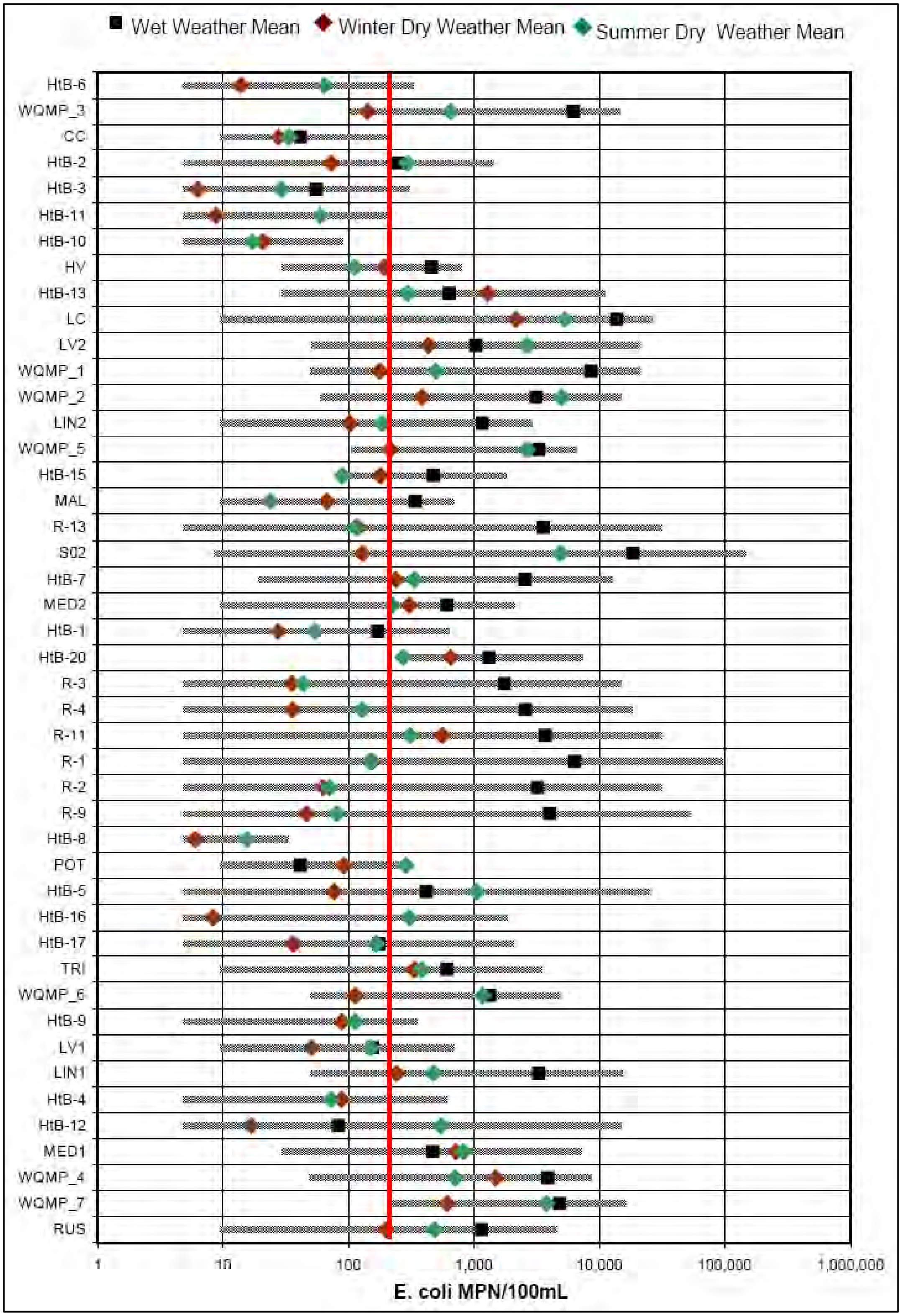
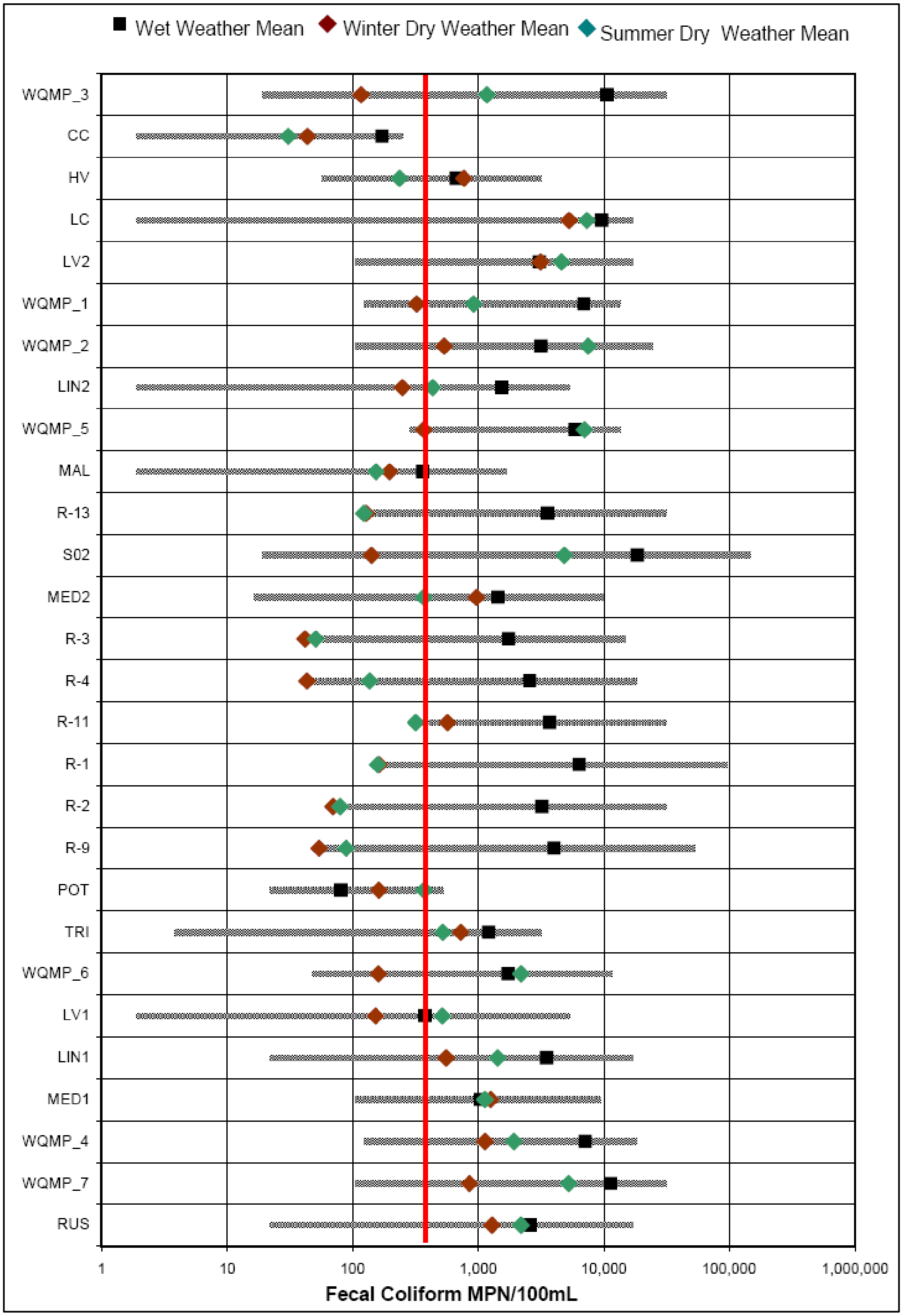


Figure 2-2
Range of Fecal Coliform Data and Mean Concentrations for Wet Weather, Winter Dry Weather, and Summer Dry Weather



2.1.2 Nutrients

Nutrient data was collected for several constituents at sites throughout the Malibu Creek Watershed. Constituents include Ammonia, Chlorophyll-a, Orthophosphate, and Total Nitrogen. The number of samples conducted for each constituent is shown in Table 2-3.

In 2003, EPA Region 9 developed a TMDL and set numeric targets for the MCW for ammonia, algae biomass (Chlorophyll-a), total nitrogen, and total phosphorous. Since nutrient impairments are amplified during the summertime when water temperatures rise, flushing of algal growth is reduced, and daytime length increases, the TMDL includes numeric targets for total nitrogen (1 mg/l) and total phosphorous (0.1 mg/l) during the summer and total nitrogen (8 mg/l) during the winter. The EPA TMDL for Nutrients in MCW also sets water quality targets for the following constituents:

- Ammonia – Acute Toxicity: 2.59 mg/L (2.01 mg/L Ammonia-N)
- Ammonia – Chronic Toxicity: 1.75 mg/L (1.36 mg/L Ammonia-N)
- Algae (% coverage) – 30% for floating algae, 60% for bottom algae
- Chlorophyll-A – 150 mg/m^2
- Phosphorous (Orthophosphate as P) – 0.1 mg/L in summer only
- Total Nitrogen – 1.0 mg/L in summer, 8.0 mg/L in winter

The summer period is defined as April 15 through November 15 and winter is the period between November 16 and April 14. Unlike bacteria TMDL targets, there is not a separate wet weather target for nutrients. The percent of samples exceeding these targets for each season are shown in Table 2-4 for Ammonia-N and Table 2-5 for Chlorophyll-A, Orthophosphate as P, and Total Nitrogen.

Table 2-3
Number of Nutrient Samples Per Site

Site	Subwatershed	Ammonia	Chlorophyll-A	Orthophosphate	Total Nitrogen
HtB-6	Cheseboro Creek	50	No data	57	49
WQMP_3	Cheseboro Creek	8	No data	15	13
CC	Cold Creek	27	27	27	27
HtB-2	Cold Creek	76	No data	83	75
HtB-3	Cold Creek	83	No data	83	82
HtB-11	Cold Creek	15	No data	19	15
HtB-10	Hidden Valley Creek	18	No data	19	18
HV	Hidden Valley Creek	10	9	10	10
HtB-13	Lower Las Virgenes Creek	42	No data	45	42
LC	Lower Las Virgenes Creek	34	34	34	34
LV2	Lower Las Virgenes Creek	36	36	36	36
WQMP_1	Lower Las Virgenes Creek	5	No data	15	14
WQMP_2	Lower Las Virgenes Creek	8	No data	15	11
LIN2	Lower Lindero Creek	33	32	33	33
WQMP_5	Lower Lindero Creek	10	No data	15	12
HtB-15	Lower Malibu Creek	71	No data	No data	71
MAL	Lower Malibu Creek	34	34	34	34
R-13	Lower Malibu Creek	73	No data	75	61
S02	Lower Malibu Creek	28	No data	29	29
HtB-7	Lower Medea Creek	83	No data	83	82
MED2	Lower Medea Creek	34	34	34	32
HtB-1	Malibu Lagoon	80	No data	81	80
HtB-20	Malibu Lagoon	71	No data	No data	71
R-3	Malibu Lagoon	No data	No data	73	69
R-4	Malibu Lagoon	No data	No data	64	60
R-11	Malibu Lagoon	No data	No data	71	64
R-1	Middle Malibu Creek	120	No data	72	69
R-2	Middle Malibu Creek	No data	No data	74	62
R-9	Middle Malibu Creek	No data	No data	54	19
HtB-8	Palo Comado Creek	12	No data	25	14
POT	Potrero Creek	5	5	5	5
HtB-5	Stokes Creek	82	No data	83	81
HtB-16	Stokes Creek	15	No data	19	15
HtB-17	Triunfo Creek	37	No data	42	37
TRI	Triunfo Creek	34	33	34	33
WQMP_6	Triunfo Creek	10	No data	15	11
HtB-9	Upper Las Virgenes Creek	29	No data	30	30
LV1	Upper Las Virgenes Creek	34	33	34	34
LIN1	Upper Lindero Creek	32	31	32	32
HtB-4	Upper Malibu Creek	59	No data	59	57
HtB-12	Upper Malibu Creek	42	No data	45	42
MED1	Upper Medea Creek	33	32	33	33
WQMP_4	Upper Medea Creek	5	No data	15	13
WQMP_7	Westlake	7	No data	15	13
RUS	Westlake	32	31	32	32

Table 2-4
Percent of Ammonia-N Samples Exceeding TMDL Targets

	Ammonia - Acute		Ammonia - Chronic	
Site	**Winter**	**Summer**	**Winter**	**Summer**
HtB-6	0%	0%	3%	0%
WQMP_3	0%	0%	0%	0%
CC	0%	0%	0%	0%
HtB-2	0%	0%	0%	0%
HtB-3	0%	2%	0%	2%
HtB-11	0%	0%	0%	0%
HtB-10	0%	0%	0%	0%
HV	0%	0%	0%	0%
HtB-13	0%	0%	0%	0%
LC	0%	0%	0%	0%
LV2	0%	0%	0%	7%
WQMP_1	0%	0%	0%	0%
WQMP_2	0%	0%	0%	0%
LIN2	0%	0%	0%	0%
WQMP_5	0%	0%	0%	0%
HtB-15	0%	0%	0%	0%
MAL	0%	0%	0%	0%
R-13	0%	0%	0%	0%
S02	4%	0%	4%	0%
HtB-7	0%	0%	0%	0%
MED2	0%	0%	0%	0%
HtB-1	2%	3%	2%	3%
HtB-20	0%	0%	0%	0%
R-1	0%	0%	0%	0%
HtB-8	0%	0%	0%	0%
POT	0%	0%	0%	0%
HtB-5	0%	2%	0%	2%
HtB-16	0%	0%	0%	0%
HtB-17	0%	0%	0%	0%
TRI	0%	0%	0%	0%
WQMP_6	0%	0%	0%	0%
HtB-9	0%	0%	0%	0%
LV1	0%	0%	0%	0%
LIN1	0%	0%	0%	0%
HtB-4	0%	0%	0%	0%
HtB-12	0%	0%	0%	0%
MED1	0%	0%	0%	0%
WQMP_4	0%	0%	0%	0%
WQMP_7	0%	0%	0%	0%
RUS	0%	0%	0%	0%

Table 2-5
Percent of Nutrient Samples Exceeding TMDL Targets

Subwatershed	Site	Orthophosphate-P	Winter Total Nitrogen	Summer Total Nitrogen
Cheseboro Creek	HtB-6	52	0	0
Cheseboro Creek	WQMP-3	0	0	0
Cold Creek	CC	21	0	0
Cold Creek	HtB-11	33	0	42
Cold Creek	HtB-2	27	0	12
Cold Creek	HtB-3	0	0	0
Hidden Valley Creek	HtB-10	30	0	25
Hidden Valley Creek	HV	100	29	100
Lower Las Virgenes Creek	HtB-13	100	0	79
Lower Las Virgenes Creek	LC	33	0	89
Lower Las Virgenes Creek	LV2	68	0	95
Lower Las Virgenes Creek	WQMP-1	100	0	60
Lower Las Virgenes Creek	WQMP-2	0	0	0
Lower Lindero Creek	LIN2	31	0	88
Lower Lindero Creek	WQMP-5	56	0	10
Lower Malibu Creek	HtB-15	n/a	43	20
Lower Malibu Creek	MAL	72	0	6
Lower Malibu Creek	R-13	100	9	82
Lower Malibu Creek	S02	100	3	43
Lower Medea Creek	HtB-7	80	0	10
Lower Medea Creek	MED2	63	0	18
Malibu Lagoon	HtB-1	100	18	20
Malibu Lagoon	HtB-20	n/a	0	15
Malibu Lagoon	R-11	86	0	6
Malibu Lagoon	R-3	100	0	6
Malibu Lagoon	R-4	76	0	8
Middle Malibu Creek	R-1	13	0	15
Middle Malibu Creek	R-2	78	7	14
Middle Malibu Creek	R-9	39	0	0
Palo Comado Creek	HtB-8	0	0	0
Potrero Creek	POT	0	0	50
Stokes Creek	HtB-16	86	0	7
Stokes Creek	HtB-5	88	3	98
Triunfo Creek	HtB-17	68	0	0
Triunfo Creek	TRI	35	0	38
Triunfo Creek	WQMP-6	56	0	0
Upper Las Virgenes Creek	HtB-9	0	0	0
Upper Las Virgenes Creek	LV1	28	0	72
Upper Lindero Creek	LIN1	63	0	94
Upper Malibu Creek	HtB-12	43	0	0
Upper Malibu Creek	HtB-4	59	0	0
Upper Medea Creek	MED1	44	6	44
Upper Medea Creek	WQMP-4	33	0	0
Westlake	RUS	67	0	87
Westlake	WQMP-7	89	0	40

The ranges of data for each constituent and mean sample value during each weather condition are shown in Figures 2-3. The bold lines in the following figures indicate water quality targets for one or multiple criteria for the various nutrient constituents.

Figure 2-3
Range of Ammonia-N Data and Mean Concentrations for
Wet Weather, Winter Dry Weather, and Summer Dry Weather

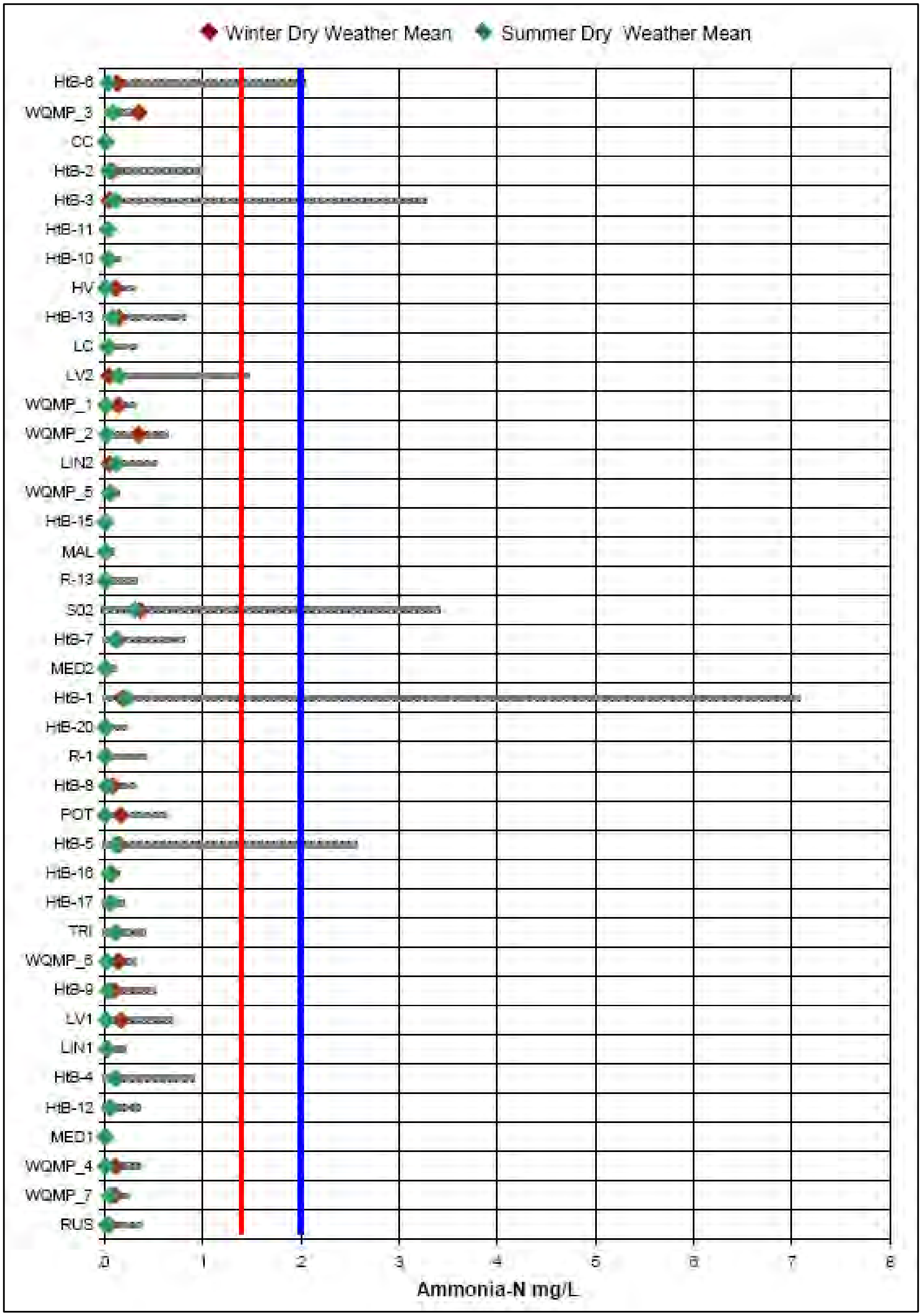


Figure 2-4
Range of Chlorophyll-A Data and Mean Concentrations for Wet Weather, Winter Dry Weather, and Summer Dry Weather

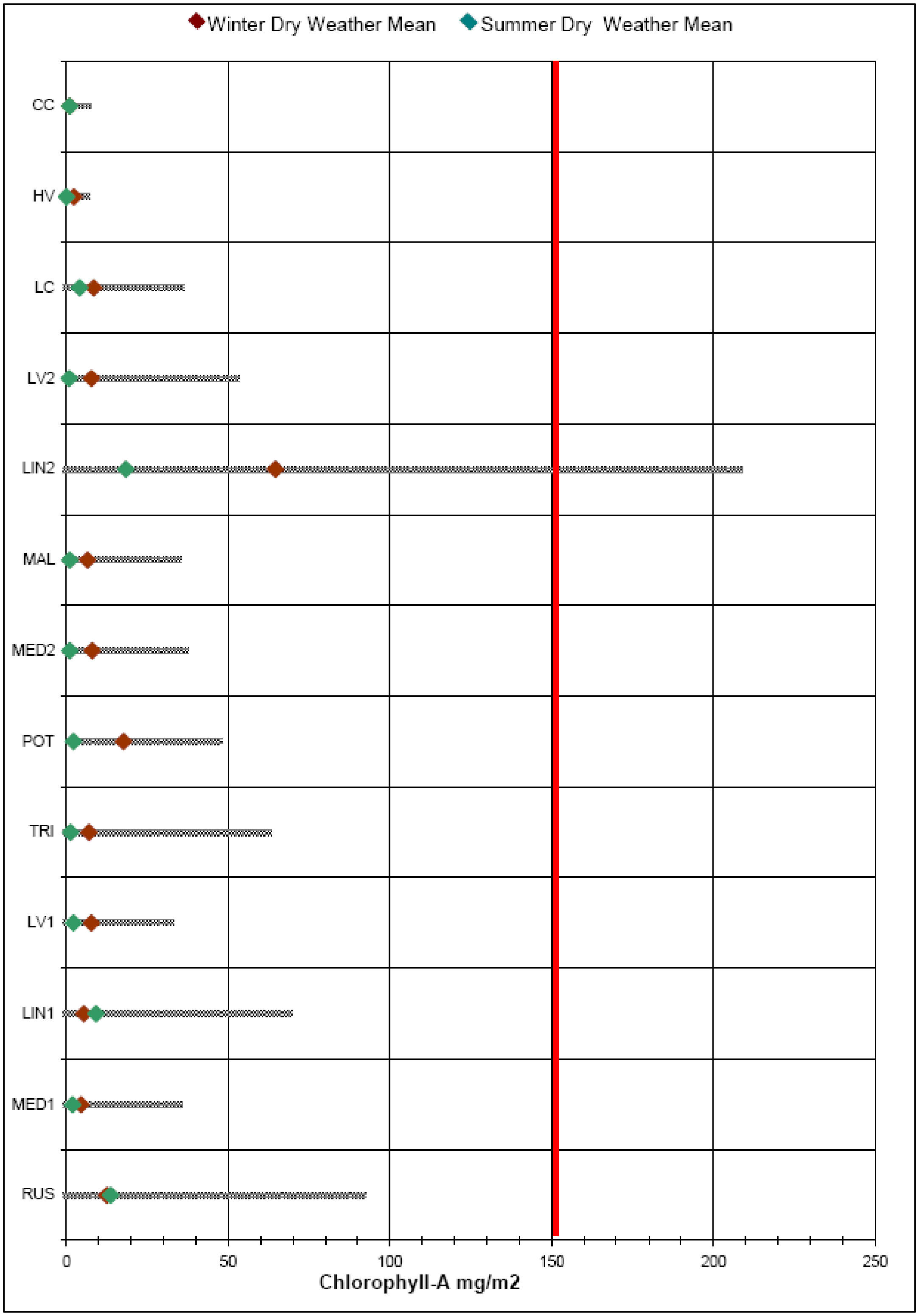


Figure 2-5
Range of Orthophosphate as P Data and Mean Concentrations for Wet Weather, Winter Dry Weather, and Summer Dry Weather

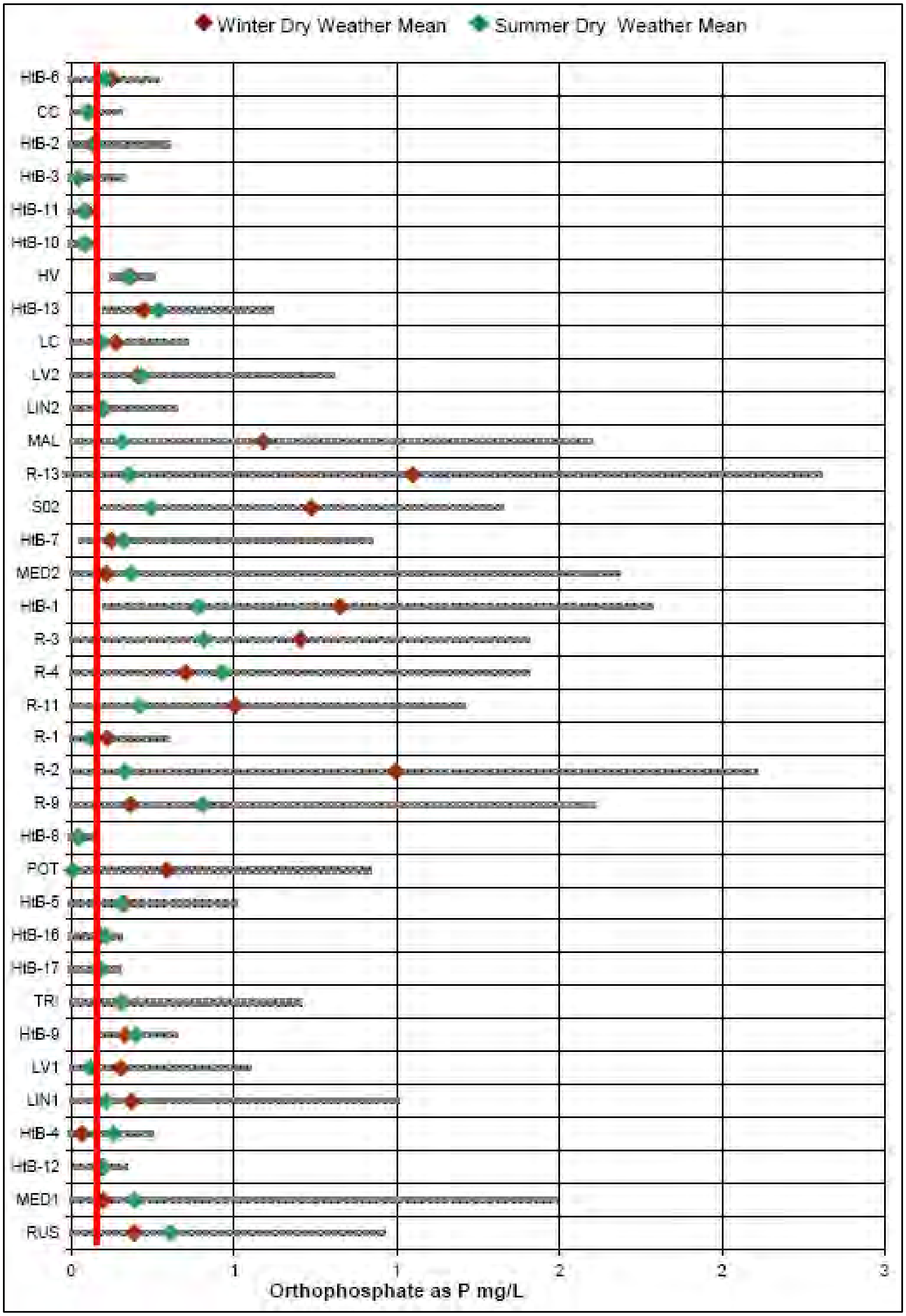
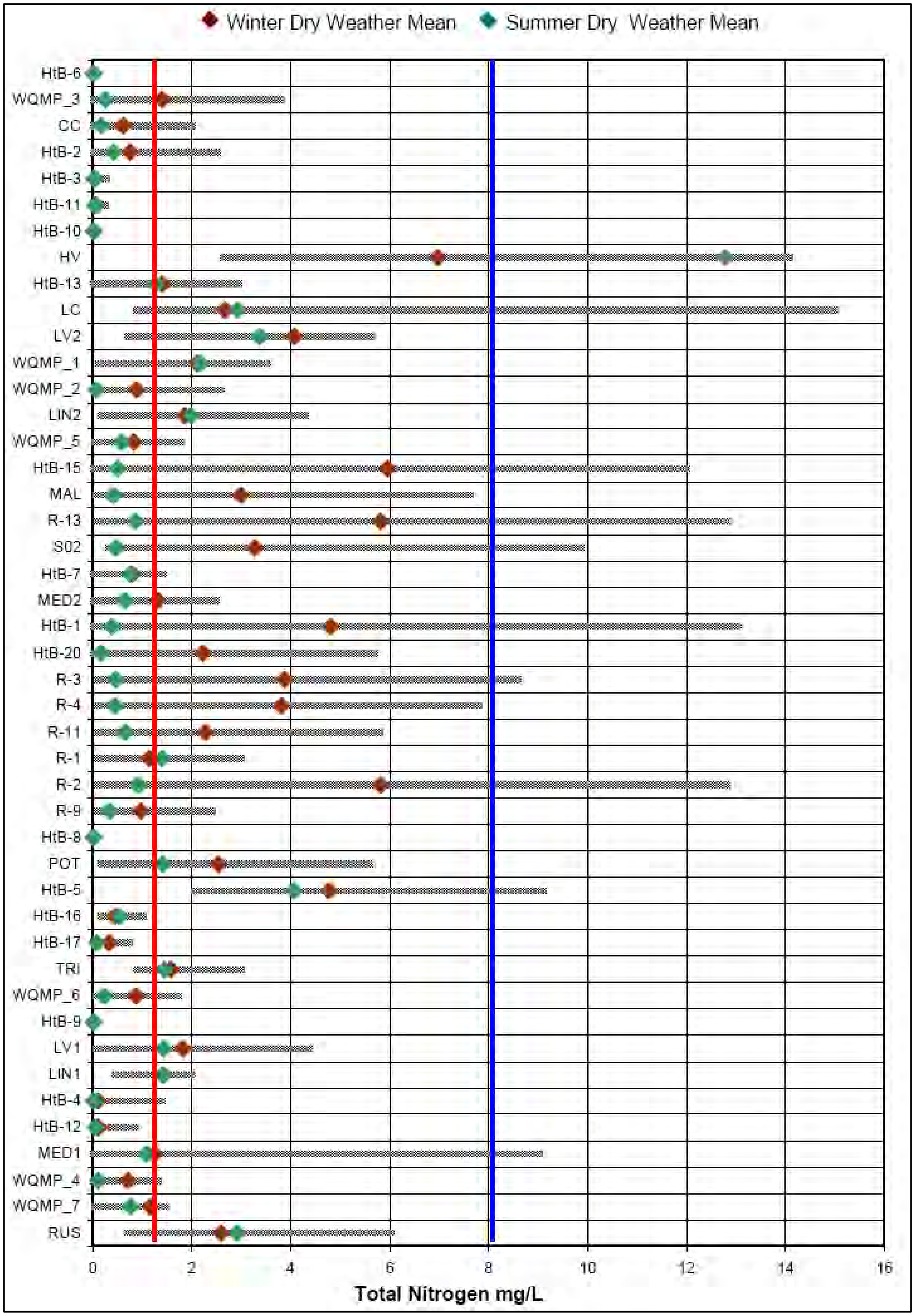


Figure 2-6
Range of Total Nitrogen Data and Mean Concentrations for Wet Weather, Winter Dry Weather, and Summer Dry Weather



2.1.3 Metals

Metals data was collected at 20 sites throughout the Malibu Creek Watershed. Nine of these sites were sampled for 23 different trace metals as a component of the "Hot Spots" monitoring conducted as part of the MCWMP. The number of samples available per site as part of the "Hot Spots" program is shown in Table 2-6. Wet day samples were taken on March 1, 2006 and April 7, 2006. A dry day sample set was taken on February 15, 2007. Table 2-7 presents the number of samples of the three "Hot Spots" monitoring events, in which metal concentrations were above laboratory analytical detection limits. Table 2-7 shows that several metals were not detected at some or all of the sites.

Metals data was also collected at three monitoring locations, SD1S, SD3, and SD4, in the vicinity of the Calabasas landfill on two wet days in 2006. Aluminum, manganese, molybdenum, silver, strontium, thallium, tin and titanium were not sampled at these locations. All other metals were detected during sampling with the exception of mercury at SD3. Soluble metal concentrations were also sampled at these sites for the same set of constituents. Soluble beryllium, lead, and mercury were not detected. Mean concentrations for the remaining soluble metal samples are shown in Table 2-8.

Table 2-6
Availability of "Hot Spot" Metal Samples

Site	Number of Samples
LC	1 Dry
LV2	2 Wet, 1 Dry
LIN2	2 Wet, 1 Dry
MED2	2 Wet
TRI	2 Wet
TRI-ALT	1 Dry
HtB-4	1 Dry
MED1	1 Dry
RUS	1 Dry

Additional metals data was obtained by the Las Virgenes Municipal Water District for lead, mercury, and selenium. A total of 18 sample sets were taken at site R-1 in the Middle Malibu Creek subwatershed.

Summary graphs showing minimum, mean, and maximum metal concentrations for each constituent are shown in Figures 2-7 to 2-28. Water quality targets indicated by the red lines are based on EPA Priority Toxic Pollutant Levels, when applicable, and EPA secondary MCLs. Metals with Criteria Continuous Concentration (CCC) levels dependent upon water hardness did not exceed targets for Cadmium, Copper, Chromium, Lead, Nickel, Silver, and Zinc. Due to the nature of these hardness dependent targets, there is no red line shown in subsequent figures. Section 2.1.4 provides a description of all of the metals detected within the watershed and the values and sources of their recommended limits.

