SWAMP
Surface Water Ambient Monitoring Program

Final Technical Report	2007

Water Quality Monitoring and Bioassessment in Nine San Francisco Bay Region Watersheds in 2001-2003:

Walker Creek
Lagunitas Creek
San Leandro Creek,
Wildcat Creek/San Pablo Creek
Suisun Creek
Arroyo Las Positas
Pescadero Creek/Butano Creek
San Gregorio Creek
Stevens Creek/Permanente Creek

June 2007

California Water Boards

SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD

www.waterboards.ca.gov/swamp

SURFACE WATER AMBIENT MONITORING PROGRAM

SAN FRANCISCO BAY REGION

WATER QUALITY MONITORING AND BIOASSESSMENT IN NINE SAN FRANCISCO BAY REGION WATERSHEDS

WALKER CREEK, LAGUNITAS CREEK, SAN LEANDRO CREEK, WILDCAT CREEK/SAN PABLO CREEK, SUISUN CREEK, ARROYO LAS POSITAS, PESCADERO CREEK/BUTANO CREEK, SAN GREGORIO CREEK, AND STEVENS CREEK/PERMANENTE CREEK

2001 – 2003

Final Report

2007

SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD
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Note: Each chapter contains a comprehensive table of contents for that chapter, including tables and figures. Please see Chapter 1: Introduction for detailed explanations of the scope and organization of this report.

Executive Summary

Study Objectives

The goal of the Surface Water Ambient Monitoring Program (SWAMP) in the San Francisco Bay Region is to monitor and assess watersheds in the Region, using a weight-of-evidence approach based on measurement of physical, chemical, and biological water quality parameters. Data developed in this program are intended to be used for evaluating watersheds for Clean Water Act section 305(b) reporting and 303(d) listing. Specific objectives of the monitoring program are:

- Develop new data to support beneficial use protection
- Measure water quality indicators and stressors to evaluate spatial and temporal trends
- Determine relationships between water quality indicators, specific stressors, and land use, including water management
- Identify reference sites
- Evaluate monitoring tools

Watershed monitoring has been implemented over three hydrologic cycles and across nine planning watersheds. The watershed monitoring data reported here, for SWAMP Fiscal Year 1 (2000-2001) and Fiscal Year 2 (2001-2002), were generated in 2001-2002 and 2002-2003, respectively. Watershed data were compared with water quality thresholds for assigned beneficial uses and analyzed for spatial and temporal trends and linkages with land use. The report does not provide an evaluation of beneficial use support, nor does it assess watershed impairment; however, data provided herein can be used in support of such determinations.

Design

In this study water, sediment, and tissue samples were collected in nine major watersheds: Walker Creek, Lagunitas Creek, San Leandro Creek, Wildcat/San Pablo Creek, Suisun Creek, Arroyo Las Positas in 2001-2002; and Pescadero/Butano Creek, San Gregorio Creek, and Stevens/Permanente Creek in 2002-2003. Sampling sites were selected in a deterministic design to target tributaries and specific land uses so that data could be used to help identify general sources of stressors. At selected sites, suites of parameters were sampled, including benthic macroinvertebrate assemblages, temperature, dissolved oxygen, nutrients, trace metals, trace organic compounds, toxicity, and coliforms. Parameters were measured in a two-tiered design in which aquatic bioassessment was the most widely used indicator of stream condition. Other suites of indicators were monitored based on land use and beneficial use (*e.g.*, coliform bacteria for water contact recreation).

Regional Results

Bioassessment data indicated a relationship between biological integrity in streams and land use practices. Stream sites receiving runoff from open space and rural residential areas had the best biological conditions; stream sites draining agricultural, grazing, and mixed use sites had intermediate biological conditions; and stream sites draining urban areas had the most degraded benthic invertebrate communities. Physical habitat conditions, particularly riparian habitat and channel alteration, were associated with the health of benthic communities. One of the most important natural factors affecting benthic communities was flow intermittency.

Elevated temperatures and depressed dissolved oxygen concentrations were common throughout the watersheds, and these conditions were often beyond ranges supportive of salmonid populations. Region-wide there were significant correlations between riparian habitat conditions and measurements of temperature and dissolved oxygen. Sites at which channels were less modified, riparian and stream bank vegetation more extensive, and canopy cover was greatest had significantly lower stream temperatures and significantly higher dissolved oxygen concentrations.

Nutrients were often elevated in urban areas which were most commonly found at the downstream end of watersheds. Nitrate concentrations over all seasons were highest and most variable in streams draining urban areas, followed by mixed land use, agriculture, grazing, rural residential and open space. The mean nitrate level for urban streams was more than twice that for streams draining agricultural areas and nearly ten times that of streams in open space areas. Although nitrate concentrations never exceeded Basin Plan objectives for drinking water or agricultural supply, most measured nitrate values exceeded the EPA reference guideline of 0.155 mg-N/L that was developed to protect against eutrophication.

In general, the number of contaminant exceedances was low. However, urban areas tended to have the highest concentration of contaminants. This was particularly true of polycyclic aromatic hydrocarbons (PAHs). Legacy pesticide and PCB concentrations tended to be highest at the downstream ends of urban watersheds. In general, ambient concentrations of contaminants were highest during the dry season, which may be due to dilution during wet weather. Samples were not collected during storms.

Throughout the region, toxicity was moderate. Out of 59 water samples, algal growth was reduced in 15 samples, invertebrate growth or survival was affected in three samples and fish larval survival was affected in one sample. Sediment toxicity affecting amphipod growth was observed in approximately half of the samples. In general, the level of water and sediment toxicity was moderate, except in San Leandro Creek. Results from this study combined with previous data showed that *Ceriodaphnia* toxicity due to diazinon has decreased in urban creeks, probably as a result of management measures restricting its use.

Watershed Specific Results

Pescadero/Butano and San Gregorio Creeks had the highest water quality and most intact benthic communities of the watersheds surveyed. Arroyo Las Positas had the highest number of temperature and dissolved oxygen measurements outside ranges acceptable for salmonid or coldwater habitat. Stevens Creek had the highest aquatic toxicity. San Leandro Creek had the highest sediment toxicity with 100 percent amphipod mortality. Relationships between toxicity and individual chemicals were not clear. Toxicity is most likely due to the combined action of a variety of contaminants. Arroyo Las Positas and San Pablo Creek had elevated levels of the herbicide oxadiazon.

Conclusions

Most of the watersheds in this study had similar overlapping patterns of water quality stressors. Temperature and dissolved oxygen values often exceeded thresholds for fish and other aquatic life, even in areas with less intensive human land use activities. As healthy riparian habitat correlated significantly with temperature and dissolved oxygen in this study, the primary management focus in these areas is likely to be improvement and maintenance of riparian habitat. Overlapping this basic physical pattern is the influx of nutrients and chemical contaminants from areas of more intensive human activity, primarily urban areas. Management activities here should also include riparian habitat improvement to allow for the absorption and degradation of pollutants through retention in vegetated areas. Designing riparian corridors to limit transport of these materials is likely to be among the easiest and more successful strategies to reduce contaminants, improve temperature and dissolved oxygen conditions, and maintain the essential ecological values of riparian areas. Management measures should also concentrate on preventing pollution from entering creeks by: 1) educating urban citizens on the use of pesticides and fertilizers, pet care and car washing, 2) regulating pollution sources and source materials, and 3) using pervious surface and vegetation in the design of green buildings, parking lots, green swales and decentralized landscape for the treatment of stormwater.

In this study, macroinvertebrate bioassessments proved to be an excellent indicator for evaluating the health of aquatic life. Multi-probe continuous monitoring sondes were extremely valuable in determining whether elevated temperatures and low dissolved oxygen may have an impact on salmonids and other aquatic life. In many cases physical habitat assessments illustrated the probable cause of elevated temperatures and low dissolved oxygen.

A watershed monitoring coalition should be established in the Bay Area to provide the development of more meaningful watershed information and maximize resource efficiency. In a collaborative effort, SWAMP may best serve to provide a regional context for local monitoring programs.

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1 Introduction

1.1 Overview of the Surface Water Ambient Monitoring Program in California

California Assembly Bill 982 (Water Code Section 13192; Statutes of 1999) required that the State Water Resources Control Board (SWRCB) assess and report on State water monitoring programs and prepare a proposal for a comprehensive surface water quality monitoring program. In the SWRCB Report to the Legislature from November 2000 entitled "Proposal for a comprehensive ambient surface water quality monitoring program," the SWRCB proposed to restructure the existing water quality monitoring programs into a new program, the Surface Water Ambient Monitoring Program (SWAMP). This new program consists of statewide environmental monitoring focused on providing the information needed to effectively manage the State's water resources. SWAMP is designed to be consistent, cooperative, adaptable, scientifically sound, and to meet clear monitoring objectives. It will also facilitate reporting and categorizing of the State's water quality under Sections 305 (b) and 303 (d) of the federal Clean Water Act. Details of SWAMP can be found in the SWAMP Quality Assurance Management Plan (QAMP) (Puckett 2002).

Specifically, the statewide SWAMP has been designed to meet four goals:

1. Create an ambient monitoring program that addresses all hydrologic units of the State.

2. Document ambient water quality conditions in potentially clean and polluted areas.

3. Identify specific water quality problems preventing the realization of beneficial uses of water in targeted watersheds.

4. Provide data to evaluate the overall effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

A new statewide monitoring design is currently being developed.

1.2 Goals and Objectives of SWAMP in the San Francisco Bay Region

In October 1999, the San Francisco Bay Regional Water Quality Control Board (Regional Board) developed a Regional Monitoring and Assessment Strategy (RMAS) in order to collect information on all in the San Francisco Bay Region. SWAMP is being used in this Region to implement the RMAS. The three components of SWAMP/RMAS are:

1) Regional Board-lead activities, concentrating on monitoring watersheds, lakes/reservoirs and bays and estuaries other than San Francisco Bay, including programs such as State Mussel Watch (SMW), the Toxic Substances Monitoring Program (TSMP) and the Coastal Fish Contamination Program (CFCP)

2) Partner-lead watershed monitoring programs that are being conducted by local agencies/groups with similar goals, structure, scope, protocols and quality assurance as the Regional Board-lead activities

3) The San Francisco Estuary Regional Monitoring Program (RMP)

Information collected in Component 1 (Regional Board-lead activities) is the subject of this report.

The goal of the SWAMP program in this Region has been to monitor and assess watersheds in the Region, using a weight-of-evidence approach based on measurement of physical, chemical, and biological water quality parameters. Data developed in this program is intended to be useful for evaluating for 305b reporting and 303d listing. Specific objectives of the monitoring program are to:

1) Collect and evaluate physical, chemical, and biological water and sediment quality data to determine whether beneficial uses are being protected in watersheds in the Region

2) Use a weight-of-evidence approach to measure environmental stressors (pollutants or other water quality parameters), biological effects (e.g., toxicity tests), and ecological indicators (e.g., benthic community analysis) using a study design that allows evaluation of spatial and temporal trends

3) Determine relationships between observed biological effects, levels of specific stressors, and land uses including water management

4) Identify reference sites

5) Evaluate watershed monitoring tools to develop a program that uses the best environmental indicators to achieve the purposes of the program

Due to a reduction in regional SWAMP funding, we plan in the future to meet these objectives in collaboration with other watershed monitoring programs.

1.3 Overview of the San Francisco Bay Region SWAMP Sampling Program

The technical approach in the San Francisco Bay Region for Regional Board lead activities under SWAMP included:

1) Monitoring watersheds to assess water quality impacts and establish regional reference sites; and
2) Monitoring edible fish for contaminant levels in reservoirs and coastal areas where people catch and consume fish.

Watershed monitoring was implemented by San Francisco Bay Regional Board staff and contract laboratories over three hydrologic cycles and across nine planning watersheds. The watershed monitoring data reported here, for SWAMP Fiscal Year 1 (2000-2001) and Fiscal Year 2 (2001-2002), were generated in 2001-2002 and 2002-2003, respectively.

Contaminant monitoring in edible fish was implemented through the Toxic Substances Monitoring Program (TSMP) and the Coastal Fish Contamination Program (CFCP), which were included under SWAMP. Edible fish sampling occurred in coastal areas and reservoirs popular for fishing. TSMP data were generated from fish collected during 2000 and 2001; CFCP data were generated from fish collected during 1998, 1999 and 2001. The results of fish tissue studies can be found in the report "Chemical Concentrations in Fish Tissues from Selected Reservoirs and Coastal Areas in the San Francisco Bay Region," (SFBRWQCB 2005). This report is available at http://www.waterboards.ca.gov/sanfranciscobay/monitoring.html.

1.4 Scope of the Report

This report provides a data summary for watershed monitoring completed during Fiscal Years 1 and 2 (2001 to 2003). Watershed data were compared with published water quality goals and analyzed for spatial trends, temporal trends, and linkages with land use. The report does not provide an evaluation of beneficial use support, nor does it assess impairment; however, data provided herein can be used in support of such determinations.

1.5 Organization of the Report

Each section, with the exception of Section 9 (References), is prefaced by its own table of contents, followed by lists of the tables and figures in that section.

Section 1. Introduction. Provides the background of SWAMP in California, outlines its goals and sampling program in the San Francisco Bay Region, and defines the scope of the report. The introduction also includes this description of the report's sections and category definitions for the maps.

Section 2. Selection and Description of Watersheds. Provides a regional map to locate each watershed, explains how the watersheds in this report were selected, lists the sequence in which the watersheds are presented throughout the report, and gives general watershed descriptions.

Section 3. Sampling Design. Reviews how sampling sites were chosen and the overall sampling design, as well as which parameters were sampled and the relationship to land use.

Section 4. Methods. Provides a review of the procedures used in sampling, laboratory analysis, and data analysis, including a background on bioassessment.

Section 5. Quality Assurance & Quality Control. Details the data quality procedures applied to water, sediment, clam tissue, and toxicity test data and summarizes the general QA/QC used throughout the report. For specific QA/QC results, refer to the tables in Appendix C.

Section 6. Regional Trends in Water Quality. Presents spatial and seasonal trends in the data; background on temporal patterns in continuous monitoring data; an extensive discussion of natural variation in reference conditions for bioassessment; and a brief discussion of reference conditions for water and sediment chemistry, and for nutrients.

Section 7. Results by Watershed. Summarizes sites of concern, exceedances, and water quality in relation to land use for each watershed. Presents, by watershed, results and analysis for bioassessment; continuous monitoring; water, sediment, and clam tissue chemistry; water and sediment toxicity; and coliform bacteria.

Section 8. Conclusions and Recommendations. Discusses findings in relation to land use, physical habitat, and seasonal trends; discusses reference conditions; evaluates monitoring tools; and presents recommendations for management and future monitoring and assessment.

Section 9. References. Lists references cited in the report.

If you are interested in one particular watershed, reviewing the following parts of the report will help orient you before reading the results in section 7:

- Section 1: Map Notes
- Section 2: Watershed descriptions
- Section 3: Watershed maps (Figures 3-1 through 3-9) and Table 3-4, which show what was monitored where and general land use categories
- Section 4: Methods; Tables 4-2 and 4-3 for water and sediment thresholds; Table 4-4 for biological metrics
- Section 6: Overview of regional results and background for understanding the watershed-specific results

Station lists

In Section 3, **Table 3-4** is a comprehensive list of the stations in each watershed and what was sampled where, along with land use. Table 3-4 does not include the station name, but the subsequent maps indicate the general location, and **Appendix B** (the Station Location Table) provides a station list with full station codes, station names, waterbodies, and the latitude and longitude. The order of the watersheds follows the sequence listed in Section 2.1 under watershed selection. **Appendix A** lists land use in detail and general category by full station code and station name.

In Section 7, **7.x.3 (**the macroinvertebrate assemblage subsection for each watershed) includes a table of bioassessment sites (with short station code and station name) and gives descriptions of the sites by assemblage group.

Full station codes are nine characters (such as 201WLK030), beginning with a three-digit hydrological unit code (HUC) for the basin (201 for Marin), followed by a three-character alpha code for the watershed (WLK for Walker Creek) and a three-digit code for the station (030 for a downstream Keys Creek site). The last three-digit code increases from the mouth, up tributaries, then back up to the mainstem headwaters. In the appendices and several tables, the initial HUC is usually included, but the maps and most of the report narrative use the shortened six-character watershed and station code to identify the station (WLK030).

The appendices provide the detailed data as follows:
Appendix A: Land uses
Appendix B: Station location information
Appendix C: Quality assurance data
Appendix D: Continuous field measures
Appendix E: Rapid bioassessment
Appendix F: Discrete field measures
Appendix G: Water chemistry
Appendix H: Sediment chemistry
Appendix I: Clam tissue chemistry
Appendix J: Water and sediment toxicity
Appendix K: Water coliforms

1.6 Map Notes: How to read the maps in this report

1. Overview map: Section 2, Figure 2-1
2. Watershed index maps: Section 3, Figures 3-1 through 3-9
3. Regional *E. coli* map: Section 6, Figure 6-31
4. Bioassessment maps: Section 7 throughout
5. Continuous Monitoring maps: Section 7 throughout

1. The **Overview map** (Figure 2-1) locates each watershed within the San Francisco Bay region's boundary.

2. Watershed index maps category definitions
The watershed station index maps (Figures 3-1 through 3-9) are a guide to what sampling was done where and the land use at each station. It is a graphic representation of the information presented in more detail in Table 3-4.

The ***Land use*** designation is from the simplified table of six land uses:

Urban , Mixed , Agricultural , Grazing , Rural Residential ,
and Open Space . Although not a general land use category, indicates a quarry or mine.

Bioassessment refers to Rapid Bioassessment of benthic macroinvertebrates using the California Stream Bioassessment Protocol, which includes a physical habitat assessment. The selection includes stations sampled in a National Park Service study on Olema Creek in the Lagunitas Creek watershed and from a separate SFBRWQCB study at selected stations on Wildcat and San Leandro Creeks.

At stations with ***Continuous monitoring***, the standard field parameters (temperature, dissolved oxygen, pH, and specific conductance) were monitored with YSI 6600 sondes for an average of 11 days at a time and up to four times a year.

Conventional water parameters include ammonia, nitrate, nitrite, total kjeldahl nitrogen (TKN), orthophosphate (OP), total phosphate, boron, chloride, sulfate, total dissolved solids (TDS), chlorophyll-*a*, pheophytin-*a*, alkalinity, hardness, suspended sediment concentration (SSC), total organic carbon (TOC), and dissolved organic carbon (DOC) as well as standard field parameters, sampled as grab samples, usually three times a year.

The ***Water contaminants and toxicity*** category includes testing for presence of OP and organochloride (OC) pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and trace metals, as well as ELISA tests and three-species toxicity tests. This category aggregates the water metals and toxicity and the water organics categories in Table 3-4 to limit icons represented on the maps; thus not all stations were tested for all parameters.