Table 2-7
Number of Samples with Metal Concentrations Above Detection Limits

Metal	LC	LV2	LIN2	MED2	TRI	TRI-ALT	HtB-4	MED1	RUS
Aluminum	1	3	3	2	2	1	1	0	1
Antimony	1	3	3	2	2	1	1	1	1
Arsenic	1	3	3	2	2	1	1	1	1
Barium	1	3	3	2	2	1	1	1	1
Beryllium	0	0	0	0	0	0	0	0	0
Cadmium	1	3	2	2	2	0	0	0	1
Chromium	1	3	3	2	2	1	1	1	1
Cobalt	1	3	3	2	1	1	1	1	1
Copper	1	3	3	2	2	1	1	1	1
Iron	1	3	3	2	2	1	1	1	1
Lead	1	2	2	2	2	0	1	0	1
Manganese	1	3	3	2	2	1	1	1	1
Mercury	0	2	2	2	2	0	0	0	0
Molybdenum	1	3	3	2	2	1	1	1	1
Nickel	1	3	3	2	2	1	1	1	1
Selenium	1	3	3	2	2	1	1	1	1
Silver	0	0	1	0	0	0	0	0	0
Strontium	1	3	3	2	2	1	1	1	1
Thallium	0	0	0	0	0	0	0	0	0
Tin	0	1	2	1	1	0	0	0	1
Titanium	1	3	3	2	2	1	1	1	1
Vanadium	1	3	3	2	2	1	1	1	1
Zinc	1	3	3	2	2	1	1	1	1

Table 2-8.
Mean Concentrations of Soluble Metals near Calabasas Landfill

Metal	SD1S	SD3	SD4
Antimony (Sb) ug/L	1.40	1.30	1.90
Arsenic (As) ug/L	4.50	1.95	5.15
Barium (Ba) ug/L	37.50	30.00	45.00
Cadmium (Cd) ug/L	0.98	4.85	2.30
Chromium (Cr) ug/L	1.14	0.40	0.73
Cobalt (Co) ug/L	1.04	2.55	3.00
Copper (Cu) ug/L	11.40	12.45	17.50
Iron (Fe) ug/L	22.50	ND	ND
Nickel (Ni) ug/L	29.50	58.50	68.00
Selenium (Se) ug/L	8.10	20.00	25.50
Vanadium (V) ug/L	6.85	3.40	7.50
Zinc (Zn) ug/L	10.30	185.00	20.00