Sediment analysis includes grain size evaluation and testing for presence of OP and OC pesticides, PAHs, PCB congeners, and trace metals, as well as *Hyalella azteca* toxicity tests.

Tissue analysis includes testing for presence of OP and OC pesticides, PAHs, PCB congeners, and trace metals.

The ***Pathogens*** category includes weekly sampling for five weeks in the summer and analysis for total coliform, fecal coliform, and *E. coli*.

3. Regional *E.coli* map (Figure 6-31) represents in red each station that exceeded the *E. coli* steady state limit; other stations tested are represented in grey.

4. Bioassessment maps category definitions

The maps of benthic macroinvertebrate index scores (Figures 7-4, 7-9, 7-18, 7-26, 7-35, 7-44, 7-54, 7-64, and 7-73) report taxa richness and percent sensitive EPT (Ephemeroptera, Plectoptera, Trichoptera). Table 4-4 defines the bioassessment metrics.

Taxa richness

◆ (orange)	<17	Poor
◆ (light orange)	18 - 27	Fair
◆ (yellow)	28 – 38	Reference condition for intermittent streams
◆ (blue)	>38	Reference conditions for perennial streams
◆ (gray)	no data	Incompatible data

Taxa richness data from Olema Creek (in the Lagunitas Creek watershed) were collected using a variation in the protocol, thus comparisons using those data are inappropriate, and the "no data" symbol is displayed at those sites.

Percent sensitive EPT

■ (orange)	0	Poor
■ (light orange)	1 - 20	Fair
■ (yellow)	21 - 44	Reference conditions for intermittent streams
■ (blue)	>44	Reference conditions for perennial streams

5. Continuous monitoring maps category definitions

The maps of temperature and dissolved oxygen display exceedances from episodes of continuous monitoring (Figures 7-4, 7-12, 7-20, 7-29, 7-38, 7-48, 7-58, 7-68, 7-76).

Temperature

✕ (crossed-out fish)	>24°C	Instantaneous maximum for salmonids
● (light orange)	> 17°C	MWAT for steelhead
● (yellow)	>14.8°C	MWAT for coho salmon
● (blue)	≤14.8°C	No exceedance
● (gray)	no data	<7 days or not in critical period

The limits mapped for temperature include:

- 24°C as an instantaneous maximum for salmonids; this temperature is the lower end of the range of acute thresholds considered lethal to salmonids (U.S. EPA 1977)

- 17°C as Maximum Weekly Average Temperature (MWAT) limit for steelhead (Sullivan *et al.* 2000)
- 14.8°C as an MWAT for coho salmon (Sullivan *et al.* 2000)

The MWATs are limits representing a 10 percent growth reduction. The instantaneous maximum, represented by the dead fish, is independent of the weekly average temperature. Thus, a station could exceed 24°C on a few days, but still have an average weekly temperature below both MWAT standards. Therefore, the expected red dot for poor temperature is replaced by the dead fish, which may be accompanied by an exceedance of either MWAT standard.

All the watersheds in this survey are designated as supporting coldwater habitat except for Wildcat and San Pablo creeks. Lagunitas and Walker creeks are the only creeks to support coho habitat currently, although San Gregorio, Pescadero, and Butano creeks may have historically. While the maps represent limits for coho and coldwater habitat, the watershed may not be designated for that beneficial use. The text will evaluate each watershed appropriately.

The grey circle, meaning no MWAT, indicates that either there were fewer than seven days of continuous monitoring or that the station was not monitored during the critical summer period so that its highest weekly average temperature is not representative of an annual maximum.

Dissolved Oxygen

■	<5 mg/L	warmwater fish minimum
■	<7 mg/L	coldwater fish minimum
■	< 9 mg/L	critical spawning minimum
■	≥ 9mg/L	no exceedance
■	no data	not in critical period or QC rejected data

The limits mapped for dissolved oxygen reflect tolerances for warmwater fish, coldwater fish, and coho salmon. The Basin Plan minimum dissolved oxygen limit for warmwater fish habitat is 5 mg/L (milligrams per liter); for coldwater fish habitat, it is 7 mg/L. The 9 mg/L limit is a protective limit used by the North Coast RWQCB for spawning during critical periods and applied only to selected streams and those with no specific criterion (NCRWQCB 2001); it is also the level at which slight impairment occurs to embryo-larval production (U.S. EPA 1991). It is mapped here as an indication of DO levels, not as a standard. The text will interpret the levels appropriately for each watershed and season.

The grey square for no data means either the data were rejected because post-calibration indicated drift exceeding limits for quality assurance or that the station was not monitored during the critical summer period so that its dissolved oxygen values are not representative of an annual minimum.

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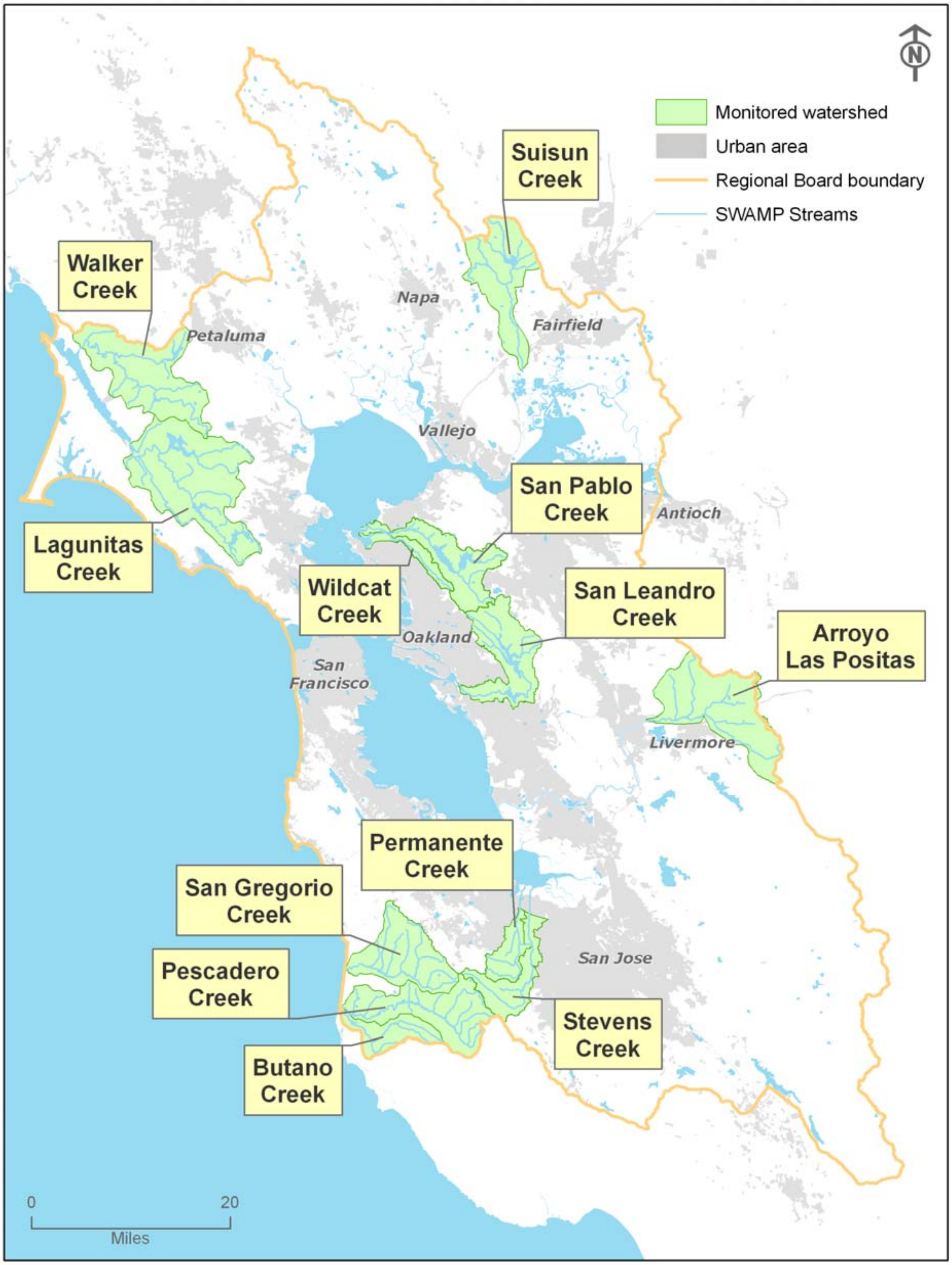

Figure 2-1. Regional overview map showing locations of sampled watersheds

2 Selection and Description of Sampled Watersheds

2.1 Watershed Selection

The Region was divided into 47 planning watersheds, each between 30 and 200 square miles in area, with most between 50 and 100 square miles. Some of these planning watersheds are self-contained hydrologic units that drain to an estuary or the ocean, and others have been either combined with adjacent watersheds or are sub-watersheds within a larger drainage basin. All planning watersheds are fully contained within one of the seven hydrologic basins of the San Francisco Bay Region.

Planning watersheds were prioritized for monitoring and assessment using criteria aimed at generating the most useful and current information with the least amount of new resources and investigations. Criteria also consider time-sensitive issues such as imminent development plans (*e.g.*, major housing or flood control projects), upcoming stream restoration projects, or declining sensitive aquatic resources. The prioritized order of planning watersheds achieves balance geographically, by eco-region, and includes both data-rich and data-poor watersheds as well as a balance of potentially clean and problem watersheds.

The prioritization criteria for planning watersheds include:

1. **Existing local efforts**. Build on existing watershed monitoring and assessment efforts, including citizen monitoring.
2. **Sensitive aquatic resources**. Focus on areas with sensitive aquatic resources or species, such as habitat for steelhead trout, a federally-listed threatened species.
3. **Pre-project information**. Collect pre-project ambient data in areas proposed for urbanization, stream restoration, or hydromodification.
4. **Watersheds with limited information**. Initiate monitoring in areas that have little or no current water quality and habitat information.
5. **Represent all eco-regions**. Fill information gaps in certain eco-regions. For instance, collect stream bioassessment data to support biocriteria development or geomorphic data to support physical criteria development.
6. **Geographic balance**. The list of planning watersheds should be balanced geographically and by eco-region, in order to capture the full range of stream types in the region and to recognize watershed management efforts in all parts of the region.

The prioritized list of all planning watersheds to be monitored under SWAMP in the San Francisco Bay Region is presented in the SWAMP 5-year Workplan (SFBRWQCB 2004). The top nine prioritized planning watersheds were the focus of SWAMP sampling efforts in Year 1 and Year 2 (shown in Figure 2-1) in the following order:

Year 1

- Walker Creek
- Lagunitas Creek
- San Leandro Creek
- Wildcat Creek/San Pablo Creek
- Suisun Creek
- Arroyo Las Positas

Year 2

- Pescadero Creek/Butano Creek
- San Gregorio Creek
- Stevens Creek/Permanente Creek

Descriptions of these watersheds are presented below.

2.2 Watershed Descriptions

The following sections provide descriptions of the watersheds monitored for this report. Each description includes, when available, an overview of the watershed and surrounding geologic and vegetation features, as well as current and past land use activities water quality issues, and existing beneficial uses listed for the watershed. More detailed information, including geologic characteristics and past studies, can be found in the project Workplan (SFBRWQCB 2002).

2.2.1 Walker Creek Watershed

The Walker Creek watershed has a drainage area of 73 square miles, mostly in northwestern Marin County, with a small portion in Sonoma County. Significant tributaries to Walker Creek include Keys Creek (also known as Keyes), which flows through the gentle hills east of Tomales, joining Walker Creek near Tomales Bay; Chileno Creek, which flows through Chileno Valley; and, in the upper watershed, Salmon Creek and Arroyo Sausal Creek, which flow through Hicks Valley. Frink and Verde Canyons each support ephemeral streams that join Walker Creek upstream from Chileno Creek. Soulajule Reservoir impounds the 15 square mile drainage of Arroyo Sausal. Privately-owned Laguna Lake at the headwaters of Chileno Creek is a large, shallow water body.

Annual rainfall varies from 24 to 30 inches (Rantz 1971); Chileno Valley is notably hotter and drier than the coastal areas. The lower watershed is composed of low, rolling hills, while the upper watershed consists of rugged canyons in the southeastern headwaters. Vegetation is 60 percent open grassland and 40 percent shrub and woodland (mixed hardwood and a few conifers) (Zumwalt 1972). Portions of the watershed are susceptible to landslides, erosion, and gullying.

Land use in the watershed includes grazing, farming, residential, and mining. Grazing is the major land use impact in the Walker Creek watershed, with dairies concentrated in the valleys of

Keys Creek near Tomales and Chileno Valley, and beef or sheep ranches predominating elsewhere (Bush 1995). Until 1991, Laguna Lake was annually drained and planted with corn; a duck farm currently drains to the lake. Historic potato farming, which resulted in increased erosion, peaked in the 1860s around Tomales (Bush 1995). The only residential communities (both in the lower watershed) are the small town of Tomales, and Blue Mountain, a community near Keys Creek. There is a sewage treatment pond adjacent to Keys Creek. Tomales Bay supports commercial oyster farming which, due to coliform inputs from the watershed, closes down during periods of heavy rainfall; a TMDL for pathogens has been developed for Tomales Bay. The Gambonini Mine operated as a large open pit cinnabar mine for mercury from 1964 to 1970, and is a significant source of mercury to Walker Creek and Tomales Bay (Whyte 2002). Several smaller historic mercury mines also exist in the watershed. Walker Creek was once mined for gravel, just downstream of the confluence with Chileno Creek (Bush 1995). Based on land use and soil characteristics, the major water quality issues in the watershed are water diversion, nutrients, coliforms, erosion, sedimentation, and mercury.

Walker Creek is protected habitat for coho salmon, steelhead trout, and California freshwater shrimp (U.S. Fish and Wildlife Service 1997). The beneficial uses listed in the Basin Plan for the San Francisco Bay Region (SFBRWQCB 1995) that cover habitat for these species are: warm and cold freshwater habitat, preservation of rare and endangered species, fish migration and spawning, and wildlife habitat. These beneficial uses are also listed for the entire watershed. Soulajule Reservoir is a municipal/domestic water supply, source of freshwater replenishment, and fishing area that provides warm freshwater habitat, wildlife habitat, and contact/non-contact water recreation. Walker Creek and its watershed are also listed for potential use in contact and non-contact water recreation.

2.2.2 Lagunitas Creek Watershed

The Lagunitas Creek watershed drains 103 square miles of west central Marin County. From the headwaters on the north slope of Mount Tamalpais, Lagunitas Creek flows about 25 miles before emptying into Tomales Bay. The first eight miles of Lagunitas Creek are dammed for municipal drinking water by the MMWD; Peters Dam holds 32,900 acre-feet in Kent Lake, about a mile downstream from three smaller reservoirs near the headwaters—Lake Lagunitas, Bon Tempe Lake, and Alpine Lake. San Geronimo Creek drains San Geronimo Valley and joins Lagunitas Creek at Shafter Bridge, about a mile below Peters Dam. Devils Gulch drains the western slope of Barnabe Mountain and joins Lagunitas Creek about 2.5 miles downstream. The reach between San Geronimo and Tocaloma, especially in Samuel P. Taylor State Park, is prime habitat for coho salmon, steelhead, and California freshwater shrimp. Halleck and Nicasio Creeks drain 35.9 square miles of the gentle grassland hills of Nicasio Valley, joining in Nicasio Reservoir. About a mile below Seeger Dam, Nicasio Creek joins Lagunitas Creek. Olema Creek drains 14.5 square miles of Inverness and Bolinas Ridges; it joins Lagunitas Creek southwest of Point Reyes Station, where tidal influence affects the flow.

Annual rainfall varies from 28 to 52 inches (Rantz 1971), with the most intense rain over Kent Lake and the upper watershed, and the driest portion in Nicasio Valley. Some areas are subject to landslides, erosion, and gullying. The upper watershed supports a dense forest of redwood, Douglas fir, coast live oak, bay, and alder. The northern uplands of Nicasio and San Geronimo Valleys are grassland, with bay, coast live oak, and Douglas fir on the steeper slopes to the south. The gentle slopes on the east side of Olema Creek and the lower watershed are predominantly grassland and chaparral.

Current and historic land use in the watershed has been highly diverse. Historically, some lowland areas of Olema Creek were farmed for feed crops and vegetables, and extensive logging took place between 1850 and 1964. Grazing is a current and predominant land use in the watershed and includes dairy and beef cattle and horses. Several golf courses exist in the watershed, one of which drains to Bon Tempe Lake. Gravel extraction also occurs at two sites in the watershed. Most of the Lagunitas Creek watershed is publicly owned and protected land, offering numerous recreational opportunities. MMWD owns about 30 percent of the watershed, mostly in the southern portion near the headwaters; the National Park Service (NPS) owns 21 percent of the watershed as Point Reyes National Seashore (PRNS) and Golden Gate National Recreation Area (GGNRA); Marin County Open Space District (MCOSD) has 3.5 percent; and Samuel P. Taylor State Park accounts for 3 percent. Each has trails for hikers, bicycles, and horses. There are also many residential communities in the watershed, all of which use septic systems. Tomales Bay supports commercial oyster farming which, due to coliform inputs from the watershed, closes down during periods of heavy rainfall. The Regional Water Board recently developed a TMDL for pathogens in Tomales Bay. Given these land uses and the instability of some soils, water quality issues in the watershed include habitat impairment, nutrients, herbicides, pesticides, erosion, turbidity, temperature, and coliforms.

Lagunitas Creek is protected habitat for coho salmon, steelhead, and California freshwater shrimp. It is one of the most important coho salmon streams in California, supporting approximately 10 percent of the current population. The beneficial uses listed in the Basin Plan (SFBRWQCB 1995) that cover habitat for these and other species in the creek and watershed are: cold and warm freshwater habitat, preservation of rare or endangered species, fish migration and spawning, and wildlife habitat. Nicasio Reservoir is a source of municipal/domestic water and freshwater replenishment, as well as a fishing area with water contact and non-contact recreation, and provides habitat for fish spawning, warm water species, and wildlife. Nicasio Creek provides habitat for cold-water species, wildlife, and fish spawning and migration (in limited areas), is used for water contact and non-contact recreation, and provides municipal/domestic water and freshwater replenishment. The MMWD reservoirs are each a municipal/domestic water supply, with open trails for non-contact water recreation, and are also listed for water contact recreation, cold and warm water habitat, fish spawning, and wildlife habitat. Olema Creek is listed for cold and warm water habitat, wildlife habitat, fish spawning and migration, navigation and water contact recreation. The entire watershed is listed for agricultural supply.

2.2.3 San Leandro Creek Watershed

San Leandro Creek watershed is a 46.5 square mile drainage basin in Alameda and Contra Costa Counties. Although it is channelized and concrete lined in portions of the lower watershed, San

Leandro Creek is one of the few East Bay creeks entirely above ground. From the headwaters near Round Top Peak, the creek drains to Arrowhead Marsh in San Leandro Bay, just north of the Oakland International Airport. Redwood, Indian, Moraga, Buckhorn, and Kaiser Creeks drain into the Upper San Leandro Reservoir; downstream, Grass Valley Creek drains into Lake Chabot. The Mokelumne Aqueduct delivers drinking water from the Sierra Nevada to the reservoir near the mouth of Moraga Creek. Lower San Leandro Creek, from below Chabot dam to Arrowhead Marsh, runs through residential and urban industrial areas of Oakland and San Leandro. Freshwater input to Lower San Leandro Creek is limited by upstream diversions, and consists primarily of seepage (URS Greiner Woodward Clyde 1999) and occasional winter releases from Lake Chabot; summer flow in the lower watershed is dominated by storm drain runoff.

Annual rainfall in the watershed ranges from 18 to 28 inches per year (Rantz 1971). The landscape of this highly urbanized watershed varies considerably, from gently rolling hills to steep canyons. Grassland is the dominant vegetation type in undeveloped areas, with scattered oak woodlands and coastal chaparral. Redwood Creek runs through a second and third growth redwood forest in Redwood Regional Park. Stands of introduced eucalyptus, Monterey pine, and fruit trees are common. A freshwater marsh of about 18 acres near Upper San Leandro Reservoir supports wetland species.

Land use in the upper watershed includes recreation, residential, and grazing. The drainage of upper San Leandro Creek above Chabot dam is protected watershed of the East Bay Municipal Utility District (EBMUD) and undeveloped parkland for recreational use held by the East Bay Regional Park District (EBRPD). Cattle-grazing occurs on portions of EBMUD and EBRPD lands. The towns of Moraga and Rheem Valley are in the upper drainage above Upper San Leandro Reservoir. Recreational land use in the upper watershed includes horse stables and golf courses. Lake Chabot provides water for golf course irrigation. Land use below Lake Chabot is exclusively urban. Water quality issues in the watershed associated with land use and erodibility include low flow conditions due to water diversions, bacteria toxicity, nutrients, sediment and other contamination due to urban runoff.

The beneficial uses listed in the Basin Plan (SFBRWQCB 1995) for resident species in Lake Chabot and Upper San Leandro Reservoir are cold and warm freshwater habitat, wildlife habitat, and fish spawning. Other beneficial uses for these reservoirs include municipal/domestic supply (emergency only), and water recreation (both contact and non-contact). Existing beneficial uses in San Leandro Creek include freshwater replenishment, cold freshwater habitat and wildlife habitat. Potential beneficial uses associated with San Leandro Creek are fish migration, contact and non-contact recreation, fish spawning and warm freshwater habitat.

2.2.4 Wildcat Creek/San Pablo Creek Watershed

Wildcat and San Pablo Creeks are contiguous watersheds in Contra Costa County, together draining 48 square miles. Wildcat Creek drains the western slopes of Vollmer Peak in the Berkeley Hills, flows north through Wildcat Canyon, turns west through San Pablo, Richmond, and North Richmond, and runs through Wildcat Marsh before entering San Pablo Bay just north of Point Richmond. Wildcat Creek has a major tributary, Havey Creek, and two small impoundments, Lake Anza and Jewel Lake. The first four miles of its headwaters are within the East Bay Regional Park District (EBRPD). The remaining seven miles of creek are mostly above ground and un-channelized, making it one of the few streams in the San Francisco Bay Area with a nearly continuously vegetated riparian channel.

Adjoining the narrow Wildcat Creek watershed on the north is the wider 39 square mile watershed of San Pablo Creek. Perennial tributaries of San Pablo Creek include Bear Creek, which drains into Briones Reservoir, and Lauterwasser Creek, which joins San Pablo Creek just upstream of San Pablo Reservoir. The Mokelumne Aqueduct imports drinking water from the Sierra Nevada for storage in Briones and San Pablo Reservoirs. Much of the upper watershed is in protected East Bay Municipal Utility District (EBMUD) land or EBRPD land. In the lower watershed below San Pablo Dam, San Pablo Creek runs through the suburban towns of El Sobrante and San Pablo before entering the bay at Wildcat Marsh. Until 1895, San Pablo Creek meandered in Wildcat Marsh where it connected to Wildcat Creek.

Average annual rainfall in the watershed ranges from 20 to 28 inches (Rantz 1971). The landscape varies from gently rolling to steeply sloping hills. Grasslands dominate the upper watershed, with patches of northern coastal scrub and chaparral and woodlands of oak, bay, and buckeye on the south-facing slopes. Monterey pine and eucalyptus were planted in the hills.

Land use in the watershed includes grazing, residential, and industrial. Grazing occurs in the Havey Canyon area on EBRPD land. Urban communities within the watershed include Orinda, El Sobrante, San Pablo, Richmond, and North Richmond; the latter three include heavily industrialized portions. The EBMUD Orinda water treatment plant discharges its filter backwash to San Pablo Creek. New residential developments are under construction just north of San Pablo Dam. The 300-acre salt marsh at the mouth of the watershed is bordered by a landfill, a sewage treatment plant, and Chevron’s industrial holding ponds and refineries. Potential water quality issues in the watershed resulting from these land uses include erosion, sedimentation, coliforms, eutrophication, and toxicity (see also Section 2.3).

Beneficial uses in the Wildcat Creek watershed, as listed in the Basin Plan (SFBRWQCB 1995), include fish migration and spawning, warm water habitat, wildlife habitat, and non-contact water recreation. Beneficial uses in the San Pablo Creek watershed include all of the uses in Wildcat Creek except fish spawning. Beneficial uses in San Pablo Reservoir and Briones Reservoir include cold and warm water habitat, fish spawning, wildlife habitat, municipal/domestic supply, and water contact and non-contact recreation. Lake Anza and Jewel Lake are small impoundments used for recreational purposes only. Two endangered species live in Wildcat Marsh, at the outlet of both creeks: the salt marsh harvest mouse and the clapper rail. Native rainbow trout were re-introduced to Wildcat Creek in 1983 and are still present.

2.2.5 Suisun Creek Watershed

The Suisun Creek watershed is a 57 square mile drainage basin in Solano and Napa Counties. Suisun Creek originates in the Vaca Mountains of the central California Coast Range and empties into Suisun Marsh and Suisun Bay in the San Francisco Estuary. The major tributary to Suisun Creek is Wooden Valley Creek, which flows through Wooden Valley before its confluence with Suisun Creek three miles below Lake Curry. Suisun Creek and Wooden Valley Creek are perennial streams, while many of the smaller tributaries, such as White's Creek, dry up in mid-summer. There are two reservoirs in the watershed: Lake Curry, a large reservoir on the main stem of Suisun Creek; and Suisun Reservoir, a small, dammed lake on a minor tributary to Suisun Creek. Lake Curry has been owned and operated by the city of Vallejo since the 1920s; however, the City of Vallejo has not drawn water from Lake Curry since the early 1990s.

Suisun Creek and Wooden Valley Creek flow through broad alluvial valleys. The hills of the central California Coast Range are highly erosive, with large amounts of sediment being transported to streams during severe winter rain events. Annual precipitation in the watershed ranges from 18 to 32 inches (Rantz 1971).

Land use in Suisun Valley is predominantly agricultural, with numerous vineyards and orchards spread throughout Suisun Valley, Gordon Valley, and Wooden Valley. Population centers include the small communities of Rockville, Wooden Valley, and Gordon Valley. Other activities include grazing, and water release and retention from Lake Curry Dam. Potential water quality issues in Suisun Creek watershed include pesticides, erosion, sedimentation, nutrients, and dissolved oxygen.

Beneficial uses in the Suisun Creek watershed listed in the Basin Plan (SFBRWQCB 1995) are cold and warm water habitat, fish spawning and migration, freshwater replenishment, and wildlife habitat. Beneficial uses in Lake Curry include municipal/domestic supply, contact and non-contact water recreation, fish spawning, warm-water habitat, and wildlife habitat.

2.2.6 Arroyo Las Positas Watershed

The Arroyo Las Positas watershed (also Arroyo de Las Positas), a 77 square mile watershed in eastern Alameda County, is one of the main tributaries to Alameda Creek in the Livermore Valley basin. Arroyo Las Positas originates at the confluence of its two major tributaries, Altamont Creek and Arroyo Seco. From this confluence, Arroyo Las Positas flows west until it meets Arroyo Mocho, just east of the city of Pleasanton. Other tributaries to Arroyo Las Positas include Cottonwood Creek, Collier Canyon, and Cayetano Creek. Arroyo Las Positas, Arroyo Mocho, Arroyo Valle, Tassajara Creek, and Alamo Creek together drain the Livermore Valley watershed before entering Arroyo Laguna and Alameda Creek west of San Antonio reservoir. Altamont Creek drains the Altamont Hills and is joined by several unnamed, second- and third-order tributaries that drain Brushy Peak and other hills to the north. The 31 square-mile Arroyo Seco watershed drains the south-eastern mountains of the Livermore Valley. Arroyo Seco flows through recent residential developments and the Lawrence Livermore National Laboratory before meeting Altamont Creek. Numerous smaller, unnamed tributaries feed Arroyo Seco, including a Zone 7 Water Agency flood control channel (P-1) that drains the central part of eastern Livermore Valley.

The average rainfall in the Arroyo Las Positas watershed ranges from 12 to 16 inches per year (Rantz 1971). Arroyo Las Positas, and the lower portions of both Altamont Creek and Arroyo Seco, are perennial streams. Cottonwood Creek, Collier Canyon, and Cayetano Creek are believed to be intermittent, with groundwater-fed base flow occurring from December through May. The upper portions of all of the creeks in the Arroyo Las Positas watershed are dry for much of the year. During the dry season the primary source of water in Arroyo Seco is wastewater from the Lawrence Livermore National Laboratory, which is drained by the Zone 7 Water Agency P-1 flood-control channel. Upstream of the confluence with this channel, Arroyo Seco is dry for much of the year, beginning soon after the last winter storm.

Land use in the watershed includes residential, recreation, and agriculture. The Livermore Valley is one of the fastest-growing regions of the Bay Area, characterized by rapid construction of residential communities, golf courses, and commercial areas in previously undeveloped open space. Urban areas include the City of Livermore, Lawrence Livermore National Laboratory, Springtown Golf Course, Los Positas Golf Course, Livermore sewage disposal site, and recent residential developments. Much of the upper portion of the watershed is rangeland, farmed, or open space, although substantial land development is predicted in the future. Potential water quality issues in Arroyo Las Positas watershed include pesticides, erosion, sedimentation, nutrients, and dissolved oxygen.

The Basin Plan does not differentiate beneficial uses between the tributaries of the Alameda Creek watershed. Therefore the existing beneficial uses in the Alameda Creek watershed are applied to the Arroyo Las Positas watershed (SFBRWQCB 1995): agricultural supply, warm and cold water habitat, groundwater recharge, fish spawning and migration, water contact and non-contact recreation, and wildlife habitat.

2.2.7 Pescadero Creek/Butano Creek Watershed

The watershed of Pescadero Creek and Butano Creek is an 82 square mile drainage basin in western San Mateo County. The headwaters of both Pescadero Creek and Butano Creek are in the steep, forested Santa Cruz Mountains. Pescadero Creek and Butano Creeks converge in Pescadero Marsh, which drains into the Pacific Ocean. Numerous tributaries feed Pescadero Creek including Honsinger Creek, Hoffman Creek, McCormick Creek, Lambert Creek, Slate Creek, and Oil Creek. The main tributary to Butano Creek is Little Butano Creek. Average annual precipitation in the watershed ranges from 20 inches at the coast to 46 inches at the headwaters (Rantz 1971).

The primary urban center is the town of Pescadero, near the mouth of the creek. Pescadero Creek is listed on the 303(d) list of impaired water bodies for excessive sedimentation and siltation. Flooding and agricultural runoff are also issues of concern in the watershed.

The Basin Plan (SFBRWQCB 1995) identifies 10 beneficial uses in the surface waters of the Pescadero Creek watershed: agricultural supply, cold and warm freshwater habitat, fish migration and spawning, municipal/domestic supply, preservation of rare or endangered species, contact and non-contact water recreation, and wildlife habitat. Pescadero Marsh serves as estuarine habitat.

2.2.8 San Gregorio Creek Watershed

San Gregorio Creek watershed is a 52 square mile drainage basin in western San Mateo County. San Gregorio Creek has its headwaters in the Santa Cruz Mountains, and drains into the Pacific Ocean. Numerous tributaries feed San Gregorio Creek including El Corte de Madera Creek, Clear Creek, Bogess Creek, Harrington Creek, La Honda Creek, Woodruff Creek, Alpine Creek, and Mindego Creek. The watershed is characterized by very unstable rock types and soils, high relief, and high-intensity rain events. Average annual precipitation ranges from 20 inches at the coast to over 40 inches in the headwaters (Rantz 1971).

Land use in the watershed includes logging, road-building, farming, grazing, and residential. The watershed is generally very sparsely populated; the largest urban center in the watershed is the town of La Honda, just upstream of the confluence of La Honda Creek and Alpine Creek. Other communities and residences include the town of San Gregorio, residences along Alpine Creek east of La Honda, and residences along the mainstem of San Gregorio Creek. Septic tanks are used in some areas. Agriculture is concentrated along the floodplains and main channel of San Gregorio Creek. San Gregorio Creek is listed on the 303(d) list of impaired water bodies for excessive sedimentation. In addition to sedimentation, water quality issues include water diversion, coliforms, and pesticides.

The Basin Plan (SFBRWQCB 1995) identifies nine beneficial uses in the surface waters of the San Gregorio Creek watershed: agricultural supply, cold and warm freshwater habitat, fish migration and spawning, preservation of rare and endangered species, water contact and non-contact recreation, and wildlife habitat. In addition to these uses, San Gregorio Creek serves as a source of drinking water for residents.

2.2.9 Stevens Creek/Permanente Creek Watershed

The Stevens Creek and Permanente Creek watersheds are neighboring drainage basins in the western Santa Clara Basin. The watershed of Stevens Creek is a 38 square mile drainage basin, with its headwaters high in the densely forested Santa Cruz Mountains. Permanente Creek, just north of Stevens Creek, originates in the Los Altos Hills, which are covered by chaparral and oak woodland. Permanente Creek flows through the cities of Los Altos and Mountain View, where the channels have been heavily modified, and drains into South San Francisco Bay at Mountain View Slough. Peak flows from Permanente Creek are diverted, via the Permanente Creek Diversion, to Stevens Creek at rates up to 1500 cubic feet per second.

The upper portions of both watersheds drain upland, mountainous or hilly landscapes where human development is largely absent. The lower portions of the streams flow through western Santa Clara Valley, a large flat alluvial valley draining into South San Francisco Bay. Average annual precipitation in the watershed ranges from 14 inches at the bayshore to over 40 inches in the headwaters (Rantz 1971). Stevens Creek Reservoir was built where Stevens Creek emerges from a deep canyon between Monte Bello Ridge and Table Mountain, and serves to store winter runoff for the recharge of the Santa Clara Groundwater Basin during the summer months (SCBWMI 2003). Swiss Creek, the largest tributary of Stevens Creek, enters the reservoir from the west. The capacity of the reservoir is 3,465 acre-feet; the upstream drainage area is approximately 17 miles.

Land uses in the watershed include mining, urbanization, forests, and parks. A cement plant and rock quarry occupies a large segment of land along much of the length of upper Permanente Creek. Stevens Creek Quarry, at the base of Stevens Creek Reservoir on Stevens Canyon Road, has been in operation since 1932, producing crushed rock for the building industry. Both watersheds are heavily populated, and industrial and commercial areas are also significant. Potential water quality issues include sedimentation, channel modification, increased stream temperature, dissolved oxygen, metals, coliforms, nutrients, pesticides, organic pollutants, and other toxic substances.

Beneficial uses in both watersheds include cold water and wildlife habitat, fish spawning, and contact and non-contact water recreation (SFBRWQCB 1995). Stevens Creek watershed is also listed for warm water habitat, fish migration, and freshwater replenishment. Stevens Creek Reservoir is listed for cold and warm water habitat, wildlife habitat, fish migration and spawning, non-contact water recreation, municipal/domestic supply, and groundwater recharge.

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3 Sampling Design

3.1 Watershed Site Selection

Watershed sampling sites were selected deterministically, focused on the following types of areas:

1. Above confluences (to characterize tributaries)
2. Areas of minimal human land use (to characterize reference conditions)
3. Areas where previous monitoring data indicates a potential impact
4. Areas where land use changes (to evaluate the potential impacts of particular land use types)
5. Areas with particular beneficial uses
6. Locations of restoration projects and permitted entities

Major types of land-use activity occurring within each watershed were identified (based on field reconnaissance, land use/land coverage maps, and other sources of information) in order to inform the selection of water quality indicators. Land-use types occurring at, or upstream, of each sampling site are presented in Appendix A, and are summarized in Table 3-1. Land uses were then related to the potential for various types of water quality degradation (Table 3-2). These potential water quality impacts were used to select appropriate monitoring tools for each site and watershed (Table 3-3, Table 3-4).

Sampling sites were distributed fairly evenly throughout each watershed in order to (1) assess conditions across the entire watershed and (2) identify locations where water quality conditions exhibit significant changes between adjacent sites. Watershed sampling sites are listed in Table 3-4, and shown on Figures 3-1 through 3-9; site location information is presented in Appendix B.

3.2 Watershed Sampling Parameters

Watershed monitoring was conducted using a tiered approach, designed: 1) to determine overall patterns of water quality in the Region and 2) to answer basic questions concerning the protection of beneficial uses and potential impacts of land use and water management. The assessment of physical and biological indicators, toxicity, and chemistry constitutes a weight-of-evidence approach for characterizing water quality in the San Francisco Bay Region. Parameters sampled at each site during Year 1 and 2 are listed in Table 3-4 with land use and shown on the maps in Figures 3-1 through 3-9.

3.2.1 Tier 1 Sampling

Tier 1 sampling was designed to optimize spatial coverage in determining the basic water quality of watersheds, to identify reference sites, and to complement the Tier 2 evaluation. Tier 1 sampling included bioassessment, physical habitat assessment, and discrete measurements of basic water quality parameters such as temperature, dissolved oxygen, specific conductance, and pH. However, due to the temporal variability in these measurements, only data from continuous monitoring probes were used to evaluate these parameters.