Figure 2-7
Range of Aluminum Data and Mean Concentrations

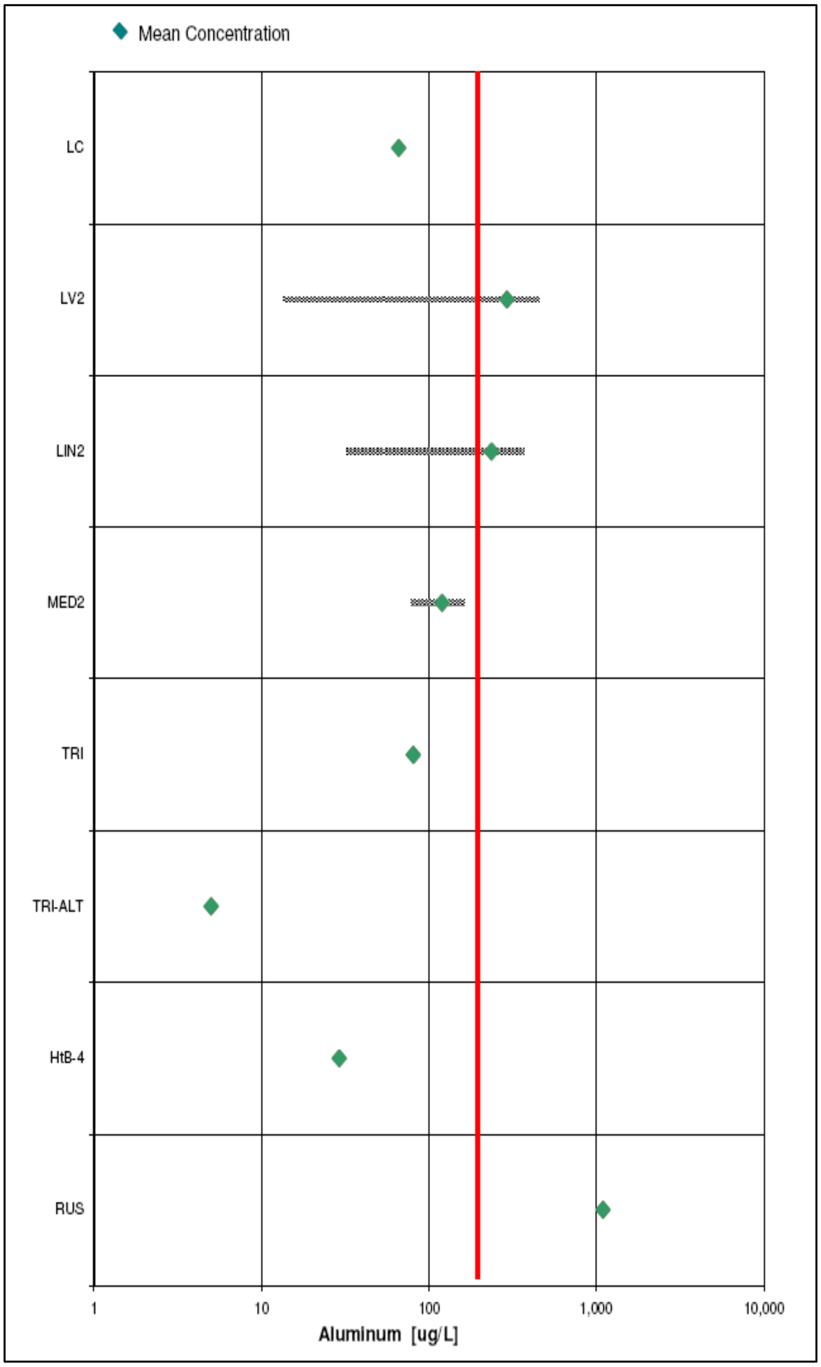


Figure 2-8
Range of Antimony Data and Mean Concentrations

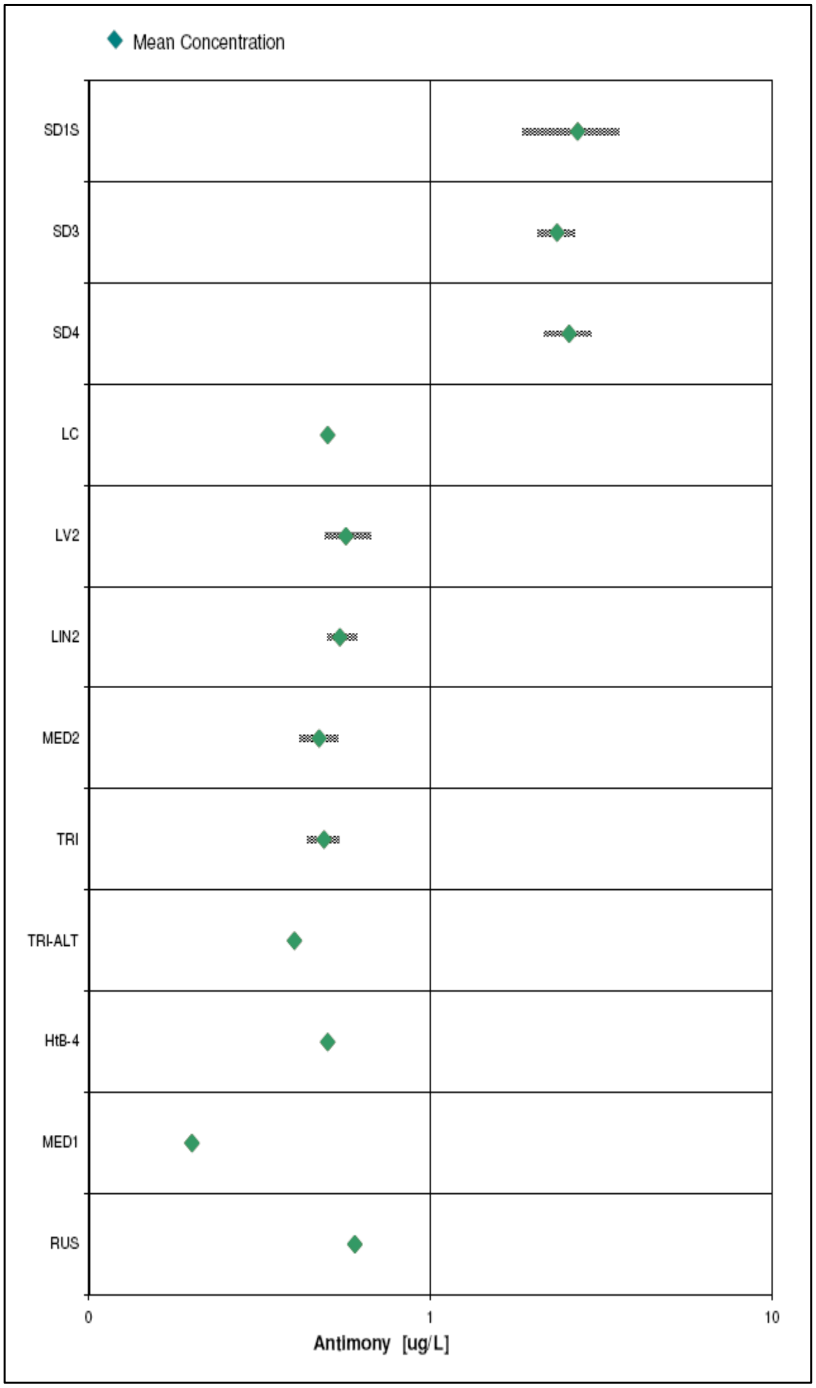


Figure 2-9
Range of Arsenic Data and Mean Concentrations

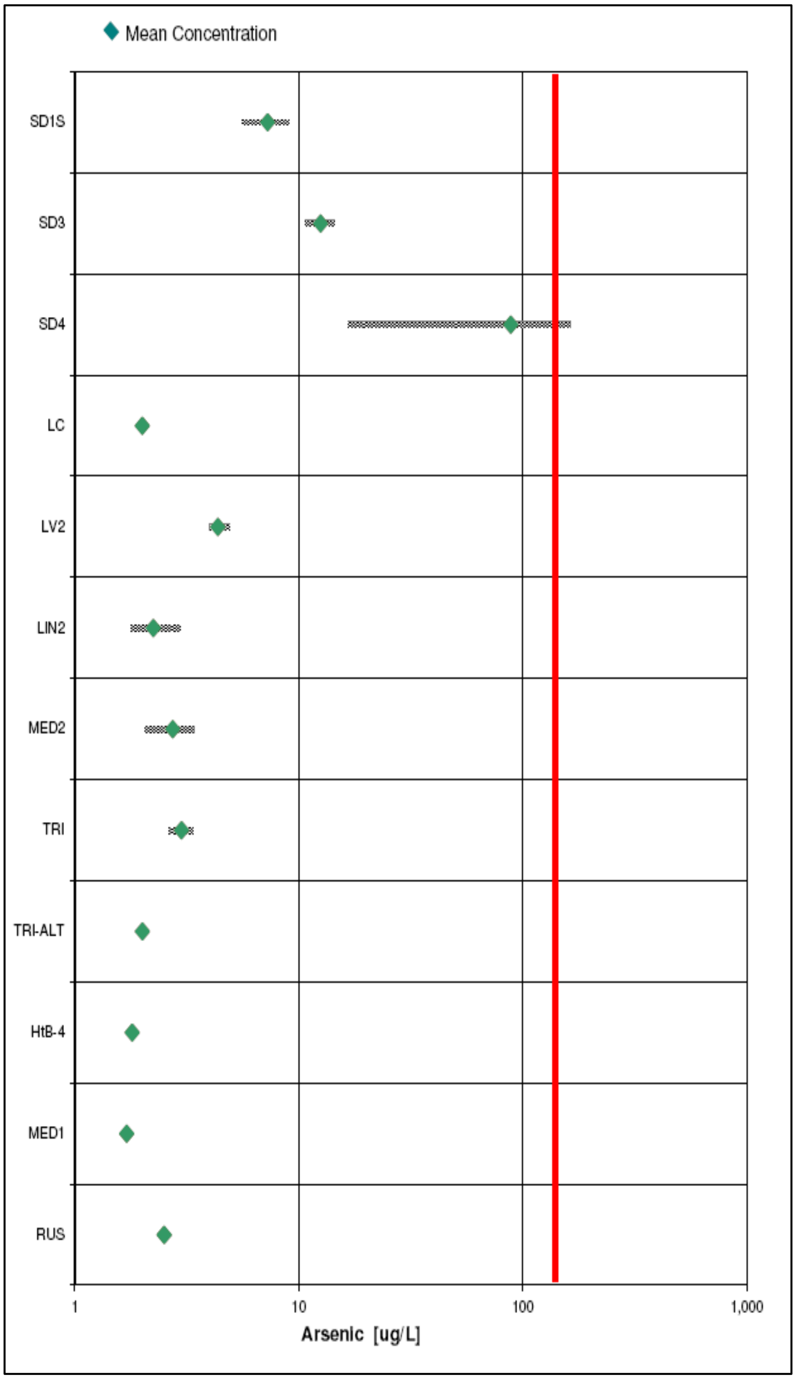


Figure 2-10
Range of Barium Data and Mean Concentrations

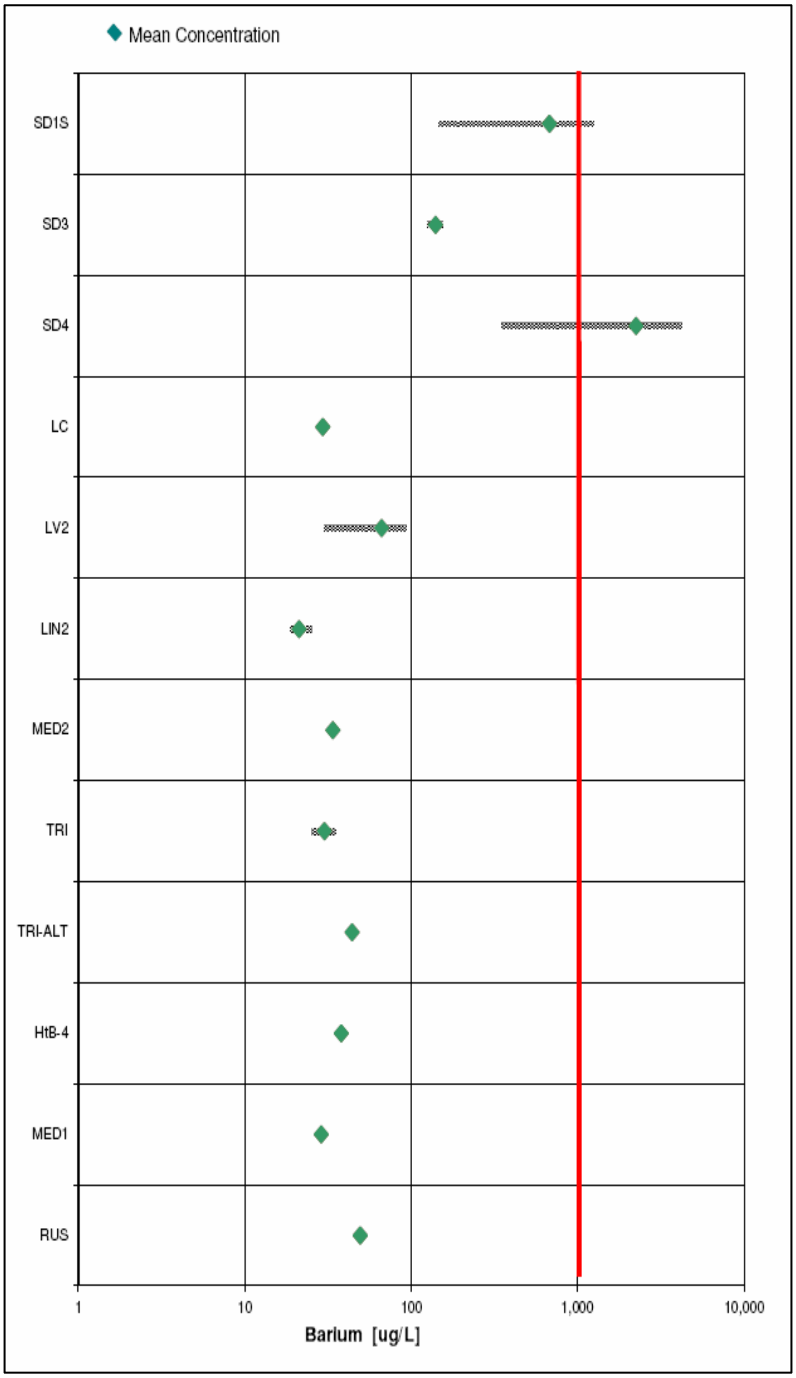


Figure 2-11
Range of Beryllium Data and Mean Concentrations

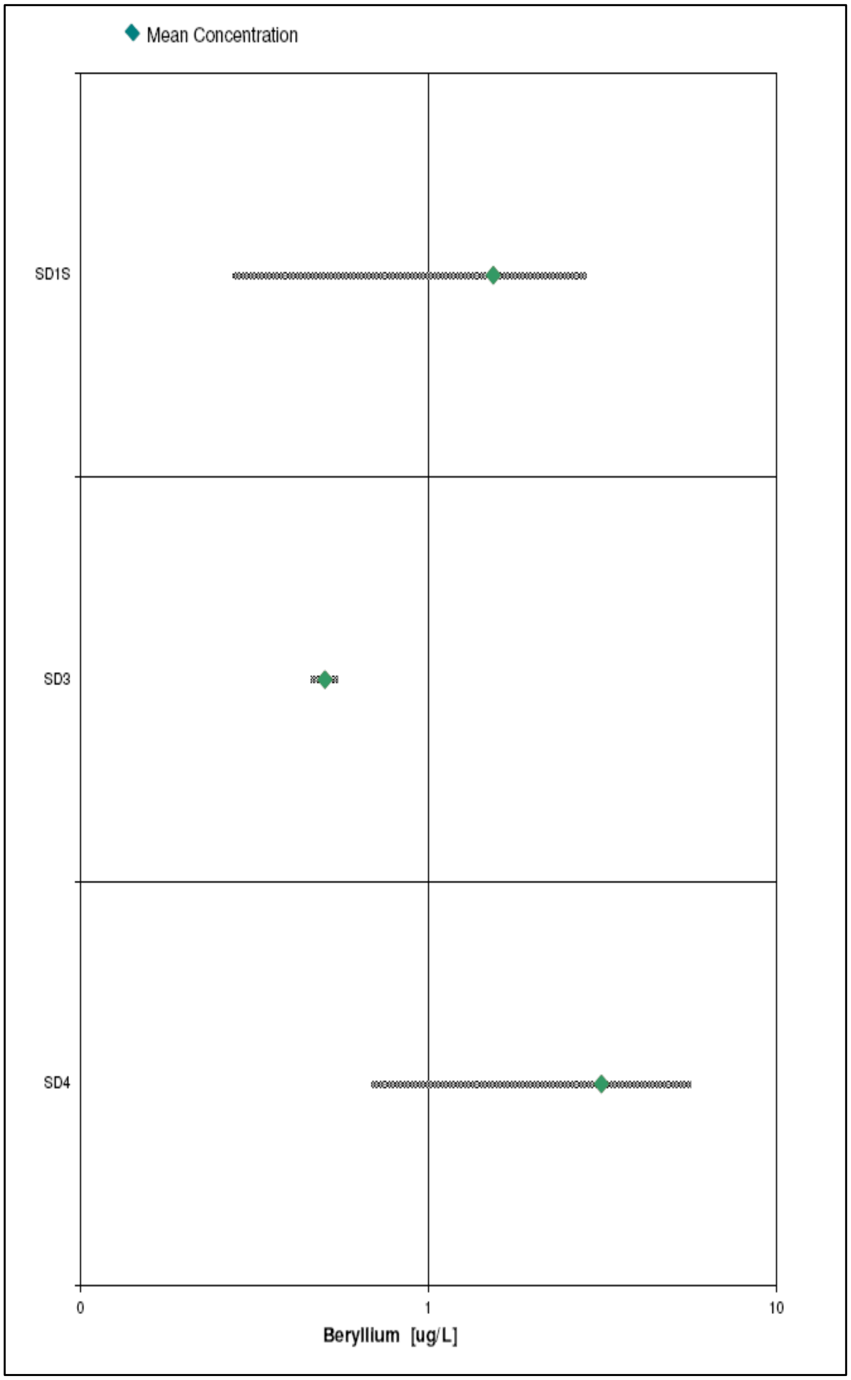


Figure 2-12
Range of Cadmium Data and Mean Concentrations

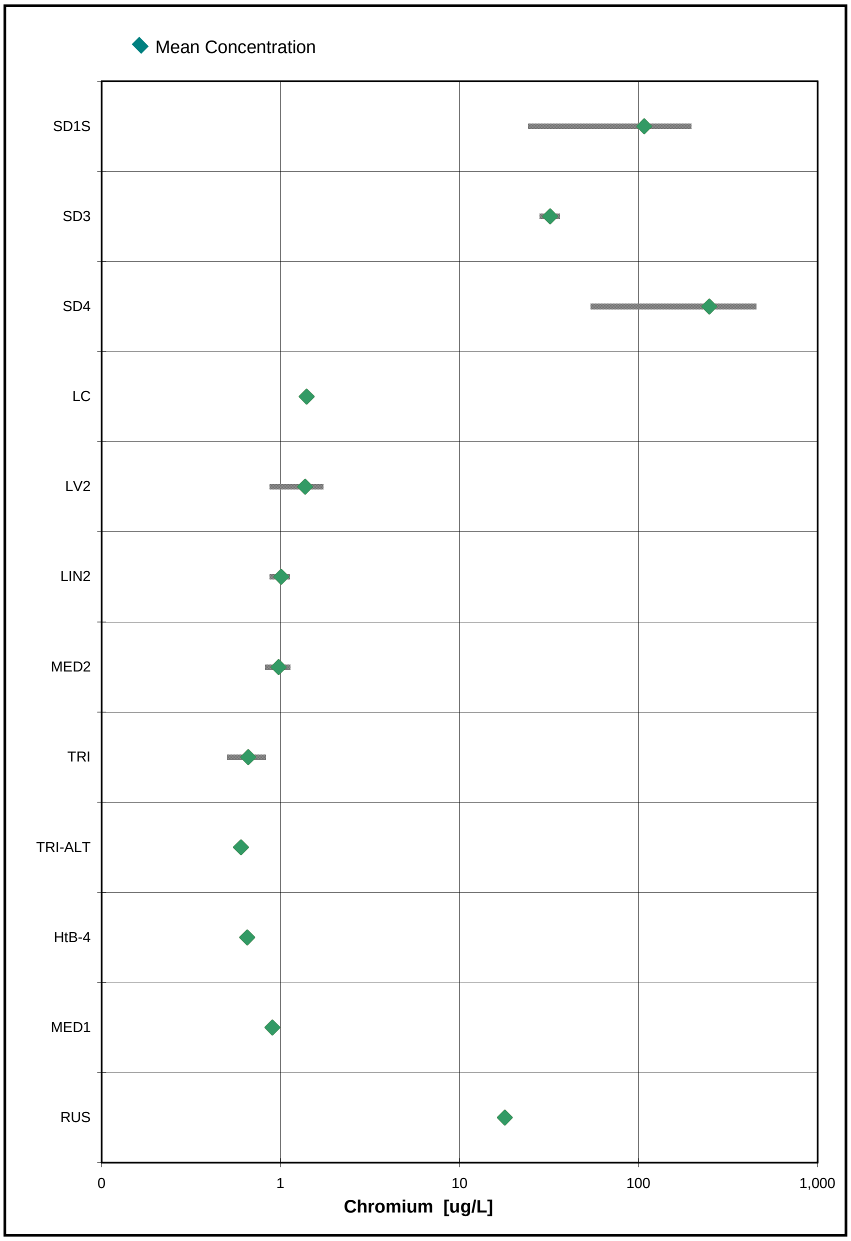


Figure 2-13
Range of Chromium Data and Mean Concentrations

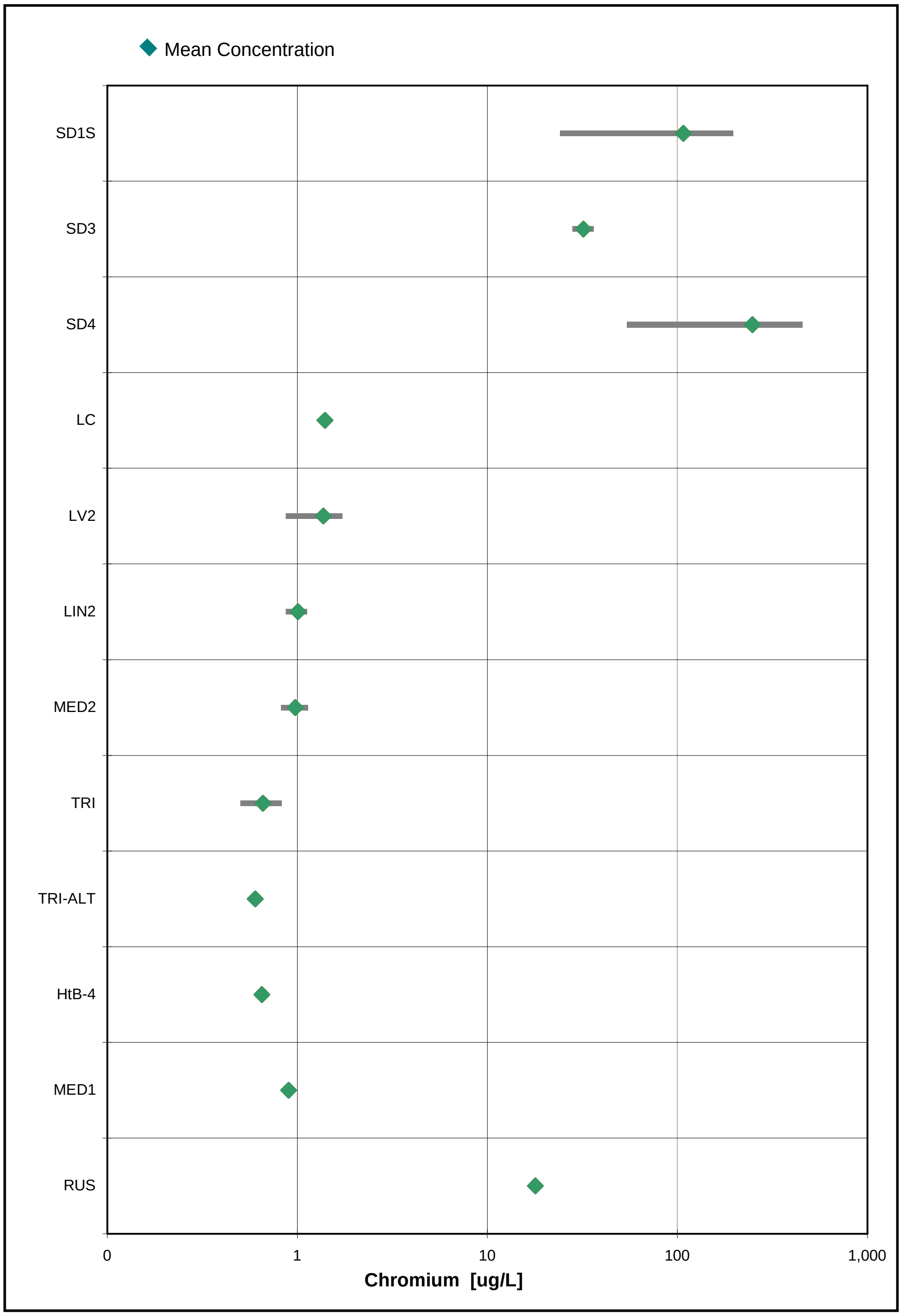


Figure 2-14
Range of Cobalt Data and Mean Concentrations

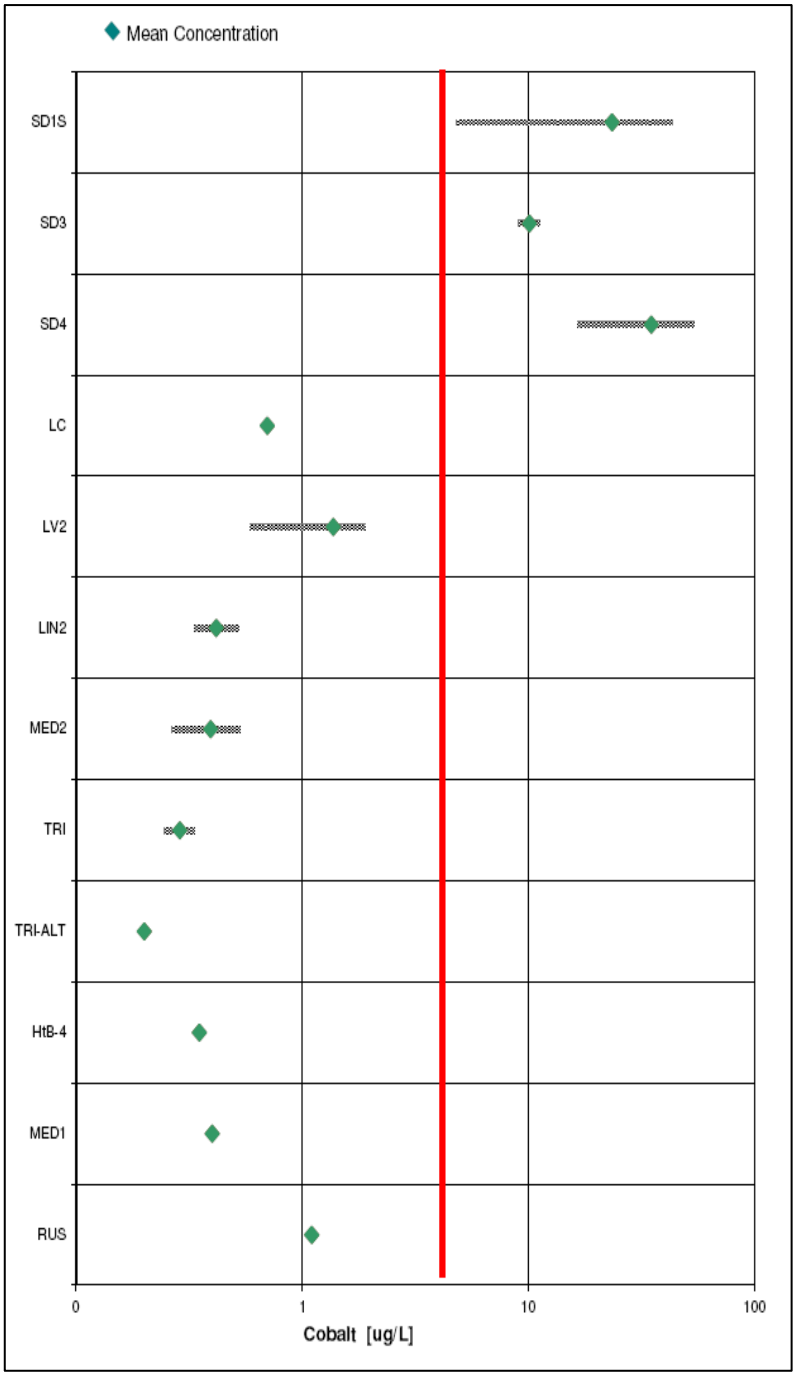


Figure 2-15
Range of Copper Data and Mean Concentrations

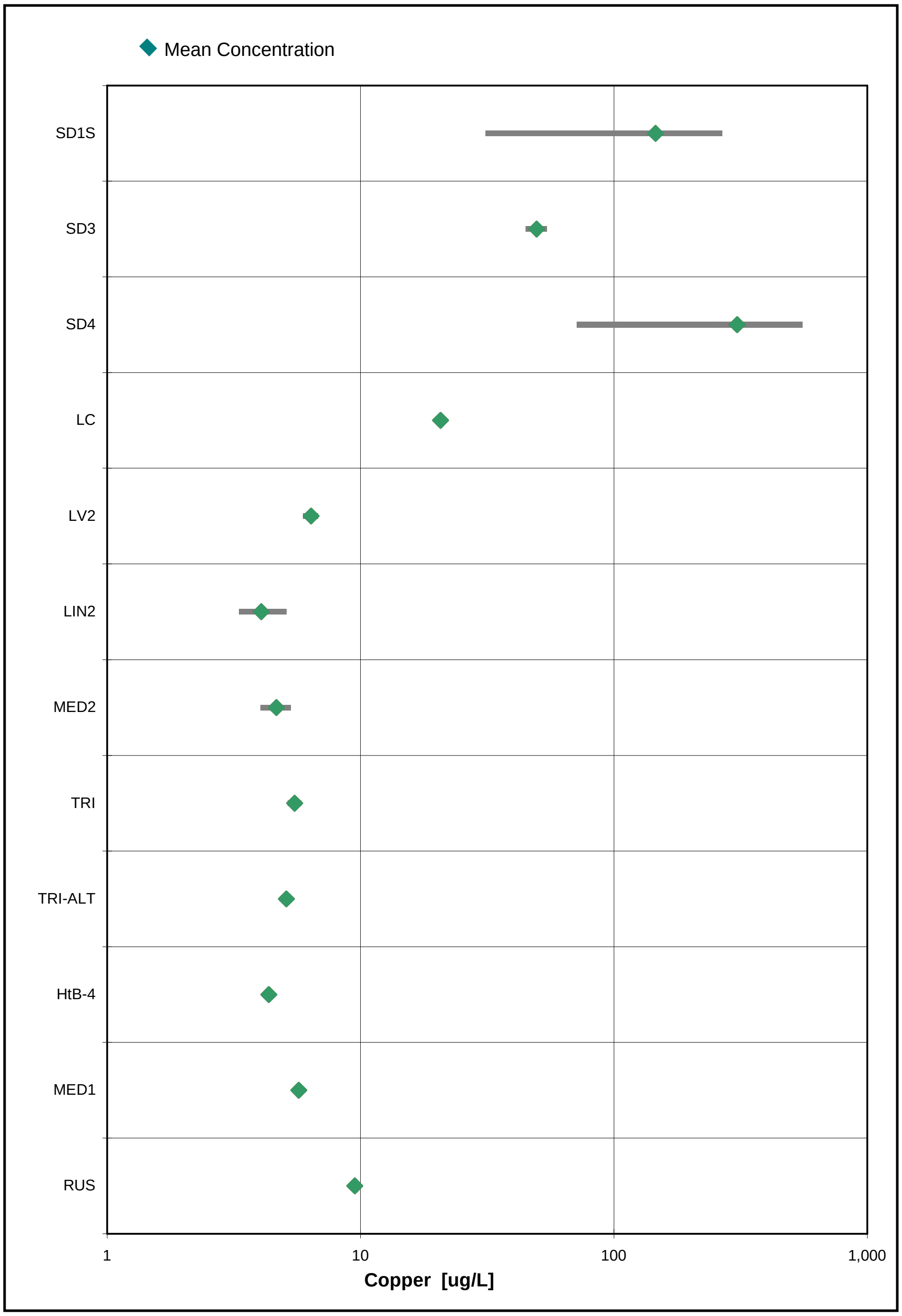


Figure 2-16
Range of Iron Data and Mean Concentrations

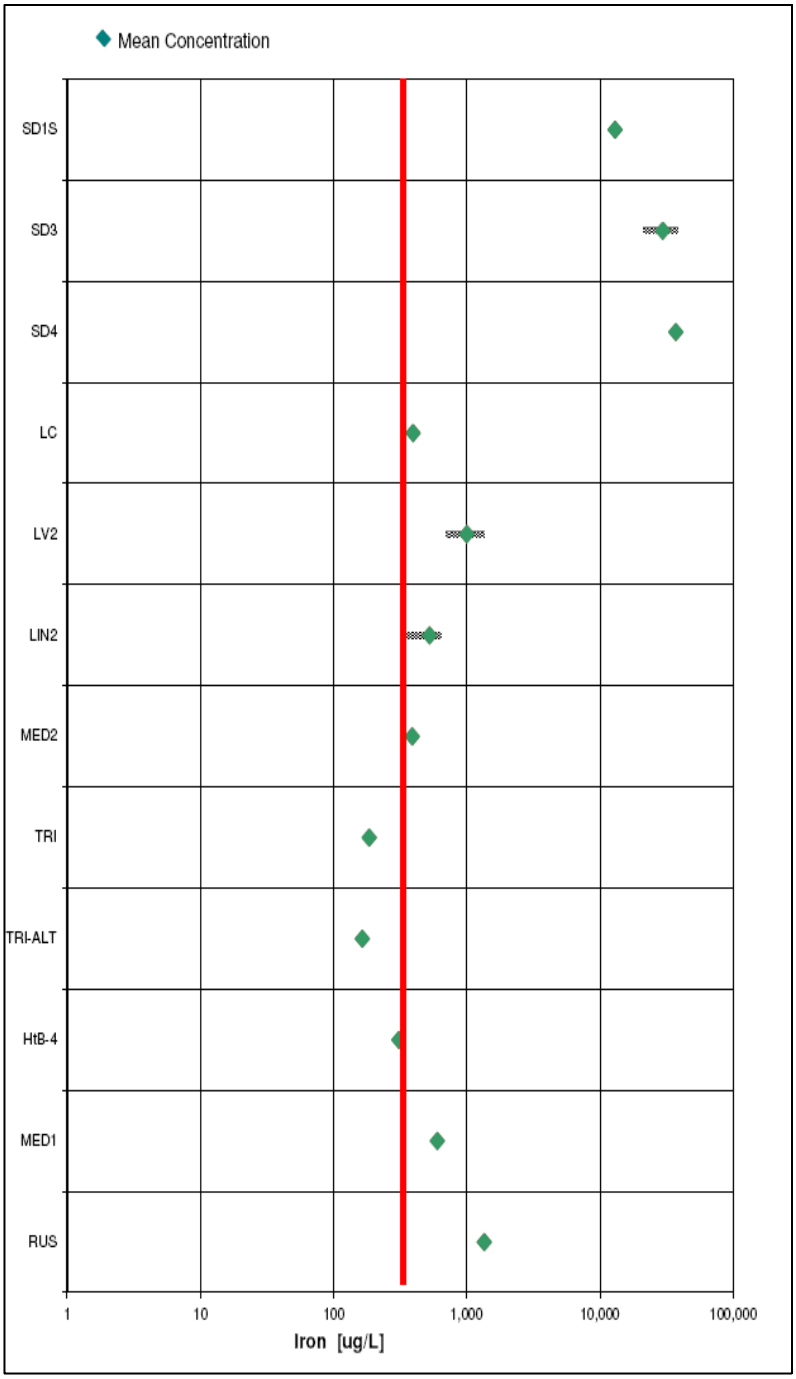


Figure 2-17
Range of Lead Data and Mean Concentrations

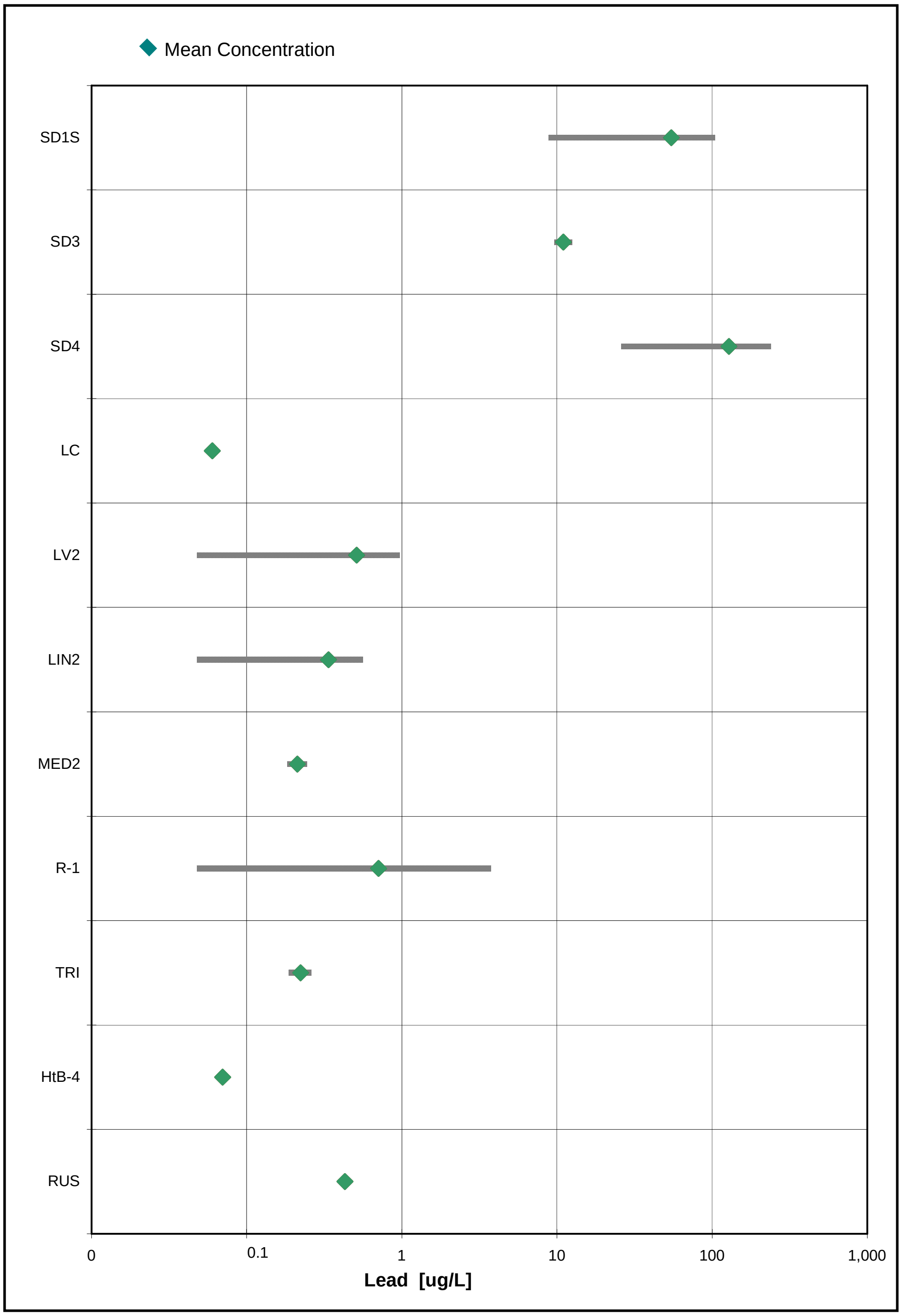


Figure 2-18
Range of Manganese Data and Mean Concentrations

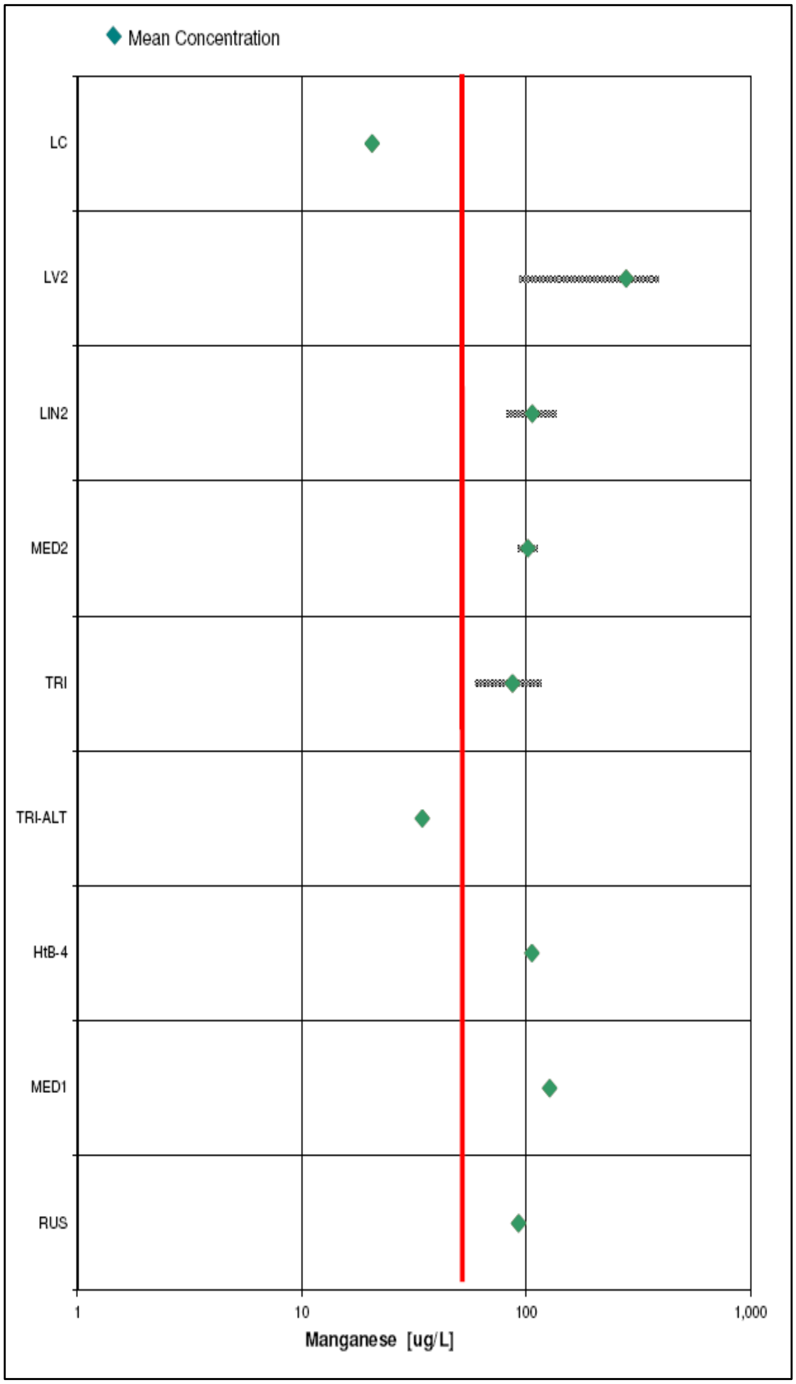


Figure 2-19
Range of Mercury Data and Mean Concentrations

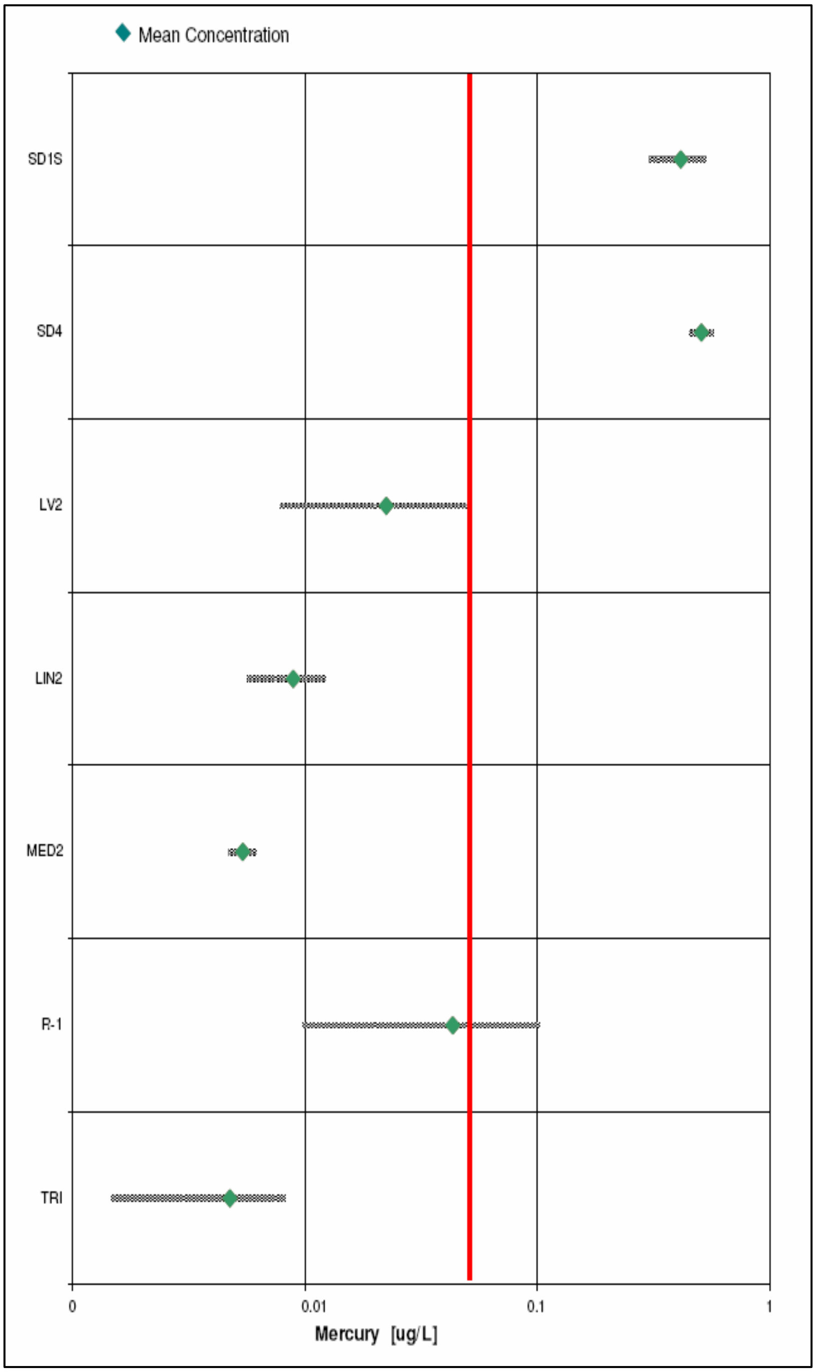


Figure 2-20
Range of Molybdenum Data and Mean Concentrations

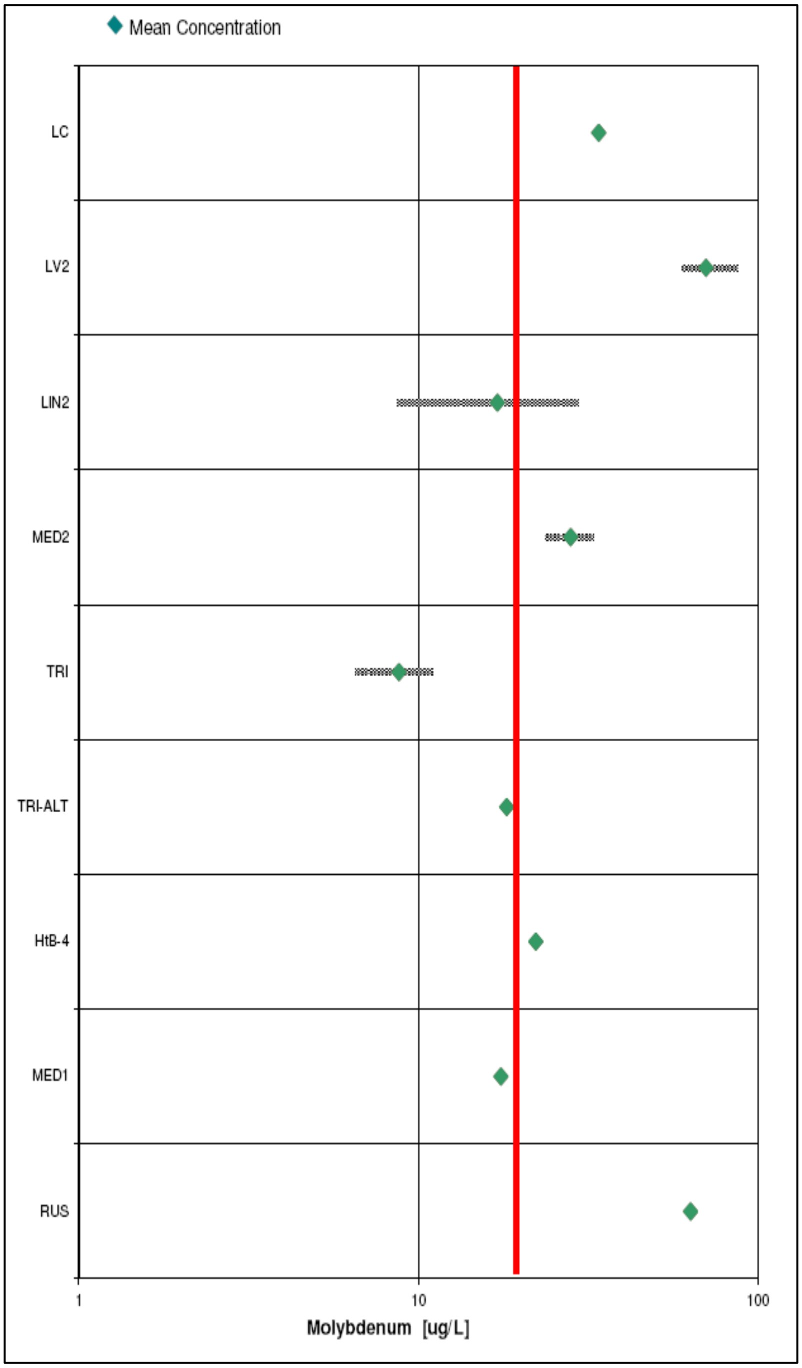


Figure 2-21
Range of Nickel Data and Mean Concentrations

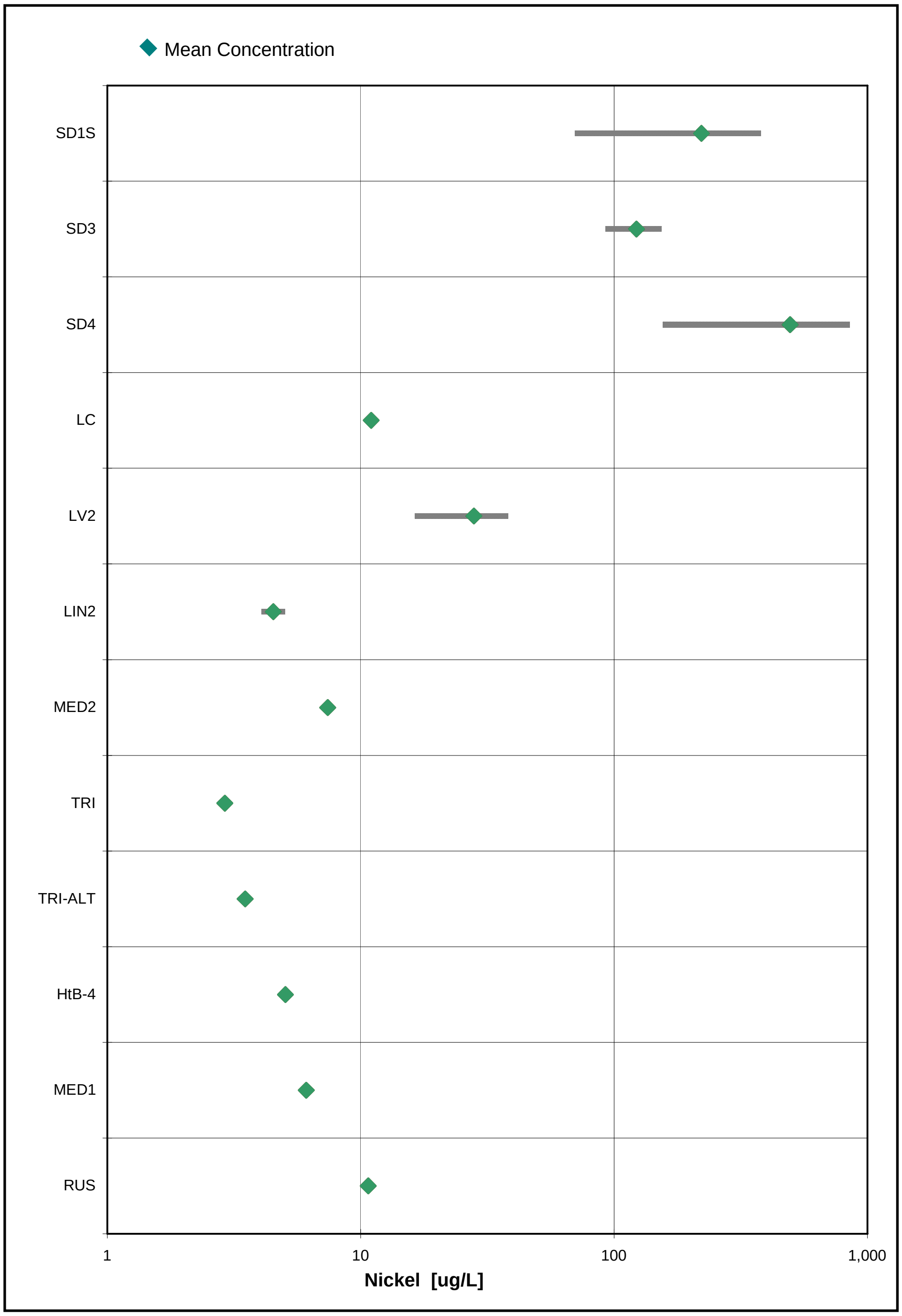


Figure 2-22
Range of Selenium Data and Mean Concentrations

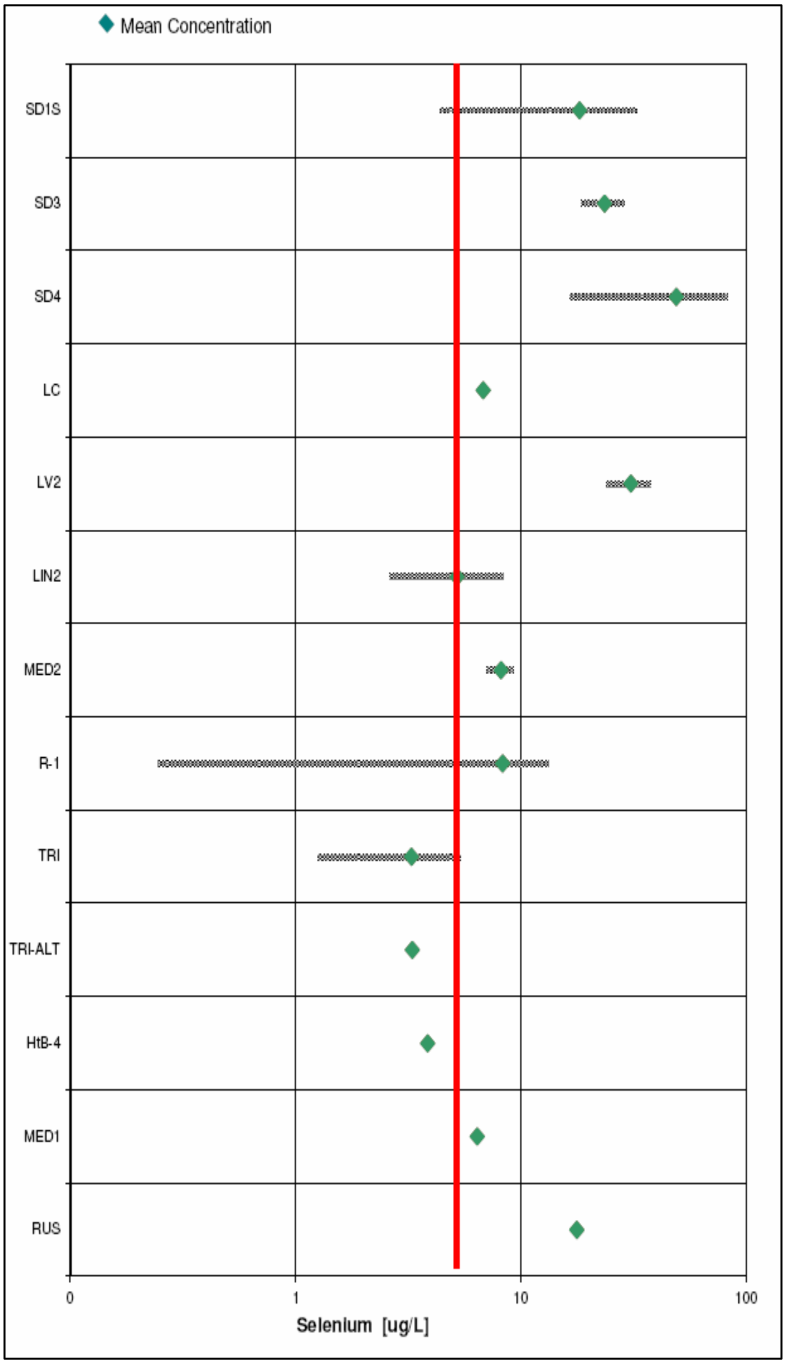


Figure 2-23
Range of Silver Data and Mean Concentrations

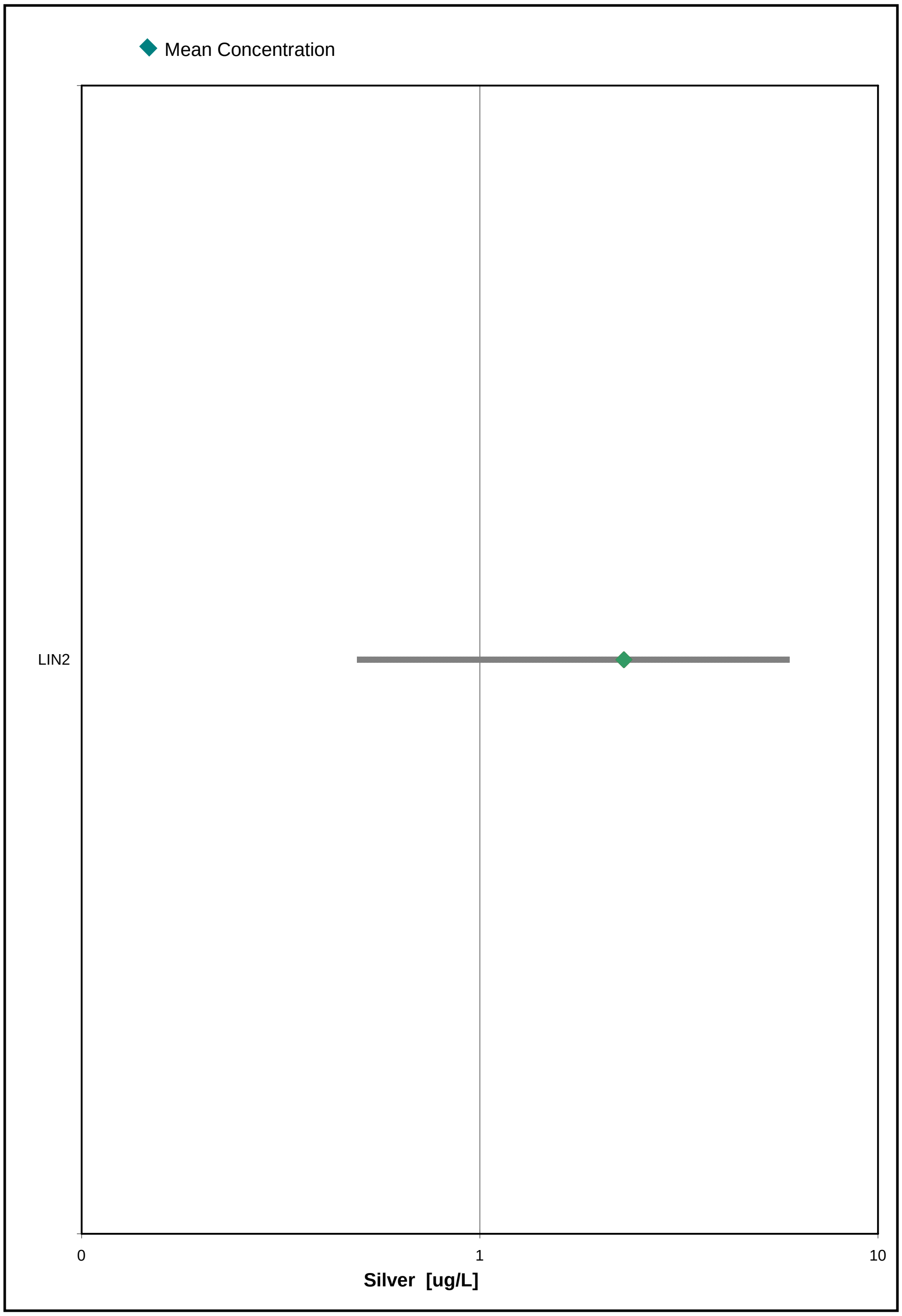


Figure 2-24
Range of Strontium Data and Mean Concentrations

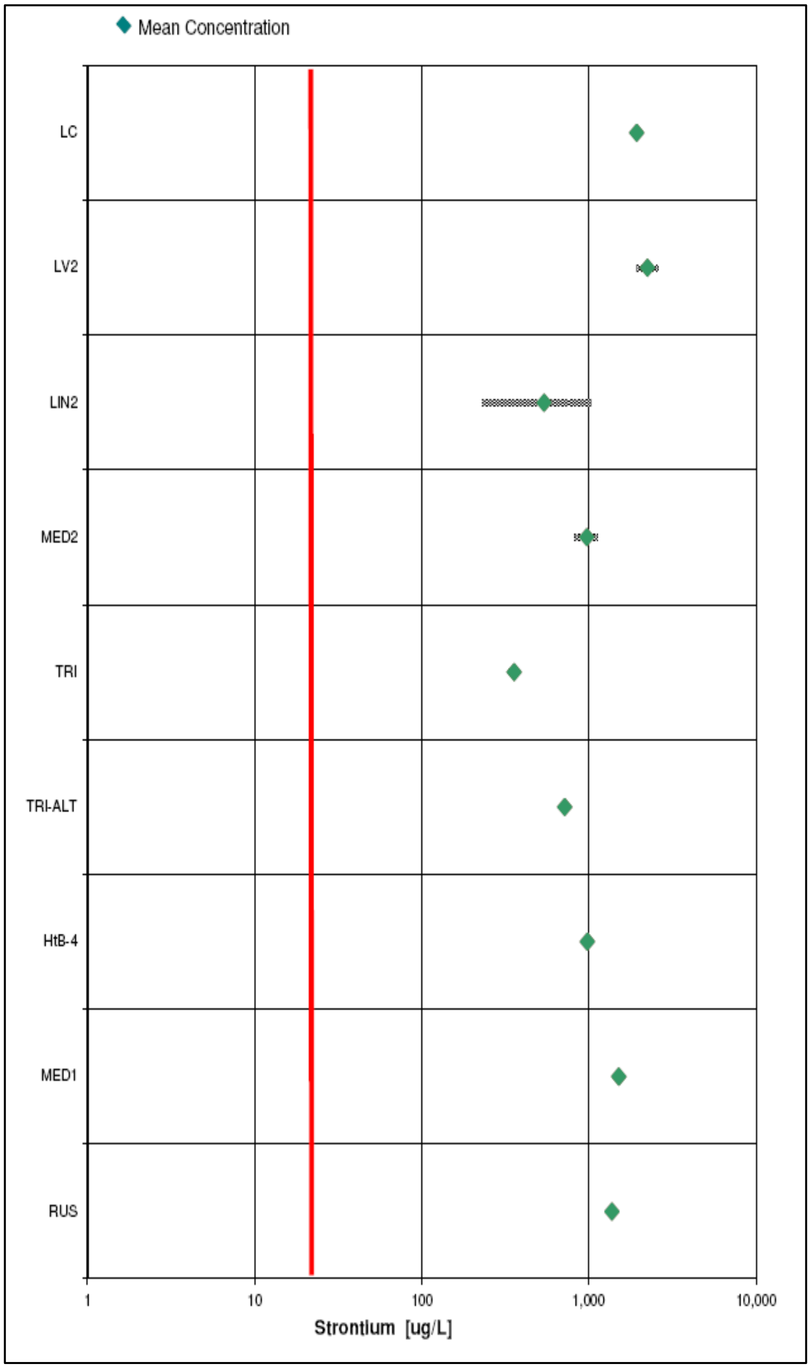


Figure 2-25
Range of Tin Data and Mean Concentrations

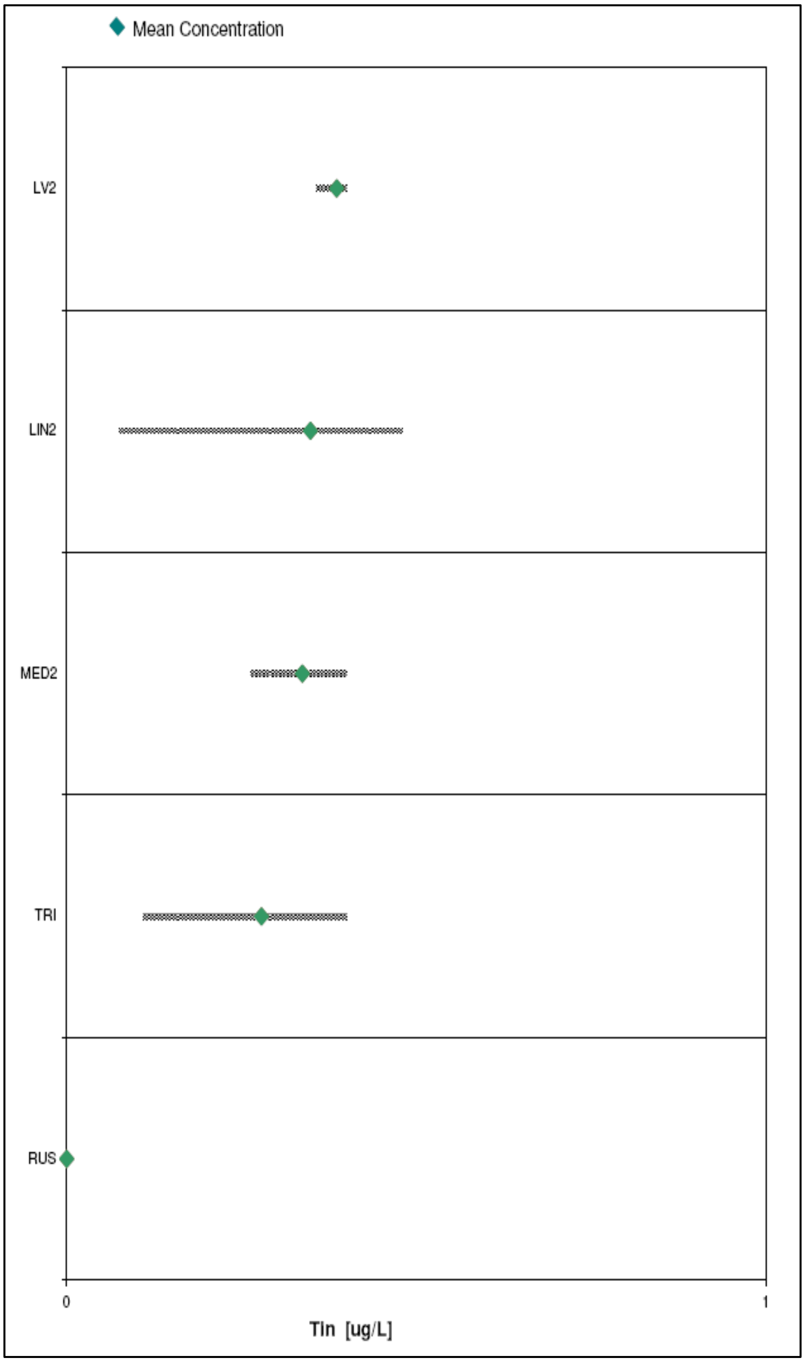


Figure 2-26
Range of Titanium Data and Mean Concentrations

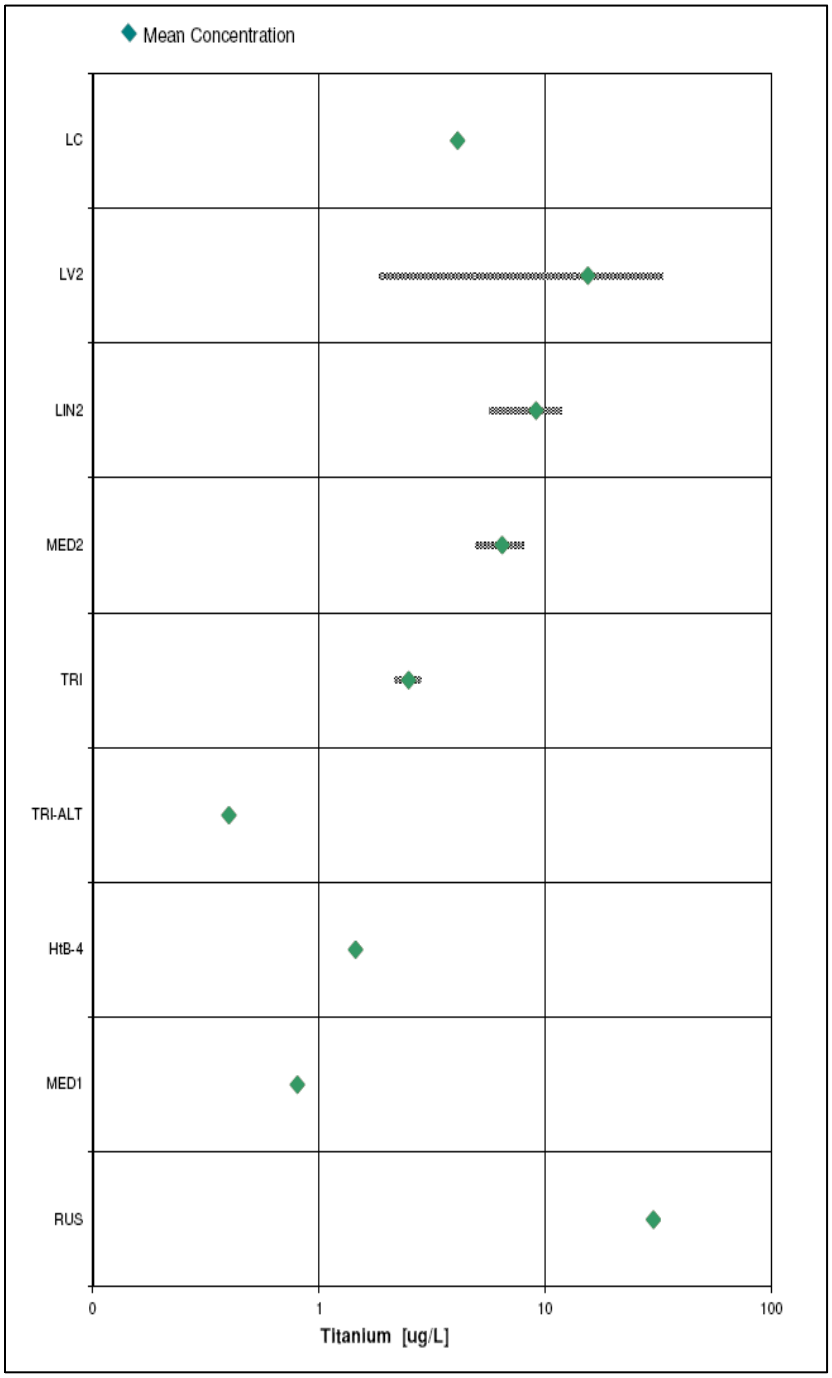


Figure 2-27
Range of Vanadium Data and Mean Concentrations

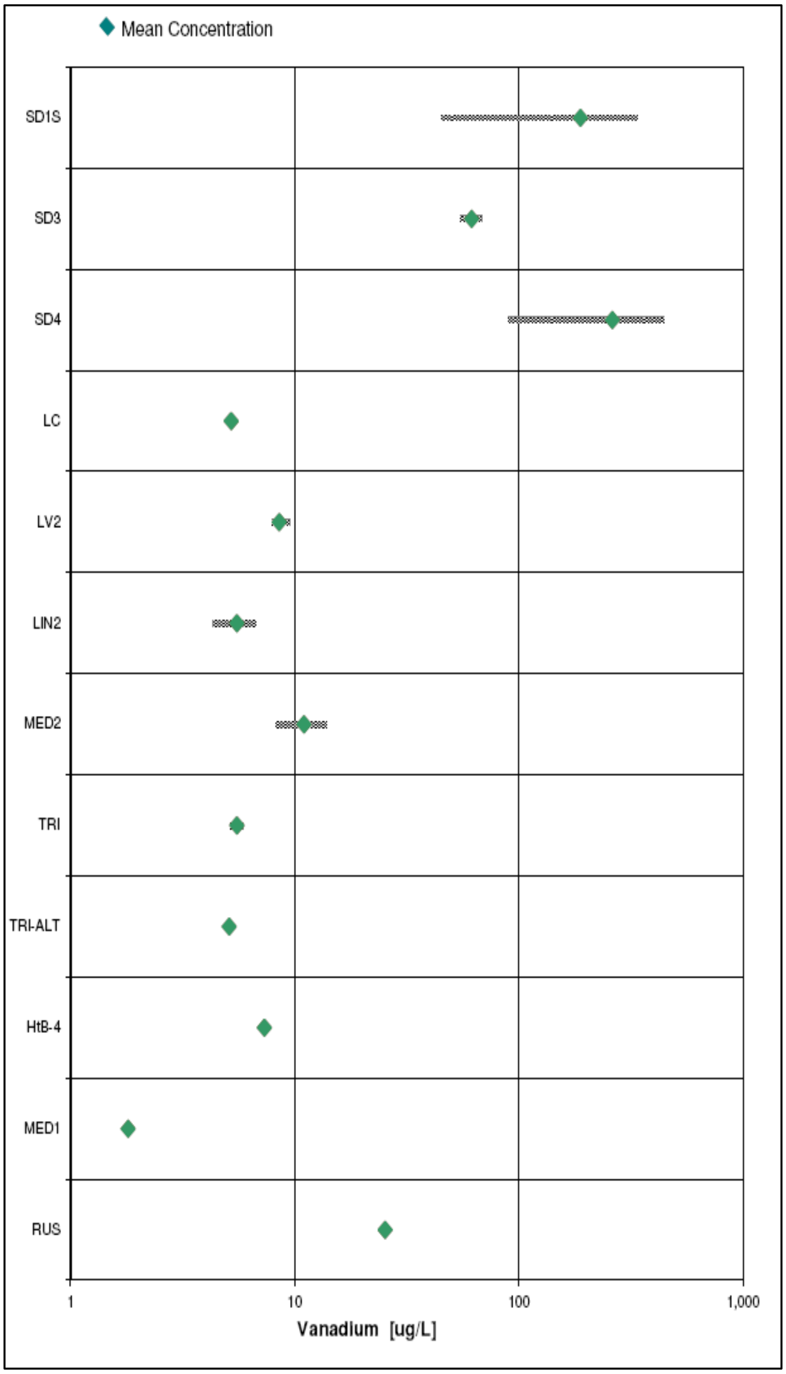
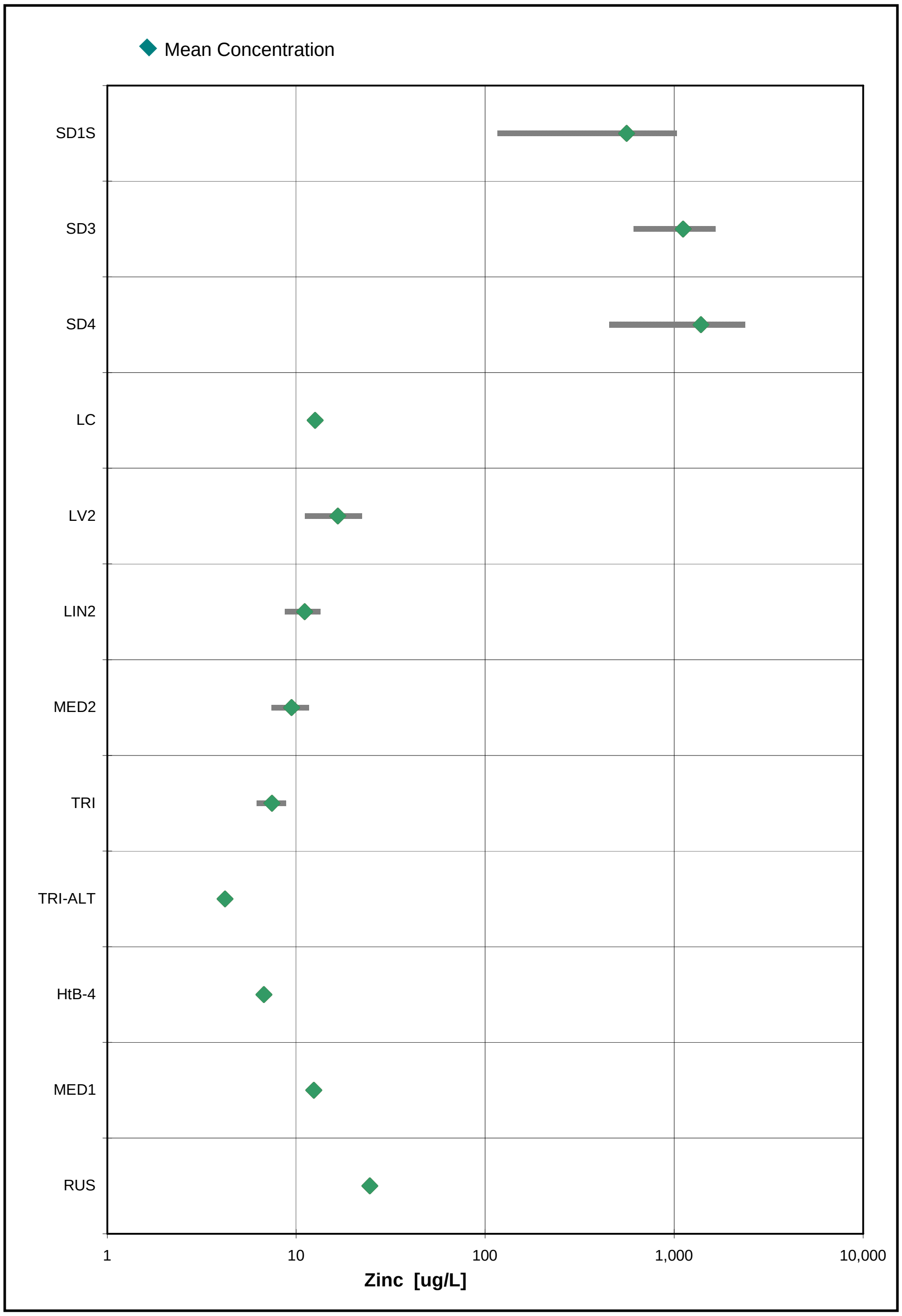


Figure 2-28
Range of Zinc Data and Mean Concentrations



2.1.4 EPA Priority Toxic Pollutants and Additional Pollutants of Concern

Additional pollutant data, including asbestos, cyanide, total hardness, acid, base, and neutral extractable compounds, chlorinated pesticides, PCB congeners, and polynuclear aromatic hydrocarbons, was collected at 13 sites throughout Malibu Creek Watershed.

Nine sites were sampled for 146 additional parameters as a component of the "Hot Spots" monitoring conducted as part of the Malibu Creek Watershed Monitoring Program. The number of samples available per site as part of the "Hot Spots" program is shown above in Table 2-6. Wet day samples were taken on March 1, 2006 and April 7, 2006. A dry day sample set was taken on February 15, 2007.

The 146 additional constituents included the following compounds:

- Asbestos;
- Cyanide;
- Total Hardness;
- Acid Extractable Compounds including: 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chlorophenol, 2-Methyl-4,6-dinitrophenol, 2-Nitrophenol, 4-Chloro-3-methylphenol, 4-Nitrophenol, Pentachlorophenol, and Phenol;
- Base/Neutral Extractable Compounds including: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-Chloronapthalene, 3,3-dichlorobenzidine, 4-Bromophenylphenylether, 4-Chlorophenylphenylether, Azobenzene, Benzidine, bis(2-Chloroethoxy)methane, bis(2-Chloroethyl)ether, bis(2-Chloroisopropyl)ether, bis(2-Ethylhexyl) Phthalate, Butylbenzyl Phthalate, Diethyl Phthalate, Dimethyl Phthalate, Di-n-butyl Phthalate, D-n-octyl Phthalate, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Isophorone, Nitrobenzene, N-Nitrosodimethylamine, N-Nitrosodi-n-propylamine, and N-Nitrosodiphenylamine;
- Chloronated Pesticides including: 2,4'-DDD, 2,4'-DDE, 2,4'-DDT ND, 4,4'-DDE, 4,4'-DDT, Aldrin, BHC-alpha, BHC-beta, BHC-delta, BHC-gamma, Chlordane-alpha, Chlordane-gamma ND, cis-Nonachlor, Dieldrin, Endosulfan Sulfate, Endosulfan-I, Endosulfan-II, Endrin, Endrin Ketone, Heptachlor, Heptachlor Epoxide, Methoxychlor, Mirex, Oxychlordane, Total Chlordane, Total Detectable DDTs, Toxaphene, and trans-Nonachlor;
- PCB Congeners including: PCB018, PCB028, PCB031, PCB033, PCB037, PCB044, PCB049, PCB052, PCB066, PCB070, PCB074, PCB077, PCB081, PCB087, PCB095, PCB097, PCB099, PCB101, PCB105, PCB110, PCB114, PCB118, PCB119, PCB123, PCB126, PCB128+167, PCB138, PCB141, PCB149, PCB151, PCB153, PCB156, PCB157, PCB158, PCB168+132,

PCB169. PCB170, PCB177, PCB180, PCB183, PCB187, PCB189, PCB194, PCB200, PCB201, PCB206, and Total Detectable PCBs; and

- Polynuclear Aromatic Hydrocarbons including: 1-Methylnaphthalene, 1-Methylphenanthrene, 22,3,5-Trimethylnaphthalene, 2,6-Dimethylnaphthalene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Bez[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[e]pyrene, Benzo[g,h,I]perylene, Benzo[k]fluoranthene, Biphenyl, Chrysene, Dibenz[a,h]anthracene, Dibenzothiophene, Fluoranthene, Fluorene, Indeno[1,2,3-c,d]pyrene, Naphthalene, Perylene, Phenanthrene, Pyrene, and Total Detectable PAHs.

Table 2-9 shows mean concentrations of these pollutants where they were detected. Only the chrysene sample at LV2 exceeded the EPA Priority Pollutant Level of 3.8 ng/L, with a concentration of 11.3 ng/L.

Additional sampling data was evaluated from sites in the vicinity of the Calabasas Landfill. Data was available from one site, Ches, for the 2nd quarter of 2004 and from three sites, SD1S, SD3, and SD4, for the year 2006.

Table 2-9.
Mean Concentrations of EPA Priority Toxic Pollutants and Additional Pollutants of Concern

Parameter	LC	LV2	LIN2	MED2	TRI	TRI-ALT	HtB-4	MED1	RUS
1-Methylnaphthalene ng/L	2.5	3.23	2.17	ND	3	1.1	1.4	1.6	ND
2,4-Dinitrophenol ng/L	ND	ND	118.67	ND	ND	ND	ND	ND	ND
2,6-Dimethylnaphthalene ng/L	ND	1.8	10.1	ND	ND	3.6	8.9	ND	ND
2-Methylnaphthalene ng/L	2.8	5.3	3.90	ND	7.10	ND	3.5	ND	ND
Anthracene ng/L	ND	ND	3.33	ND	ND	ND	ND	ND	ND
Benz[a]anthracene ng/L	ND	2.2	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene ng/L	4.4	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) Phthalate ng/L	743.3	160.9	267.7	172.5	145	137	179.3	169.1	253.7
Butylbenzyl Phthalate ng/L	119.4	41.1	99.47	44.50	59.7	21.1	37.2	30.1	33.4
Chrysene ng/L	ND	11.3	ND	ND	ND	ND	ND	ND	ND
Diethyl Phthalate ng/L	152.3	165.63	213.27	402	165	44.4	79.1	46.6	987
Dimethyl Phthalate ng/L	ND	ND	13.47	ND	ND	13.1	13.6	ND	13.9
Di-n-butyl Phthalate ng/L	466.6	116.03	163.83	80.75	74.4	247.4	252.7	235.7	235.8
Di-n-octyl Phthalate ng/L	219.4	ND	12.13	ND	ND	ND	ND	ND	24.70
Fluoranthene ng/L	3	12	2.83	ND	ND	ND	ND	ND	ND
Isophorone ng/L	137	68	61.67	ND	ND	73	74	101	84
Naphthalene ng/L	11.8	10.25	3.23	ND	7.7	2.5	2.6	4	4.1
Perylene ng/L	ND	26.7	ND	ND	ND	ND	ND	ND	ND
Phenanthrene ng/L	ND	13.7	ND	ND	ND	ND	ND	ND	ND
Pyrene ng/L	2.6	8.7	3.23	ND	ND	ND	ND	ND	ND
Total Detectable PAHs ng/L	27.1	52.43	19.63	ND	14.05	7.2	16.4	6.7	4.1
Total Hardness as $CaCO_3$ mg/L	818	1462.67	414.17	707.75	284.75	448	656.5	1675	670

ND = Non-detect

The 2004 sample set included data on several volatile organic compounds including: 2-Butanone, 2-Hexanone, 4-Methyl-2-Pentanone, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,2-Dibromo-3-Chloropropane, 1,2-Dibromoehtane, 1,2-Dichloroethane, 1,2-Dichloropropane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,2,3-trichloropropane, 1,1,1,2-Tetrachloroethane, 1,1,2,2-Tetrachloroethane, Acetone, Acrylonitrile, Benzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbono Disulfide, Carbon Tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, Cis-1,2-Dichloroethene, Cis-1,3-Dichloropropene, Dibromochloromethane, Ethyl Benzene, Freon-11, Freon-12, M+P – Xylenes, Methyl Iodide, Methylene Bromide, Methylene Chloride, O-Dichlorobenzene, O-Xylene, P-Dichlorobenzene, Styrene, T-1,4-Dichloro-2-Butene, Tetrachloroethylene, Toluene, Trans-1,2-Dichloroethylene, Trans-1,3-Dichloropropene, Trichloroethylene, Vinyl Acetate, and Vinyl Chloride. None of these compounds were detected in the 2004 sample conducted on May 3, 2004.

The 2006 sample set included data on the following volatile organic compounds: 2-Chloroethylvinylether, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,2-Dichloroethane, 1,2-Dichloropropane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Acetone, Benzene, Bromodichloromethane, Bromoform, Bromomethane, Carbon Tetrachloride, Chlorobenzene, Chloroform, Chloroethane, Chloromethane, Cis-1,3-Dichloropropene, Dibromochloromethane, Ethyl Benzene, M-Dichlorobenzene, Methylene Chloride, O-Dichlorobenzene, P-Dichlorobenzene, Tetrachloroethylene, Toluene, Trans-1,2-Dichloroethylene, Trans-1,3-Dichloropropene, Trichloroethylene, and Vinyl Chloride. Of these compounds, acetone was detected at SD1S at 23.5 μg/L, at SD3 at 16 μg/L, and at SD4 at 36.5 μg/L. Trichloroethylene was also detected at SD3 at a concentration of 0.8 μg/L, below the Basin Plan limit of 5.0 μg/L.

Table 2-10 below shows as listing of all of the metals and EPA priority pollutants detected within the watershed and the values of their recommended limits. The source of the limit data is also shown.

Table 2-10.
List Of Detected Pollutants (Priority Pollutants And Metals) With Their Recommended Limits And Source Of Limit Data

PARAMETER	RECOMMENDED LIMITS	RECOMMENDED LIMITS SOURCE
1-Methylnaphthalene	1840 mg/kg	Cartwright, Hugh. Physical and Theoretical Chemistry Laboratory, Oxford University: MSDS for 1-Methylnaphthalene. Oxford, UK, June 2007.
2,6-Dimethylnaphthalene	193 µg/L	J.Great Lakes Res.14(4):394-404; Aquat.Sci.Fish.Abstr.17(2):139 (1987) Toxicity to the Water Flea
2-Methylnaphthalene	28 µg/L	Marshack, Jon B. Beneficial Use-Protective Water Quality Limits for Components of Petroleum-Base Fuels. RWQCB - Central Valley, April 2004.
Aluminum (Al)	200 µg/L	EPA. 40 CFR 143.3, Secondary Maximum Contaminant Levels for Public Water Systems
Antimony (Sb)	14 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Arsenic (As)	150 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B2
Barium (Ba)	1 mg/L	Los Angeles Regional Water Quality Control Board. Basin Plan,Table 3-5: Maximum Contaminant Levels: Inorganic Chemicals for MUN. June, 1994.
bis(2-Ethylhexyl) Phthalate	1.8 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Butylbenzyl Phthalate	3000 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Chromium (Cr)	0.05 mg/L at 100 mg/l Hardness as $CaCO_3$	Los Angeles Regional Water Quality Control Board. Basin Plan,Table 3-5: Maximum Contaminant Levels: Inorganic Chemicals for MUN. June, 1994.
Cobalt (Co)	4 µg/L	Government of British Columbia, Ambient Water Quality Guidelines for Cobalt: Aquatic Life Freshwater 30-d Average. September, 2004.
Copper (Cu)	9.0 µg/L at 100 mg/l Hardness as $CaCO_3$	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B2
Diethyl Phthalate	23000 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Dimethyl Phthalate	313000 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Di-n-butyl Phthalate	2700 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Isophorone	8.4 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Lead (Pb)	2.5 µg/L at 100 mg/l Hardness as $CaCO_3$	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B2
Naphthalene	170 µg/L	State of California. Office of Environmental Health Hazard Assessment: Notification Levels for Chemicals in Drinking Water. April, 2000.
Nickel (Ni)	52 µg/L at 100 mg/l Hardness as $CaCO_3$	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B2
Selenium (Se)	5 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B2
Titanium (Ti)	N/A	Not currently regulated.

Total Detectable PAHs	4000 µg/kg	EPA. Stormwater Effects Handbook: Appendix G Water Quality Criteria - Table G.7.
Vanadium (V)	N/A	EPA. Integrated Risk Information System. June, 1988.
Zinc (Zn)	120 µg/L at 100 mg/l Hardness as $CaCO_3$	EPA. Federal Register Part III: 40 CFR Part 131.38, Type B1
2,4-Dinitrophenol	70 µg/L	EPA. Federal Register Part III: 40 CFR Part 131.38, Type D1
Barium (Ba)	1 mg/L	Los Angeles Regional Water Quality Control Board. Basin Plan, Table 3-5: Maximum Contaminant Levels: Inorganic Chemicals for MUN. June, 1994.
Biphenyl	0.014 µg/L	EPA. Current National Recommended Water Quality Criteria - Priority Pollutants. April, 2007.
Perylene	210 µg/L	EPA. Region 1 - NPDES Remediation, Appendix A. NHGWS. February, 1999.
2-Methylnaphthalene	10 µg/L	EPA. 40 CFR 401.15, Appendix C, PQL. 2003.

2.2 Bioassessment Results

In 2005 a bioassessment survey of the Malibu Creek watershed was conducted by staff members of the Malibu Creek Watershed Monitoring Program and Aquatic Bioassay and Consulting Laboratories. Eleven benthic macroinvertebrate (BMI) sampling locations were visited during two synoptic surveys in the spring and fall of 2005. Of these, three sites (Liberty Canyon Creek, lower Lindero Creek and Potrero Creek) were not sampled during either season because they were not flowing; and Hidden Valley Creek, which is located on private land, was only sampled in the spring due to access problems.

Biological assessments (bioassessments) can be used as a watershed management tool for surveillance of conditions and to provide recommendations for land-use best management practices. Bioassessment monitoring has been ongoing in the Malibu Creek watershed since 2000 as part of Heal the Bay's, Stream Team monitoring effort. The bioassessment data presented in this report were collected as part of the Malibu Creek Watershed Monitoring Program.

Water resource monitoring using benthic macroinvertebrates (BMI) is by far the most popular method used throughout the world. BMIs are ubiquitous, relatively stationary and their large species diversity provides a spectrum of responses to environmental stresses (Rosenberg and Resh 1993). Individual species of BMIs reside in the aquatic environment for a period of months to several years and are sensitive, in varying degrees, to temperature, dissolved oxygen, sedimentation, scouring, nutrient enrichment and chemical and organic pollution (Resh and Jackson 1993). Finally, BMIs represent a significant food source for aquatic and terrestrial animals and provide a wealth of ecological and bio-geographical information (Erman 1996).