Biological community and physical habitat indicators tend to integrate the effects of water quality stressors over time, and are sensitive to various physical, chemical and biological influences. Rapid Bioassessment (RBA), an in stream macroinvertebrate sampling procedure, was conducted at all Tier 1 sites to help determine overall patterns of water quality in the Region, and to help assess the protection of beneficial uses for aquatic life. The California Stream Bioassessment Procedure (CDFG 1999) is the standardized RBA protocol for assessing biological and habitat conditions of wadeable streams in California, as adapted from national RBA protocols outlined by the U.S. Environmental Protection Agency (Barbour *et al.* 1999). The CSBP was used to measure stream benthic macroinvertebrate (BMI) community and physical/habitat characteristics, in order to determine stream biological and physical integrity. RBA sampling occurred once at each site, in spring of 2001 or 2002.

3.2.2 Tier 2 Sampling

Tier 2 sampling was conducted at a subset of the Tier 1 sites in order to assess water quality in more detail, to identify potential stressors, and to provide information for the assessment of beneficial use protection in relation to land use. Water quality parameters measured during Tier 2 sampling included the following:

- Continuous field measurements of basic water quality (temperature, DO, pH, and specific conductance)
- Conventional chemistry, including boron, chloride, sulfate, hardness, alkalinity, total dissolved solids (TDS), suspended sediment concentration or total suspended solids (SSC or TSS), total organic carbon (TOC), dissolved organic carbon (DOC), nitrate, nitrite, total Kjeldahl nitrogen (TKN), orthophosphate, total phosphorous, ammonia, chlorophyll-a and pheophytin-a
- Toxicity to three EPA test species: *Ceriodaphnia dubia*, *Selenastrum capricornutum* (= *Raphidocelis subcapitata*), and *Pimephales promelas*
- Trace metals
- Trace organics, including pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs)
- Coliform bacteria, including total coliforms, fecal coliforms, and *E. coli*

Tier 2 sampling occurred during three hydrologic cycles: the wet season (January through March), spring/decreasing hydrograph (April through May) and the dry season (June through October). Coliform sampling, however, was conducted during five consecutive weeks within the dry season only to obtain data comparable to water quality standards. Prevailing seasonal conditions determined the timing of monitoring events, which occurred on the following schedule:

Tier 2 Sampling Periods

Sampling Year	September/ October 2001	January 2002	April 2002	June 2002	January 2003
1	X	X*	X	X**	
2			X	X	X

*Toxicity testing was not performed in January 2002.
**Year 1 sampling at sites that were dry in October 2001 was attempted again in June 2002.

To determine temporal variability in basic water quality, continuous field monitoring of temperature, dissolved oxygen (DO), pH, and specific conductance (electrical conductivity compensated to 25°C) was conducted at a subset of sites characterized by bioassessment. As part of our pilot study, continuous monitoring was scheduled at sites for one to two week periods, three to four times per year. Deployments averaged 11 days, ranging from 2-29, in order to determine the optimum period of deployment and because of field conditions.

3.2.3 Integrator Sites

Integrator sites were established at the bottom of each watershed area above tidal influence. These sites were intended to assess contaminant levels in watersheds at the locations where they discharge into receiving waters (*e.g.* the bay). In addition to physical, chemical, and toxicity monitoring, *Corbicula fluminea* (a freshwater clam) were deployed, retrieved, and analyzed for chemical bioaccumulation. Sediment samples were collected from integrator sites for analysis of grain size, chemistry, and toxicity to the amphipod *Hyalella azteca*. Sediment collection and clam deployments occurred once for each watershed, in the dry season only. Watershed boundaries, site locations, land use, and parameters measured at each site are shown in Figures 3-1 through 3-9.

Table 3-1. Land-use classifications

category	code	classification	definition
1.1	COM	Commercial	commercial, not necessarily high density
1.1	DOE	Department of Energy	military or government energy sites (Lawrence Livermore/SLAC/UTC)
1.1	IND	Industrial	light or heavy industry
1.1	ROD	Road	major paved roadway (*e.g.*, freeway)
1.1	URB	Urban	high density, commercial, high impervious coverage
1.2	RES	Residential	suburban low density
1.2	SWR	Sewage treatment plant	POTWs and community septic systems
2.1	DAM	Dam	water impoundment
2.2	CHN	Channel modification	concrete channels
2.2	DIV	Diversion	flow alteration by diversion or addition
3.1	AGR	Agriculture	crops, excluding trees and grapes
3.1	NUR	Nursery	intense planting for wholesale and retail; includes greenhouses
3.1	ORC	Orchards	tree fruit, nuts
3.1	VIN	Vineyards	grapes
3.2	GRZ	Grazing	cattle, horse, or any ruminant (historic grazing included)
3.3	DRY	Dairy	dairy cows (confined animal facility)
3.3	HRS	Horse	stables, trails
4.1	MNG	Mining	mercury, pyrite, coal, magnesite, manganese, chromite
4.2	QRY	Quarry	gravel, sand
4.3	LOG	Logging	tree removal, roads (historic logging included)
5.1	GLF	Golf	golf courses
5.1	PRK	Park	urban or developed park, landscaped, in developed area.
5.2	OPS	Open Space	wildland park, not developed, likely reference sites

Table 3-2. Land uses and potential land use impacts

	Watersheds									Potential Land Use Impacts						
Land Use	**Walker**	**Lagunitas**	**San Leandro**	**Wildcat / San Pablo**	**Suisun**	**Arroyo Las Positas**	**Pescadero/Butano**	**San Gregorio**	**Stevens / Permanente**	**sedimentation**	**human / aquatic toxicity**	**eutrophication**	**human illness**	**trash**	**aquatic community effects**	**aquatic habitat degradation**
Commercial		•	•	•		•	•	•	•	•	•		•	•	•	•
Department of Energy						•					•				•	
Industrial			•	•		•			•	•	•			•	•	•
Road		•	•	•	•	•			•	•	•			•	•	•
Urban			•	•					•	•	•	•	•	•	•	•
Residential	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sewage treatment plant	•	•								•	•	•	•		•	
Dam	•	•	•	•	•				•	•					•	•
Channel modification						•			•	•					•	•
Diversion				•					•	•					•	•
Agriculture	•						•	•		•	•	•			•	•
Nursery				•			•				•	•			•	
Orchards					•					•	•	•			•	•
Vineyards					•		•			•	•	•			•	•
Grazing	•	•	•	•	•	•	•			•		•	•		•	•
Dairy	•									•		•	•		•	•
Horse		•	•							•		•	•		•	•
Mining	•									•	•				•	•
Quarry		•				•			•	•					•	•
Logging							•			•					•	•
Golf		•		•		•					•	•			•	•
Park		•	•	•			•		•		•	•	•	•	•	•
Open Space	•	•	•	•	•		•	•	•							

Table 3-3. Water quality indicators

Potential land use impacts	Water quality indicators
sedimentation	suspended sediment, turbidity physical habitat assessment (as part of RBA)
aquatic and human toxicity	toxicity testing pesticides, PCBs, PAHs, metals conventional chemistry and basic water quality
eutrophication	conventional chemistry including nutrients, basic water quality (temperature, dissolved oxygen, and pH), chlorophyll-a and pheophytin
human illness	coliforms
trash	Rapid Trash Assessment
aquatic community effects	Rapid Bioassessment (RBA)
aquatic habitat degradation	physical habitat assessment (as part of RBA)

These water quality indicators were used to evaluate potential land use impacts in monitored watersheds.

Table 3-4. Watershed stations with parameters sampled and land use categories

Parameters sampled: **BMI** = benthic macroinvertebrates and physical habitat; **CM** = continuous monitoring of basic water quality field parameters (temperature, DO, pH, SC); **CWQ** = conventional water quality (includes nutrients, chlorophyll, organic carbon); **WMT** = water metals and toxicity; **SCT** = sediment chemistry and toxicity (includes metals and organics); **TMO** = tissue metals and organics (bioaccumulation); **BAC** = coliform bacteria; **LU** = land-use categories. Land-use categories: A = agriculture; G = grazing; M = mixed; OS = open space; RR = rural residential; U = urban. All sites with water chemistry and sediment chemistry also had discrete measurements of basic water quality field parameters (Appendix F). One station marked ***** (201WLK090) had mercury analyzed, but no other metals or toxicity tests.

Site Code	BMI	CM	CWQ	WMT	WO	SCT	TMO	BAC	LU
Walker Creek Watershed									
total # sites	**13**	**5**	**4**	**0**	**0**	**1**	**1**	**1**	
201WLK030	•		•						RR
201WLK050	•								M
201WLK090			•	*		•	•		M
201WLK100	•	•	•						G
201WLK120	•								M
201WLK130	•								M
201WLK140	•	•	•						G
201WLK160	•	•							M
201WLK162								•	RR
201WLK170	•								G
201WLK180	•	•							M
201WLK190	•								G
201WLK200	•	•							M
201WLK230	•								G
201WLK240	•								G

Site Code	BMI	CM	CWQ	WMT	WO	SCT	TMO	BAC	LU
Lagunitas Creek Watershed									
total # sites	**24**	**6**	**8**	**3**	**3**	**2**	**3**	**5**	
201LAG040	●		●	●	●		●		M
201LAG050	●	●							M
201LAG060	●								G
201LAG075	●								G
201LAG085	●	●							G
201LAG100	●								G
201LAG115								●	M
201LAG120						●		●	G
201LAG130	●		●	●	●		●		M
201LAG150	●		●						M
201LAG160	●	●	●						RR
201LAG165	●	●							M
201LAG170	●								M
201LAG180	●								M
201LAG185								●	M
201LAG190	●	●	●						M
201LAG210	●		●						M
201LAG220	●								M
201LAG230								●	RR
201LAG240	●								RR
201LAG270	●	●	●	●	●	●	●		RR
201LAG290	●								RR
201LAG300	●								RR
201LAG320	●		●						M
201LAG330	●								OS
201LAG335	●								OS
201LAG380	●								OS
201LAG390	●							●	OS
San Leandro Creek Watershed									
total # sites	**11**	**7**	**4**	**2**	**1**	**1**	**0**	**5**	
204SLE030	●		●	●	●	●			U
204SLE050	●	●							U
204SLE070	●	●						●	U
204SLE090	●	●						●	M
204SLE170	●	●						●	M
204SLE180	●	●							OS
204SLE190	●	●	●					●	RR
204SLE200	●							●	RR
204SLE210	●	●	●						U
204SLE220	●								G
204SLE230	●		●	●					OS
San Pablo Creek Watershed									
total # sites	**13**	**5**	**5**	**4**	**1**	**1**	**1**	**2**	
206SPA020	●		●	●	●	●	●		U
206SPA050	●	●							U

Site Code	BMI	CM	CWQ	WMT	WO	SCT	TMO	BAC	LU
206SPA060								•	U
206SPA070	•	•	•	•					U
206SPA100	•								U
206SPA110	•								U
206SPA130	•								M
206SPA140	•								M
206SPA150	•		•					•	G
206SPA160	•								G
206SPA170	•								M
206SPA200	•	•	•	•					U
206SPA220	•	•	•	•					U
206SPA240	•	•							U
Wildcat Creek Watershed									
total # sites	**8**	**3**	**1**	**1**	**1**	**1**	**0**	**2**	
206WIL020		•	•	•	•	•			U
206WIL030	•								U
206WIL050	•								U
206WIL060	•								U
206WIL070	•	•						•	M
206WIL100	•	•							M
206WIL130	•							•	M
206WIL170	•								M
206WIL180			•						M
206WIL190	•								M
Suisun Creek Watershed									
total # sites	**9**	**7**	**8**	**4**	**3**	**1**	**1**	**0**	
207SUI010	•		•	•	•				M
207SUI020	•	•	•	•	•	•	•		A
207SUI050	•	•							A
207SUI060	•		•	•					A
207SUI090		•							M
207SUI110	•	•	•	•	•				M
207SUI125		•	•						M
207SUI130	•		•						M
207SUI180	•	•	•						M
207SUI185		•							M
207SUI210	•		•						A
207SUI260	•								G
Arroyo Las Positas Watershed									
total # sites	**7**	**5**	**4**	**3**	**1**	**1**	**1**	**0**	
204ALP010	•	•	•	•	•	•	•		U
204ALP040	•	•							U
204ALP070	•								U
204ALP080	•	•							U
204ALP100	•		•	•					U
204ALP105		•							U
204ALP110	•		•	•					U

Site Code	BMI	CM	CWQ	WMT	WO	SCT	TMO	BAC	LU
204ALP140	●		●						M
204ALP150		●							M
Butano Creek Watershed									
total # sites	**5**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	
202BUT010	●	●	●	●	●	●	●		A
202BUT020	●		●						A
202BUT030	●	●							RR
202BUT040	●							●	OS
202BUT050	●	●						●	OS
Pescadero Creek Watershed									
total # sites	**17**	**9**	**4**	**2**	**2**	**1**	**1**	**6**	
202PES050	●		●	●	●	●	●		M
202PES060	●	●						●	M
202PES070	●		●	●	●				A
202PES080	●								A
202PES095	●								A
202PES100	●	●							RR
202PES105		●							RR
202PES120	●								RR
202PES134								●	RR
202PES135								●	RR
202PES140	●	●	●						M
202PES150	●	●						●	RR
202PES160	●								M
202PES170	●	●							M
202PES180	●	●							OS
202PES190	●	●	●						OS
202PES193								●	OS
202PES194								●	OS
202PES200	●								OS
202PES210	●								OS
202PES230	●								M
202PES240	●	●							OS
San Gregorio Creek Watershed									
total # sites	**11**	**6**	**4**	**2**	**2**	**1**	**1**	**2**	
202SGR010	●	●	●	●	●	●	●		M
202SGR020		●							RR
202SGR030	●								RR
202SGR040	●	●	●						M
202SGR060	●								RR
202SGR075	●								RR
202SGR079								●	RR
202SGR080	●		●	●	●				RR
202SGR090	●	●	●						RR
202SGR100		●						●	RR
202SGR110	●								RR
202SGR120	●	●							RR

Site Code	BMI	CM	CWQ	WMT	WO	SCT	TMO	BAC	LU
202SGR130	●								RR
202SGR150	●								RR
Permanente Creek Watershed									
total # sites	**7**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	
205PER010	●	●	●	●	●	●	●		U
205PER020	●								U
205PER030	●								U
205PER040	●								U
205PER050	●	●							U
205PER070	●		●	●	●				M
205PER080	●							●	M
Stevens Creek Watershed									
total # sites	**8**	**3**	**3**	**2**	**2**	**1**	**1**	**4**	
205STE020	●	●	●	●	●	●	●	●	U
205STE030	●								U
205STE040	●								U
205STE060	●	●	●	●	●				U
205STE070	●	●						●	M
205STE080								●	RR
205STE090								●	RR
205STE100	●		●						RR
205STE110	●								RR
205STE120	●								RR
Year 1 & 2 Total	**125**	**61**	**45**	**26**	**19**	**13**	**12**	**30**	