Results from BMI monitoring can be compiled using a multi-metric scoring technique that combines a set of biological measurements ("metrics"), each representing a different aspect of the community data, to produce an Index of Biotic Integrity (IBI). The IBI is the end point of a multi-metric analytical approach and represents an overall site score. Sites can then be ranked according to their scores and classified as having "good", "fair" or "poor" water quality. This is the approach recommended by the Environmental Protection Agency (EPA) for development of biocriteria (Davis and Simon 1995). The original IBI was created for assessment of fish communities (Karr 1981) but was subsequently adapted for BMI communities (Kerans and Karr 1994).

The Southern California Index of Biological Integrity (So. Cal. IBI) score provides a measure of the aquatic health of a stream reach and is calculated using a multi-metric technique that employs seven biological metrics that were each found to respond to a habitat and/or water quality impairment. Each of the seven biological metrics that were measured at a site were converted to an IBI score then summed. These cumulative scores can then be ranked according to very good (80-56), good (41-55), fair (27-40), poor (14-26) and very poor (0-13) habitat conditions. The threshold limit for this scoring index is 26. Sites with scores below 26 are considered to have impaired conditions.

This section includes a summary of the results and analyses of physical habitat and bioassessment data collected at eight sites in the spring and fall of 2005. In addition, these data were compared and contrasted to previous BMI IBI scores generated by the Heal the Bay Stream Team.

2.2.1 Materials and Methods

The full details of the methods performed and data collected during the bioassessment can be found in the report, Malibu Creek Watershed Monitoring Program Bioassessment Monitoring Spring/Fall 2005 (hereafter known as the Bioassessment Report). The steps involved in the bioassessment are listed below.

- Collection of Benthic Macroinvertebrates
- Physical/Habitat Quality Assessment, Water Quality and Chemical Measurements
- Sample Analysis/Taxonomic Identification of BMIs
- Data Development and Analysis

The *Data Development and Analysis* procedures included collecting data for the Multi-metric Analysis and then developing the Southern California Index of Biological Integrity (So. Cal. IBI). Some related details are described here:

Multi-metric Analysis

The following bioassessment metrics were calculated to assess the spatial and temporal BMI community changes in the watershed and the community responses to impaired conditions. (The metrics are listed here, and brief descriptions can be found with the data in Section 2.2.2 Bioassessment Results.)

1. RICHNESS MEASURES: taxa richness, cumulative taxa, EPT[1] taxa, cumulative EPT taxa, Coleopteran taxa.
2. COMPOSITION MEASURES: EPT index, sensitive EPT index, Shannon diversity.
3. TOLERANCE/INTOLERANCE MEASURES: mean tolerance value, intolerant organisms (%), tolerant organisms (%), dominant taxa (%), Chironomidae (%), non-insect taxa (%).
4. FUNCTIONAL FEEDING GROUP: collectors (%), filterers (%), grazers (%), predators (%), shredders (%).

Southern California IBI

Seven biological metric values are used to compute the So. Cal. IBI. The So Cal. IBI is based on the calculation of biological metrics from a group of 500 organisms from a composite

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[1] EPT taxa richness is a measure of stream water quality. Its name is shorthand for the three orders of insects used in its calculation: *Ephemeroptera* + *Plecoptera* + *Trichoptera*. See the biological metrics subsection in the 2.2.2 Results section below.

sample collected at each stream reach. Tables listing the BMI metrics and the scoring ranges for the California IBI can be found in the Bioassessment Report (Tables 2 and 3).

2.2.2 Results

Complete results from the bioassessment can be found in the Bioassessment Report. Key results in the report are presented according to the categories listed below.

- Physical Habitat Characteristics (velocity, canopy cover and substrates)
- Species Composition
- BMI Community Structure (biological metrics)
- IBI scores

Physical Habitat Characteristics

Of the eight sites visited during the 2005 surveys, only Malibu Creek upstream of the lagoon (MAL) ranked in the optimal range during both the spring and fall. Scores for sites on Lower Medea Creek (MED2), Lower Las Virgenes Creek (LV2), and Triunfo Creek downstream of Westlake Lake (TRI) were in the suboptimal range. Marginal scores were recorded for the upper reaches of Lindero Creek (LIN1) and Medea Creek (MED1), and for Hidden Valley (HV). One site on Upper Las Virgenes Creek (LV1) was scored in the poor range.

Species Composition

A combined total of 7,686 BMIs (benthic macroinvertabrates), represented by 46 taxa, were identified from the 15 samples collected at the eight sampling sites during the spring and fall of 2005. The estimated total abundance for all sites and seasons combined would be 109,737 individuals.

During the spring the most abundant species at most sites included Baetid mayflies (Baetis sp.), flies (Orthocladiinae, Chironominae, Simulium sp.), ostracods and amphipods (Cyprididae and Hyalella sp.) (Table 6a). At each of the sites, the combined abundances of three to five species accounted for over 75% of the total abundance, except at Medea Creek Station MED2, where the New Zealand mudsnail (Potamopyrgus antipodarum) accounted for 85% of the population. This species was also collected at MED1, accounting for 15% of the population. This was the first positive identification of this invasive species in the watershed.

By fall the New Zealand mudsnail had become more abundant at both Medea Creek sites (MED1 and MED2), accounting for 80 and 91% of these populations, respectively (Table 6b). This species had also spread to lower Malibu Creek (n = 3), upper Las Virgenes Creek (n = 1), and Lindero Canyon Creek (n = 1). Ostracods were the most abundant species collected at MAL, TRI and LV1. The stonefly, Malenka sp., is sensitive to disturbances and was only found in the fall at the upper Las Virgenes Creek site (LV1).

BMI Community Structure

The structure of the community of organisms in the watershed is described by a listing of the taxa found living in the watershed[1]. Analyzing the composition of the taxa according to certain established metrics can provide information about the health of the water resources in the watershed. The biological metrics calculated for this survey were grouped into four categories: richness measures, composition measures, tolerance/intolerance measures and functional feeding groups.

Richness Measures:
Taxa richness is a measure that counts the total number of species found at a site. This relatively simple index can provide much information about the integrity of the community. *EPT taxa* is the simultaneous count of all of the mayflies (**E**phemeroptera), stoneflies (**P**lecoptera) , and caddisflies (**T**richoptera) present at a location. These families are generally sensitive to impairment and, when present, are usually indicative of a healthy community. In this case, both Coleopteran and Predator taxa are included since they are used to calculate the So. Cal. IBI.

For the Malibu Creek Watershed Monitoring Program, taxa richness ranged from lowest (n = 10) in Lower Las Virgenes Creek (LV2) during the fall and Lower Medea Creek (MED2) in both spring and fall surveys, to greatest (n = 24) in the fall in Upper Las Virgenes Creek (LV1). EPT taxa were ≤3 at all sites except Lower Malibu Creek (MAL) during both surveys (6 and 5). Few Coleoptera taxa were collected at any of the sites, except Upper Las Virgenes Creek (LV1) during both the spring and fall (4 and 3, respectively). The greatest numbers of predator taxa were collected in Lower Malibu Creek (MAL), Lower Las Virgenes Creek (LV2) and Triunfo Creek downstream of Westlake Lake (TRI) in the spring and LV1 in the spring. The fewest predators were collected in Lower Las Virgenes Creek (LV2) in the fall and in Upper and Lower Medea Creek (MED1, MED2) during both seasons. Estimated abundances were greatest in Upper Medea Creek (MED1) during both surveys and least in Lower Las Virgenes Creek (LV2), Upper Lindero Creek (LIN1) and Triunfo Creek (TRI).

Composition Measures:
The *EPT taxa*, *sensitive EPT*, *percent non-insects*, and the *Shannon Diversity Index* are all measures of community composition. Species diversity indices are similar to numbers of species; however they also measure the distribution of total population numbers among the species present (as a measure of evenness or balance).

While EPT taxa are the numbers of taxa at a site that are mayflies, stoneflies and caddisflies, the metric, percent Sensitive EPT taxa, is the proportion of all of the EPT taxa whose tolerance values range from 0 to 3. These taxa are very sensitive to impairment and, when present, can be indicative of more natural conditions. The greatest numbers of EPT taxa were collected at MAL and the fewest were found at MED1 and HV in the fall (Figure 7). No Sensitive EPT taxa were collected at any of the sites. The greatest percentages of non-insects were collected in the fall at LV2, MED2 and MED1 (>90%). The lowest percentages of non-insects were found in the spring at MAL and LV1. Shannon Diversity ranged from lowest at

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[1] The complete taxa list including raw abundances by site as well as the ranked abundance of each species by site are presented in Tables 6a and 6b and Appendix A, Table A-1 of the Bioassessment Report.

MED2 in the spring and fall and MED1 in the fall to greatest at LV1 in the fall. Diversity was similar to or greater at each site in the spring compared to the fall, except at LV1 and LIN1 where diversity was slightly greater in the fall.

Tolerance Measures:
The Southern California IBI uses both the *percent intolerant* and *percent tolerant* organisms to evaluate the overall sensitivity of organisms to pollution and habitat impairment. With these metrics, each species is assigned a tolerance value from 0 (highly intolerant) to 10 (highly tolerant). The percent Intolerance Value for a site is calculated by multiplying the tolerance value of each species with a tolerance value ranging from 0 to 2, by its abundance, then dividing by the total abundance for the site. The percent Tolerant Value is similar except that only species with tolerance values ranging from 8 to 10 are included. A site with many tolerant organisms present is considered to be less pristine or more impacted by human disturbance than one that has few tolerant species.

Another tolerance measure is the *percent dominance.* This reflects the proportion of the total abundance at a site represented by the most abundant species. For example, if 100 organisms are collected at a site and species A is the most abundant with 30 individuals, the percent dominance index score for the site is 30%. The benthic environment tends to be healthier when the dominance index is low, which indicates that more than just a few taxa make up the majority of the community.

The percent Hydropsychidae (caddisflies) and Baetidae (mayflies) present in a stream reach can indicate stressed habitat conditions when they are found in high abundance. They will not be present in highly polluted streams, but can be found in moderately polluted streams, especially when nutrients are high or there is a large amount of sedimentation.

Mean Tolerance Values were similar across sites, ranging from 5.2 to 7.8 and were slightly greater in the fall (Figure 8). Dominance was greatest at MED 2 (spring and fall) and MED1 (fall) and least at MED1 in the spring. The greatest percentage of tolerant organisms was collected at LV2 (fall), MED2 (spring and fall) and MED1 (fall), and the least were collected in the spring at MAL and LIN1. No intolerant species were collected at any site except at LV1 in the fall (Malenka sp., <0.01%). Few Hydropsychidae (caddisflies) were collected, except at MAL in the spring (17%). The greatest number of Baetidae (mayflies) was collected at MAL in the spring (34%).

Functional Feeding Groups:
The functional feeding group indices provide information regarding the balance of feeding strategies represented in an aquatic assemblage. The combined feeding strategies of the organisms in a reach provide information regarding the form and transfer of energy in the habitat. When the feeding strategy of a stream system is out of balance it can be inferred that the habitat is stressed. For the purposes of this study, species were grouped by feeding strategy as percent collector-gatherers, collector-filterers, grazers, predators and shredders. The Southern California IBI uses the numbers of predators and percent collectors (gatherers + filterers) at a site to calculate the index.

Collecting was the predominant feeding strategy used by organisms in the watershed, especially in the spring. This was not the case in Lower Las Virgenes Creek (LV2) during the fall survey, Lower Medea Creek (MED2) during both surveys, and Upper Medea Creek (MED1) in the fall survey, where grazing was the preferred strategy. Predation was greatest in Lower Malibu Creek (MAL), Upper Las Virgenes Creek (LV1) and Upper Lindero Creek (LIN1) in the spring and Triunfo Creek (TRI) in the fall.

IBI Scores

The IBI is a multi-metric technique that employs seven biological metrics that were each found to respond to a habitat and/or water quality impairment. Each of the seven biological metrics measured at a site are converted to an IBI score then summed. These cumulative scores can then be ranked according to very good (80-56), good (41-55), fair (27-40), poor (14-26) and very poor (0-13) habitat conditions, based on the Southern California Index of Biological Integrity scale of 0-80. Such scores are sometimes adjusted to a range of 0-100 (for SWAMP and other purposes), but the categories would not change. The threshold limit for this scoring index is 26. Despite the fact that rankings can be identified as “fair”, sites with scores above 26 are within two standard deviations of the mean reference site conditions in southern California and are not considered to be impaired. Sites with scores below 26 are considered to have impaired conditions.

The IBI scores for all but one site in the Malibu Creek Watershed were ranked as “poor or very poor” and were therefore considered as impaired. The exception was Malibu Creek (MAL) in the spring, which ranked in the “fair” range. Table 2-11 and Figure 2-29 show these scores.

Table 2-11
Bioassessment metrics used to describe characteristics of the benthic macroinvertebrates (BMI) community.