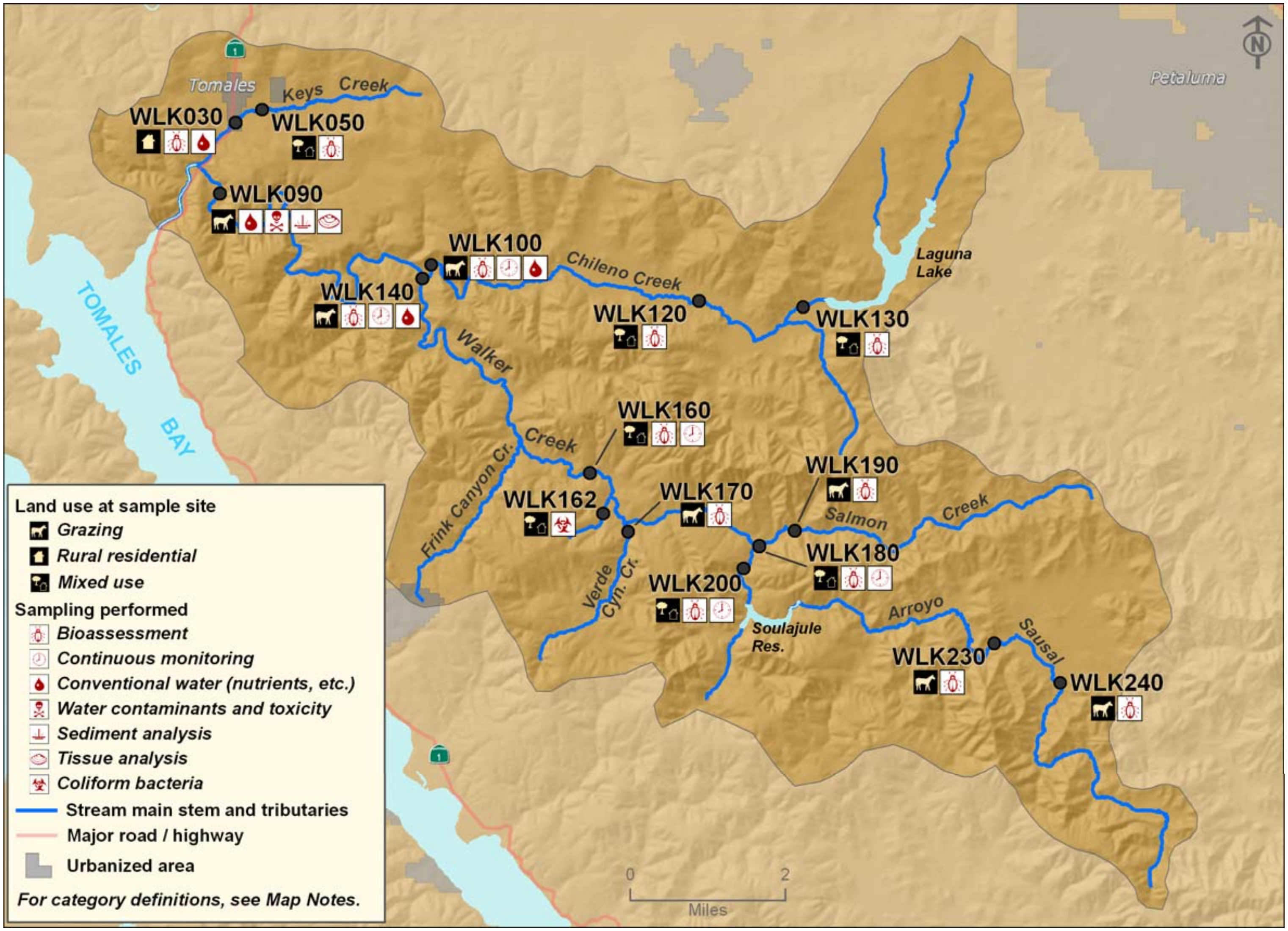

Figure 3-1. Walker Creek watershed

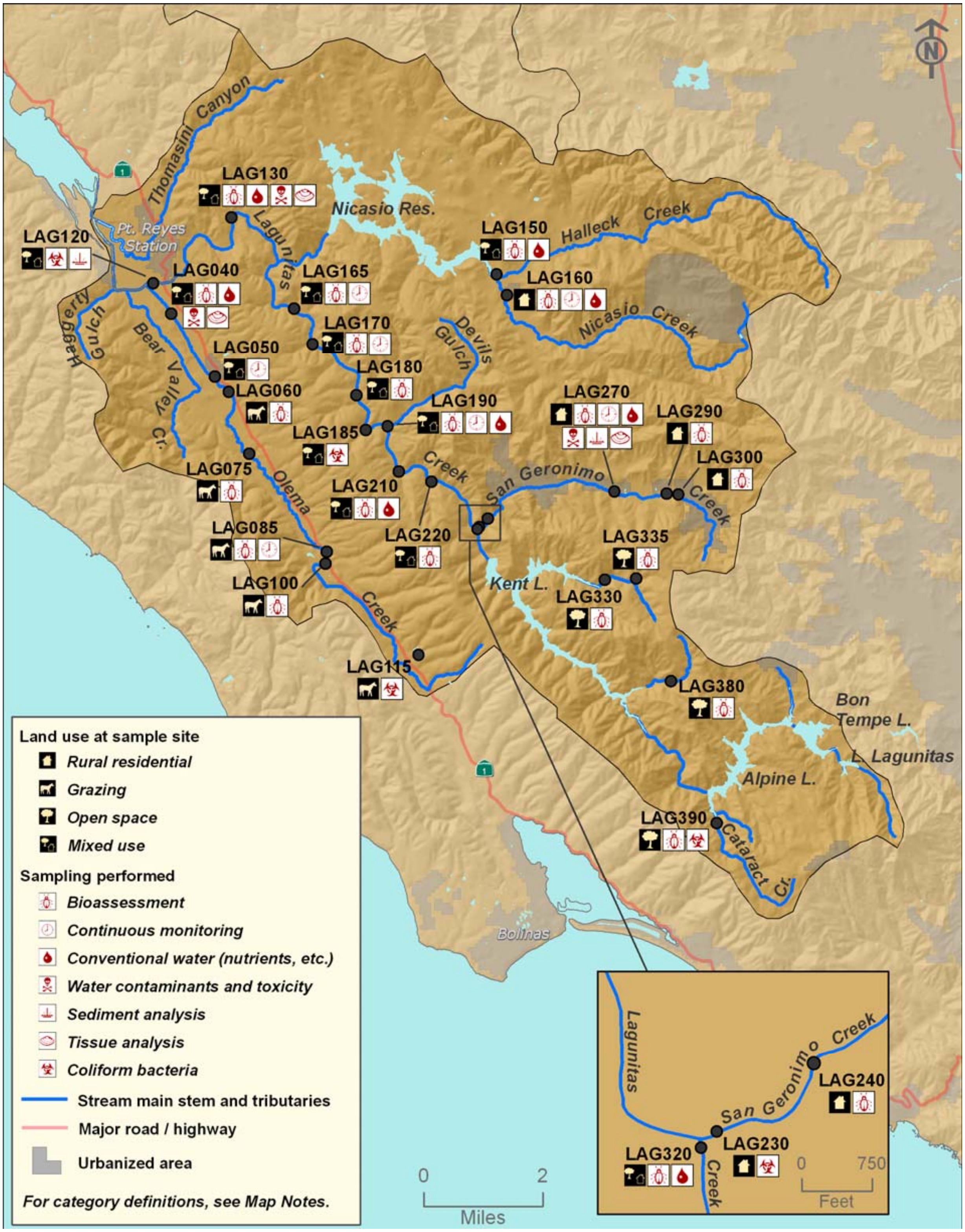

Figure 3-2. Lagunitas Creek watershed

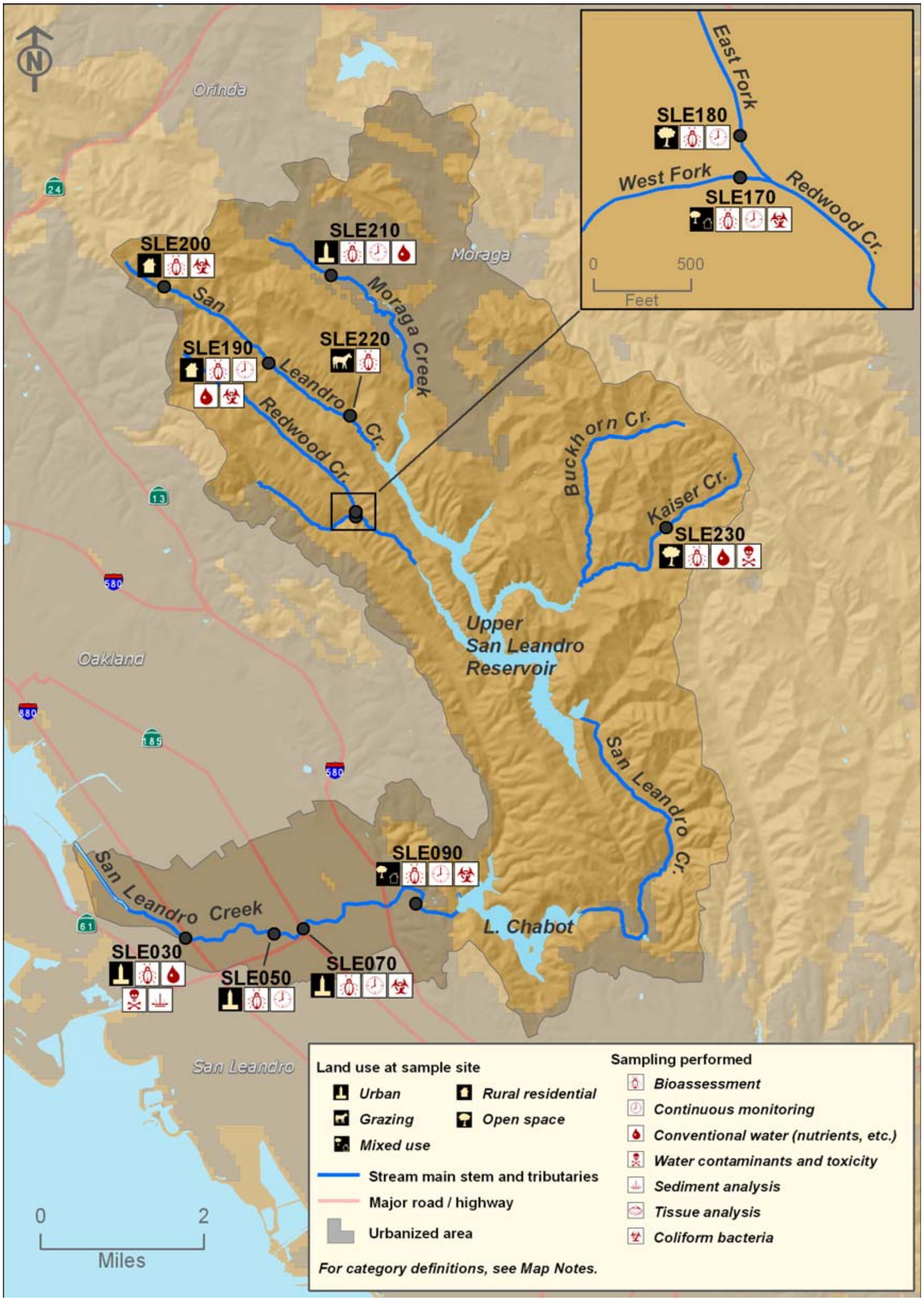

Figure 3-3. San Leandro Creek watershed

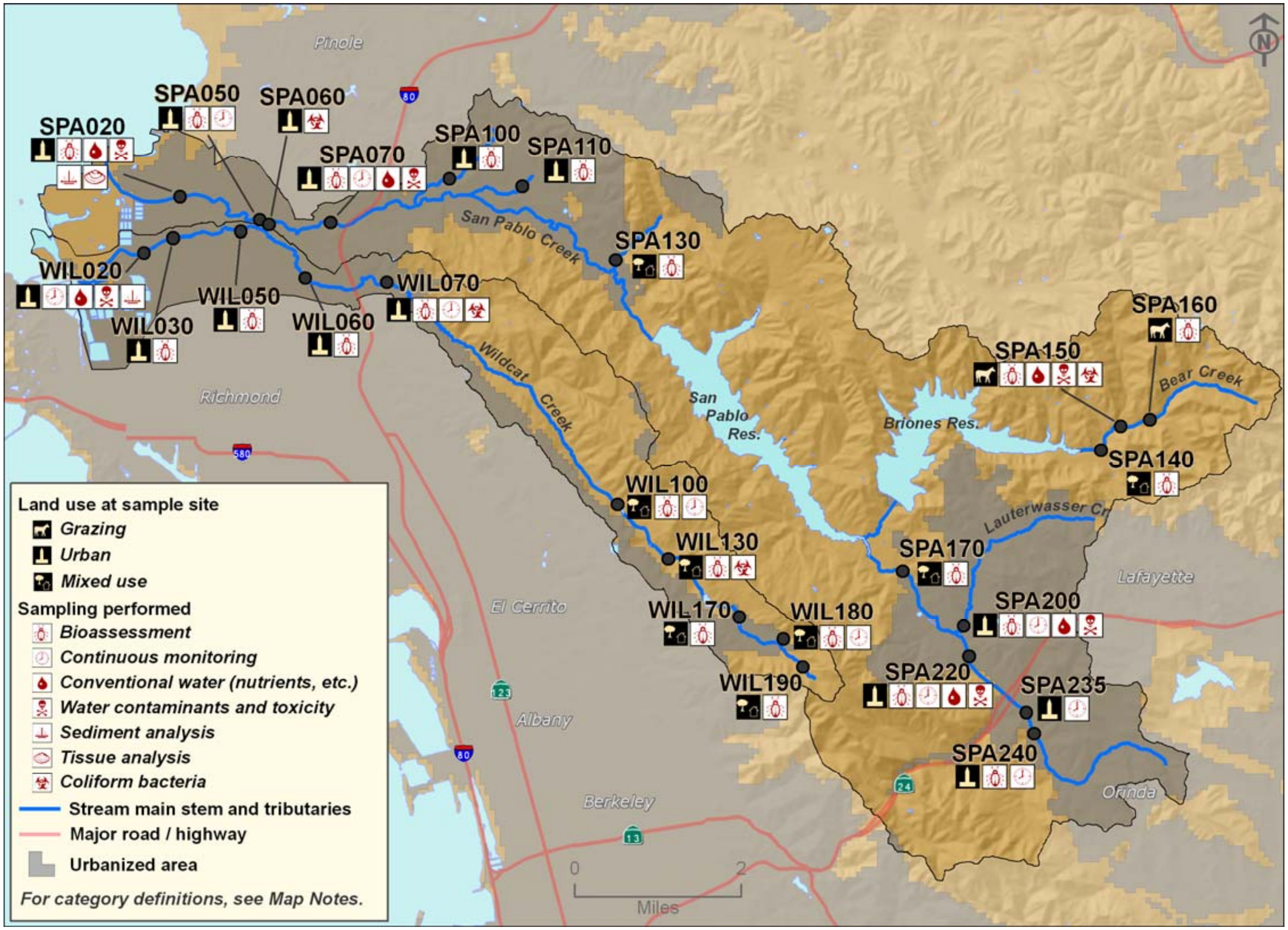

Figure 3-4. Wildcat Creek and San Pablo Creek watershed

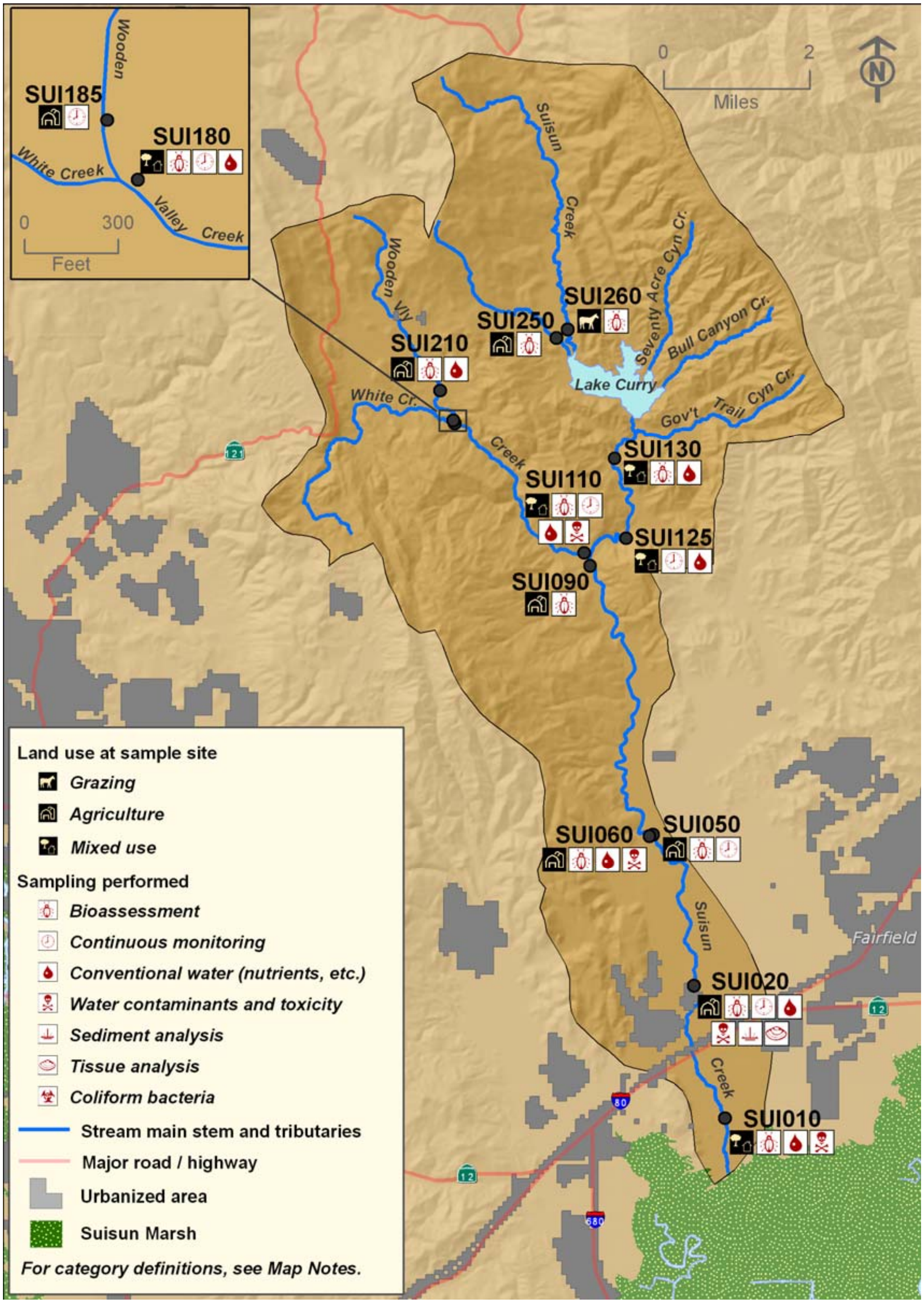

Figure 3-5. Suisun Creek watershed

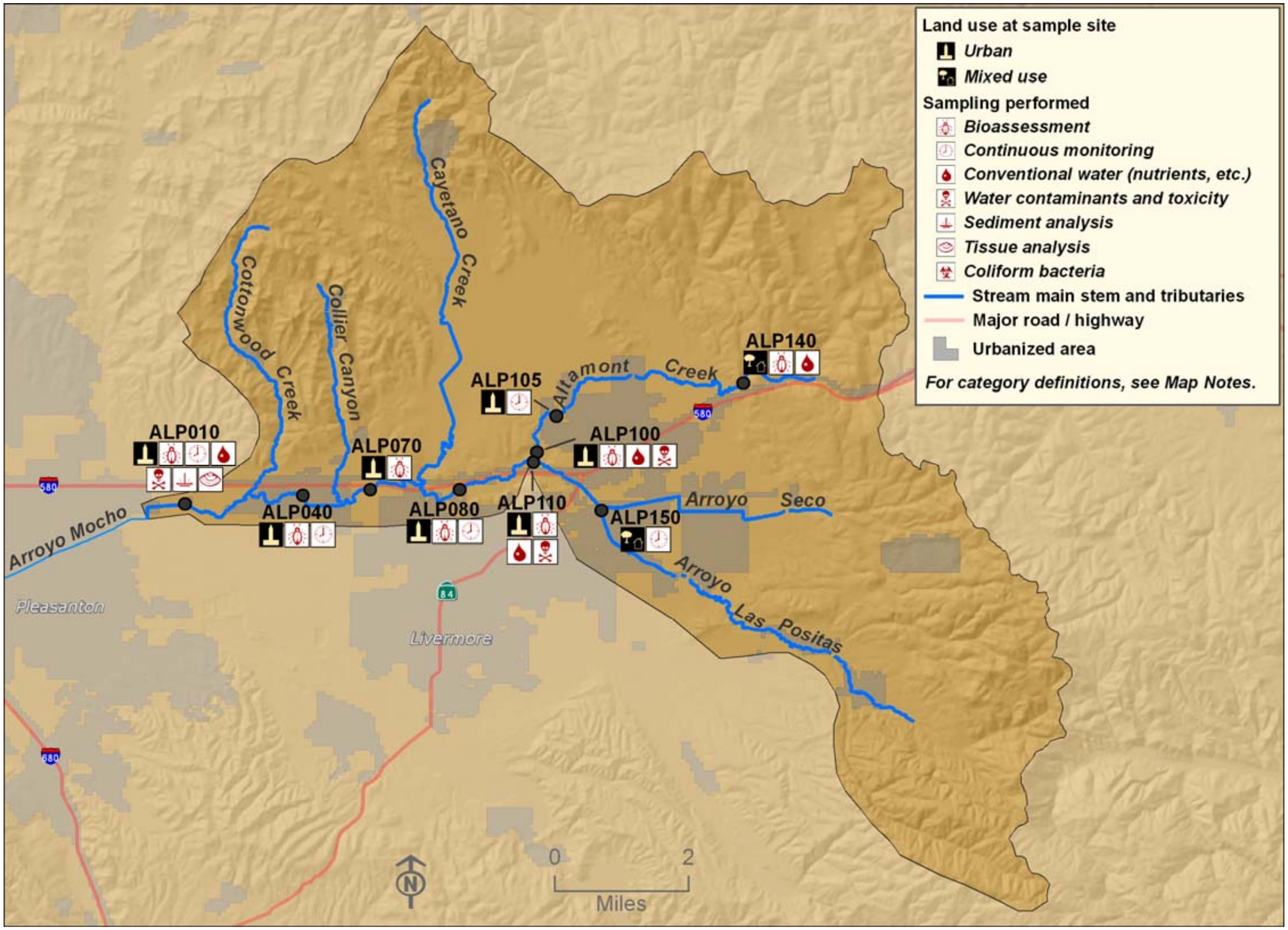

Figure 3-6. Arroyo Las Positas watershed

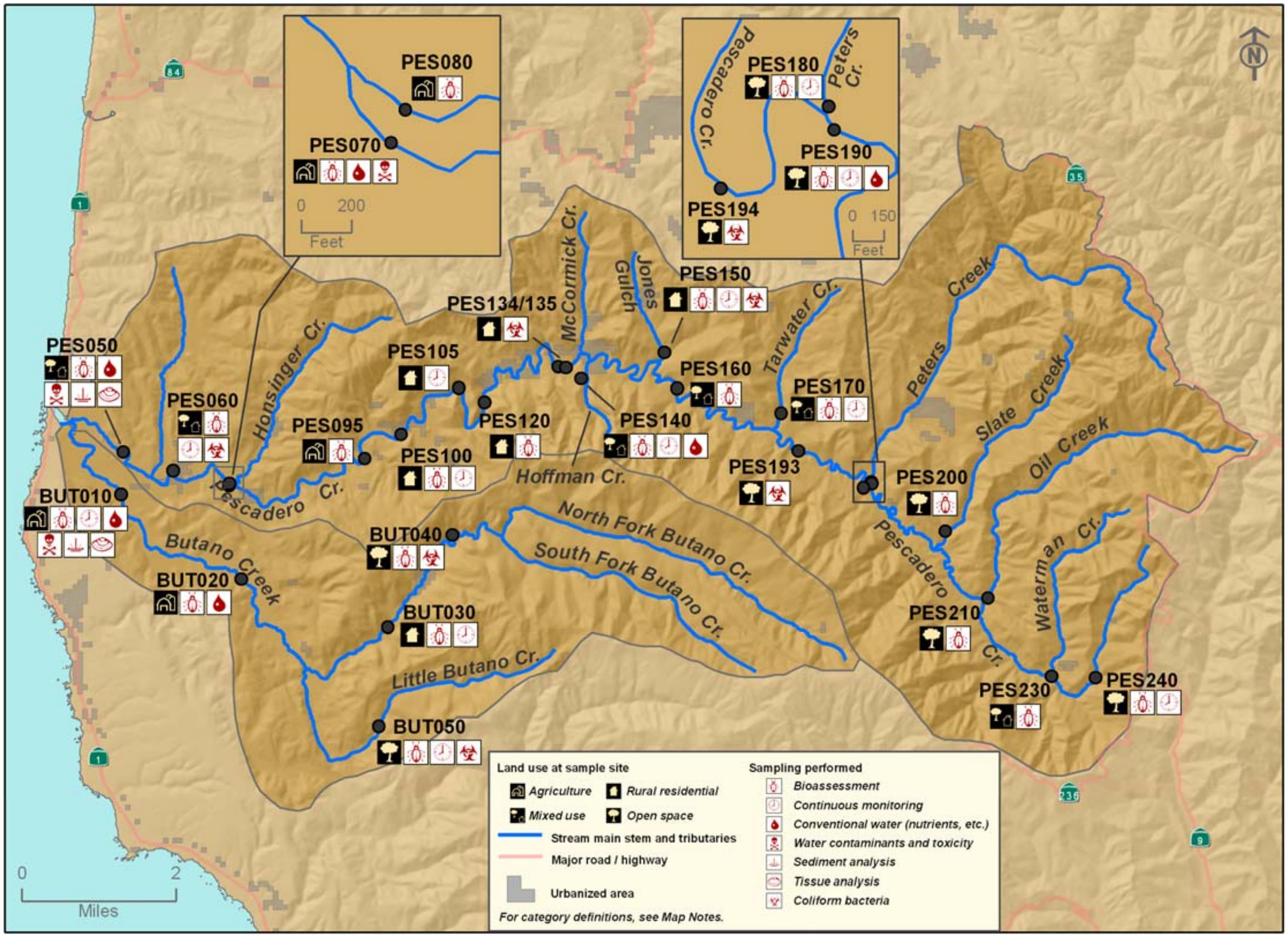

Figure 3-7. Pescadero Creek and Butano Creek watershed

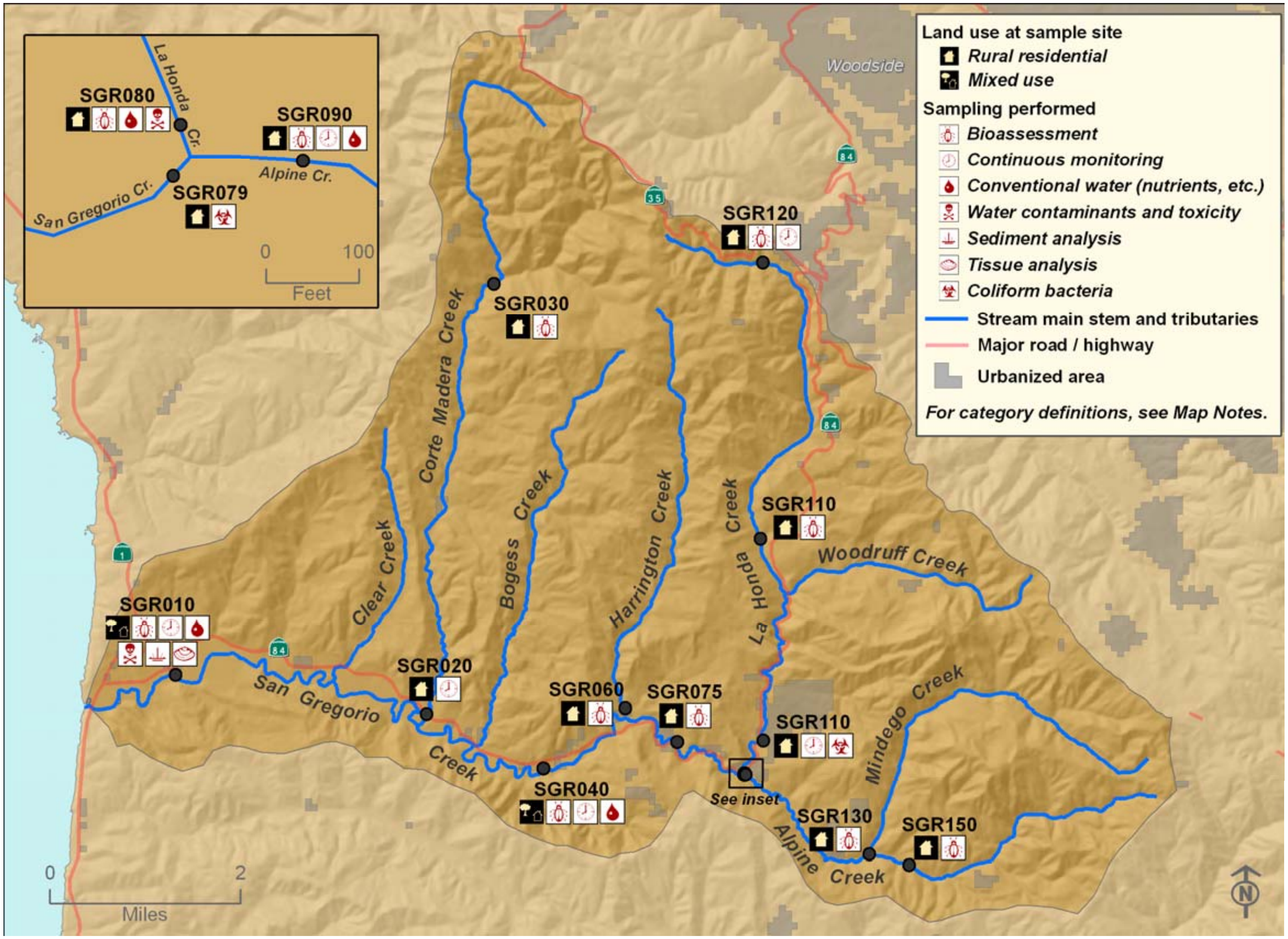

Figure 3-8. San Gregorio Creek watershed

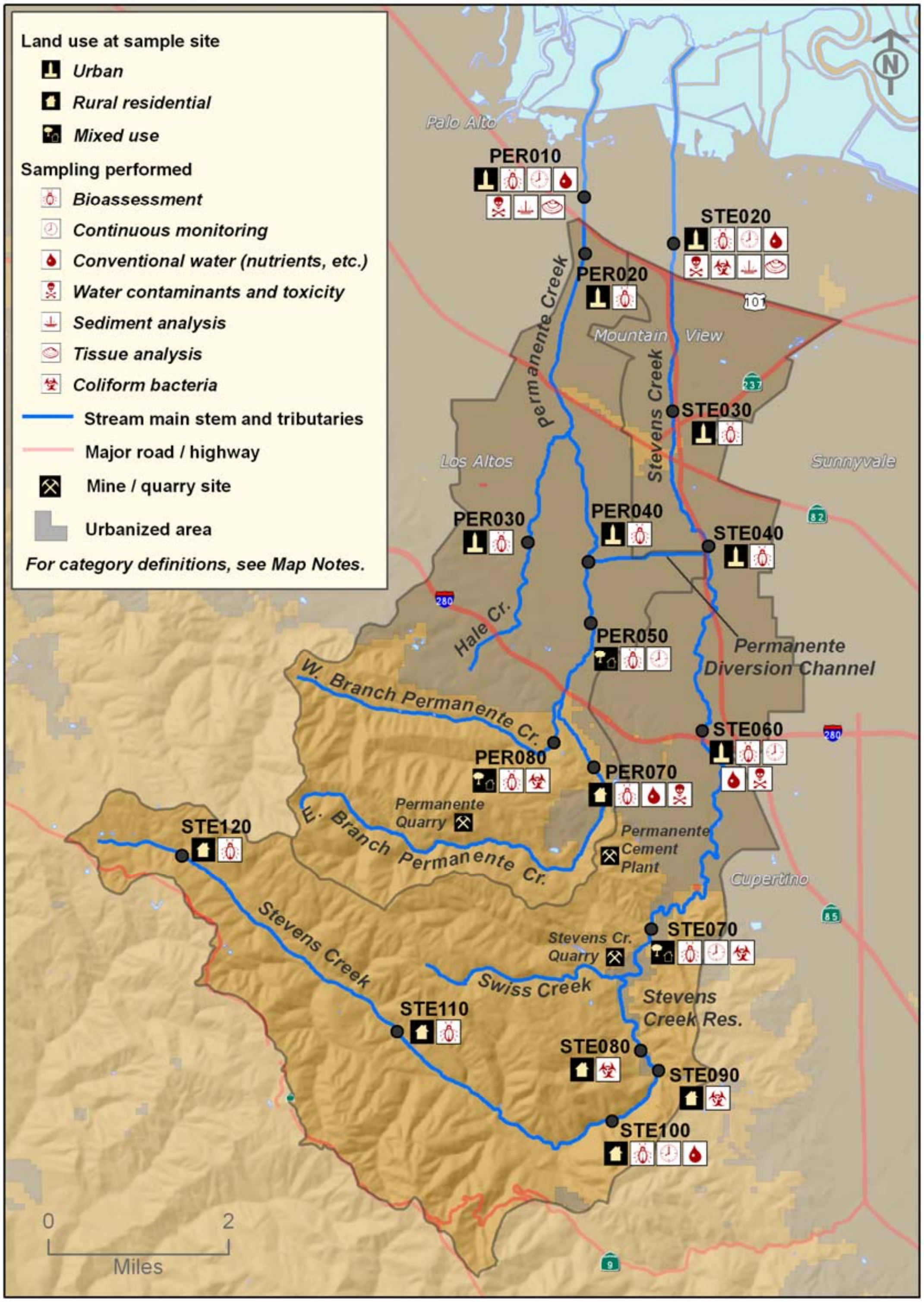

Figure 3-9. Stevens Creek and Permanente Creek watershed

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4 Methods

A summary of sampling, laboratory analysis, and data analysis procedures is provided in this section. All sampling, chain of custody procedures, and laboratory analyses were performed according to objectives and procedures outlined in the SWAMP QAMP and its appendices (Puckett 2002), unless otherwise noted. Regional Board contacts, as well as participants contracted for field and laboratory studies, are also provided in the QAMP (Puckett 2002). All field activities occurred at GPS-located sites.

4.1 Rapid Bioassessment

4.1.1 Background and Rationale for Bioassessment

Benthic macroinvertebrates are commonly used to assess environmental conditions in freshwater ecosystems around the world, and are the preferred biological assemblage for bioassessment in streams in California (Harrington and Born 1999). Benthic macroinvertebrate assemblages in streams are dominated by insects (Class: Insecta), although other invertebrates such as aquatic worms (Class: Oligochaeta) and snails (Class: Gastropoda) are common. Major orders of benthic insects include mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), true flies (Diptera), aquatic beetles (Coleoptera), and dragonflies and damselflies (Odonata). Most aquatic insects live in the benthos as larvae and have terrestrial adult life stages, although some groups have complete aquatic life cycles.

Benthic macroinvertebrates are extremely diverse and exhibit a wide range of tolerance to pollution and habitat alteration, making them ideal indicators of water quality (Rosenberg and Resh 1993). Additionally, unlike water chemistry samples, benthic assemblages integrate environmental conditions over time, as the lifespan of aquatic invertebrates ranges from several months to several years. In general, members of the insect orders Ephemeroptera, Plecoptera, and Trichoptera (hereafter EPT) are intolerant of degraded water quality and stream conditions relative to many other macroinvertebrates. Other taxonomic groups, such as Oligochaetes and many taxa of Diptera, respond favorably to certain types of pollution such as nutrient enrichment and fine sediment deposition.

Benthic macroinvertebrates have been used throughout the world to set management objectives and guide policy decisions for freshwater ecosystems. For example, in Great Britain, Canada, New Zealand, and Australia, multivariate statistical models that use correlations between habitat variables and species occurrences have been used to predict the composition of macroinvertebrate assemblages in streams (Wright *et al.* 1984). Differences between the predicted and expected assemblages are representative of the amount of environmental degradation due to altered water quality and habitat conditions. Using a different approach, the California Department of Fish and Game’s Aquatic Bioassessment Laboratory (DFG ABL) has developed an Index of Biological Integrity (IBI) for coastal Southern California (Ode *et al.* 2005). An IBI is an assessment tool for ranking the biological condition of stream systems using observed relationships between environmental degradation and the composition of the benthic community. The DFG ABL is planning to develop additional region-specific IBIs for the Sierra Nevada, North Coast, and Central Valley of California (Ode 2005).