Station	**MAL**	**LV2**	**LV1**	**MED2**	**MED1**	**LIN1**	**TRI**	**HV**
Metric				**Spring**				
Coleoptera Taxa	2	0	7	2	0	0	0	4
EPT Taxa	3	1	1	1	1	0	1	1
Predator Taxa	4	3	3	0	0	1	4	2
% Collector Taxa	7	6	3	10	9	3	8	5
% Intolerant Taxa	0	0	0	0	0	0	0	0
% Non-Insect	8	1	6	0	0	0	0	0
% Tolerant	9	1	5	0	0	8	0	0
Total	**33**	**12**	**25**	**13**	**10**	**12**	**13**	**12**
So. Cal. IBI[1] Rating	**Fair**	**Very Poor**	**Poor**	**Very Poor**	**Very Poor**	**Very Poor**	**Very Poor**	**Very Poor**
Station	**MAL**	**LV2**	**LV1**	**MED2**	**MED1**	**LIN1**	**TRI**	**HV**
Metric				**Fall**				
Coleoptera Taxa	2	0	5	0	0	0	0	NS
EPT[2] Taxa	3	1	1	1	0	1	0	
Predator Taxa	2	0	6	0	0	1	1	
% Collector Taxa	10	10	10	10	10	10	2	
% Intolerant Taxa	0	0	0	0	0	0	0	
% Non-Insect	0	0	1	0	0	0	0	
% Tolerant	0	0	0	0	0	5	0	
Total	**17**	**11**	**23**	**11**	**10**	**17**	**3**	
So. Cal. IBI Rating	**Poor**	**Very Poor**	**Poor**	**Very Poor**	**Very Poor**	**Poor**	**Very Poor**	

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[1] Index of Biological Integrity, Southern California (So. Cal. IBI)
[2] EPT taxa richness is a measure of stream water quality and is shorthand for the three Orders of insects: *Ephemeroptera* + *Plecoptera* + *Trichoptera*.

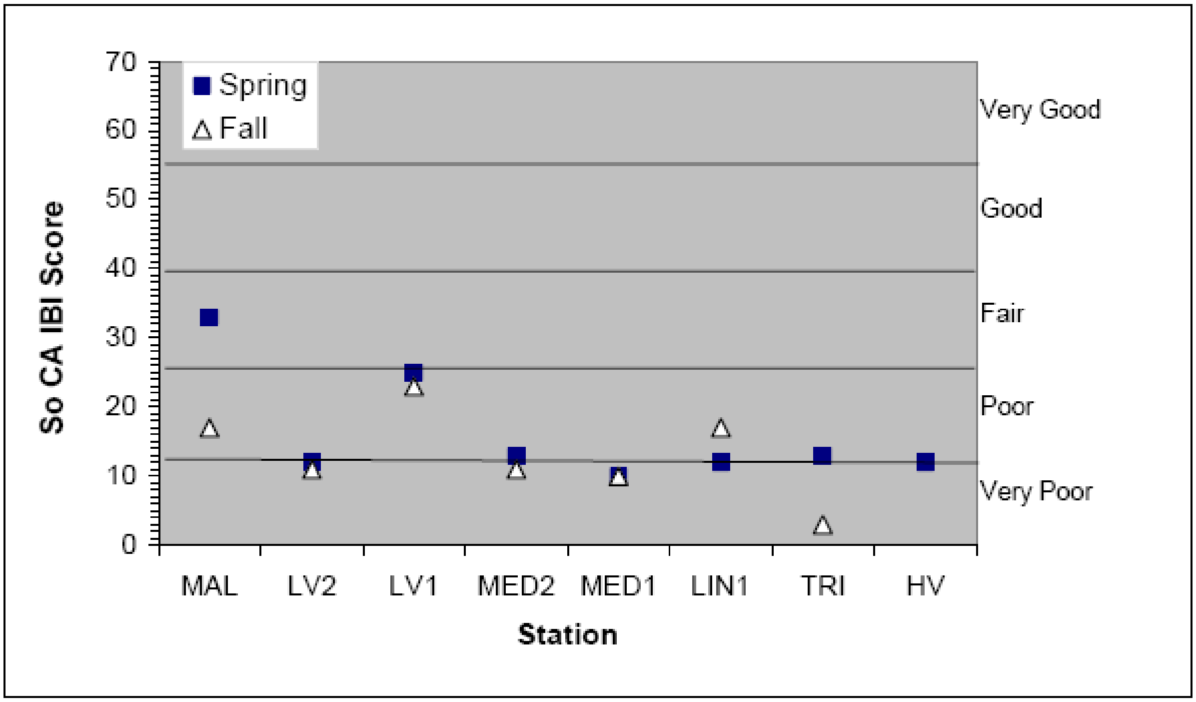

Figure 2-29
Scoring ranges for the seven metrics included in the Southern California IBI and the cumulative IBI score ranks.

2.2.3 Discussion

The IBI results for the 2005 benthic macroinvertebrate survey indicated that the aquatic health of sites visited for the MCWMP were impaired, with all stations ranking in the "very poor to poor" range, with the exception of Malibu Creek (MAL) in the spring which ranked in the "fair" range. Multiple factors have most likely contributed to the impaired BMI communities found at these sites, including the degradation of stream habitat and anthropogenic inputs. It should be noted that the wet season of 2004-2005 included several high intensity storm events. For this reason, the results of the MCWMP are compared to the extent possible to measurements taken in other recent years from nearby sites by Heal the Bay Stream Team and County of Los Angeles Department of Public Works NPDES bioassessment monitoring.

Malibu Creek (MAL)

The results of the physical/habitat assessment indicated that the best habitat conditions occurred at the Malibu Creek site located just above the lagoon (MAL). Although located next to a residential area, this site had relatively good in-stream cover and complexity, low sedimentation, high bank stability and good vegetative protection. The IBI scores at this site ranked in the "fair" range (33) in the spring and "poor" (17) in the fall. This indicated that the BMI populations at this site were possibly responding to a water quality stressor(s) in combination with any physical habitat impairments. In seven BMI samples collected at a site located 0.3 miles downstream of MAL during the spring and fall from 2000 to 2003, the Heal the Bay Stream Team found similar IBI scores (range = 16 to 39; mean = 25). In addition, during the spring sample collection large mats of algae were present along the entire reach. Luce (2003) showed that these algal mats were significantly related to the discharge of nitrate and orthophosphate from the Tapia Water Reclamation Facility.

Upper Las Virgenes Creek (LV1)

The upper Las Virgenes Creek site, located just below the Ahmanson Ranch property had the lowest physical/habitat score of all sites. There was little in-stream cover, heavy sedimentation, extensive bank erosion, little to no riparian vegetation and the west bank was cement stabilized with a road on top. Reductions in riparian habitat have resulted from recent fires which have denuded the banks of vegetation. The IBI scores were in the "poor" range during both the spring and fall (25 and 23, respectively) surveys but were slightly better than all other sites. Considering the poor habitat conditions, it is expected that the IBI scores would be correspondingly lower than all other sites. This indicates that the water quality emanating upstream of this site may be good enough to overcome some of the local, degraded, habitat conditions found there.

Lower Las Virgenes Creek (LV2), lower Medea Creek (MED2) and Triunfo Creek (TRI)

Three sites scored in the suboptimal physical/habitat range including the middle Las Virgenes Creek site (LV2), the Medea Creek site at Paramount Ranch (MED2) and Triunfo Creek (TRI). The IBI scores at each of these sites ranked in the "very poor" range. LV2 is located downstream of a mostly residential community in, what appears to be, relatively good stream bed habitat. There is moderately good in-stream and vegetative cover, and the riparian zone is fairly wide. The banks are shored with walking paths down to the creek and there is evidence of heavy human usage. MED2 is located in a dredged channel with a walking bridge and abutments located just upstream. There is good vegetative cover and undercut banks, but the riparian zone is narrow and ends on the south bank with a parking lot and the north bank with a grass recreation area. The site receives heavy recreational use and has walking paths along both banks. The streambed is mostly fine grain sand and cobble with few boulders. This site had high abundances of the New Zealand mudsnail (*Potamopyrgus antipodarum*) during both the spring and fall (see discussion below). The Triunfo Creek site is located downstream of Lakes Sherwood and Westlake. Most of the bottom and southern bank has been shored with cement and there is a bridge upstream of the site. Heal the Bay's Stream Team found similar IBI scores at this site from four samples collected from 2000 to 2003 (range = 4 to 20; mean = 15).

Upper Medea Creek (MED1), upper Lindero Creek (LIN1) and Hidden Valley Creek (HV)

Three sites scored in the marginal physical/habitat range including the upper Medea Creek site (MED1), upper Lindero Creek (LIN1) and Hidden Valley Creek (HV). Correspondingly, the IBI for each of these sites ranked as "very poor". MED1 is located in a mostly concrete lined channel, below a bridge. The complexity of the streambed has been improved with boulders embedded in the concrete and the streambed is unlined in the lower portion of the reach. During the spring, dense algal mats were present and the New Zealand mudsnail had become established at this site by the fall survey. IBI scores found by Heal the Bay ranked as "very poor to fair" (range = 9 to 34; mean = 20) between 2000 and 2003. LIN1 is located downstream of a golf course in a cement lined drainage channel containing irrigation runoff. This channel empties into a relatively large pool which empties into an unlined channel that is densely packed with reeds. HV is located in a dirt lined drainage channel surrounded by horse property. There is little in-stream cover, no riparian zone and a road running along one bank.

New Zealand Mudsnail

The collection of the New Zealand mudsnail (Potamopyrgus antipodarum) in the watershed is of immediate environmental concern. The snail was first collected in the upper and lower Medea Creek in the spring of 2005 representing 85 and 15% of the populations at these sites respectively. By the fall survey the snail populations had increased to 91% at MED2 and 80% at MED1, and were collected in low numbers in upper Lindero Canyon Creek, Las Virgenes Creek and in Malibu Creek above the lagoon. This invasive species is thought to have been introduced to the Great Lakes by ships arriving from Europe. Since then the snails have invaded streams in Colorado, Montana, Arizona, Oregon, Utah, Wyoming and California. The North American populations of this tiny snail (up to 6 mm) are all females which reproduce without the need of a male, through an asexual process called parthenogenesis. They are capable of surviving a wide range of water quality conditions including desiccation. These factors have allowed them to quickly spread to new stream systems, since they don't rely on the transport of both a male and female to establish a reproductive population and they can survive transport to new stream systems on the equipment of anglers and water quality monitors. Once established in a stream, the New Zealand mudsnail population can reach between 100,000 to 800,000 individuals per square meter and exclude most other taxa. Methods for controlling New Zealand mudsnail populations have not yet been established. At present the only controls include methods to stop its spread to new stream systems.

2.3 Fish Tissue Analysis

In 2005 fish tissue bioaccumulation data was collected at six sites in the Malibu Creek Watershed by staff members of the Malibu Creek Watershed Monitoring Program and Aquatic Bioassay and Consulting Laboratories. Results from the data collection and analysis are summarized here. Data tables, charts, and sampling location figures from the study can be found in the full report, *The Malibu Creek Watershed Monitoring Program: Fish Tissue Bioaccumulation Survey 2005*.

2.3.1 Materials and Methods

Fish samples for bioaccumulation analysis were collected on September 21st, 2006 from 6 sites in the Malibu Creek Watershed. Sites were located in Malibu, Las Virgenes, Medea, Lindero and Trifuno Creeks. Fish were collected using a 15 by 6 foot beach seine with 3/8 inch mesh size. Multiple seines were taken until sufficient biomass for tissue analysis had been collected. Fish were identified to species, placed in clean zip-lock bags, covered with wet ice and taken to Aquatic Bioassay and Consulting Laboratories in Ventura, CA. Upon return to the laboratory, the standard length of each fish was measured to the nearest centimeter and the total biomass was compiled for each species by station. The samples were frozen and then shipped to CRG Marine Laboratories in Torrance, California.

A total of 325 fish, representing six species were collected on September 21st, 2005 from six locations in the Malibu Creek Watershed to assess contaminant bioaccumulation. These species included the arroyo chub (*Gila orcuttii*), bluegill (*Lepomis macrochirus*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), and largemouth bass (*Micropterus salmoides*). The target number of six fish of the same species per composite sample was met at each site, except for the green sunfish (n = 5) and largemouth bass (n = 4) at Medea Creek (MED2). Since these individuals were relatively large, the decision was made to include them in the analysis.

Composite samples were created by homogenizing a minimum of six fish of the same species, from the same station in a blender. The study utilized whole fish in developing the composite samples, because the size of the fish collected was not sufficient to use only muscle fillets. Each composite sample was analyzed for the following constituents (and all results are presented in wet weight):

- Chlorinated pesticides by GCMS using EPA Method 8270Cm
- PCBs by GCMS using EPA Method 8270Cm
- Total trace metals by ICPMS using EPA Method 6020m
- Percent lipids

2.3.2 Summary of Results

The general feeding habits of the fish that are being surveyed impact contaminant concentrations, whereby higher concentrations are found in organisms that feed at higher levels in the food chain from herbivores to piscivores. The general feeding strategies for the fish collected for this survey were as follows (McGinnis 1984):

- Fathead minnow - browser feeding on phytoplankton, invertebrates and organic debris.
- Arroyo chub - omnivorous feeding on vegetation and invertebrates associated with vegetation.
- Common carp - benthivorous feeding on benthic invertebrates both selectively from the sediment surface and by “grubbing”, a technique where the fish takes sediment into its mouth and rakes out the invertebrates.
- Bluegill – omnivorous feeding on plants, invertebrates, fish eggs and other fish.
- Green sunfish - carnivores feeding as young fish on small invertebrates and as adults become partially piscivorous.

- Largemouth bass – piscivores feeding on other fish and are the top predators in their habitat.

Metals and Organic Contaminants

The complete set of data resulting from the fish tissue bioaccumulation sampling is presented in Table 2-12. Of the ten metals measured in this survey, all were detected in each species at each of the six locations. Chromium and lead were below the method detection limits at all sites except at Lindero Creek where chromium was measured in fathead minnows and lead was measured in arroyo chub and fathead minnows. Arsenic, cadmium, nickel and zinc were all elevated in the tissues of arroyo chub and fathead minnows collected at Las Virgenes and Lindero Creeks compared to the other sampling locations. The mean arsenic concentration from all samples at each site was 0.11 mg/kg. Mercury concentrations were generally low across sites and species, but exceeded 0.04 mg/kg limit in green sunfish at Malibu and Medea Creeks. Selenium concentrations were similar across sites and were greatest in arroyo chub at Las Virgenes Creek.

Chlorinated pesticides (total DDT and total chlordane) were detected in each species, at each location except for in common carp at Malibu Creek. 4,4'-DDE was the dominant congener of DDT present in most samples. DDT concentrations were relatively low across sites except in the arroyo chub at Las Virgenes Creek where concentrations exceeded 50 ug/kg as measured from whole fish samples. The highest concentration of chlordane was 17.2 ug/kg in green sunfish at Medea Creek. PCBs were only detected in fish collected in Lindero and Triunfo Creeks, where concentration ranged from 6 to 10 ug/kg.

Table 2-12
Whole fish tissue concentrations of metals (ppm wet weight) and organic (ppb wet weight) contaminants in the Malibu Creek Watershed

Constituent	MAL		LV2	MED2		MED1		LIN1			TRI
	Common Carp	Green Sunfish	Arroyo Chub	Bluegill	Largemouth Bass	Green Sunfish	Largemouth Bass	Arroyo Chub	Fathead Minnow	Green Sunfish	Largemouth Bass
Arsenic	0.09	0.06	0.15	0.11	0.14	0.03	0.08	0.16	0.2	0.09	0.1
Cadmium	0.1	0.03	0.41	0.06	0.08	0.07	0.05	0.23	0.16	0.07	0.03
Chromium	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.04	<0.025	<0.025
Copper	1.49	0.6	2.23	0.72	0.85	0.56	1.68	1.6	1.46	0.71	2.29
Lead	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.05	0.06	<0.025	<0.025
Mercury	0.02	0.04	0.01	0.01	0.02	0.05	0.01	0.02	0.01	0.02	0.02
Nickel	0.17	0.06	0.27	0.11	0.11	0.07	0.1	0.19	0.35	0.1	0.07
Selenium	1.48	1.49	2.99	1.43	1.32	0.81	1.05	1.91	1.93	2.1	1.99
Silver	0.32	0.25	0.29	0.17	0.12	0.25	0.15	0.25	0.28	0.26	0.16
Zinc	34.5	13.9	34.2	16.15	19.5	17.35	12.5	30.7	29.5	16.6	17.9
Complex Organics (ng/wet g)											
4,4'-DDD	<1	<1	42.1	<1	<1	11	<1	<1	<1	<1	<1
4,4'-DDE	<1	2.8	9.4	5.8	5.3	12.3	6.2	18.9	15.6	19.5	10.8
Total Detectable DDTs	0	2.8	51.5	5.8	5.3	23.3	6.2	18.9	15.6	19.5	10.8
Chlordane-alpha	<1	<1	1.7	1.5	1.1	<1	1	1.6	2.1	1.2	1.8
cis-Nonachlor	<1	<1	<1	2.2	1.8	3.9	1.4	1.9	1.4	2.8	3.7
Heptachlor Epoxide	<1	<1	<1	<1	<1	<1	<1	<1	3.2	<1	<1
trans-Nonachlor	<1	1.8	1.7	4.7	4.4	13.3	3.2	4.3	3.2	5.8	6.4
Total Chlordane	0	1.8	3.4	8.4	7.3	17.2	5.6	7.8	6.7	9.8	11.9
PCB052	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.2
PCB066	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.3
PCB101	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
PCB110	<1	<1	<1	<1	<1	<1	<1	1.6	1.4	1.1	
PCB114	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB118	<1	<1	<1	<1	<1	<1	<1	1.8	1.3	1.2	1.1
PCB138	<1	<1	<1	<1	<1	<1	<1	3.7	2.5	3.1	1.7
PCB153	<1	<1	<1	<1	<1	<1	<1	2.5	1.3	1.7	<1
Total Detectable PCBs	0	0	0	0	0	0	0	9.6	6.5	7.1	6.3

Section 3

Interpretation of Monitoring Results

Monitoring results from the MCWMP were integrated into a database of water quality records from multiple agencies and monitoring programs. This served to enhance the spatial and temporal coverage of water quality data for interpretation (see Section 1 for description of sites and period of record for different monitoring activities). Several approaches were implemented to interpret the full set of water quality data from the Malibu Creek watershed, including watershed-wide and subwatershed specific investigations.

Section 303(d) of the Federal Clean Water Act of 1972 requires states to establish maximum limits of pollutant(s) that streams, rivers, lakes, and the ocean can accept before their beneficial uses are impaired. Appendix A contains narrative descriptions of beneficial uses presented in the sections below were extracted from the Los Angeles Basin Water Quality Control Plan (Basin Plan). Section 303(d) lists the pollutants of concern for specific water bodies. Several pollutants are currently on the 303d list of waterbody impairments within the MCW (Table 3-1). Recent sample data collected by the MCWMP and other monitoring activities reviewed in this report were evaluated relative to these impairments.

Table 3-1
Water Quality Impairments on the 2006 303d list in the Malibu Creek Watershed

Waterbodies	Coliform	Nutrients	Trash	Scum/Foam	Sediment	Fish Barriers	Algae	Enrichment / Low DO	Selenium	Mercury	Lead	Odors	Chloride	Specific Conductivity	Ammonia	Eutrophic
Malibu Creek	X	X	X	X	X	X										
Stokes Creek	X															
Lindero Creek Reach 1	X		X	X			X		X							
Lindero Creek Reach 2	X		X	X			X		X							
Palo Comado Creek	X															
Medea Creek Reach 1	X		X		X		X		X							
Medea Creek Reach 2	X		X		X		X		X							
Las Virgenes Creek	X	X	X	X	X			X	X							
Triunfo Creek Reach 1					X					X	X					
Triunfo Creek Reach 2					X					X	X					
Malibou Lake							X	X								X
Westlake Lake							X	X			X				X	X
Sherwood Lake							X	X		X					X	X
Lake Lindero			X				X					X	X	X		X

3.1 Pollutant/Stressor Sources

3.1.1 Bacteria

There are a number of existing sources of bacteria in the MCW, including human influenced and naturally occurring sources. Human sources in the MCW include failing septic systems, urban runoff, and residential land use activities. Animal sources of bacteria in the watershed include horses and livestock, which are found in some subwatersheds and birds, which have been shown to be a significant source of bacteria especially in Malibu Lagoon (Warshall et al., 1992).

Human sources of bacteria in the MCW may come from failing septic systems; however there has been no statistically defensible correlation. On the other hand, it is known that many septic systems in these watersheds have been poorly designed or maintained (Septic System Management Task Force, 2001). The source of bacteria given the greatest non-point source load allocation in the MCW bacteria TMDL was urban runoff, during dry and wet weather. Based on the TMDL model, the load allocation (LA) to urban runoff from commercial/industrial and residential land uses accounted for over 80 percent of the total bacteria load in the MCW. Analysis of bacteria indicator data from the MCWMP and other monitoring programs showed that proximity to urbanization is a strong predictor of exceedences of numeric targets for bacteria. Build up of bacteria on impervious surfaces in residential and commercial areas is washed off during rain events or by irrigation overflow and car/driveway washing during dry weather. Sources of bacteria in urbanized areas include;

- Lawn and landscape fertilization
- Organic debris from gardens, landscaping, and parks
- Trash
- Domestic animal waste
- Human waste

Natural sources of bacteria exist within the undeveloped parts of the Malibu Creek watershed and may originate from wildlife, primarily birds and mammals. A study was recently completed that monitored dry weather bacteria concentration in 15 reference streams upstream of any human development throughout southern California, including two locations within the Malibu Creek watershed (Tiefenthaler et al., 2008). The study found a mean dry weather *E.coli* concentration in Cheseboro Creek of 90.3 MPN/100 mL, with samples ranging from 10 to 9,804 MPN/100 mL. In Cold Creek, the mean E.coli concentration was 13.6 MPN/100 mL, with samples ranging from 10 to 108 MPN/100mL. The results from these reference streams with the MCW suggest that background sources of bacteria can be significant, but can vary greatly between subwatersheds.

3.1.2 Nutrients

The waste load allocation (WLA) and LA for the EPA Region 9 Nutrient TMDL are shown in **Table 3.-2**. Generally, in the winter months during the period when Tapia WRF discharges effluent to Malibu Creek, Tapia is the single greatest source of nutrients to Malibu Creek. During the summer months Tapia sells its effluent for non-potable uses such as irrigation in the MCW, which may be a source of nutrients in Malibu Creek. Yet, nutrient related impairments are as common upstream in the MCW as they are downstream of the Tapia WRF.

Septic systems may be a significant source of nitrogen during the summer months. Although many pollutants, including phosphorous are removed by binding to soil particles, nitrogen is more difficult to control in a leachfield (Bedessem et al., 2005). The EPA adopted Nutrient TMDL linkage model estimated that 22% of summertime nitrogen loads and 21% of summertime phosphorous loads are generated by septic systems.

Table 3-2
Relative Contribution from Potential Source Categories based on Calibrated TMDL Linkage Model

Source Category	% of Total Nitrogen Load During Winter	% of Total Nitrogen Load During Summer	% of Total Phosphorous Load During Summer
Waste Load Allocations			
Tapia Direct Discharge	34	5	8
Load Allocations			
Septic Systems	9	22	21
Effluent irrigation/sludge	8	15	13
Runoff from developed areas	11	6	6
Golf Course Fertilization	5	9	16
Agriculture/Livestock	5	8	4
Dry Weather Urban Runoff	2	13	11
Runoff from undeveloped land	22	9	11
Other	5	14	10
Total	100	100	100

Urban runoff is estimated to be a limited source of nutrients to Malibu Creek watershed during dry weather conditions (approximately 11%). During wet weather nitrogen concentrations are typically below the water quality objectives for the beneficial uses in Malibu Creek. The following are potential sources of nutrients from dry weather runoff in urbanized areas:

- Lawn and landscape fertilization
- Organic debris from gardens, landscaping, and parks
- Phosphorous is car washing/other detergents
- Trash

- Domestic animal waste
- Human waste

Nutrient loading from golf courses can be significant due to the high fertilization and watering rates generally associated with these areas. There are a number of golf courses within the watershed, the majority of which are located adjacent to waterways. Excess nutrients accumulate in golf course soils which can be washed into streams and lakes during storm events.

Agricultural activities within the Malibu Creek watershed consist primarily of pastures and grazing with limited areas of orchards and vineyards. The bulk of this agricultural land is located in the Hidden Valley area but smaller agricultural plots can be found in the Stokes Creek, Lower Las Virgenes Creek, Lower Malibu Creek, Malibu Lagoon, and Triunfo Creek subwatersheds. Nutrients sources on agricultural lands include fertilizers applied during cultivation and decomposed litter from vegetation. The soluble nutrients can be introduced to area waterways through surface runoff and groundwater transport. Livestock facilities throughout the watershed can also be a source of nutrient loading. Manure from animals may contribute nutrients directly to surface waters (i.e. waterfowl or cattle watering in streams) or through non-point source overland storm runoff.

Nutrient sources not influenced by human activity may also exist naturally in the MCW. Open space makes up approximately 75 percent of the land within the Malibu Creek watershed. Nutrients can be introduced to area waterways through the erosion of soils that contain organic litter from the local vegetation. Soluble nutrients from the decomposition of organic materials can potentially reach area streams through surface runoff or through groundwater transport. Waterfowl are a component of the Malibu lagoon ecosystem and are believed to be a potentially important source of nutrients in the lagoon (Warshall et al, 1992). The EPA adopted Nutrient TMDL estimated that runoff from undeveloped land contributes 20 percent of the nitrogen and 17 percent of the phosphorus loads to the watershed annually.

3.1.3 Metals

Limited studies have been conducted to identify watershed-specific sources of high metal concentrations. Urban runoff can include metals from atmospheric deposition, landscape irrigation, street cleaning, vehicle braking, and accidental sewer overflows, as well as illegal industrial and commercial discharges. Sabin et al. (2005) analyzed dry and wet atmospheric deposition samples for metals (Chromium, Copper, Nickel, Lead, and Zinc) from in a small urban watershed in the San Fernando Valley. The study showed that atmospheric sources of metals could account for 57 to 100% of trace metal loads measured in stormwater runoff. Metals can also be traced to natural background leaching of different geologic formations or atmospheric deposition.

Lindero Creek, Medea Creek, and Las Virgenes Creek are 303d listed as impaired due to Selenium. Selenium is present in marine sedimentary bedrock formations within the

MCW. The selenium within these geologic units is released through natural weathering processes, which may be accelerated by human activities in the watershed. Naturally occurring selenium can be mobilized to waterways when soils are disturbed through storm events, construction, and/or agricultural activities, particularly irrigated agriculture where selenium can be easily transported through ditches. Hibbs and Andrus (2007) concluded that shallow groundwater is a significant source of selenium in Las Virgenes Creek and selenium concentrations are positively correlated with nitrate concentrations, with the most significant correlation found in shallow groundwater samples. It was also shown through end member mixing analysis that during dry weather, shallow groundwater is a significant hydrologic source of water to the channel.

Triunfo Creek, Westlake Lake and Sherwood Lake are 303d listed for lead and or mercury. Lead is a naturally occurring element in the earth's crust. Lead in the environment can be traced to the following sources: past lead additives in gasoline, paint, household dust and soil around homes, lead piping, and industrial emissions. Sources of lead in surface water include deposits of lead-containing dust from the atmosphere, waste water from industries that handle lead (iron and steel and lead producers), and urban runoff from roadways and residential areas.

The ultimate source of mercury to most aquatic ecosystems is deposition from the atmosphere, primarily associated with rainfall. In addition, particles attach to soils and are washed into streams and lakes through storm runoff. Mercury can be associated with industry, particularly in the manufacturing of electrical equipment (batteries, lamps, switches, and rectifiers). It may enter the environment through mining, smelting (not found in this watershed), and fossil fuel combustion. Fungicides used in agricultural practices can contain mercury. Mercury can also be reintroduced through sediment releases where anoxic bottom conditions exist in lakes and reservoirs.

3.2 Correlation of Variables

Preliminary correlation analyses were conducted from data collected at the 13 MCWMP sites to assess any relationships between monitored variables. Appendix B shows the correlation coefficients computed for all data and also for subsets of the complete dataset, representing wet weather, and dry weather during the summer or winter. Generally, little correlation was found that could be used to draw conclusions about water quality conditions in the MCW. The most strongly correlated variables involved similar measures, such as fecal coliform versus *E. Coli* and nitrate versus total nitrogen. Correlation results of Chlorophyll-a and some nitrogen forms during dry weather conditions suggested that further investigation, involving the larger integrated dataset of 45 monitoring locations would be valuable.

Certain water quality parameters may influence in-stream chemical and biological processes that result in responses in other water quality parameters. If such correlations can be made, these processes could be determined to be responsible for impairment of beneficial uses in MCW waterbodies; and could therefore be targeted by incorporation of BMPs or management actions that focus on addressing these processes. For this reason, basic correlations were tested between several water quality parameters, hypothesized to be interrelated, through the development and statistical analysis of covariate regressions. Regressions were evaluated to test whether sediment erosion is the predominant source of impairment in MCW streams for bacteria, nutrients, or metals (Figure 3-1). In addition, the hypothesis that algae growth in MCW streams is nutrient limited was evaluated (Figure 3-2). Lastly, the relationship between selenium and nitrate was evaluated through correlation (Figure 3-3).

The analysis showed that heavy metal concentrations are moderately correlated with suspended sediment. Therefore, watershed management plans that address sediment impairments are likely to reduce in-stream concentrations of heavy metals as well.

No significant correlations were found between bacteria indicators and or nutrients, indicating that other factors in combination with in-stream chemical and biological interactions, impact water quality parameter concentrations.

A positive correlation was identified between selenium and nitrate, which is hypothesized to be due to through oxidation of selenate compounds by nitrate in marine sedimentary bedrock. This result is based on a limited paired data record (n=8) and should therefore be further monitored to draw statistically significant conclusions.

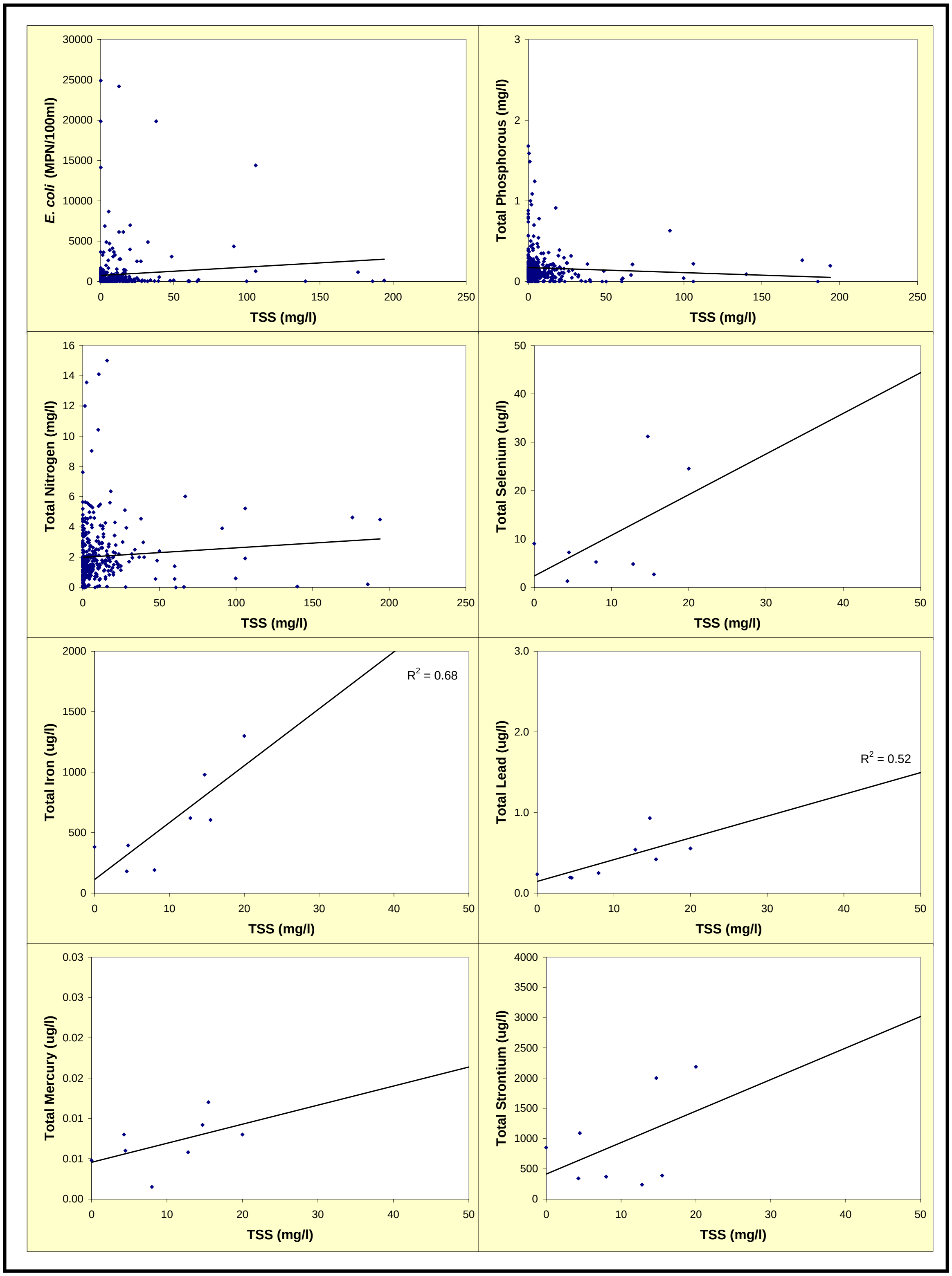

Figure 3-1
Correlation of TSS and Monitored Water Quality Parameters

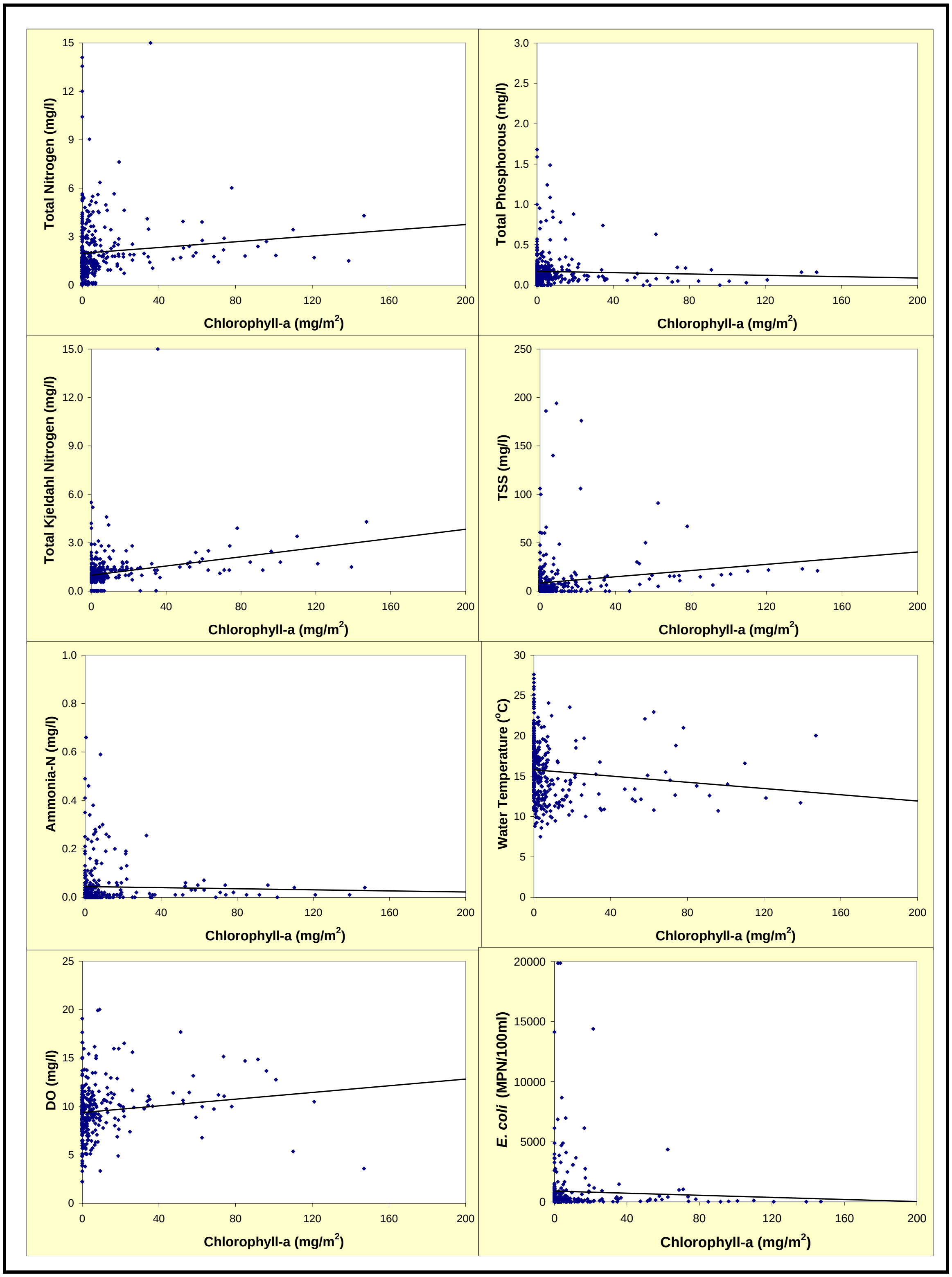

Figure 3-2
Correlation of Chlorophyll-a and Monitored Water

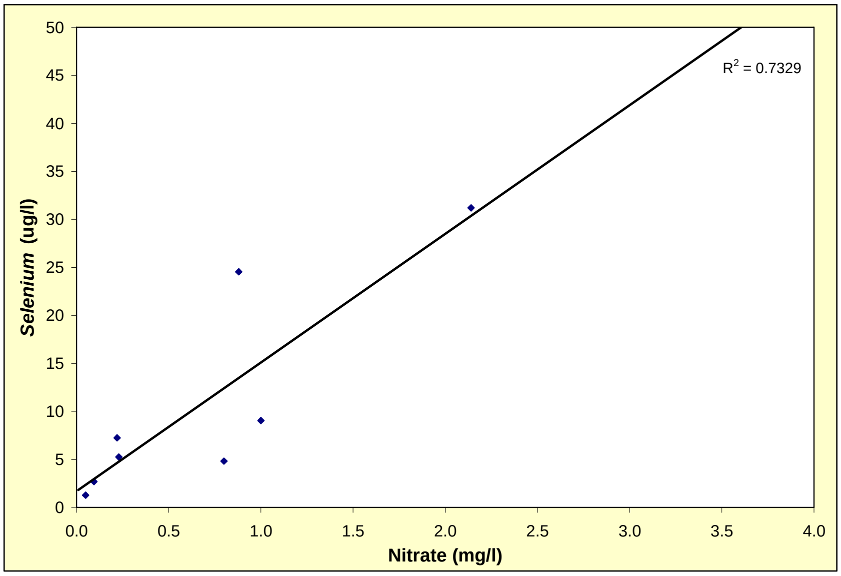

Figure 3-3
Correlation of Selenium and Nitrate

In addition to compiling this database, key characteristics of the tributary watershed to each of the monitoring locations were determined, including the land use distribution in the upstream drainage areas (Figure 3-4). Drainage areas were first estimated from a digital elevation map (DEM) for each of the water quality monitoring locations by using ArcHydro, an extension for ArcGIS 9.2. The land use classifications for each watershed were aggregated into general categories, including Residential, Commercial, Industrial, Open Space, and Agricultural. Regressions were then developed to assess the role of contributing area land use upon water quality conditions at a monitoring location. Generally increasing trends shown by these regressions showed that land use characteristics do play a role in water quality; however with limited statistical significance (Figure 3-5). This finding shows that strictly land use based approaches to non-point source pollution source characterization are not sufficient.