In the San Francisco Bay Area, aquatic bioassessment with benthic macroinvertebrates is used by many watershed monitoring programs, including municipal stormwater monitoring programs, citizen monitoring groups, and government agencies. Despite the high level of interest in using bioassessment for water quality monitoring and assessment, an assessment tool specific to the Bay Area has not yet been developed. The Bay Area Macroinvertebrate Bioassessment Information Network (BAMBI), organized in 2001, is a group of individuals representing government agencies, private consulting firms, watershed groups, and researchers whom are interested in furthering the utility of bioassessment in the Bay Area. The Regional Water Quality Control Board is working closely with BAMBI in order to help develop water quality assessment and management tools on a collaborative basis. Until information on minimally disturbed conditions and natural variability is available, only coarse relative comparisons between monitoring sites are possible. Accordingly, one of the major goals of this report is to analyze bioassessment data collected by the Regional Board with a focus on identifying assessment tools to maximize the utility of aquatic bioassessment for monitoring watershed conditions.

4.1.2 Field Sampling

Bioassessment sampling was conducted at 133 sites in April 2001 and April 2002. Six of those sites were sampled by the National Park Service in Olema Creek using a point-source method; those results were used when metrics were comparable. At the other 127 sites, bioassessment monitoring was performed with a consistent sampling protocol, the 1999 version of the California Stream Bioassessment Procedure (CSBP), developed and conducted by the DFG-ABL (Harrington 1999, Puckett 2002). At each sampling site, a reach of stream containing riffles was selected for sampling. Riffles are the most taxonomically diverse microhabitats within streams, and can be used to determine the relative community composition of streams. Three riffles within each stream reach were randomly selected for sampling. A D-shaped kick net (0.5 mm mesh) was used to collect macrofaunal samples at three sites within each riffle. A 1 by 2-foot portion of substrate upstream of the kick-net was located and disturbed to approximately 4-6 inches in depth for 1-3 minutes at each site. The three site collections per riffle were composited to create one sample that was sieved to 0.5 mm and preserved in 95 percent ethanol.

In addition to the benthic sampling, field crews performed a physical habitat (P-HAB) assessment at each site. The physical habitat assessment component of the CSBP is a qualitative visual assessment of various habitat attributes, modeled after the EPA's Rapid Bioassessment Protocol (Barbour *et al.* 1999a, 1999b). This consisted of generating scores for the following habitat parameters: epifaunal substrate, embeddedness, velocity and depth regimes, sediment deposition, channel flow, channel alteration, riffle frequency, bank vegetation, bank stability, and riparian zone.

4.1.3 Laboratory Analysis

All samples were sorted and identified by the DFG ABL in accordance with the CSBP and the California Aquatic Macroinvertebrate Laboratory Network (CAMLnet) Standard Taxonomic Effort (STE). Macrofaunal samples were randomly subsampled and sorted to obtain 300 individuals per sample. These individuals were stored in an ethanol-glycerin solution, identified to genus or the lowest possible taxonomic unit, and enumerated. In general, insects were identified to genus, except chironomid midges which were identified to tribe/sub-family. Non-insects were identified to order, family, or genus, depending on the taxonomic group (see the CAMLnet STE: http://www.dfg.ca.gov/cabw/camlnetste.pdf).

4.2 Water Chemistry, Basic Water Quality, and Toxicity

4.2.1 Water Sampling

Water sampling was conducted by Marine Pollution Studies Laboratory (MPSL)-DFG at Tier 2 sampling sites. Grab samples were collected in appropriately pre-cleaned containers (amber glass, polyethylene or Teflon™, as required). Samples were collected in well-mixed stream sections by uncapping, filling and recapping the container just below the water surface. Samples collected for dissolved metals analyses were collected into a clean syringe and syringe-filtered into the sample container. Some chlorophyll-a samples were filtered in the field and frozen prior to analysis. Techniques used to insure collection of a valid water sample included sampling before other field activities, use of appropriate gloves, and implementation of the "clean hands-dirty hands" technique. Once collected, samples were preserved as needed, labeled, stored at a nominal 4°C, and shipped with appropriate chain-of-custody and handling procedures to the analytical laboratories. Field data sheets were completed for each sampling event to document conditions and sampling details. Regular field duplicates (for all sample types) and field blanks (for mercury, metals, and DOC) were also collected for quality control. For details on water sampling, see the QAMP (Puckett 2002) and Appendix G.

4.2.2 Field Measurements of Basic Water Quality

During Tier 2 sampling, field crews from MPSL-DFG also performed discrete measurements of temperature, DO, pH, specific conductance, salinity, velocity, and turbidity. All measurements were made just below the water surface and according to protocols outlined in the QAMP (Puckett 2002, Appendix F). Bioassessment field crews also performed discrete field measurements of water quality; however, these data were not evaluated in this report because of the problem with temporal variability inherent in this kind of measurement.

Regional Board Staff used YSI 6600 sondes with multi-parameter probes at selected Tier 1 sites to continuously monitor temperature, DO, pH, and specific conductance. Instruments were secured to stationary objects, camouflaged if necessary, and deployed for an average of 11 days (ranging from 2 to 29 days), recording water quality measurements every 15 minutes. Data were collected at selected sites in each watershed during each hydrologic season. For details on continuous monitoring of water quality, see the QAMP (Puckett 2002) and Appendix D.

4.2.3 Chemical Analyses

Water samples were analyzed for organics, TOC, DOC, total and dissolved metals, sulfate, chloride, boron, hardness, alkalinity, TDS, SSC or TSS, TOC, DOC, nitrate, nitrite, TKN, orthophosphate, total phosphorous, ammonia, chlorophyll a, and pheophytin a. Methods used in these analyses are presented in Table 4-1. Water chemistry data were assessed using the water quality guidelines in Table 4-2, as described in Section 4.6.

Unionized ammonia was calculated from total ammonia using the equations of Whitfield (1974). Field-collected temperature and pH measurements were entered into the equations with laboratory-measured total ammonia. Where necessary, pK values were interpolated from known values.

4.2.4 Toxicity Testing

Water toxicity testing was performed at the UC Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC) to assess the toxicity of waters collected from watershed sites. Three standardized test protocols were used: *Pimephales promelas* 7-day survival and growth, *Ceriodaphnia dubia* 7-day survival and reproduction, and *Selenastrum capricornutum* (*Raphidocelis subcapitata*) 96-hour growth test. Water quality was monitored daily, and temperature monitored continuously. All tests were conducted according to U.S. EPA (1994) guidelines. Negative controls were included with each test batch, and monthly reference toxicant tests (positive controls) with cupric chloride were performed for each species. Approximately every one in ten samples tested was a blind field duplicate. Details of toxicity testing methods can be found in the SWAMP QAMP (Puckett 2002) and Appendix J.

4.3 Coliforms in Water

A coliform assessment was conducted for screening purposes at sites with the potential for recreational water contact. Each site was sampled five times within a 30-day period to satisfy sampling requirements for evaluation of bacteria in water as stipulated in the Basin Plan (SFBRWQCB 1995) and U.S. EPA guidance (U.S. EPA 1986). Sampling took place during the summer months, when water contact recreation is most frequent. Samples from 2001 were collected between August 7 and September 4 at 15 sites; samples from 2002 were collected between July 22 and August 18 at a different set of 15 sites.

Sampling was performed according to U.S. EPA methods for volunteer stream monitoring (U.S. EPA 1997). Samples were collected in lab-sealed, sterile, 100-ml polyethylene bottles, using techniques to exclude bacteria associated with the surface film and bottom sediment. Filled sample bottles were placed in zip-lock bags and stored in a cooler with wet ice. Most samples were delivered to the laboratory within 6 hours of collection; the longest delivery time was 9:35 hours. All samples were held at the laboratory at 5°C, and analyzed within 24 hours of collection. Field replicates were also collected: in 2001, one duplicate sample was collected; in 2002, six triplicate samples were collected (two during each of three weeks). Replicates were collected simultaneously and adjacent to one another. For details on coliform sample collection, see the QAMP (Puckett 2002) and Appendix K.

Water samples were analyzed in accordance with Standard Method 9221 (multiple-tube fermentation; APHA 1998) for total coliforms, fecal coliforms, and *Escherichia coli*, which are used as indicators for the presence of human pathogens. Dilutions of 1, 10, and 100 yielded minimum reporting limits from 2 to 200 MPN/100 mL (most probable number per 100 milliliters) and reporting ceilings from 1,600 to 160,000 MPN/100 mL. This variation typically affected only the total coliform counts.

4.4 Sediment Chemistry and Toxicity

4.4.1 Sediment Sampling

Bed sediment (hereafter termed "sediment") samples were collected by MPSL-DFG at watershed integrator sites. Sediment collection was carried out after collection of other samples and measurements. Samples were ideally collected from undisturbed, low-energy areas devoid of hard clay, bank deposits, fill, and gravel; where conditions did not allow for collection of a fine-grained sample, sampling was rescheduled when possible. A pre-cleaned Teflon™ scoop was used to spoon the top 2 cm of sediment from five or more sub-sites into a pre-cleaned glass composite jar. After an adequate amount of sediment was collected, it was homogenized thoroughly and aliquoted into pre-cleaned, pre-labeled sample jars (glass or polyethylene, as appropriate) for chemical or toxicological analysis. Once collected, samples were stored at a nominal 4°C and shipped to the analytical laboratories. Field data sheets were completed for each sampling event to document conditions and sampling details. Regular field duplicates and initial field blanks were also collected for quality control. For details on sediment sampling, refer to the bed sediment sampling procedures outlined in the QAMP (Puckett 2002) and Appendix H.

4.4.2 Chemical Analyses

Sediments were analyzed for organics, metals, total organic carbon, moisture, and grain size according to methods presented in Table 4-1. Sediment chemistry data were assessed using the consensus-based sediment quality guidelines (SQGs) for freshwater (MacDonald *et al*. 2000a), as shown in Table 4-3 and as described in Section 4.6. Measured sediment chemical concentrations below threshold effects concentrations (TECs) are considered unlikely to contribute to adverse effects in sediment-dwelling organisms. In contrast, sediment chemical concentrations above probable effects concentrations (PECs) are considered likely to be toxic to sediment-dwelling organisms.

4.4.3 Toxicity Testing

Sediment toxicity was tested at UCD-GC with the *Hyalella azteca* 10-day survival and growth test according to standard U.S. EPA guidelines (U.S. EPA 2000). Granite Canyon well water was used as the overlying water. Overlying water quality was monitored daily, and temperature monitored continuously. Negative controls were included with each test batch, and reference toxicant tests (positive controls) with cadmium chloride were performed monthly. Field duplicates were also tested. Details of toxicity testing methods can be found in the SWAMP QAMP (Puckett 2002) and Appendix J.

4.5 Bioaccumulation Studies with *Corbicula*

Deployment, collection and preparation of *Corbicula fluminea* were performed by MPSL-DFG at watershed integrator sites. Clams were collected in Lake Isabella or the Sacramento River, and tested for contamination prior to deployment. Clams were deployed for one month in anchored polypropylene mesh bags, approximately 15 cm above the stream bed. Approximately 25 to 50 clams, 20 to 30 mm in diameter, were deployed at each site for each analysis (organics and metals). After a month-long deployment, clams were collected and sent to the laboratory for analysis. Clams intended for metals analysis were transported in plastic bags; clams intended for organics analysis were bagged in aluminum, then plastic. All clam handling was performed with methods designed to minimize contamination. Details of clam collection, handling, deployment and retrieval can be found in the SWAMP QAMP (Puckett 2002) and Appendix I.

Clam tissues were analyzed for organics, metals, lipids, and percent moisture according to methods presented in Table 4-1.

4.6 Approach to Data Analysis and Interpretation

Water and sediment quality guidelines (Table 4-2 and Table 4-3) were used to evaluate the condition of streams in each watershed. Water and sediment chemistry values were compared to guidelines established for the protection of aquatic life beneficial uses. Pathogen values were compared to guidelines established for the protection of human health in relation to contact and non-contact recreation beneficial uses. These assessments were done to address two primary questions:

1) Is the water suitable for aquatic life?
2) Is the water useable for recreation (including contact and non-contact water recreation)?

Numerous other guidelines have been established for protection of other beneficial uses, such as drinking, agricultural supply, fishing, etc. Fishing beneficial uses were addressed in a separate report (SFBRWQCB 2005). Drinking water is provided to customers from distribution systems that include treatment to remove harmful levels of chemicals and pathogens. Other beneficial uses are generally protected by standards developed to protect aquatic life.

To examine the relationships between watershed land use and water quality parameters, sampling sites were categorized into discrete land use classes using a conservative classification scheme. Watershed land use data was evaluated by extensive field reconnaissance and verification, as well as from digital topographic maps (TOPO! 1999) and other published sources. Sites were categorized into six land use types, based on land use in the upstream drainage area:

1. Agriculture: row crop agriculture, including orchards, vineyards, and outdoor nurseries,
2. Grazing: grazing of livestock,
3. Open Space/Parkland: protected open space with minimal human land use other than minor park facilities, roads, and trails,
4. Rural Residential: low intensity residential land use associated with small unincorporated communities with no commercial or industrial land use,
5. Urban: High density residential, commercial, and/or industrial land use,
6. Mixed: Multiple land uses, or watersheds that did not clearly represent one land use.

Streams that drained exclusively protected open space and parkland, with no agricultural or urban land use present, were classified as open space/parkland. If any amount of human land use was present in the upstream watershed, sites were classified according to the type of land use present. For example, a site draining primarily parkland and open space with several residences within the drainage basin was classified as rural residential. Only sites that exclusively drained one land use type, other than open space, were classified as grazing, agriculture, rural residential, or urban. Sites that drained multiple land uses or basins that contained other confounding factors (e.g. mines) were classified as mixed land use.

This analysis should not be interpreted as an examination of direct cause-effect relationships between land use and stream condition, because correlations between land use and natural environmental gradients may confound the analysis. For example, urban areas are often located in low gradient valleys and bay margins, which naturally support different benthic communities and water quality conditions than upland hills and mountains, where most open space land is now found.

4.6.1 Analysis of Bioassessment Data

Bioassessment and habitat assessment parameters were evaluated for potential degradation of wildlife habitat and invertebrate communities, in order to answer the question, "Is the water suitable for aquatic life?"

Data from the 2001 and 2002 sampling events were combined into one dataset by standardizing taxonomic levels and functional feeding groups to the 2003 version of the CAMLnet STE (CAMLnet, www.dfg.ca.gov/cabw/camlnetste.pdf). Bioassessment data from other sources were included in portions of the analysis for the purposes of examining (1) natural geographic and temporal variability and (2) trends within specific watersheds. All data were collected and analyzed according to the CSBP, and were standardized according to the 2003 CAMLnet STE.

Samples from Olema Creek (National Park Service) were collected using the CSBP point-source sampling method, which involves sampling along three transects in one riffle. Although the area sampled (18 sq. ft.) is the same as the non-point source sampling design, only one riffle is sampled, so the richness metrics calculated from this data are believed to underestimate reach-scale values and are not quantitatively comparable to data collected with the non-point source sampling design. For the purposes of making general basin-wide comparisons, the Olema Creek data has been analyzed with data from Lagunitas Creek.

Samples from the Napa River (Friends of the Napa River) were collected using the CSBP, but 500 organisms were subsampled from each riffle, meaning that the total number of organisms sampled was 1500 rather than 900. A randomized subsampling procedure was performed to reduce the number of organisms to make the data comparable to other data analyzed in this report. Additionally, Napa River samples were identified to a lower taxonomic level than is required for the CAMLnet STE, so taxonomic levels were standardized to the 2003 STE. Data collected in the Wildcat Creek and San Leandro Creek watersheds for a separate monitoring study by the Regional Board (Breaux *et al.* 2004) were also included in the watershed analyses.

In order to standardize the data to the 2003 CAMLnet STE, several significant changes were made to much of the raw taxonomic data: chironomid midges were classified at the family level (Chironomidae) rather than at the sub-family level, and oligochaetes were classified at class level (Oligochaeta). To compare data to the results described in this report, data must be standardized to this taxonomic level. For data analysis purposes, three riffle samples for each site were combined into a composite sample of approximately 900 organisms. Once standardized, 23 common metrics were recalculated based on the 900 count composite sample (Table 4-2).

Variability in metrics within a site group or between years was examined with the coefficient of variation (C.V.), calculated as:

C.V. = Standard Deviation / Mean.

A coefficient of variation less than 0.25 for inter-riffle variation has been suggested as a criterion for biological metrics (Harrington and Born 1999). Using the same criterion for inter-site and inter-annual variation provides a conservative indicator of low natural variability.

Several multivariate statistical analyses are presented in this report. Multivariate analyses were performed using PC-ORD for Windows (v. 4.20, MjM Software). Ordination is a technique whereby multiple variables are reduced and expressed in a small number of dimensions. Ordinations were performed on sites using log-transformed taxa abundance data. Sites that are close together in ordination space exhibit similar benthic assemblages; increasing distance between sites indicates that a greater number of different taxa were present at the sites. Non-metric multidimensional scaling (NMS) is the most generally effective ordination technique for ecological community data (McCune and Grace 2002). We used NMS with the Sorensen distance measure, 400 iterations, an instability criterion of 0.00001, 6 potential axes, 40 real runs and 50 randomized runs (NMS autopilot slow and thorough setting). The same ordination graph is used to plot both the regional analyses and the individual watershed analyses.

Cluster analysis defines groups of sites based on the similarity of taxa present. In contrast with the ordination approach, where log-transformed abundance data was used, presence/absence data was used for the cluster analysis in order to examine the results of a variety of analyses. The analysis is graphically represented as a cluster dendrogram, in which sites connected by shorter horizontal lines are more similar than sites connected by longer horizontal lines. Hierarchical cluster analyses were performed using the Sorenson (Bray-Curtis) distance measure and the flexible beta linkage method (b = -0.25). Clusters of site-groups were chosen in order to balance (1) group size (i.e. ideally 2-5 sites), (2) geographic similarity of groups (e.g. all mainstem river sites), and (3) moderate to high levels of information remaining (i.e. 50-75%).

4.6.2 Basic Water Quality

Discrete field measurements were taken to calculate concentrations of chemicals (*e.g.*, unionized ammonia), and used to determine the bioavailability of trace metals so that they could be compared to guidelines. However, discrete temperature and dissolved oxygen (DO) measurements are insufficient for evaluating potential impacts since they don't take into account diurnal fluctuations, nor can they be compared to the most appropriate guidelines for salmonids. Therefore, continuous monitoring results were used for comparison to water quality guidelines and objectives and conditions of concern were identified.

Basic water quality measurements were compared to water quality objectives from the San Francisco Bay Regional Water Quality Control Board's Basin Plan (Basin Plan) developed to protect aquatic life, agriculture, and drinking water (Table 4-20). Measurements specific to the support of salmonid populations were also evaluated using guidelines presented in Table 4-2: maximum temperature, Maximum Weekly Average Temperature (MWAT; U.S. EPA 1977), and minimum DO. Highest weekly average temperatures (HWATs) were calculated at sites with at least seven consecutive days of temperature measurement, by averaging the daily temperatures, calculating the seven-day average of these daily temperatures for each seven-day period, and selecting the highest seven-day average as the HWAT. The HWAT is the MWAT for the period sampled. The annual MWAT for most stations in Region 2 occurs between June and October, typically in August; however not all stations were monitored during this period and not all stations were monitored for seven or more days. Continuous field measurements consisted of numerous 24-hour periods and sometimes an additional period of less than 24 hours; where this additional period was less than 21 hours, it was not used in the calculation of HWATs.

4.6.3 Water, Sediment, and Clam Tissue Chemistry

Water Chemistry: Water chemistry was compared to water quality objectives from the San Francisco Bay Regional Water Quality Control Board's Basin Plan developed to protect recreation and aquatic life, as well as to other selected guidelines (Table 4-2).

Sediment Chemistry: The two primary guidelines (Table 4-3) used to evaluate sediment chemistry for potential aquatic life impacts were the threshold effects concentration (TEC), below which harmful biological effects are considered unlikely to be observed, and the probable effects concentration (PEC), above which harmful effects are considered likely to be observed (MacDonald *et al.* 2000). Sediment Quality Guideline Quotient (SQGQ) values were calculated to estimate the synergistic effect of a mixture of contaminants. SQGQ are calculated by dividing the measured sediment concentration of a chemical by its PEC value. The SQGQ values for a suite of chemicals are then averaged to give a mean value for each sediment sample. These SQGQ values can be compared to ranges evaluated by MacDonald et al. (2000), who found that 85 percent of sediment samples with mean PEC quotients greater than 0.5 were toxic to sediment-dwelling organisms. Similarly, 92 percent of sediment samples with mean PEC quotients greater than 1.0 were toxic to one or more species of aquatic organisms.

Clam Tissue Chemistry: Wet weight concentrations were compared to State Mussel Watch 85th percentile Elevated Data Levels (EDL 85) calculated for the period 1977 through 1997 (Rasmussen 2000). These EDLs are presented in Appendix I along with the clam tissue data evaluation. The EDL 85 is only an indication that a tissue chemical concentration is notably elevated above this value, and is not a measure or predictor of potentially adverse human or animal health effects.

4.6.4 Toxicity

Toxicity test data were evaluated by comparing mean organism response in samples and negative controls, using two methods. In the first method, a separate-variance t-test was conducted to determine whether statistically significant differences (with $\alpha = 0.05$) existed between samples and negative controls; a significant difference would indicate possible toxicity. In the second method, sample response was compared to 80 percent of the negative control response; anything less than 80 percent could indicate toxicity. This second method was chosen to emulate the use of protocol-specific 90th percentile minimum significant difference (MSD) values (Thursby *et al*. 1997). Once MSD-based criteria are generated for all SWAMP test organisms, they will replace the 80 percent criterion. Potentially toxic conditions were identified where both methods indicated a difference in toxicity between samples and controls.

4.6.5 Coliforms

For purposes of comparison with water quality guidelines, various statistics were calculated for the five sample results from each site. Depending on the coliform measure, these included the median, geometric mean (log mean), average, and 90th percentile. Non-detect values were replaced with the reporting limit for that sample in order to perform calculations. Where one sample was not collected due to lack of water, statistics were calculated using four values.

Coliform data were compared with water quality guidelines for protection of recreational use. These guidelines are presented in Table 4-2, as described in Section 4.2.2. It is important to note that coliform counts are extremely variable and can become elevated in the presence of sewage inputs, pets, cattle, wildlife, and even plant material. Because the presence of *E. coli* is directly related to fecal contamination and has been shown to correlate with incidences of human illness in recreational waters (U.S. EPA 1986), it is the most relevant of the three bacterial indicators measured here in terms of assessing the potential for human illness at the sites sampled.