Therefore, the interpretation of results required a multi-parameter investigation of conditions at a more localized scale. To aid in the application of this approach, a rating system was developed for multiple constituents based on water quality targets or objectives. The constituents selected to evaluate in more detail are intended to be representative of a full range of conditions of concern in the watershed, including bacteria indicators, sediment, heavy metals, and nutrients. These categories cover most of the 303d listed impairments for waterbodies within the MCW. To evaluate the spatial component of the rating system within subwatersheds, water quality monitoring locations were symbolized by their rating and mapped for each of the evaluated constituent groups (Figures 3-6 through 3-10).

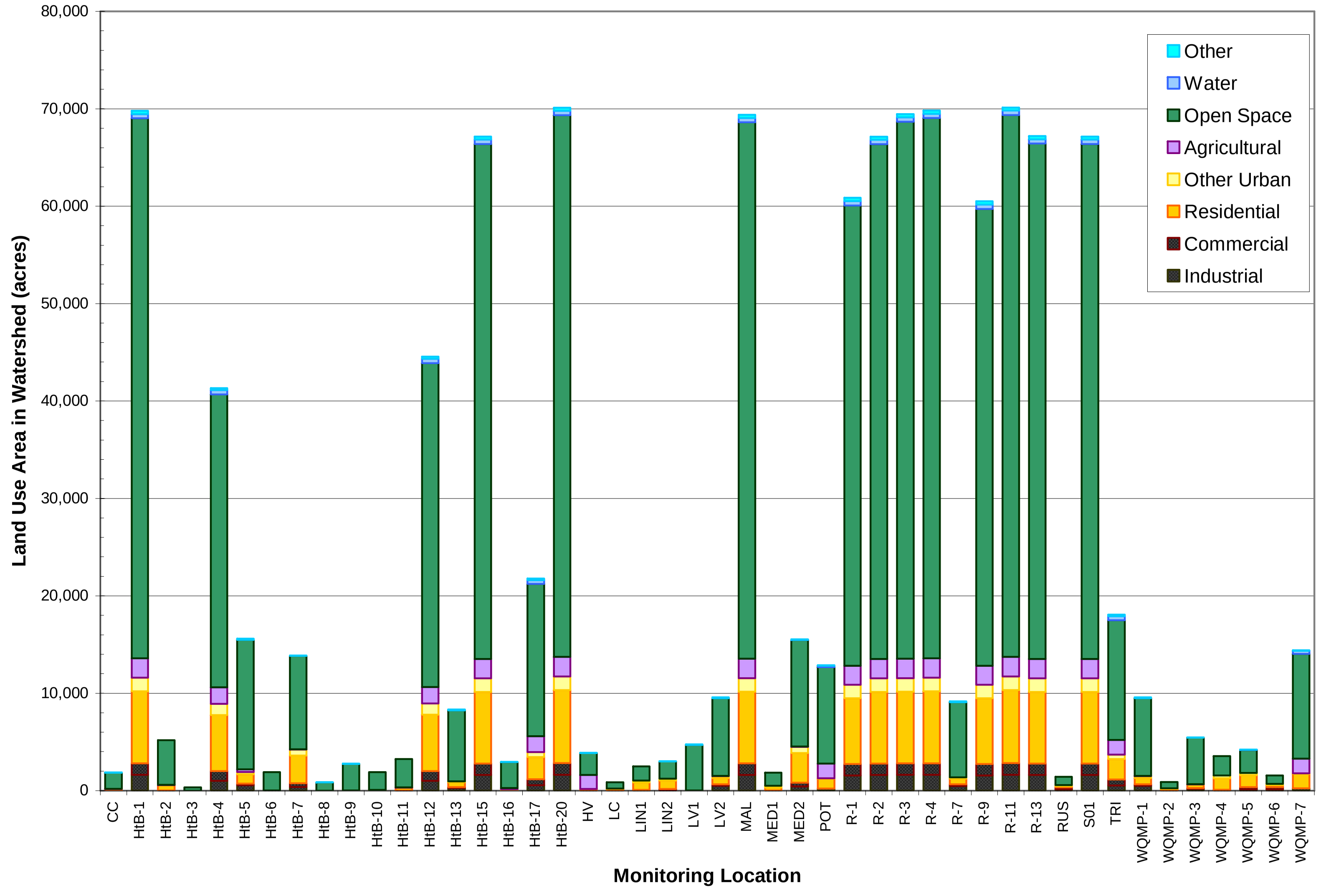

Figure 3-4
Land Use Distribution in Drainage Areas of MCW Monitoring Locations

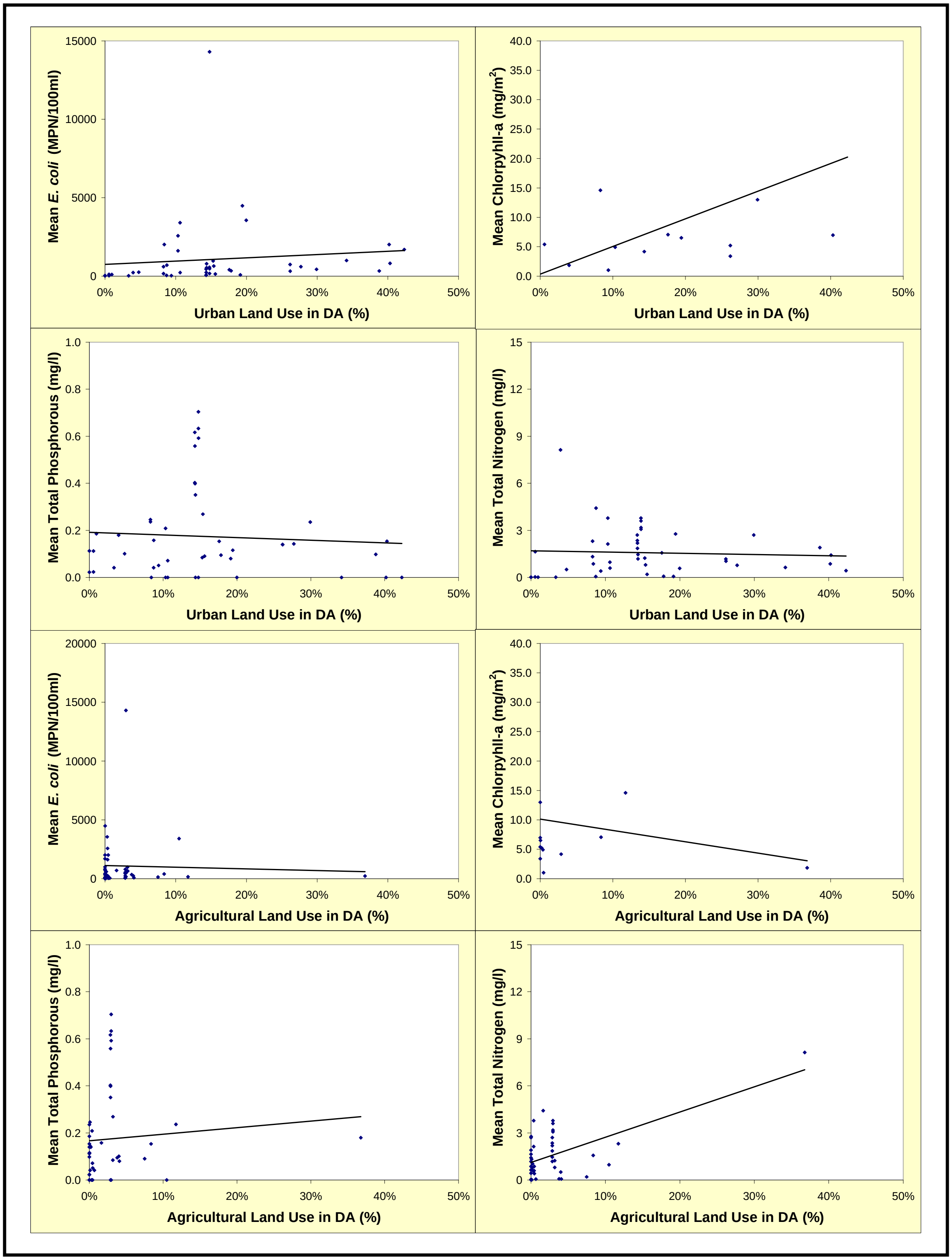

Figure 3-5
Correlation of Urban and Agricultural Land Use in Watershed to Monitored Water Quality Parameters

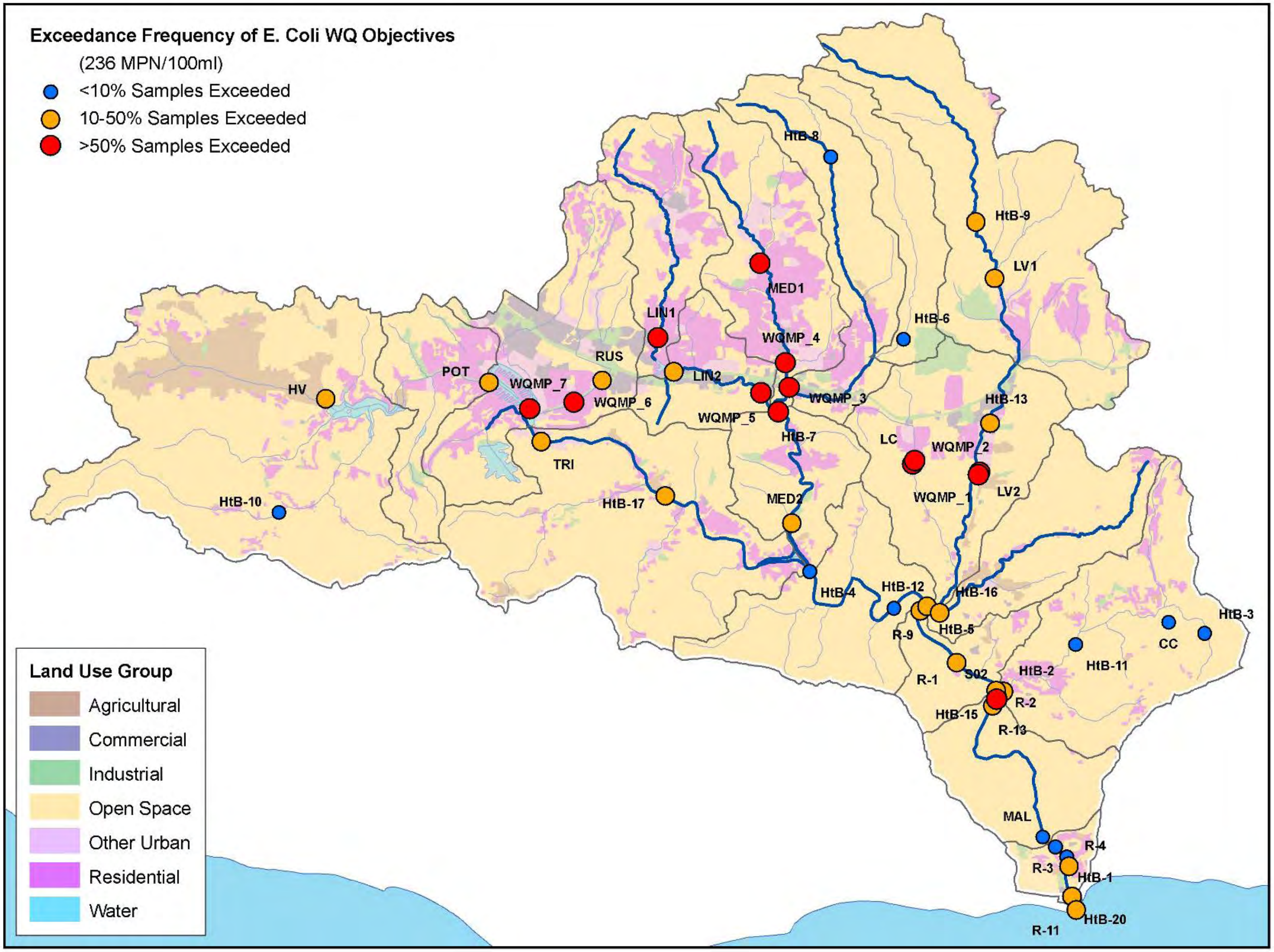

Figure 3-6
Evaluation of Bacteria Indicators within the Malibu Creek Watershed

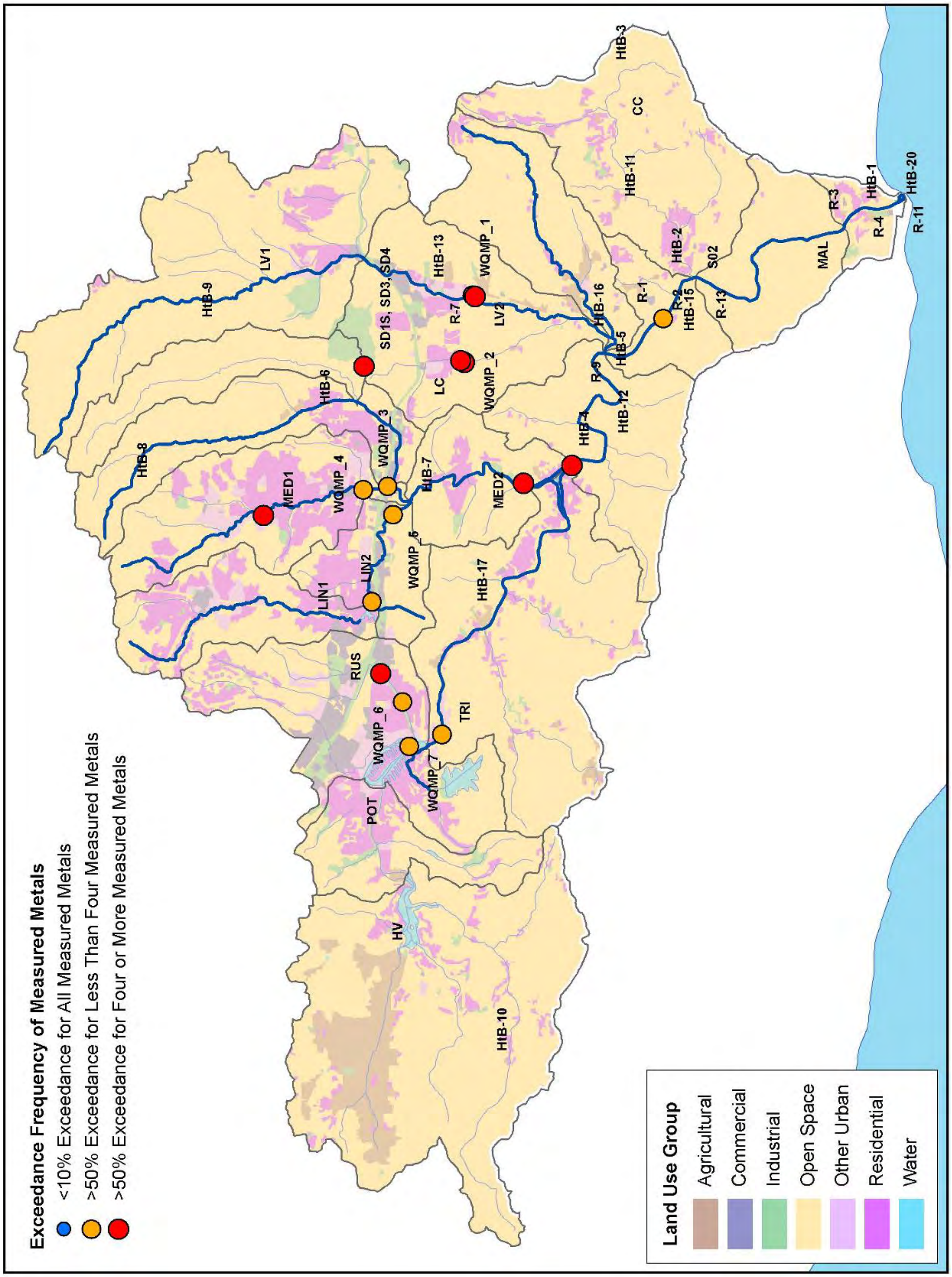

Figure 3-7
Evaluation of Heavy Metals within the Malibu Creek Watershed

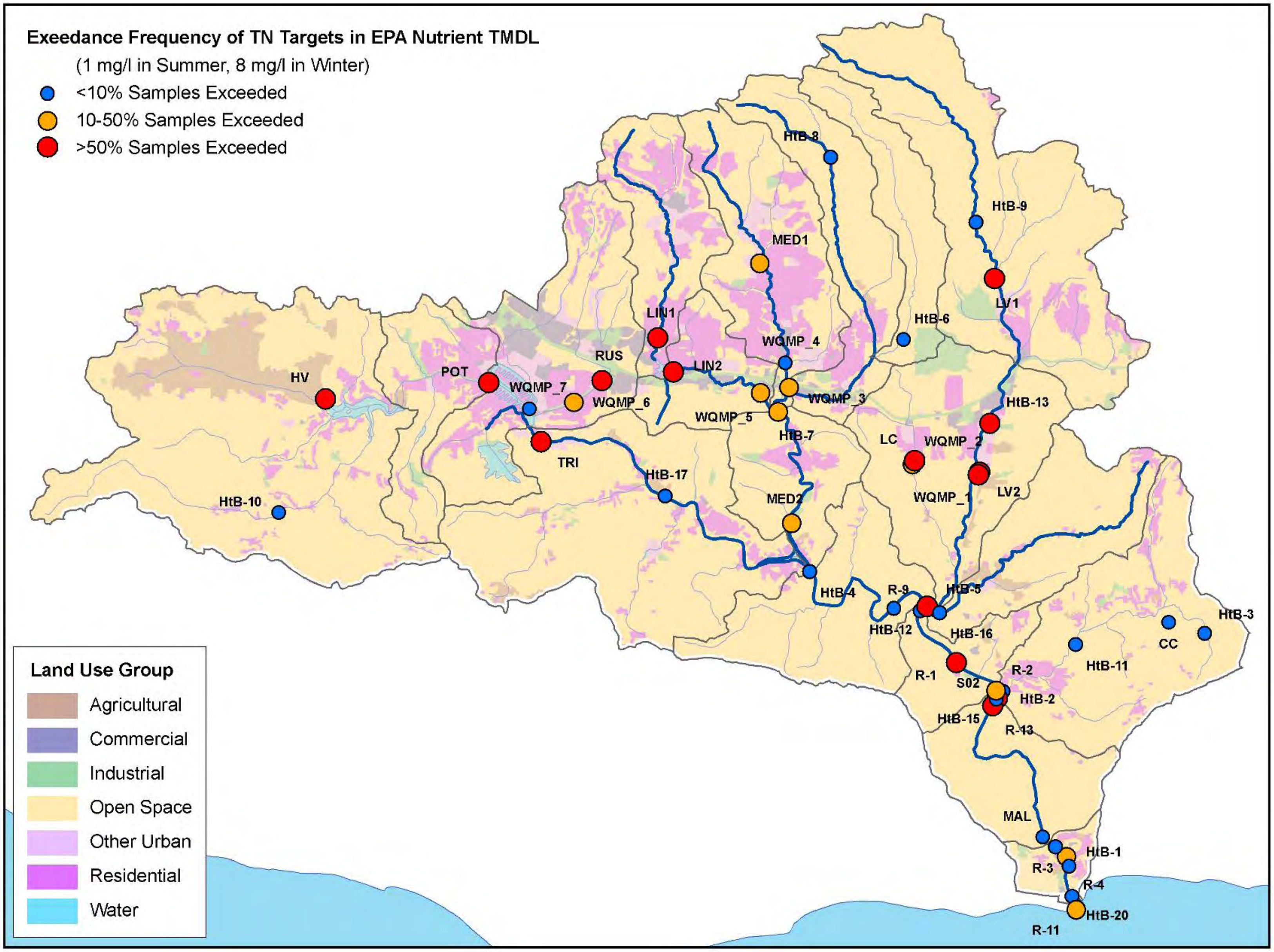

Figure 3-8
Evaluation of Total Nitrogen within the Malibu Creek Watershed

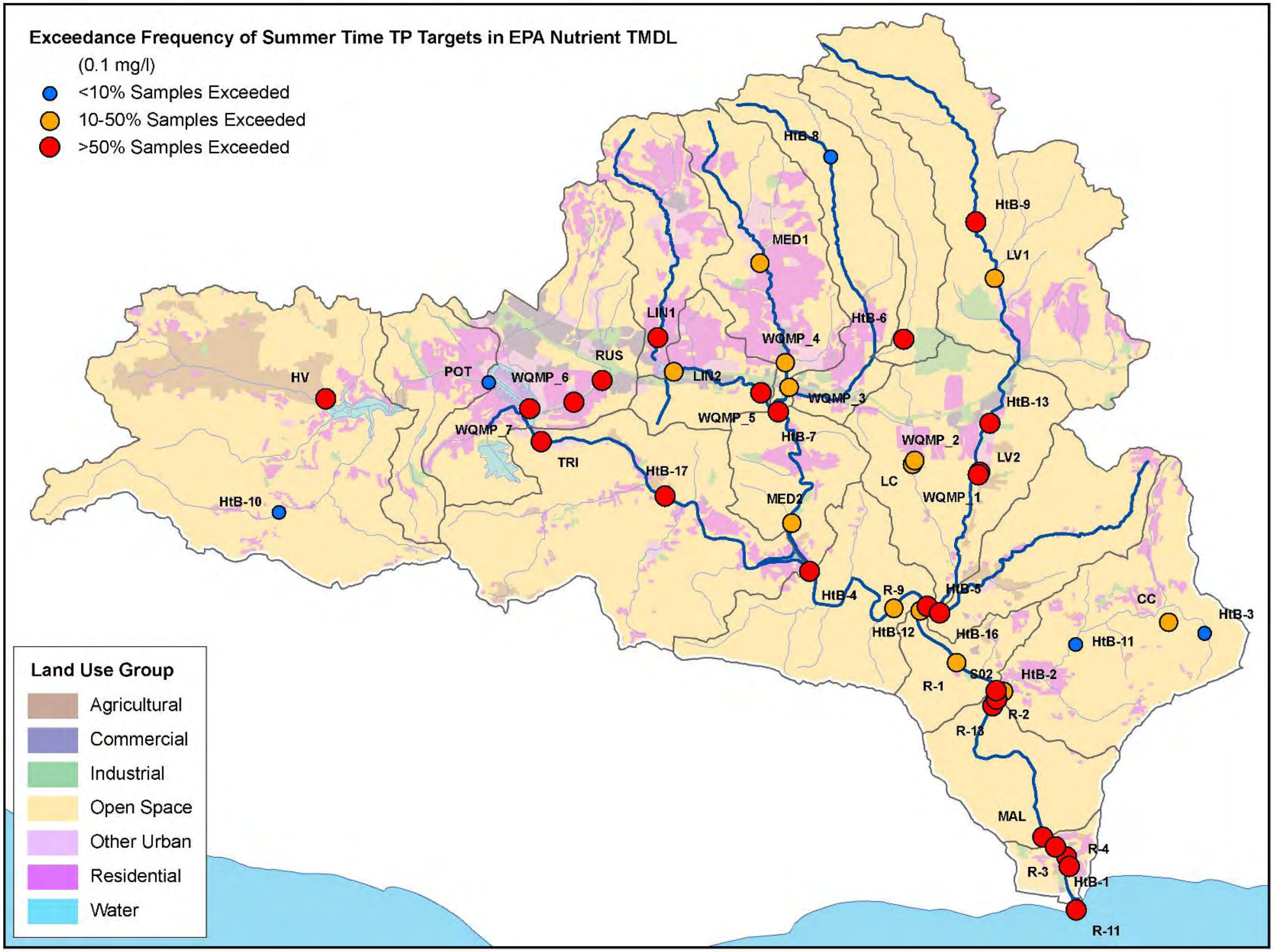

Figure 3-9
Evaluation of Total Phosphorous within the Malibu Creek Watershed

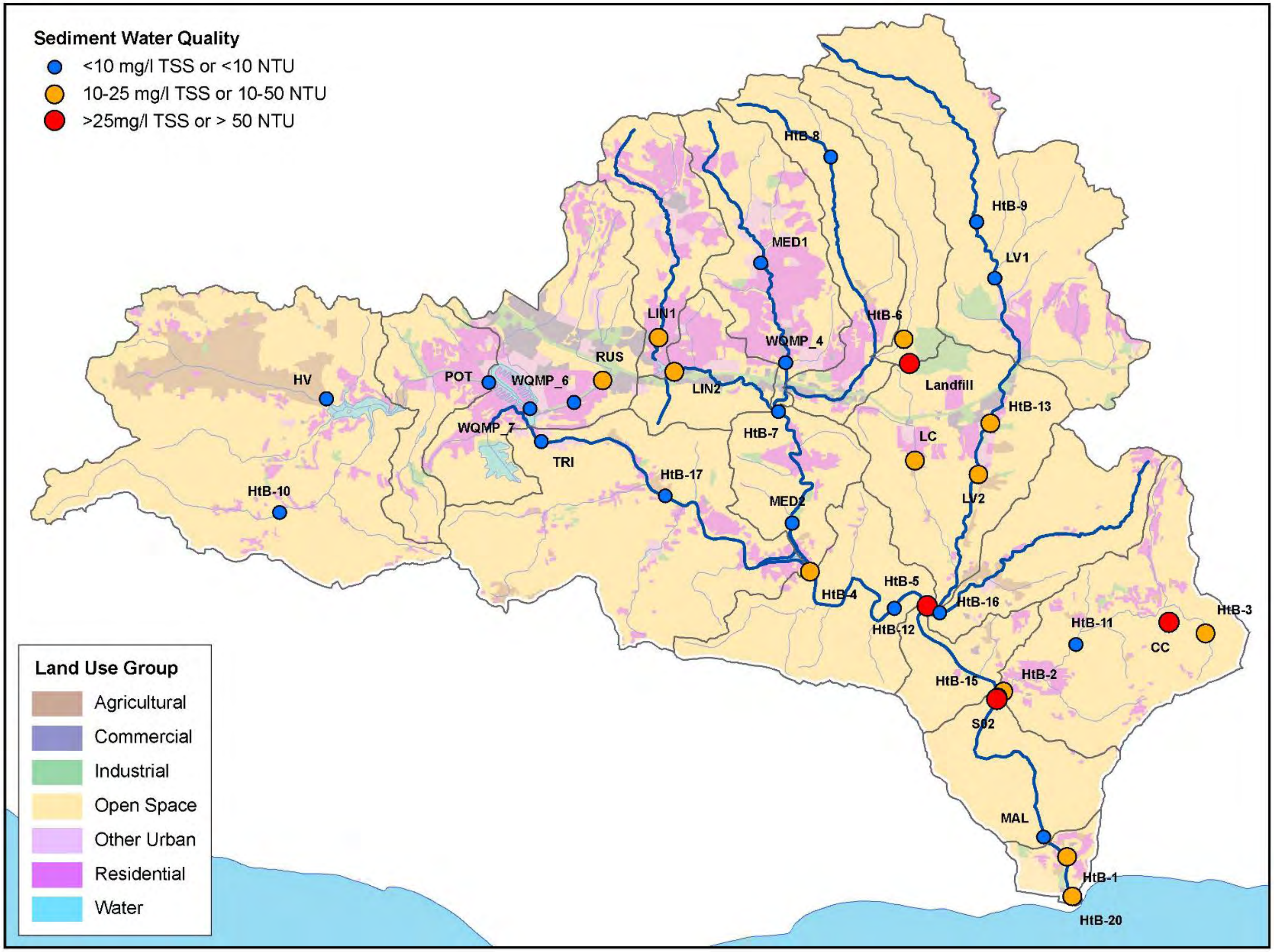

Figure 3-10
Evaluation of Total Suspended Solids within the Malibu Creek Watershed

3.3 Subwatershed Evaluation

3.3.1 Triunfo Creek

Triunfo Creek is the most western waterbody draining large areas into Malibou Lake and ultimately Malibu Canyon, and includes the Westlake, Potrero Canyon, and Triunfo Creek subwatersheds. Two lakes, Westlake and Lake Sherwood, are in the flowpath from the headwaters of the watershed to its mouth at Malibou Lake. Water quality conditions in this part of the MCW are unique, as they are controlled by very different land use and hydrology in different subareas. Beneficial uses in Triunfo Creek include MUN, REC1, REC2, WARM, WID, and RARE.

There is a large agricultural area in the Hidden Valley subwatershed. Samples collected from downstream of this area (HV) have very high concentrations of nutrients, with all samples exceeding TN and TP water quality objectives. Conversely, all samples from another site within this subwatershed (HtB-10) with no agricultural land uses did not exceed water quality objectives. In the Potrero Canyon subwatershed (POT), nutrient concentrations were lower than in Hidden Valley, but 40% and 80% of samples still exceeded TP and TN objectives, respectively. Downstream of Westlake Lake, samples collected in Triunfo Creek (TRI, HtB-17, and WQMP-6) showed lower exceedence frequencies than upstream monitoring locations for nutrient objectives. This indicates that some nutrient uptake may be occurring within Sherwood Westlake Lakes and vegetative communities within Triunfo Creek. These nutrient enriched conditions in the Triunfo Creek watershed may be a reason for the “Very Poor” IBI rating that was assessed (TRI). The County of Los Angeles conducted a bioassessment survey for Triunfo Creek in 2003 and 2004 resulting in an estimated IBI score of 22 giving a rating of “Poor”. This score is significantly higher than the one recorded just below Westlake Lake. This difference in the IBI score within Triunfo Creek may be due to the closer proximity to urban influences in the upstream site. The County of Los Angeles survey site was much further downstream in a predominantly undeveloped area than the site evaluated in the MCWMP. Alternatively, the differences in IBI scores could be due to the occurrence of several very high intensity storms in the 2004-2005 wet season preceding the MCWMP survey.

Sediment concentrations were low in all sample locations through the Triunfo Creek watershed; expect for within Russell Creek, where wet weather TSS concentrations exceeded 100 mg/l. This general condition in Triunfo Creek may make it a candidate for evaluating the potential for delisting sediment/siltation from the 303d list.

Bacteria indicator concentrations in the Triunfo Creek watershed exceeded *E. coli* water quality objectives in more than 50% of samples collected (WQMP-6 and WQMP-7) from Russell Creek (WQMP-6) and a storm drain to Westlake (WQMP-7). Elsewhere in the watershed, *E. coli* concentrations exceed objectives less frequently (TRI, POT, RUS, HtB-17, and HtB-10). At all monitoring locations, elevated bacteria concentrations were observed to be independent of season or weather condition.

Metals concentrations did not exceed water quality targets in any of the monitoring stations in the Hidden Valley or Potrero Canyon subwatersheds. However, some water quality targets for heavy metals were exceeded downstream in the more urbanized part of the watershed, near the City of Westlake Village. Although Triunfo Creek is 303d listed for Mercury and Lead, these metals were not found to be present (TRI and RUS) and only exceeded recommended limits in one of 14 samples (WQMP-6 and WQMP-7). Concentrations of other metals such as Iron, Manganese, Molybdenum, Selenium, and Strontium exceeded targets in all samples in at least one monitoring location (RUS, TRI, WQMP-6, and WQMP-7). Most of these metals were not analyzed as part of the fish tissue analyses for Triunfo Creek. Metals that were analyzed in fish tissue samples showed elevated levels of copper in Largemouth Bass and reached the non-carcinogenic health endpoint (NCHE) of 16 meals/month for Selenium (TRI).

3.3.2 Lindero Creek

Lindero Creek is a small creek that originates in very low density residential parts of the City of Thousand Oaks and flows through the Lindero Country Club to Lake Lindero, where the watershed area is more densely developed. Lindero Creek continues from the lake outflow to its confluence with Medea Creek near the intersection of Kanan Road and Cornell Road. Beneficial uses in Lindero Creek include MUN, REC1, REC2, WARM, and WILD.

Upstream of Lake Lindero nutrient concentrations in approximately 65% of TN and TP summertime samples exceeded there respective targets (LIN1). These nutrient enriched conditions in the Triunfo Creek watershed may be a reason for the “Very Poor” IBI rating that was assessed (LIN1). The influence of Lake Lindero on nutrient concentrations in Lower Lindero Creek was shown by an increase in TN concentration and frequency of water quality objective exceedence from upstream samples, with 14 of 15 TN samples collected during the summer (LIN2). Freshwater lakes are typically nitrogen limited; therefore the increase in TN concentrations may be indicative of additional pollutant sources in the Lindero Creek watershed downstream of the Country Club. The influence of the lake on TP is less certain, where a decrease in mean concentration from LIN1 to LIN2 of 0.15 mg/l to 0.09 mg/l was found, but with intermittent spikes in TP downstream of Lake Lindero (LIN2 and WQMP-5) in the summer of 2005, above upstream concentrations.

Suspended sediment concentrations increase from a mean of 10 mg/l upstream of Lake Lindero (LIN1) to between 16 and 20 mg/l at sites downstream of the lake (LIN2, WQMP-5). This finding suggests that settling of suspended sediment in Lake Lindero may not be a condition of concern.

Bacteria concentrations in Lindero Creek upstream of Lake Lindero exceed water quality objectives in 56% of samples collected (LIN1). Directly downstream of the lake, the mean concentration was less than half of the upstream site, and exceeded water quality objectives in 30% of samples (LIN2). While the lake may attenuate bacteria, additional sources of bacteria in Lower Lindero Creek are significant, as shown by an 87%

exceedence frequency and almost a full order of magnitude greater mean concentration of 2,300 MPN/100ml at the confluence with Medea Creek (WQMP-5).

Samples were analyzed for heavy metals at two locations in Lindero Creek, downstream of Lake Lindero and at the confluence with Medea Creek. Exceedences of water quality targets were observed for Selenium at both locations, but the mean concentration at the confluence (WQMP-5) was approximately three time greater than at the lake outflow (LIN2), showing that selenium should remain a 303d listed pollutant of concern in this reach. Other metals that were analyzed downstream of the lake exceeded targets in all three "Hot Spots" samples, including Iron, Manganese, and Strontium (LIN2). These metals were not analyzed in samples collected at the confluence. Also, mercury and lead were not found above water quality targets in the Lindero Creek watershed (LIN2 and WQMP-5).

3.3.3 Medea Creek

Medea Creek is a small creek that drains residential area in the City of Thousand Oaks within Ventura County, and flows through residential parts of the City of Agoura Hills within Los Angeles County. Both Lindero Creek and Palo Comado Creek confluence with Medea Creek near the 101 Freeway corridor. In addition, Cheseboro Creek is part of the Palo Comado Creek watershed. After these confluences, Lower Medea Creek flows south through parts of the Santa Monica Mountains Nation Recreation Area to Lake Malibou. Beneficial uses in Medea Creek include MUN, GWR, REC1, REC2, WARM, WILD, and WET.

Medea Creek is on the 303d list for nutrient related water quality impairments. Concentrations of nutrients in Medea Creek and its tributaries did not exceed winter season water objectives in more than 10% of samples (LIN1, LIN2, MED1, MED2, HtB-6, HtB-7, HtB-8, WQMP-3, WQMP-4, and WQMP-5). During the summer season, some exceedences of both TN and TP water quality objectives were measured, with the highest concentrations occurring within Upper and Lower Medea Creek (MED1, MED2, HtB-7, and WQMP-4).

Where different forms of nitrogen were monitored (i.e. Total Kjeldahl Nitrogen, which is the sum of organic nitrogen; ammonia, NH3 and ammonium, NH4+), it was found that organic N becomes the predominant source of nitrogen in Medea Creek, increasing its fraction in downstream monitoring locations (WQMP-3, WQMP-4, MED1, and MED2), indicating that watershed loading and algae growth and decay could be a source of nitrogen within Medea Creek. Nutrient enriched conditions could be the cause of low IBI scores for both the Upper and Lower sections of Medea Creek. The bioassessment survey conducted by The County of Los Angeles in 2003 and 2004 for Medea Creek also estimated an IBI score that fell within the "Very Poor" category.

Exceedences of bacteria water quality objectives occur most frequently downstream of urbanized areas in the Medea Creek watershed, including Upper Medea Creek (MED1 and WQMP-4), the lower end of Palo Comado Creek (WQMP-3), and in Lower Lindero

Creek (WQMP-5). Upstream of any urban drainage, Palo Comado and Cheseboro Creeks exceeded E. coli objectives in less than 10% of samples collected (HtB-6 and HtB-8). Samples from sites just upstream of Lower Medea Creek had the greatest concentrations of *E. coli* and most frequent exceedences of water quality objectives (WQMP-3, WQMP-4, and WQMP-5). Downstream of the confluence of these waterbodies, exceedences of bacteria objectives were measured less frequently then in the upstream WQMP monitoring locations, with approximately 51% of samples exceeding objectives (HtB-7). This change could be due to differences between the two monitoring programs and not a function of in-stream reduction. Further downstream on Lower Medea Creek, significantly lower bacteria indicator concentrations were measured from the WQMP sites, however exceedences of the 236 MPN/100ml *E. coli* objective still occurred in 13 of 38 samples (MED2).

Generally, suspended sediment in most of the Medea Creek watershed is not a pollutant of concern even during wet weather, where the mean wet weather TSS concentrations were below 40 mg/l (LIN1, LIN2, MED1, MED2, WQMP-4, and WQMP-5). The Cheseboro Creek subwatershed was found to have suspended sediment concentrations that are significantly higher than the rest of the watershed. Within Cheseboro Creek, samples collected downstream of the Calabasas Landfill have mean TSS concentrations over 3,000 mg/l (Landfill). Upstream of the Calabasas Landfill in Palo Comado Creek, suspended sediment is not a concern (HtB-8); however Palo Comado Creek below the confluence with Cheseboro Creek was found to have elevated TSS concentration during wet and dry weather conditions (WQMP-3).

Fire incidents that have been determined from remote sensing by the USDA Forest service are shown in Figure 3.10. The data reflects a few isolated incidents in the Upper Las Virgenes and Cheseboro Subwatersheds in 2003 and in the Hidden Valley Creek Subwatershed in 2006, with a more widespread fire affecting the northern part of the Malibu Watershed on September 29, 2005. The TSS samples taken in Medea Creek (MED 1 and MED2) on December 13, 2005 and November 2, 2005 after the September 29th Fire, do not show a significant increase in TSS from previous samples.

Exceedences of water quality targets were observed for Selenium in Medea Creek, Lindero Creek, and Palo Comado Creek in most samples where metals were analyzed (MED1, MED2, WQMP-3, WQMP-4, and WQMP-5). Selenium was the greatest in the Palo Comado tributary, which receives runoff with elevated TSS concentrations from the Calabasas Landfill (WQMP-3). This suggests that the presence of Selenium could be the result of mobilization of sediments from the watershed. Other metals that were analyzed in Upper and Lower Medea Creek exceeded targets in all three "Hot Spots" samples, including Iron, Manganese, and Strontium (MED1 and MED2). These metals were not analyzed in samples collected from Upper Medea, Lindero, and Palo Comado Creeks above the confluence with Lower Medea Creek. Also, mercury and lead were not found above water quality targets in the Medea Creek watershed (WQMP-3, WQMP-4, and WQMP-5).

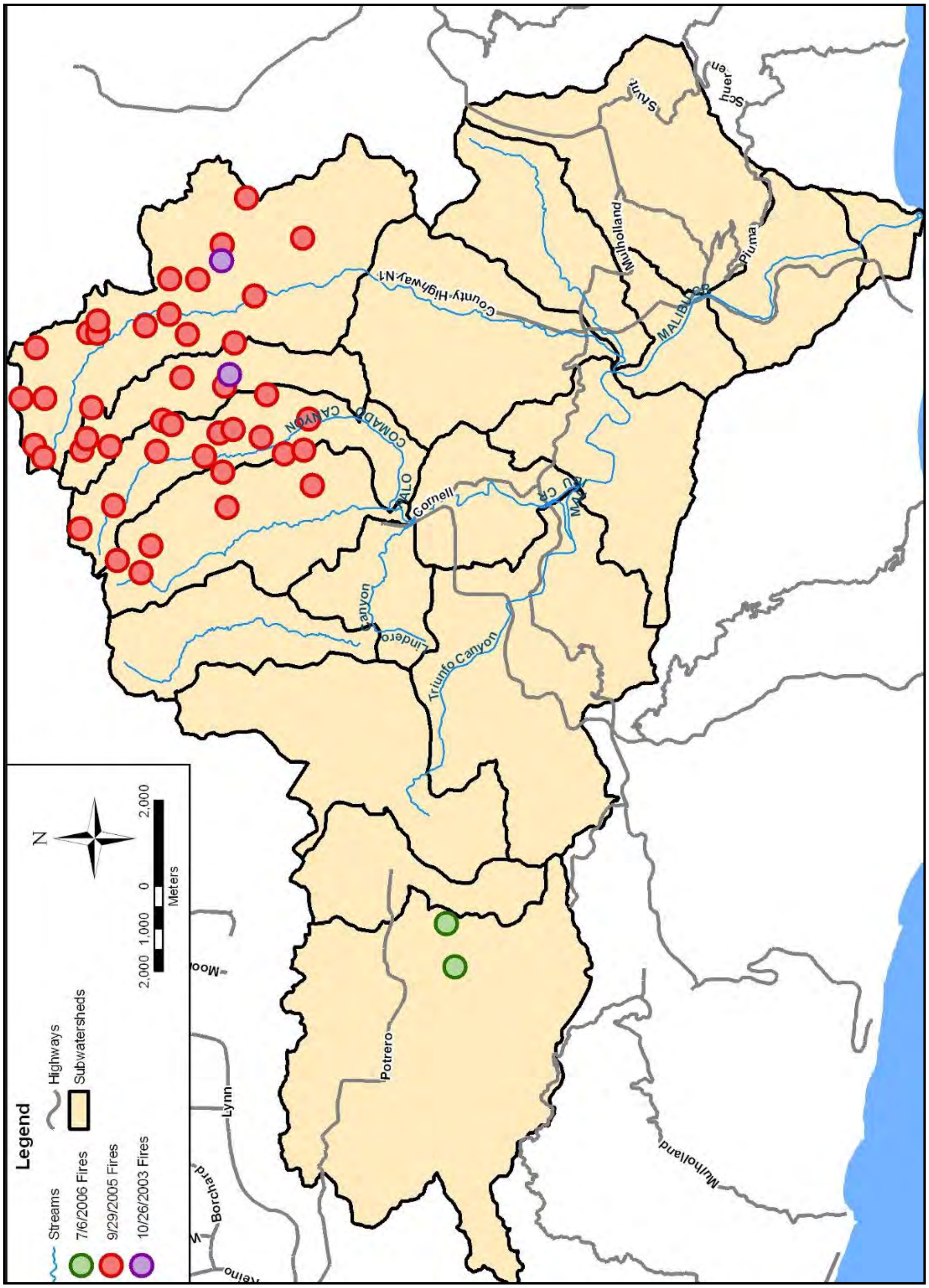

Figure 3-11
Fire Incidents in the Malibu Creek Watershed Since January 2000

3.3.4 Las Virgenes Creek

Las Virgenes Creek is located in the northeastern part of the Malibu Creek Watershed. It flows from above the county line, where the watershed is mostly open space with some sparsely scattered residential units, through parts of the City of Calabasas which includes several residential, commercial, and industrial areas. Liberty Canyon Creek and Stokes Canyon Creek are tributaries to Las Virgenes Creek, each with unique watershed characteristics. The upper section of the subwatershed Liberty Canyon Creek also drains from this city. The lower portion of the subwatershed then becomes open with areas of agriculture and residential housing before it drains into Stokes Canyon Creek. The headwaters of Stokes Canyon Creek run through some scattered residential areas followed by a larger agricultural area before it reaches Malibu Creek. Beneficial uses of Las Virgenes Creek includes: MUN, REC1, REC2, WARM, COLD, WILD, MIGR, SPWN, RARE, and WET.

Sediment is not a pollutant of concern in Upper Las Virgenes Creek (HtB-9 and LV1) and in the northernmost sample location in Lower Las Virgenes Creek (HtB-13). Erosion was identified as one of the conditions for the "Very Poor" IBI rating at the upstream station (LV1). Sample sites downstream of the residential area along Las Virgenes Creek and in Liberty Canyon were found to have wet weather TSS concentrations greater than 100 mg/l (WQMP-1, WQMP-2 and LV2). Turbidity values during wet weather were significantly higher directly downstream of the confluence with Stokes Creek (HtB-5) than upstream on Stokes Creek (HtB-16). This may show that sediment in Lower Las Virgenes Creek comes from the upper reaches of Las Virgenes Creek and Liberty Canyon, rather than Stokes Creek.

The fires shown on Figure 3.10 also affected the Upper Las Virgenes Creek subwatershed. Samples taken in December, shortly after the 2005 fire do not show any significant increase in TSS at the Upper Las Virgenes Creek site (LV1). In the Lower Las Virgenes Creek subwatershed, the site downstream of the fires shows a slight elevation of TSS on December 25, 2005, but nothing greater than other samples taken at the site.

Nutrients in the Las Virgenes Creek subwatershed did not exceed water quality objectives for the winter samples with the exception of one sample in Stokes Canyon (HtB-5) which had a TN concentration of 9.1 mg/L. In Upper Las Virgenes Creek no samples exceeded TN objectives in the most upstream monitoring location (HtB-9); however TN objectives were exceeded in 72% of the samples during the summer season at the next downstream site (LV1). The land use above these locations is mostly open space. Both sites exceeded objectives for TP during the summer. Mean TN concentration was higher in Lower Las Virgenes Creek than in the upper reach, with exceedence frequencies greater than 75% (HtB-13, WQMP-1, and LV2). These sites are downstream of residential and commercial areas which may contribute nutrients to the creek. Typical dry and wet weather nutrient concentrations are comparable in Liberty Canyon to Lower Las Virgenes Creek, but the frequency of exceedence is lower at about 33% (LC); however the maximum TN concentration was greater at 15 mg/L (LC). During the summer season, Stokes Creek had only one sample that exceeded objectives for TN

(HtB-16). However downstream of the confluence of Stokes Creek and Lower Las Virgenes Creek, the TN objectives were exceeded in 100% of the samples collected (HtB-5). This suggests that most of the TN comes from Las Virgenes Creek and not the agricultural areas within Stokes Creek.

The bacteria concentrations exceeded water quality objectives at all stations on Las Virgenes Creek. Bacteria concentrations in this region were generally higher in the summer during dry weather. Samples collected in Upper Las Virgenes Creek exceeded bacteria objectives less frequently than in Lower Las Virgenes Creek, with the highest values not correlated with weather condition or season. The Lower Las Virgenes Creek sampling sites also have heavy human traffic which contributed to the "Poor" IBI rating (LV2). Similar to Las Virgenes Creek below the 101 Freeway, Liberty Canyon Creek exceeded *E. coli* water quality objectives in most samples (LC and WQMP-2). These sample locations also immediately follow residential areas. At the mouth of the Las Virgenes Creek watershed, exceedences of bacteria water quality objectives were less frequent than several miles upstream, with less than 50% of samples exceeding criteria (HtB-5 and HtB-16).

Metal concentrations were not monitored in the upper portion of the Las Virgenes subwatershed or in the Stokes Creek subwatershed. Lower Las Virgenes Creek exceeded water quality objectives in every sample analyzed for Selenium (LV2 and WQMP-1). Lead was exceeded in 14% of the samples (WQMP-1). No other metals exceeded the water quality limits. At the Liberty Canyon sites, Selenium exceeded objectives in 80% of the samples taken (LC and WQMP-2).

3.3.5 Malibu Creek

Malibu Creek begins at the outflow of Malibou Lake and flows through parts of Malibu Creek State Park. The creek changes its course from a generally eastward to southward direction as it reaches to confluence with Las Virgenes Creek. Downstream of the Las Virgenes Creek confluence is the location of LVMWD's Tapia WRF, where effluent is discharged to Malibu Creek during the winter season (November 16 through April 14). Downstream of Tapia WRF, is the confluence with Cold Creek, which drains a primarily undeveloped watershed east of Malibu Creek. After the Cold Creek confluence, Malibu Creek flows south through an undeveloped area until it reaches the City of Malibu and Malibu Lagoon at the Pacific coast. Runoff from a small part of the City of Malibu is directed to Malibu Creek before it reaches Malibu Lagoon. The Malibu Civic Center Storm Water Treatment Facility to capture and treat up to 1,400 gpm of runoff from the 3 storm drains that discharge to the creek from the City of Malibu. During dry weather, treated runoff will be used for landscape irrigation in the vicinity of the project, rather than being discharged back to Malibu Creek.

Nutrient concentrations in Malibu Creek are impacted by upstream loads and also the Tapia WRF discharge during the winter months. Throughout the Malibu Creek watershed, summer season TP water quality objectives were exceeded in most samples at most sampling locations, except within the Cold Creek watershed where no exceedences were measured in the upper reach (HtB-3, CC, and HtB-11). Some residential development in the lower part of Cold Creek explains the exceedence of TP objectives in 13 of 41 samples collected (HtB-2). In Upper Malibu Creek, upstream of the confluence with Las Virgenes Creek, TN water quality objectives were not exceeded (HtB-4 and HtB-12). Downstream of Las Virgenes Creek, TN in winter samples increased from approximately 0.1 mg/l in Upper Malibu Creek to 1.0 mg/l (R-9, R-1, and R-2). The Tapia effluent changes the hydrology and water quality of Malibu Creek downstream of these sampling locations. Exceedence of the winter TN water quality objective of 8mg/l was measured in approximately 30% of samples downstream of the discharge (R-1, HtB-15, and R-13), except for the LADPW mass emission station, where mean TN concentrations during the winter were lower by about 2 mg/l and objectives were exceeded in less than 10% of samples (S02). Most of the samples collected at S02 were during wet weather, which suggests that wet weather events may reduce TN in the winter season, when mixed with higher concentrations in Tapia WRF effluent.

TN in the Cold Creek watershed exceeded objectives in less than 10% of samples during the winter or summer season (HtB-2, HtB-3, HtB-11, and CC). During the summer season, when baseflow in Malibu Creek is reduced by elimination of Tapia effluent, this tributary reduces concentrations within Malibu Creek below the confluence though dilution. Some nutrient reduction occurs between the confluence with Cold Creek and Malibu Lagoon, a relatively long stretch of Malibu Creek, as shown by a reduction in mean winter season TN concentrations from approximately 5 mg/l (S02, HtB-15, and R-13) to approximately 3 mg/l (MAL, R-3, R-4, R-11, HtB-1, and HtB-20). The reduction could be due to settling of particulate nitrogen or uptake by algae or macrophytes in Malibu Creek. During the summer season this reduction is not as significant, and water quality objectives are exceeded in very few samples in Lower Malibu Creek (MAL, R-3, R-4, HtB-1, and HtB-20), except at R-11, within Malibu Lagoon, where plant and algae growth and decay in stagnant water can be a large source of organic nitrogen.

Bacteria concentrations did not exceed water quality objectives during dry weather conditions in either the summer or winter seasons at most Malibu Creek monitoring locations. Between 10 and 40% of samples exceeded bacteria objectives in the lower part of Cold Creek, where there is some residential development (HtB-2) and within the City of Malibu, downstream of urban areas (R-4, R-11, amd HtB-20). Conversely, during wet weather bacteria objectives were exceeded in 45-68% of samples collected in Malibu Creek downstream of the Las Virgenes Creek confluence (HtB-1, HtB-15, HtB-20, HtB-12, R-1, R-2, R-3, R-4, R-9, R-11, R-13, and MAL), with 93% of storm event sample at S02 exceeding the 236 MPN/100ml *E. coli* objective. Wet weather samples collected from Cold Creek were not a significant source of bacteria to Malibu Creek, with only 1 of 7 wet weather samples exceeding the objective.

In Malibu Creek, sediment is only a pollutant of concern during wet weather conditions, as shown by a mean TSS of all wet weather composite samples greater than 1,100 mg/l in Malibu Creek (S02). In Lower Malibu Creek, the IBI score was significantly higher than at any other assessment site in the MCW, citing specifically that there was little deposition of fine sediments. In addition to Malibu Creek, there is an area within the upper part of the Cold Creek watershed that may have been burned during September of 2005. Samples in this part of Cold Creek increased from a mean TSS concentration of approximately 12 mg/l to 54 mg/l during dry weather following September of 2005 (CC). Bioassessment surveys conducted by The County of Los Angeles in Cold Creek in 2003 and 2004 scored Cold Creek as "Good" based on the IBI score in both years. This site was the highest scored IBI of the 16 survey locations from throughout Los Angeles County.

Malibu Creek exceeded Selenium water quality objectives in 89% of samples analyzed during LVMWD's 18 month CTR sampling program (R-1) and was detected but under the target for one sample collected under the MCWMP (HtB-4). Secondary MCLs for public water systems for Aluminum, Iron, Manganese, Molybdenum, and Strontium were exceeded in this same sample collected in February 2007(HtB-4). Lead and mercury exceeded targets in less than 10% of samples collected by LVWMD at R-1 and did not exceed targets at HtB-4 in February of 2005.

3.4 Watershed-Wide Evaluation

Several general watershed-wide observations regarding water quality conditions were developed by evaluating monitoring data from all of the sites within the MCW. These observations are summarized below:

- Bacteria concentrations are generally greatest downstream of urbanized land use areas in most waterbodies.
- Nutrient concentrations are greatest downstream of agricultural areas in the Hidden Valley Creek subwatershed. Organic nitrogen was the predominant form of nitrogen in MCW streams, except for Malibu Creek downstream of Tapia WRF during the winter months, when effluent is discharged to the creek.
- Upstream land use alone was not a strong predictor of water quality concentrations.
- Ammonia concentrations in MCW streams were below acute and chronic toxicity targets in most samples.
- Summer season TP frequently exceeded the 0.1 mg/l target at most sites.
- IBI scores were poor or very poor throughout watershed, except in Lower Malibu Creek, where conditions were categorized as fair. These IBI scores were similar to the results of the LA County NPDES bioassessment surveys. Poor IBI scores were influenced by degradation of stream habitat and anthropogenic inputs.
- Calabasas Landfill may be a significant source of TSS in Cheseboro and Liberty Canyon Creeks.

- Most "Hot Spots" monitoring found exceedences for metals not currently on the 303d list, including Al, Fe, Mb, Mn, Mo, and Sr. Mercury and lead generally below WQ targets (except at landfill) although on the 303(d) list for Triunfo Creek.

- Selenium concentrations exceeded CTR targets in most subwatersheds. Selenium is positively correlated with nitrate, suggesting that nitrate in groundwater may be mobilizing Se from marine sedimentary bedrock.

Section 4
Pollution Prevention Recommendations

In addition to analyzing data, it is important to review options for improving water quality and preventing pollution in the area. The pollution prevention recommendations detailed here are based on knowledge of watershed, available land for project implementation, and need based on water quality monitoring information. The listing of best management practices (BMPs) includes both structural and nonstructural solutions. Structural solutions range from small scale projects implemented throughout the MCW, as appropriate, such as stream buffers or local capture systems, to large scale regional projects such as sub-surface flow wetlands and regional infiltration systems.

These recommendations are largely based on implementation recommendations originally presented in the Malibu Creek Watershed Integrated TMDL Implementation Plan as further detailed in Section 4.1. Additional BMP considerations for the MCW are provided in Section 4.2.

4.1 Malibu Creek Watershed Integrated TMDL Implementation Plan

The Integrated Total Maximum Daily Load Implementation Plan (TMDLIP) for the Malibu Creek Watershed (MCW) was prepared in response to Resolution No. 2004-019R of the California Regional Water Quality Control Board—Los Angeles Region (Regional Board) amending the Water Quality Control Plan for the Los Angeles Region (Basin Plan) to incorporate Implementation Provisions for the Region's Bacteria Objectives and to incorporate a Total Maximum Daily Load (TMDL) for Bacteria for Malibu Creek and Lagoon. Taking an integrated approach to address a range of pollutants within the watershed, the BMPs included in the TMDLIP all address multiple of the key impairments listed in Section 3 of this report.

The nonstructural and structural BMPs included in the TMDLIP, and listed in this section, were evaluated using a variety of criteria such as the removal effective of targeted pollutants. The targeted pollutants included in the TMDLIP review were:

- Trash;
- Sediment (TSS);
- Nutrients (N and P);
- Metals; and
- Bacteria

While the monitoring data presented in Sections 2 and 3 did not include trash, the listing of removal effectiveness for trash has been included here for informational purposes.

4.1.1 Nonstructural BMPs

Nonstructural BMPs address major sources thought to be substantially contributing to exceedances of water quality objectives for all pollutants in both dry- and wet-weather conditions. These BMPs included additions to the NPDES permit programs such as: public outreach, industrial/ commercial facility control, development planning and development construction, public agency activity, and public agency illicit connection/illicit discharge control, as well as opportunities for OWTS management.

Table 4-1 lists the nonstructural BMPs included in the TMDLIP along with a listing of pollutants potentially targeted by each BMP.

Table 4-1
Non-Structural BMPs

Proposed Non-Structural BMP	**Additional BMP Description**	**Pollutants Potentially Targeted**
Public Information and Participation Programs		
Partnerships with HOAs to Increase Impressions and Promote Water Quality and Water Conservation	Partnerships with HOAs to educate residents; work with HOAs to reduce runoff from common area landscaping.	Toxics Sediment Nutrients Metals Bacteria
Include Water Conservation, and Water Quality in Existing Educational Programs at Schools	Program geared towards training teachers to teach children about water quality and water conservation. Field trips for students to educate students on water quality issues.	Toxics Sediment Nutrients Metals Bacteria
Outreach Fact Sheets on Water Quality for Point-of-Sale Distribution	Distribution of outreach materials at point of sale facilities regarding the link between specific activities and bacterial loading of water	Bacteria
Work with LVMWD, WBMWD, and District No. 29 to Support/Expand Water Use Survey and Conservation Programs	Work with Las Virgenes Municipal Water District (LVMWD) and West Basin Municipal Water District (WBMWD), Los Angeles County Waterworks District No. 29 (District No. 29) and to support and expand water conservation and water use survey programs and make link to bacterial loading caused by runoff.	Toxics Sediment Nutrients Metals Bacteria
Horse Stables and Confined Animal Facility Outreach and Education	Support efforts to create horse BMP outreach materials for both the County-wide horse community and agency regulatory staff. Work with other stakeholders to distribute materials and create awareness.	Toxics Sediment Nutrients Metals Bacteria
Outreach to Pet Owners Linking Waste to Water Quality Impairments	Outreach to pet owners establishing a link between animal wastes and health issues and focus on point of contact. The objective of this recommendation is to target pet owners with information about pet waste and its impact on waterbodies.	Toxics Sediment Nutrients Metals Bacteria
Place Pet Waste Bag Dispensers at Trailheads	Place pet waste bag dispensers at trailheads and trash cans with lids, if trash cans with lids are not already present.	Nutrients Bacteria
Develop an Inventory of Areas with Confined Animals and Educate Property Owners on Water Quality Impairments and BMPs (combine with commercial inventory effort)	This program will educate the owners of confined animals about bacteria TMDLs and steps they can take to decrease negative impacts on the environment. A network of volunteers from environmental organizations could be trained in this area.	Sediment Nutrients Bacteria
Post Signs at City and County-owned Trailheads for Equestrian Users Emphasizing Clean-up of Manure in Parking Lots	Post signs at City and County-owned trailheads designated for equestrian users to not clean out horse trailers in parking lots and to clean up horse waste.	Toxics Sediment Nutrients Metals Bacteria
Recreational Vehicle (RV) Disposal Site Outreach Program	Outreach program designed to encourage and teach RV owners to properly dispose of holding tank waste.	Toxics Nutrients Bacteria
Coordinate with watershed agencies to identify methods to reach visitors to the watershed		Toxics Sediment Nutrients Metals Bacteria

Table 4-1
Non-Structural BMPs

Proposed Non-Structural BMP	Additional BMP Description	Pollutants Potentially Targeted
Outreach at Trailheads Regarding Waste Disposal and Restroom Use	Posting signs at trailheads to remind hikers to use the restroom before a hike will both increase awareness and prevent improper waste disposal.	Toxics Sediment Nutrients Metals Bacteria
Coordinate Meetings Between Agencies and Environmental Organizations for Preparing Outreach Materials	Numerous efforts are continually put forth to produce outreachmaterials, but production is not always coordinated between organizations and agencies.	Toxics Sediment Nutrients Metals Bacteria
Provide Septic System (OWTS) Pumpers and Customers with Septic System Guides	The goal of this suggestion is to provide septic system owners with information pertaining to their septic system and how to prevent pollution using proper maintenance procedures.	Toxics Sediment Nutrients Metals Bacteria
Investigate Incentive Programs for Replacing Improperly Operating Septic Tanks		Nutrients Bacteria
Septic Inspections Upon Change in Ownership		Nutrients Bacteria
Outreach to homeowners and HOAs to promote native landscaping	Outreach program designed to educate homeowners about the benefits of native landscaping	Sediment Nutrients Bacteria
Industrial/Commercial Facilities Control Programs		
Trash Hauler Outreach	Meet with waste haulers; businesses not required to be inspected, but sharing dumpsters with those that are inspected; and property managers to discuss importance of closing dumpster lids.	Nutrients Bacteria
Develop Targeted Outreach for Businesses withGreatest Potential to Contribute Pollutants ofConcern (including Restaurants, Automotive,Equestrian, Industrial, Landscape Maintenance,Mobile Businesses)	Brochures targeting painting contractors, landscape and poolmaintenance personnel, contractors, site supervisors, and horseowners. Distribute targeted BMP information at public counters in conjunction with Chamber of Commerce and Malibu Contractor's Association.	Toxics Sediment Nutrients Metals Bacteria
Expand Media Partnership with Caltrans		Toxics Sediment Nutrients Metals Bacteria
Develop Minimum Requirements and Program to Enforce Parking Lot Street Sweeping for Commercial Businesses		Toxics Sediment Nutrients Metals Bacteria
Modify Inspection Staff Training to Include Enhanced Training on Water Quality Impairments and BMPs	Training staff that conduct inspections, tailgate meetings, formal classroom training, and self guided training.	Toxics Sediment Nutrients Metals Bacteria
Develop a Reward/Stewardship Program for Businesses	Develop business reward program to reward businesses helping keep the environment clean.	Toxics Sediment Nutrients Metals Bacteria

Table 4-1
Non-Structural BMPs

Proposed Non-Structural BMP	Additional BMP Description	Pollutants Potentially Targeted
During Inspections Emphasize BMPS that Reduce Pollutants of Concern	Outreach materials are provided to businesses during inspections.	Toxics Sediment Nutrients Metals Bacteria
New Development/Redevelopment Planning		
Incorporate TMDL requirements into CEQA process	Incorporate TMDL requirements into the CEQA process to adequately review proposed projects	Toxics Sediment Nutrients Metals Bacteria
Increase Inspections of Post-Development BMPs	As part of the conditions of approval of a project or CEQA mitigation measures require project applicants and future owners to conduct inspections on a periodic basis to ensure proper maintenance of BMPs per covenant agreements with the approving agency and submit documentation to the approving agency	Toxics Sediment Nutrients Metals Bacteria
Enhance Education for Developers of Projects outside SUSMP/SQUMP requirements	Provide brochures to developers and discuss items the developer can do during the permitting process to reduce runoff from the project	Toxics Sediment Nutrients Metals Bacteria
Develop vegetative filter BMP	Develop a standard Vegetative Filter Detail	Toxics Sediment Nutrients Metals Bacteria
Complete LA County BMP Technical Manual and Include Detailed BMP Requirements Related to Water Quality Impairments	LA County finalize its Countywide BMP Technical Manual for SUSMP	Toxics Sediment Nutrients Metals Bacteria
Public Agency Activities		
Emergency Spill Management - Review Existing Emergency Operation Plans on a Regular Schedule; assure availability of emergency equipment during peak traffic hours	Assure that emergency equipment or contracts are locally and immediately available, even during high-traffic hours, to address overflows or spills.	Toxics Sediment Nutrients Metals Bacteria
Additional Trash Pick Up During High Use Periods in High Use Sites	Empty trash cans during high use times during weekends or holidays and coordinate volunteer cleanups of sites heavily littered.	Sediment Nutrients Metals Bacteria
Assure that Contractors Providing Maintenance and Landscape Services Adhere to BMPs Through Contract Language and Inspections	mplement contract language with contractors providing maintenance services to assure implementation of BMPs in work activities and at facility storage locations. Inspect to assure compliance.	Toxics Sediment Nutrients Metals Bacteria
Establish Optimal Cleaning Cycles for Drainage Facilities	Cleaning drainage facilities regularly at optimal intervals removes trash, sediments, and debris that may carry bacteria into the storm drain.	Toxics Sediment Nutrients Metals Bacteria

4.1.2 Institutional and Distributed BMPs

Structural-institutional BMPs are coordinated programs that would be developed and implemented by local or county jurisdictions. Coordinated programs would target specific groups, practices, and/or sources of pollutants. Distributed BMPs (often referred to as "low impact development" practices) would reduce runoff volumes and loads at the source. As such, the stormwater management strategy is concerned with reducing the hydrologic impact caused by development and maintaining or restoring the natural hydrologic and hydraulic functions of a site. Distributed BMPs employ a variety of natural and constructed features that reduce the rate of runoff, filter pollutants, and facilitate the infiltration of water into the ground at the parcel scale.

Table 4-2 lists the institutional and distributed BMPs included in the TMDLIP. The removal effectiveness of each of the targeted pollutants is listed with each BMP.

4.1.3 Regional Structural BMPs

A total of 13 sites were identified as potential opportunities for regional BMPs in six of the ten high priority subwatersheds located within the MCW, and detailed in the TMDLIP. While a range of regional BMP types were evaluated, each of the 13 potential sites proposes either a sub-surface flow (SSF) wetland, or a regional infiltration project. The potential sites and a brief description are provided below in Table 4-3.

Those areas treated by proposed infiltration basin regional BMPs are expected to experience slightly higher removal efficiencies of bacteria, metals, and organic pollutants than those being treated by proposed SSF Wetlands. All regional BMPs are expected to provide a relatively high removal efficiency for trash, sediment, and nutrients from treated waters.

Table 4-2
Institutional and Distributed Structural BMPs

BMP Category / Type	Potential mechanisms	Description	Targeted Pollutants	Removal Effectiveness
Structural Institutional BMPs				
Development and Redevelopment Design Standards	Volume Reduction, Flow Control, WQ	Standards requiring implementation of BMPs associated with new or redevelopment activities.	Trash	NA
			Sediment	NA
			Nutrients	NA
			Metals	NA
			Bacteria	NA
Voluntary Downspout Disconnection Program	Volume Reduction, Flow Control	Program to decrease system connectivity and increase on-site infiltration; can be incentive-based	Trash	High
			Sediment	High
			Nutrients	High
			Metals	High
			Bacteria	High
Stream Buffers	Volume Reduction, WQ	Provides natural vegetation corridors to help protect stream banks and reduce pollutant loads from urban runoff	Trash	Moderate
			Sediment	High
			Nutrients	Limited
			Metals	High
			Bacteria	Limited
Horse Farm Retrofit Program	Source Control	Includes design standards, education, and BMP retrofits to reduce pollutant runoff loads	Trash	Limited
			Sediment	Limited
			Nutrients	High
			Metals	Limited
			Bacteria	High
Structural Distributed BMPs				
Local Capture Systems	Volume Reduction, Flow Control	Cisterns, rain barrels or other holding tanks for peak flow reduction and onsite reuse	Trash	Moderate
			Sediment	Moderate
			Nutrients	Moderate
			Metals	Moderate
			Bacteria	Moderate
Vegetated Treatment Systems	WQ, Volume Reduction, Flow Control	Vegetated swales, bioretention areas, etc. to filter and infiltrated runoff; support natural treatment mechanisms	Trash	High
			Sediment	High
			Nutrients	High
			Metals	Moderate
			Bacteria	Moderate
Local Infiltration Systems	Volume Reduction, Flow Control	Site-scale infiltration basins or pervious wearing surfaces such as grass pavers or pervious asphal	Trash	High
			Sediment	High
			Nutrients	High
			Metals	Moderate
			Bacteria	Moderate
Street and Parking Lot Biofiltration Retrofits	WQ, Volume Reduction, Flow Control	Small scale vegetated facilities to improve WQ, and promote infiltration	Trash	High
			Sediment	High
			Nutrients	High
			Metals	High
			Bacteria	High

Table 4-3
Regional Structural BMPs

Site	Location/Name	Type of BMP	Jurisdiction	Setting	Targeted Pollutants	Removal Effectiveness
1	Three Springs Park	Subsurface Flow Wetland	Westlake Village	Suburban pocket-park	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate
2	Triunfo Creek - Riparian Enhancement	Subsurface Flow Wetland	Westlake Village	Riparian corridor treating outflow from the Westlake reservoir	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate
3	Upper Lindero Creek at County Line	Infiltration Basin	Thousand Oaks	Rural open space with natural drainage	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
4	Lake Lindero Country Club	Infiltration Basin	Agoura Hills	Lindero Creek passes directly through the Country Club	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
5	Oak Canyon Community Park	Subsurface Flow Wetland	Oak Park- County of Ventura	Rural setting with culvert, then creek passing through park	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate
6	Medea Creek Park	Infiltration Basin	Oak Park- County of Ventura	Natural drainage near roadway and residential	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
7	Reyes Adobe Park	Subsurface Flow Wetland	Agoura Hills	Pocket park and stream in urban residential setting	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate

Table 4-3
Regional Structural BMPs

Site	Location/Name	Type of BMP	Jurisdiction	Setting	Targeted Pollutants	Removal Effectiveness
8	Upper Lindero Creek Subwatershed	Infiltration Basin	Agoura Hills	Valley Oaks Memorial Park in urban setting near Lake Lindero	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
9	Sumac Park	Infiltration Basin	Agoura Hills	Urban park with subsurface storm drain	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
10	Chumash Park	Infiltration Basin	Agoura Hills	Urban park with small channelized drainages near Medea Creek	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate
11	Liberty Canyon Creek	Subsurface Flow Wetland	Calabasas	Open space with channelized creek entering natural drainage	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High
12	Las Virgenes Creek as DeAnza Park	Infiltration Basin	Calabasas	Agricultural land at Las Virgenes Creek-channelized stream	Trash	High
					Sediment	High
					Nutrients	High
					Metals	Moderate
					Bacteria	Moderate
					Organic Pollutants	Moderate
13	Mountain View Homeowners Association	Subsurface Flow Wetland	Unincorporated L.A. County	Natural creek, between a storm drain outlet and concrete drainage channel, tributary to Las Virgenes Creek	Trash	High
					Sediment	High
					Nutrients	High
					Metals	High
					Bacteria	High
					Organic Pollutants	High

4.2 Additional BMP Considerations

As a result of the multi-pollutant, multi-benefit approached used in the TMDLIP, the structural and nonstructural described in Section 4.1 are intended to result in water quality improvements throughout the MCW and for a variety of targeted pollutants. To further understand the areas treated by the proposed regional BMPs, the following Figures 4-1 through 4-5 combine the exceedance frequency information for metals, TSS, TN, TP, and bacteria presented in Section 3 with the areas treated by the 13 proposed regional BMPs.

As Figures 4-1 through 4-5 show, the regional BMPs included in the TMDLIP are primarily located in the upper subwatersheds, treating waters upstream. It should be noted while these figures show the areas treated by regional BMPs, they do not account for the other structural and non-structural BMPs that will be implemented throughout the region, which will also be providing additional water quality improvements.

Figure 4-1, Metals Exceedance Frequency and Areas Treated by Regional BMPs, the majority of the larger exceedance frequencies occur in or downstream of a regional BMP treatment area. A few small exceedances do occur in the far western and eastern regions of the watershed (in the Hidden Valley Creek and Cold Creek subwatersheds), that are not directly downstream of a treatment area. This pattern is similarly seen with the other figures for TSS, TN, TP, and Bacteria with a few differences:

- Figure 4-2, TSS Exceedance Frequency and Areas Treated by Regional BMPs, shows a high exceedance frequency at one location in the Cold Creek subwatershed, a subwatershed that generally has a low density of urban development and which is not directly treated by any proposed regional BMPs. However, other monitoring in this subwatershed indicates lower concentrations of TSS. Localized areas of elevated TSS, particularly in a sparsely developed watershed could in part represent natural erosion processes. Any improvements in TSS water quality in this subwatershed will be dependant on implementation of applicable institutional, distributed and non-structural BMPs.

- Figure 4-3, TN Exceedance Frequency and Areas Treated by Regional BMPs, and Figure 4-4, TP Exceedance Frequency and Areas Treated by Regional BMPs, both indicate high exceedance frequencies in the Hidden Valley Creek subwatershed which is not directed treated by any one proposed regional BMPs, improvements in nutrient water quality will be dependant on proposed institutional, distributed and non-structural BMPs in this area currently.

- Figure 4-5, Bacteria Exceedance Frequency and Areas Treated by Regional BMPs, shows smaller exceedance frequency in both the Hidden Valley Creek and Cold Creek subwatersheds, with the majority of the larger exceedance frequencies occurring in locations to be treated by proposed regional BMPs.

Given the integrated, multi-benefit, multi-pollutant approach used in the development of the TMDLIP using a range of sizes and types of BMPs, no additional BMPs are suggested in this report. As implementation of the TMDLIP progresses, it will be important to monitor changes and improvements in water quality throughout the MCW to determine the success of BMPs being implemented, and potential additions or changes in BMP implementation in other areas of the subwatershed to provide further water quality improvements.

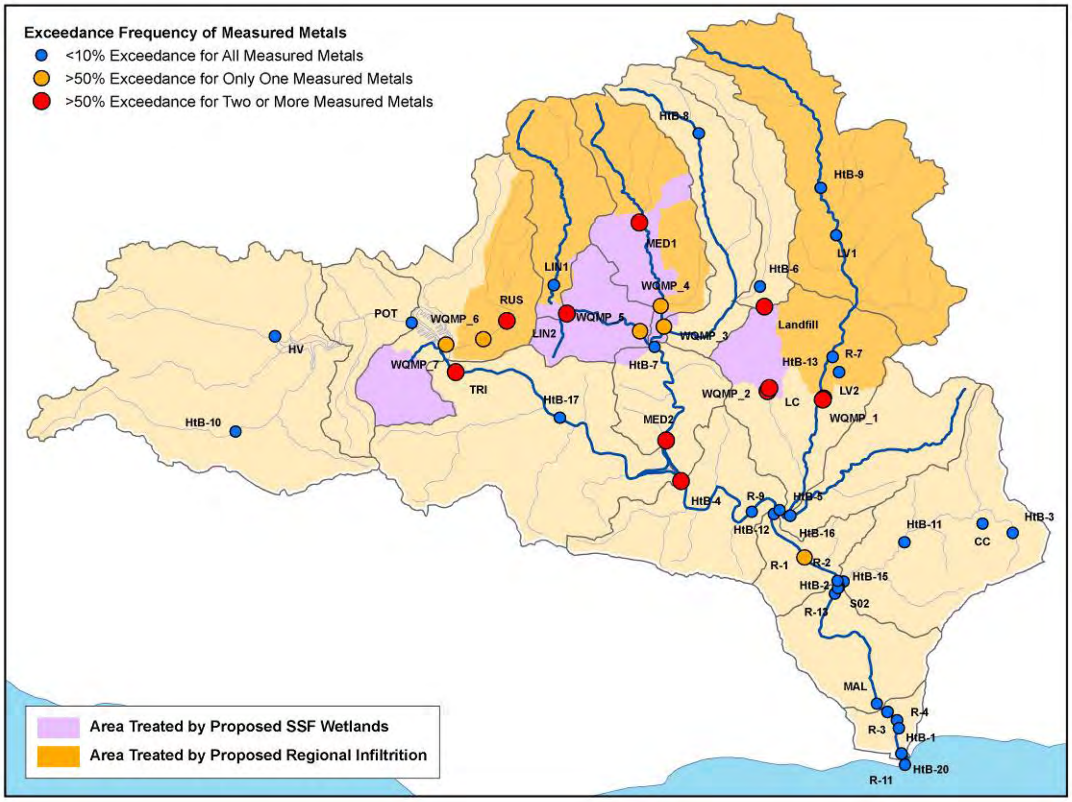

Figure 4-1

Metals Exceedance Frequency and Areas Treated by Regional BMPs

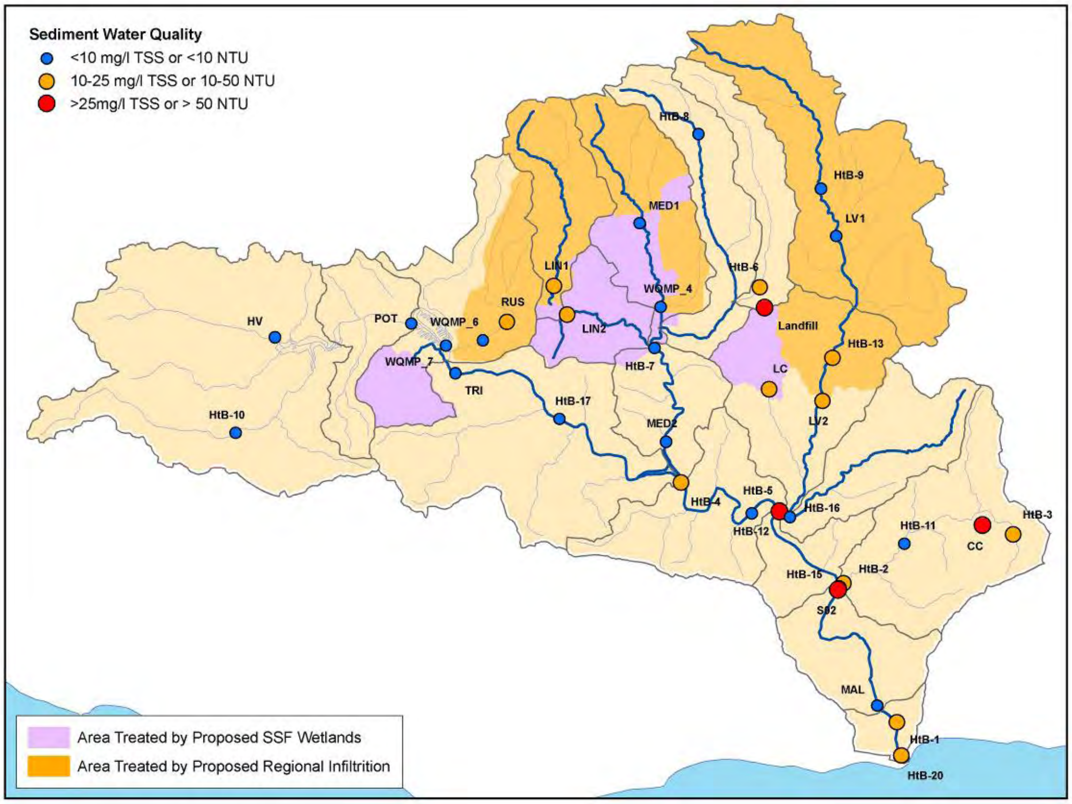

Figure 4-2
TSS Exceedance Frequency and Areas Treated by Regional BMPs

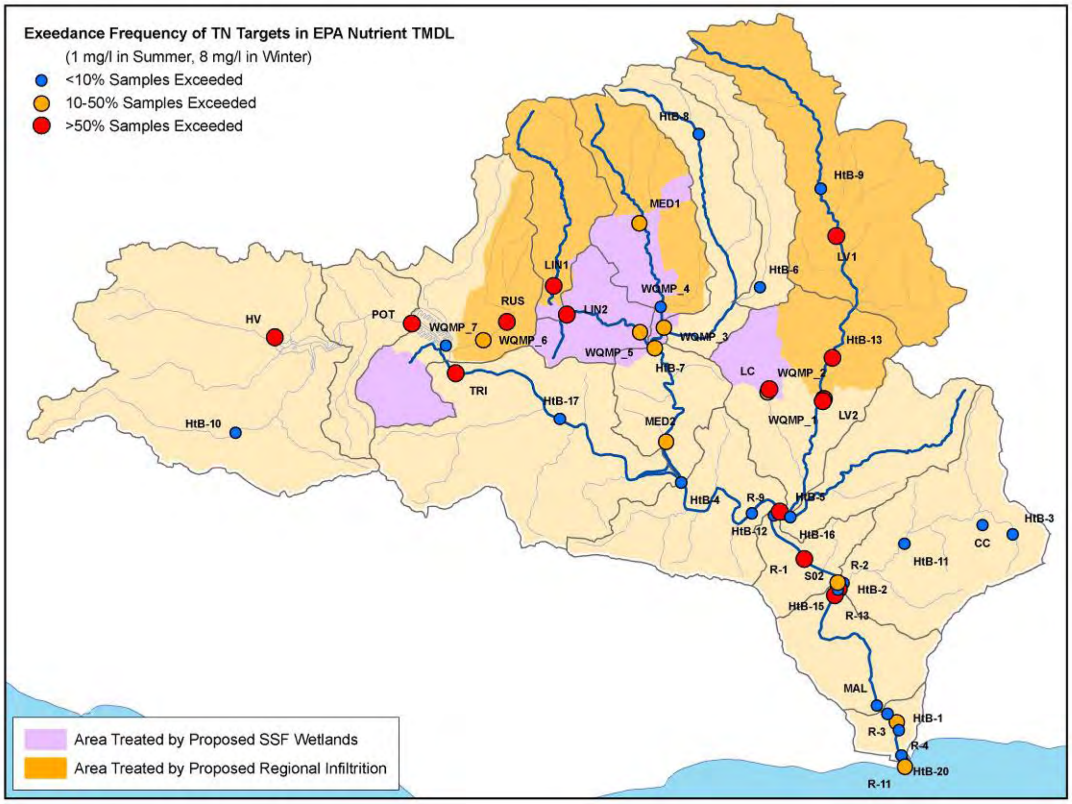

Figure 4-3

TN Exceedance Frequency and Areas Treated by Regional BMPs

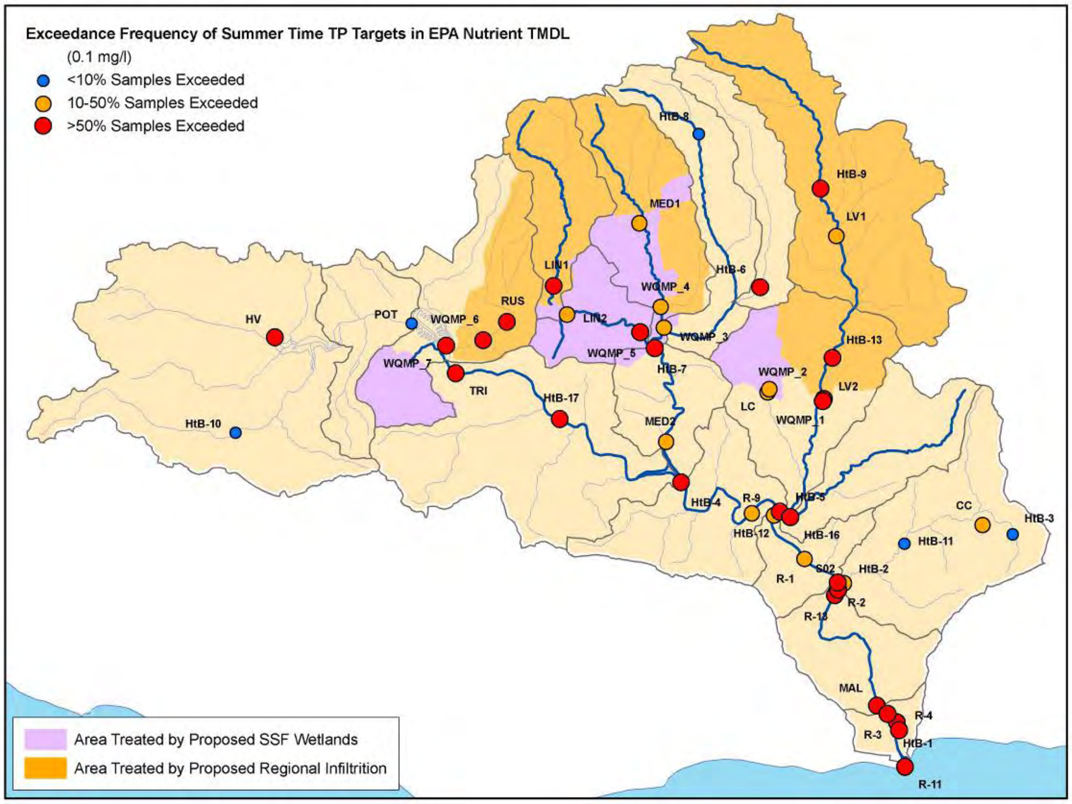

Figure 4-4

TP Exceedance Frequency and Areas Treated by Regional BMPs

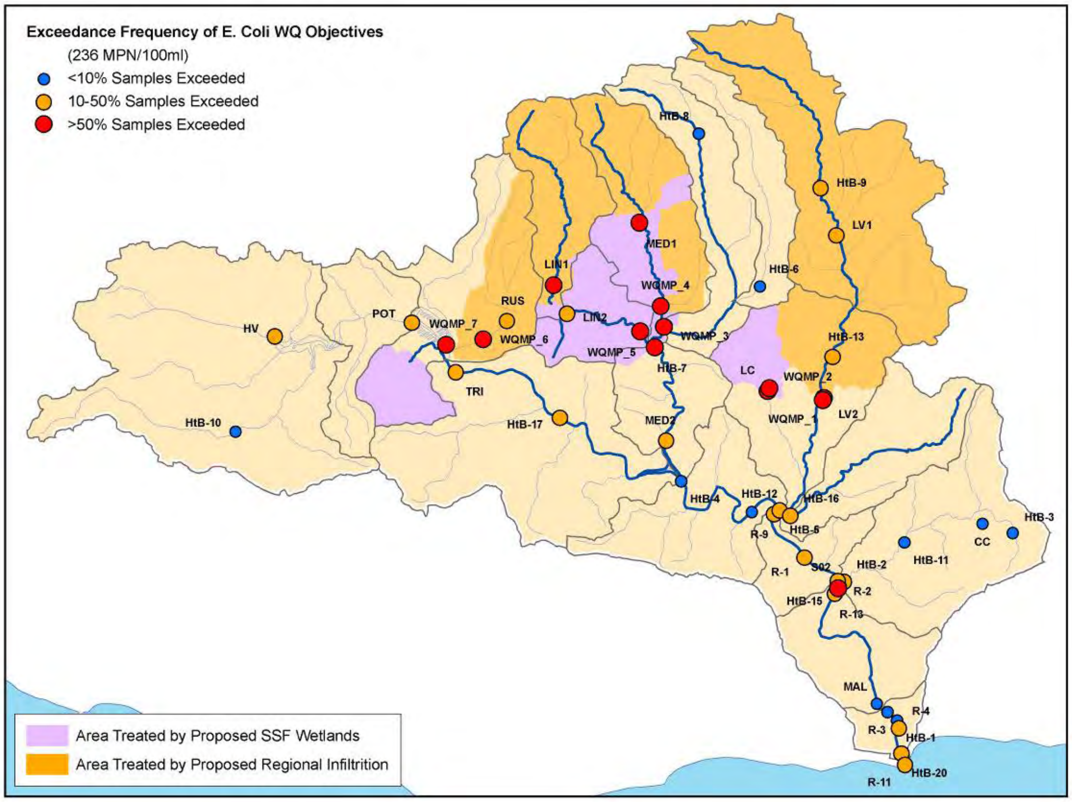

Figure 4-5
Bacteria Exceedance Frequency and Areas Treated by Regional BMPs

Section 5
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Municipal and Domestic Supply (MUN)

> Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Ground Water Recharge (GWR)

> Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Navigation (NAV)

> Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Water Contact Recreation (REC-1)

> Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2)

> Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Warm Freshwater Habitat (WARM)

> Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)

> Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates

Estuarine Habitat (EST)

> Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)

> Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such

as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Marine Habitat (MAR)

Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marlne habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g.. marine mammals, shorebirds)

Wildlife Habitat (WILD)

Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates, or wildlife water and food sources.

ALL DATA CORRELATIONS	*E.coli* MPN/100ml	Enterococci MPN/100ml	Fecal Coliform MPN/100ml	Total Coliform MPN/100ml	Ammonia-N mg/L	Chlorophyl-A mg/m3	Nitrate mg/L	Nitrite mg/L	Ortho-phosphate as P mg/L	TKN mg/L	Total Nitrogen	Organic Nitrogen	TSS mg/L	pH	Couctivity µS	Dissolved Oxygen mg/L	Water Temp °C	Flow ft^3/sec
E.coli	100%																	
Enterococcus	76%	100%																
Fecal Coliform	71%	62%	100%															
Total Coliform	44%	45%	64%	100%														
Ammonia	-4%	-4%	17%	5%	100%													
Chlorophyl	-5%	-5%	-8%	-8%	-14%	100%												
Nitrate	1%	-2%	6%	19%	-4%	-6%	100%											
Nitrite	-3%	-4%	-2%	3%	2%	-5%	-6%	100%										
Orthophosphate	-2%	-4%	0%	3%	18%	-8%	24%	1%	100%									
TKN	10%	16%	17%	12%	3%	29%	-6%	-10%	-3%	100%								
Total Nitrogen	7%	7%	16%	25%	1%	9%	88%	24%	22%	50%	100%							
Organic Nitrogen	11%	15%	16%	10%	-9%	29%	-7%	-10%	-2%	99%	49%	100%						
TSS	12%	12%	19%	11%	-1%	13%	6%	-2%	-3%	9%	6%	9%	100%					
pH	23%	33%	29%	25%	-12%	5%	4%	-2%	13%	23%	17%	24%	-7%	100%				
Conductivity	-6%	-7%	-1%	15%	8%	-9%	-8%	11%	-4%	0%	-3%	0%	-15%	4%	100%			
Dissolved Oxygen	12%	15%	13%	14%	-12%	13%	10%	-6%	2%	-1%	10%	0%	-7%	36%	15%	100%		
Water Temp	9%	6%	12%	2%	8%	-9%	-7%	2%	-6%	5%	-10%	4%	2%	10%	-2%	-23%	100%	
Flow	-6%	-5%	-8%	-4%	-6%	11%	2%	-8%	28%	-6%	3%	-6%	-4%	1%	-21%	0%	-7%	100%

WINTER CORRELATIONS	*E.coli* MPN/100ml	Enterococci MPN/100ml	Fecal Coliform MPN/100ml	Total Coliform MPN/100ml	Ammonia-N mg/L	Chlorophyl-A mg/m3	Nitrate mg/L	Nitrite mg/L	Orthophosphate as P mg/L	TKN mg/L	Total Nitrogen	Organic Nitrogen	TSS mg/L	pH	Couctivity µS	Dissolved Oxygen mg/L	Water Temp °C	Flow ft^3/sec
E.coli	100%																	
Enterococcus	54%	100%																
Fecal Coliform	61%	54%	100%															
Total Coliform	39%	55%	58%	100%														
Ammonia	-11%	1%	-5%	-10%	100%													
Chlorophyl	-7%	-8%	-9%	-11%	-21%	100%												
Nitrate	-5%	-3%	6%	21%	-12%	-13%	100%											
Nitrite	-4%	2%	7%	0%	32%	-18%	5%	100%										
Orthophosphate	-7%	-8%	-4%	-3%	25%	-11%	28%	8%	100%									
TKN	17%	25%	20%	12%	40%	26%	-8%	16%	1%	100%								
Total Nitrogen	5%	11%	17%	30%	8%	-3%	90%	15%	29%	38%	100%							
Organic Nitrogen	18%	25%	21%	12%	26%	28%	-8%	15%	0%	99%	37%	100%						
TSS	0%	11%	23%	12%	-3%	7%	12%	18%	-5%	11%	10%	11%	100%					
pH	10%	31%	13%	14%	-6%	13%	5%	-2%	13%	30%	18%	32%	-4%	100%				
Conductivity	0%	1%	8%	19%	7%	-11%	-5%	4%	-8%	-17%	-10%	-17%	-12%	14%	100%			
Dissolved Oxygen	-7%	-3%	-3%	2%	-38%	23%	1%	-19%	-1%	-9%	-2%	-7%	-9%	32%	25%	100%		
Water Temp	3%	7%	-1%	-3%	10%	-1%	8%	-4%	-7%	2%	7%	1%	10%	18%	-24%	11%	100%	
Flow	-8%	-6%	-8%	-3%	-11%	17%	1%	-8%	42%	-8%	1%	-8%	-4%	5%	-23%	-5%	2%	100%

SUMMER CORRELATIONS	***E.coli* MPN/100ml**	**Enterococci MPN/100ml**	**Fecal Coliform MPN/100ml**	**Total Coliform MPN/100ml**	**Ammonia-N mg/L**	**Chlorophyl-A mg/m3**	**Nitrate mg/L**	**Nitrite mg/L**	**Orthophosphate as P mg/L**	**TKN mg/L**	**Total Nitrogen**	**Organic Nitrogen**	**TSS mg/L**	**pH**	**Couctivity µS**	**Dissolved Oxygen mg/L**	**Water Temp °C**	**Flow ft^3/sec**
E.coli	100%																	
Enterococcus	83%	100%																
Fecal Coliform	75%	66%	100%															
Total Coliform	48%	42%	68%	100%														
Ammonia	-5%	-7%	23%	13%	100%													
Chlorophyl	0%	-2%	-2%	0%	-6%	100%												
Nitrate	7%	0%	9%	18%	2%	2%	100%											
Nitrite	-8%	-7%	-7%	5%	-10%	-4%	-9%	100%										
Orthophosphate	2%	-1%	5%	11%	15%	-3%	17%	-2%	100%									
TKN	9%	14%	18%	13%	-6%	38%	-7%	-14%	-7%	100%								
Total Nitrogen	10%	7%	18%	24%	-2%	26%	86%	32%	13%	57%	100%							
Organic Nitrogen	9%	13%	15%	10%	-16%	37%	-8%	-13%	-5%	99%	56%	100%						
TSS	32%	16%	18%	10%	2%	28%	-3%	-6%	1%	8%	1%	8%	100%					
pH	36%	39%	46%	39%	-19%	-11%	0%	-5%	13%	20%	14%	20%	-13%	100%				
Conductivity	-13%	-14%	-11%	9%	9%	1%	-9%	16%	2%	11%	6%	11%	-21%	-4%	100%			
Dissolved Oxygen	25%	27%	30%	28%	-1%	-7%	15%	-4%	4%	1%	15%	0%	-9%	39%	15%	100%		
Water Temp	0%	0%	5%	-4%	4%	2%	-12%	-11%	-3%	29%	-6%	27%	4%	25%	-12%	-23%	100%	
Flow	-19%	-17%	-15%	-21%	10%	-14%	-16%	-19%	26%	-23%	-15%	-13%	-18%	-19%	2%	-1%	1%	100%

Appendix B

WET WEATHER CORRELATIONS	***E.coli* MPN/100ml**	**Enterococci MPN/100ml**	**Fecal Coliform MPN/100ml**	**Total Coliform MPN/100ml**	**Ammonia-N mg/L**	**Chlorophyl-A mg/m3**	**Nitrate mg/L**	**Nitrite mg/L**	**Orthophosphate as P mg/L**	**TKN mg/L**	**Total Nitrogen**	**Organic Nitrogen**	**TSS mg/L**	**pH**	**Couctivity µS**	**Dissolved Oxygen mg/L**	**Water Temp °C**	**Flow ft^3/sec**
E.coli	100%																	
Enterococcus	59%	100%																
Fecal Coliform	77%	65%	100%															
Total Coliform	41%	60%	63%	100%														
Ammonia	14%	1%	13%	15%	100%													
Chlorophyl	-3%	-11%	-2%	-3%	-25%	100%												
Nitrate	-15%	-7%	-4%	17%	-1%	-33%	100%											
Nitrite	-7%	-4%	0%	25%	16%	-30%	44%	100%										
Orthophosphate	2%	16%	23%	24%	34%	-12%	46%	28%	100%									
TKN	38%	28%	53%	34%	28%	10%	-18%	30%	19%	100%								
Total Nitrogen	8%	8%	25%	37%	9%	-23%	86%	60%	54%	41%	100%							
Organic Nitrogen	39%	28%	53%	31%	-3%	12%	-18%	27%	12%	98%	39%	100%						
TSS	25%	17%	19%	25%	10%	-1%	47%	-12%	18%	-13%	36%	-16%	100%					
pH	32%	8%	32%	7%	2%	-12%	-1%	-24%	5%	33%	23%	35%	3%	100%				
Conductivity	-5%	-4%	1%	24%	9%	-48%	31%	36%	-7%	-1%	30%	-2%	-3%	21%	100%			
Dissolved Oxygen	-5%	-15%	-7%	-10%	-40%	19%	22%	-36%	10%	-39%	4%	-31%	15%	29%	15%	100%		
Water Temp	26%	2%	12%	-10%	38%	8%	-21%	-53%	-2%	-13%	-29%	-18%	6%	8%	-37%	15%	100%	
Flow	-13%	-12%	-8%	6%	-32%	4%	24%	-100%	-26%	-25%	22%	-23%	11%	84%	-34%	32%	-6%	100%

DRY WEATHER CORRELATIONS	*E.coli* MPN/100ml	Enterococci MPN/100ml	Fecal Coliform MPN/100ml	Total Coliform MPN/100ml	Ammonia-N mg/L	Chlorophyl-A mg/m3	Nitrate mg/L	Nitrite mg/L	Orthophosphate as P mg/L	TKN mg/L	Total Nitrogen	Organic Nitrogen	TSS mg/L	pH	Couctivity µS	Dissolved Oxygen mg/L	Water Temp °C	Flow ft^3/sec
E.coli	100%																	
Enterococcus	81%	100%																
Fecal Coliform	68%	61%	100%															
Total Coliform	43%	40%	62%	100%														
Ammonia	-7%	-5%	17%	3%	100%													
Chlorophyl	-5%	-5%	-8%	-8%	-13%	100%												
Nitrate	3%	-1%	8%	21%	-4%	-5%	100%											
Nitrite	-4%	-3%	-1%	5%	2%	-5%	-7%	100%										
Orthophosphate	-1%	-4%	0%	4%	18%	-8%	23%	-1%	100%									
TKN	8%	15%	15%	9%	2%	29%	-5%	-10%	-3%	100%								
Total Nitrogen	6%	6%	15%	24%	1%	11%	88%	24%	22%	50%	100%							
Organic Nitrogen	8%	14%	13%	8%	-9%	30%	-6%	-10%	-2%	100%	49%	100%						
TSS	8%	9%	18%	7%	-3%	15%	3%	-2%	-4%	10%	4%	10%	100%					
pH	24%	37%	31%	30%	-13%	6%	4%	-3%	13%	23%	17%	24%	-7%	100%				
Conductivity	-3%	-5%	3%	20%	9%	-8%	-10%	11%	-6%	1%	-4%	1%	-16%	2%	100%			
Dissolved Oxygen	13%	17%	15%	17%	-11%	13%	9%	-7%	2%	0%	10%	1%	-8%	37%	15%	100%		
Water Temp	13%	11%	17%	8%	8%	-10%	-6%	1%	-8%	8%	-8%	6%	4%	9%	-5%	-24%	100%	
Flow	-6%	-6%	-9%	-5%	-5%	11%	2%	-8%	29%	-5%	2%	-6%	-7%	-1%	-21%	0%	-7%	100%

Malibu Creek Watershed Monitoring Program
Project Evaluation Matrix
January 2008

The project evaluation matrix lists the objectives and the status of achieving the goals for the Malibu Creek Watershed Monitoring Project. The goal of this project was to coordinate efforts in the watershed to identify point and non-point sources of pollution and methods by which such pollution can be prevented or reduced. Specific project objectives are listed with their status in the matrix in Table 1. A brief description of those objectives then follows.

	Project Objective	Status
1	Further establish and characterize baseline conditions	Achieved – Completed: *Malibu Creek Watershed Monitoring Program, 2006 Annual Baseline Report*
2	Locate EPA priority pollutants	Achieved – Completed: *2007 Report on “Hot Spot” Monitoring: Malibu Creek Watershed Monitoring Program*
3	Fill in water quality data gaps	Achieved – Ongoing: Monitoring included in this program has provided useful data, providing information where existing water quality monitoring may have had a gap or lack of consistent data. A comprehensive analysis of the watershed health was achieved by integrating data from various existing sources as well as from the new monitoring work.
4	Create Technical Advisory Committee team with watershed stakeholders	Achieved – Ongoing. The Technical Advisory Committee continues to meet monthly.

Table 1 – Project Evaluation Matrix

The specific project objectives involved a number of key aspects. The first was to establish the baseline conditions in the watershed to be used as a basis for reference. This was achieved by integrating monitoring data from various existing sources as well as conducting new monitoring activities. Secondly, supplementing the baseline conditions, EPA priority pollutants were to be located and further monitored. Also through establishing the baseline conditions, data gaps were to be identified, indicating the areas where additional data collection and monitoring would be required. From there, a plan could be developed plan for additional monitoring to fill data gaps. Finally, a project objective was to create a Technical Advisory Committee (TAC) team of watershed stakeholders that would plan and coordinate water quality efforts in the watershed. Each of these objectives would work together to make the process and resulting information available for use by policy makers, regulatory agencies and the public.

Status of Objectives

1. Establish Baseline Conditions

This objective was achieved through a program of bi-weekly watershed sampling from 2005 to 2007 at thirteen sites along ten streams. The sampling program included water quality parameters based on Clean Water Act regulatory requirements addressing impaired waters (Section 303(d)). The program also made an effort to include pre-defined data gaps, identified 'hot-spot' areas (sites indication high levels of pollutants), and included bioassessment and bioaccumulation analyses. Documentation of this work can be found in the Malibu Creek Watershed Monitoring Program, 2006 Annual Baseline Report (May 2006).

In addition to the monitoring described in the baseline report, supplemental data came from a fish tissue analysis and biological indicator monitoring (or bioassessment) which further gauged baseline watershed health.

2. Locate EPA Priority Pollutants

This objective was achieved through the 'Hot Spot' Monitoring. After the first year of baseline sampling, pollution 'hot spots' were identified as areas needing further monitoring and indicated by the reoccurrence of high levels of pollutants, especially bacteria and nutrients and/or for which there was little or no information. These areas were then further tested for EPA priority pollutants including: trace metals, asbestos, cyanide, total hardness, acid extractable compounds, base/neutral extractable compounds, chlorinated pesticides, PCB congeners and polynuclear aromatic hydrocarbons. Documentation of this work can be found in the 2007 Report on "Hot Spot" Monitoring: Malibu Creek Watershed Monitoring Program.

3. Fill in Water Quality Data Gaps

The MCWMP included 13 stations within the MCW between February 2005 and February 2006, sampling a range of targeted pollutants. The primary goal of the MCWMP has been to collect data and information on pollutants and other problems that impair beneficial uses of Malibu Creek and its tributary streams. The monitored sites were chosen to represent a variety of land uses in the upstream tributary areas so that data collected would lead to a comprehensive understanding of how pollutants are affecting the basic watershed health and beneficial uses throughout the watershed. This information is being combined with water quality data from other existing and ongoing monitoring programs to continue developing a complete picture of water quality within the area.

4. Create Technical Advisory Committee

The TAC has been meeting regularly on a bi-monthly basis since the inception of this project. Generally speaking, the TAC for this program has been meeting through the MCW Advisory Council's Monitoring and Modeling subcommittee and has included stakeholders and responsible agencies from throughout the MCW. This group has coordinated with other regional efforts, including the MCW TMDL Implementation Plan (TMDLIP) and North Santa Monica Bay Watersheds Regional Watershed Implementation Plan (RWIP) efforts.