Table 4-1. Analyte, laboratory, and method for water, sediment, and clam tissue chemistry

Analyte	Analytical Lab	Water Method	Sediment Method	Clam Tissue Method
Pesticides				
Aldrin	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Ametryn	DFG-WPCL	EPA 619M		
Aspon	DFG-WPCL	EPA 8141AM		
Atraton	DFG-WPCL	EPA 619M		
Atrazine	DFG-WPCL	EPA 619M		
Azinphos ethyl	DFG-WPCL	EPA 8141AM		
Azinphos methyl	DFG-WPCL	EPA 8141AM		
Bolstar	DFG-WPCL	EPA 8141AM		
Carbophenothion	DFG-WPCL	EPA 8141AM		
Chlordane, cis	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Chlordane, trans	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Chlordene, alpha	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Chlordene, gamma	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Chlorfenvinphos	DFG-WPCL	EPA 8141AM		
Chlorpyrifos	DFG-WPCL UCD-GC	EPA 8141AM ELISA SOP 3.3**	EPA 8081AM n/a	EPA 3545_3640A_3620B n/a
Chlorpyrifos methyl	DFG-WPCL	EPA 8141AM		
Ciodrin (Crotoxyphos)	DFG-WPCL	EPA 8141AM		
Coumaphos	DFG-WPCL	EPA 8141AM		
Dacthal	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DBCE	DFG-WPCL			EPA 3545_3640A_3620B
DBOB	DFG-WPCL			EPA 3545_3640A_3620B
DCBP (p,p')	DFG-WPCL		EPA 8081AM	EPA 3545_3640A_3620B
DDD (o,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDD (p,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDE (o,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDE (p,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDMU (p,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDT (o,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
DDT (p,p')	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Demeton-s	DFG-WPCL	EPA 8141AM		
Diazinon	DFG-WPCL UCD-GC	EPA 8141AM ELISA SOP 3.3**	EPA 8081AM n/a	EPA 3545_3640A_3620B n/a
Dichlofenthion	DFG-WPCL	EPA 8141AM		
Dichlorvos	DFG-WPCL	EPA 8141AM		
Dicrotophos	DFG-WPCL	EPA 8141AM		
Dieldrin	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Dimethoate	DFG-WPCL	EPA 8141AM		
Dioxathion	DFG-WPCL	EPA 8141AM		
Disulfoton	DFG-WPCL	EPA 8141AM		
Endosulfan I	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Endosulfan II	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Endosulfan sulfate	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Endrin	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Endrin Aldehyde	DFG-WPCL	EPA 8081AM		
Endrin Ketone	DFG-WPCL	EPA 8081AM		
Ethion	DFG-WPCL	EPA 8141AM		
Ethoprop	DFG-WPCL	EPA 8141AM		
Famphur	DFG-WPCL	EPA 8141AM		
Fenchlorphos	DFG-WPCL	EPA 8141AM		
Fenitrothion	DFG-WPCL	EPA 8141AM		
Fensulfothion	DFG-WPCL	EPA 8141AM		
Fenthion	DFG-WPCL	EPA 8141AM		
Fonofos (Dyfonate)	DFG-WPCL	EPA 8141AM		
HCH, alpha	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
HCH, beta	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
HCH, delta	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
HCH, gamma	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Heptachlor	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Heptachlor epoxide	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Hexachlorobenzene	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B

Analyte	Analytical Lab	Water Method	Sediment Method	Clam Tissue Method
Leptophos	DFG-WPCL	EPA 8141AM		
Malathion	DFG-WPCL	EPA 8141AM		
Merphos	DFG-WPCL	EPA 8141AM		
Methidathion	DFG-WPCL	EPA 8141AM		
Methoxychlor	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Mevinphos	DFG-WPCL	EPA 8141AM		
Mirex	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Molinate	DFG-WPCL	EPA 8141AM		
Naled (Dibrom)	DFG-WPCL	EPA 8141AM		
Nonachlor, cis	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Nonachlor, trans	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Oxadiazon	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Oxychlordane	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Parathion, Ethyl	DFG-WPCL	EPA 8141AM	EPA 8081AM	EPA 3545_3640A_3620B
Parathion, Methyl	DFG-WPCL	EPA 8141AM	EPA 8081AM	EPA 3545_3640A_3620B
Phorate	DFG-WPCL	EPA 8141AM		
Phosmet	DFG-WPCL	EPA 8141AM		
Phosphamidon	DFG-WPCL	EPA 8141AM		
Prometon	DFG-WPCL	EPA 619M		
Prometryn	DFG-WPCL	EPA 619M		
Propazine	DFG-WPCL	EPA 619M		
Secbumeton	DFG-WPCL	EPA 619M		
Simazine	DFG-WPCL	EPA 619M		
Simetryn	DFG-WPCL	EPA 619M		
Sulfotep	DFG-WPCL	EPA 8141AM		
Tedion	DFG-WPCL	EPA 8081AM	EPA 8081AM	EPA 3545_3640A_3620B
Terbufos	DFG-WPCL	EPA 8141AM		
Terbuthylazine	DFG-WPCL	EPA 619M		
Terbutryn	DFG-WPCL	EPA 619M		
Tetrachlorvinphos	DFG-WPCL	EPA 8141AM		
Thiobencarb	DFG-WPCL	EPA 8141AM		
Thionazin	DFG-WPCL	EPA 8141AM		
Tokuthion	DFG-WPCL	EPA 8141AM		
Toxaphene	DFG-WPCL		EPA 8081AM	EPA 3545_3640A_3620B
Trichlorfon	DFG-WPCL	EPA 8141AM		
Trichloronate	DFG-WPCL	EPA 8141AM		
PAHs				
Acenaphthene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Acenaphthylene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Anthracene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Benz(a)anthracene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Benzo(a)pyrene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Benzo(b)fluoranthene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Benzo(e)pyrene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Benzo(g,h,i)perylene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Benzo(k)fluoranthene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Biphenyl	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Chrysene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Chrysenes, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Chrysenes, C2-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Chrysenes, C3-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Dibenz(a,h)anthracene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Dibenzothiophene	DFG-WPCL	EPA 8270M	EPA 8270M	
Dibenzothiophenes, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Dibenzothiophenes, C2-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Dibenzothiophenes, C3-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Dimethylnaphthalene, 2,6-	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Fluoranthene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Fluoranthene/Pyrenes, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Fluorene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Fluorenes, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Fluorenes, C2-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Fluorenes, C3-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M

Analyte	Analytical Lab	Water Method	Sediment Method	Clam Tissue Method
Indeno(1,2,3-c,d)pyrene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Methylnaphthalene, 1-	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Methylnaphthalene, 2-	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Methylphenanthrene, 1-	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Naphthalene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Naphthalenes, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Naphthalenes, C2-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Naphthalenes, C3-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Naphthalenes, C4-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Perylene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
Phenanthrene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Phenanthrene/Anthracene, C1-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Phenanthrene/Anthracene, C2-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Phenanthrene/Anthracene, C3-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Phenanthrene/Anthracene, C4-	DFG-WPCL	EPA 8270M	EPA 8270M	EPA 8270M
Pyrene	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	EPA 8270M
Trimethylnaphthalene, 2,3,5-	DFG-WPCL	EPA 8310M, 8270M	EPA 8270M	
PCBs				
Aroclor 1248, 1254, 1260	DFG-WPCL		1988	EPA 3545_3640A_3620B
Various congeners	DFG-WPCL	EPA 8082M	EPA 8082M	EPA 3545_3640A_3620B
Metals				
Aluminum*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Arsenic (organic + inorganic)*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Cadmium*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Chromium*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Copper*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Lead*	MPSL-DFG	EPA 1638M	EPA 1638	EPA 200.7
Manganese*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Mercury (Total, organic + inorganic)	MPSL-DFG	EPA 1631B EPA 1631EM	DFG SOP 103**	EPA 3052
Nickel*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Selenium*	MPSL-DFG	EPA 1638M		EPA 200.7
Silver*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Zinc*	MPSL-DFG	EPA 1638M	EPA 200.8	EPA 200.7
Medium characteristics				
Grain Size, ASTM (Fines, Sand, Gravel)	AMS		ASTM D422	
Moisture, Percent	DFG-WPCL MPSL-DFG		EPA 8081AM, 8082M, 8270M DFG SOP 103**, EPA 200.8	DFG SOP
Lipid, Percent	DFG-WPCL			EPA 3545_3640A_3620B
Conventionals				
Alkalinity as CaCO3	DFG-WPCL	SM 2320B, QC 10303311A		
Ammonia as N	DFG-WPCL	EPA 350.3		
Boron	SFL Babcock	SM 4500BB EPA 200.7		
Chloride	DFG-WPCL	EPA 300.0		
Chlorophyll a	MPSL-DFG SFL	EPA 445.0 SM 10200H-2b		
Coliforms (Total, Fecal, *E. coli*)	SAL	SM 9221		
Hardness as CaCO3	DFG-WPCL	SM 2340C		
Nitrate as N	DFG-WPCL	EPA 300.0, EPA 353.3, QC 10107041B		
Nitrite as N	DFG-WPCL	FR 8507, QC 10107041B		
Nitrogen, Total Kjeldahl	DFG-WPCL	EPA 351.3, QC 10107062E		
Organic Carbon, Dissolved	AMS	EPA 415.1		
Organic Carbon, Total	AMS	EPA 415.1	EPA 9060	

Analyte	Analytical Lab	Water Method	Sediment Method	Clam Tissue Method
Orthophosphate as P	DFG-WPCL	EPA 300.0, EPA 365.3, QC 10115011M		
Pheophytin a	SFL	SM 10200H-2a		
Phosphorus as P, Total	DFG-WPCL	EPA 365.3, QC 10115011D		
Sediment Concentration, Suspended	AMS MPSL-DFG	ASTM D3977 SM 2540 B		
Solids, Total Dissolved	DFG-WPCL	SM 2540		
Solids, Total Suspended	DFG-WPCL	EPA 160.2		
Sulfate	DFG-WPCL	EPA 300.0		

*These metals were measured as total and dissolved in water, and total elsewhere.
**These methods for chlorpyrifos and diazinon are described in the QAMP (Puckett 2002)
Babcock: E.S. Babcock & Sons, Inc.
DFG-WPCL: Department of Fish and Game Water Pollution Control Laboratory
MPSL-DFG: Marine Pollution Studies Laboratory, Department of Fish and Game
SFL: Sierra Foothill Laboratory
AMS: Applied Marine Sciences
UCD-GC: University of California at Davis, Granite Canyon Laboratory
SAL: Sequoia Analytical Laboratories, Inc.

Tables 4-2 and 4-3 list the thresholds used to evaluate data in this report. If there were no objectives for an analyte in the Basin Plan, we used limits from the California Toxics Rule (CTR). If there were no thresholds in either of these documents, we used the most appropriate threshold from California Department of Fish and Game, TMDLs, U.S. EPA criteria, or peer reviewed literature. Results from grab samples are appropriate to compare to acute water quality objectives; chronic water quality objectives are used as a screening tool, although they are not applicable to grab samples.

Table 4-2. Water quality thresholds for aquatic life

Analyte	Description of Standard	Numeric Limit	Units	Reference
Field measures				
Temperature	Maximum, salmonid	24	° C	USEPA, 1977
	MWAT, steelhead	17	° C	Sullivan *et al.*, 2000
	MWAT, coho	14.8	° C	Sullivan *et al.*, 2000
Oxygen, dissolved	Minimum, warmwater	5	mg/L	Basin Plan, 2005
	Minimum, coldwater	7	mg/L	Basin Plan, 2005
	3-month median	80	%	Basin Plan, 2005
pH	Range	6.5 to 8.5	S.U.	Basin Plan, 2005
Nutrients				
Ammonia, unionized	Annual median	0.025	mg/L	Basin Plan, 2005
Nitrate as N	Maximum	0.16	mg/L	USEPA, 2000
Phosphorus, total as P	Maximum	30	µg/L	USEPA, 2000
Metals	*Cadmium, copper, nickel, silver, and zinc values assume a hardness of 100 mg/L CaCO3. Samples at other hardness levels must be calculated using formulas in the Basin Plan.*			
Arsenic, dissolved	1-hour average WQO	340	µg/L	Basin Plan, 2005
	4-day average WQO	150		
Cadmium, total	1-hour average WQO	3.9	µg/L	Basin Plan, 2005
	4-day average WQO	1.1		
Chromium VI, dissolved	1-hour average WQO	16	µg/L	Basin Plan, 2005
	4-day average WQO	11		
Copper, dissolved	1-hour average WQO	13	µg/L	Basin Plan, 2005
	4-day average WQO	9		
Lead, dissolved	1-hour average WQO	65	µg/L	Basin Plan, 2005
	4-day average WQO	2.5		
Mercury, total	1-hour average WQO	2.4	µg/L	Basin Plan, 2005
	4-day average WQO	0.025		
Nickel, dissolved	1-hour average WQO	470	µg/L	Basin Plan, 2005
	4-day average WQO	52		
Selenium, total	1-hour average WQO	20	µg/L	Basin Plan, 2005
	4-day average WQO	5		
Silver, dissolved	1-hour average WQO	3.4	µg/L	Basin Plan, 2005
Zinc, dissolved	1-hour average WQO	120	µg/L	Basin Plan, 2005
	4-day average WQO	120		
Organics				
PCBs	Continuous 4-day average	0.014	µg/L	CTR
Chlorpyrifos	Continuous 4-day average	0.015	µg/L	CVRWQCB, 2006
Dacthal (DCPA)	Instantaneous maximum AWQC	14300	µg/L	USEPA, 1987
Diazinon	1-hour average	0.1	µg/L	SFBRWQCB, 2005
Disulfoton (Disyston)	Instantaneous maximum AWQC	0.05	µg/L	USEPA, 1973
Endosulfan	Continuous 4-day average	0.056	µg/L	CTR
	Instantaneous maximum	0.22		CTR
HCH, gamma- (gamma-BHC, Lindane)	Maximum 1-hour average	0.95	µg/L	CTR
Parathion, methyl	Instantaneous maximum AWQC	0.08	µg/L	CDFG
Thiobencarb	Instantaneous maximum AWQC	3.1	µg/L	CDFG
Coliforms				
E. coli	steady state	126	MPN /100 mL	Basin Plan, 2005
	designated beach	235		
Fecal coliform	log mean	200	MPN /100 mL	Basin Plan, 2005
	90th percentile	400		
Total coliform	median	240	MPN /100 mL	Basin Plan, 2005
	maximum	10000		
Toxicity	Water and sediment samples were considered toxic when results were: 1) significantly different than control values and 2) less than 80% of control values.			

Table 4-3. Sediment quality guidelines (SQGs) for aquatic life

SQG type:	*PEC*		*TEC*	
Analyte	*mg/kg*	*µg/kg*	*mg/kg*	*µg/kg*
Metals				
Arsenic	33		9.79	
Cadmium	4.98		0.99	
Chromium	111		43.4	
Copper	149		31.6	
Lead	128		35.8	
Mercury	1.06		0.18	
Nickel	48.6		22.7	
Zinc	459		121	
Organics				
Anthracene		845		57.2
Fluorene		536		77.4
Naphthalene		561		176
Phenanthrene		1170		204
Benz(a)anthracene		1050		108
Benzo(a)pyrene		1450		150
Chrysene		1290		166
Dibenz(a,h)anthracene				33
Fluoranthene		2230		423
Pyrene		1520		195
PAH (total)		22800		1610
PCB (total)		676		59.8
Chlordane		17.6		3.24
Dieldrin		61.8		1.9
DDD (sum op + pp)		28		4.88
DDE (sum op + pp)		31.3		3.16
DDT (sum op + pp)		62.9		4.16
DDT (total)		572		5.28
Endrin		207		2.22
Heptachlor epoxide		16		2.47
HCH, gamma		4.99		2.37

Source: MacDonald DD, Ingersoll CG, Berger TA. 2000. "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems." *Archives of Environmental Contamination and Toxicology*. 39:20-31.

Notes: All guidelines are on a dry-weight basis. PEC = probable effect concentration; TEC = threshold effect concentration.

Table 4-4. Biological metrics

Metric	Definition
Richness Metrics	
Coleoptera Taxa	Number of taxa in the Coleoptera insect order
Diptera Taxa	Number of taxa in the Diptera insect order
Ephemeroptera Taxa	Number of taxa in the Ephemeroptera insect order
Plecoptera Taxa	Number of taxa in the Plecoptera insect order
Trichoptera Taxa	Number of taxa in the Trichoptera insect order
Non-Insect Taxa	Number of non-insect taxa
Taxa Richness	Total number of taxa (aka cumulative taxa richness)
EPT Taxa	Number of taxa in the Ephemeroptera, Plecoptera, and Trichoptera insect orders
Composition Metrics	
% EPT	Percentage of total individuals belonging to the Ephemeroptera, Plecoptera, and Trichoptera insect orders
% Sensitive EPT	Percentage of total individuals belonging to the Ephemeroptera, Plecoptera, and Trichoptera insect orders with tolerance values less than or equal to 3
% Chironomidae	Percentage of total individuals belonging to the Chironomidae family (Diptera)
% Coleoptera	Percentage of total individuals belonging to the Coleoptera insect order
% Oligochaeta	Percentage of total individuals belonging to the Oligochaeta sub-class
% Non-insect	Percentage of total individuals that are not insects
Tolerance Metrics	
% Intolerant	Percentage of total individuals that have tolerance values greater or equal than 7
% Tolerant	Percentage of total individuals that have tolerance values less than or equal to 3
Tolerance Value	Average tolerance value for all individuals
Functional Feeding Group (FFG) Metrics	
% Predator	Percentage of all individuals belonging to the predator FFG
% Collector-filterer	Percentage of all individuals belonging to the collector-filterer FFG
%Collector-gatherer	Percentage of all individuals belonging to the collector-gatherer FFG
% Scraper	Percentage of all individuals belonging to the scraper FFG
% Shredder	Percentage of all individuals belonging to the shredder FFG
% Other	Percentage of all individuals belonging to other FFGs

Biological metrics were calculated from composited (900 count) raw taxonomic data.

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5 Quality Assurance & Quality Control

The data generated by SWAMP is used to determine the status of beneficial uses throughout the state. Monitoring data are used to assess trends, make regulatory and management decisions, and to support enforcement of policies. Thorough objectives for achieving quality data are outlined in the Quality Assurance Management Plan (Puckett 2002). In general, data quality is demonstrated through analysis of:

- Laboratory method blanks
- Surrogate spikes
- Matrix spikes and matrix spike duplicates
- Certified reference materials/laboratory control samples
- Laboratory replicates
- Field blind duplicates

5.1 Laboratory Method Blanks

Laboratory method blanks were used to assess laboratory contamination introduced during sample preparation and analysis. The method blanks were processed in a manner identical to the associated field samples. According to the QAMP for both organic and inorganic analyses, at least one laboratory method blank should be analyzed per 20 samples or one per batch, whichever is more frequent. However, there were some batches where blanks were not performed at the required frequency or were not performed at all. These batches are listed in Appendix C-1 and will be classified as estimated.

Water and sediment laboratory method blanks are considered acceptable if they remain below the method detection limit (MDL) of each target analyte. All laboratory method blanks were acceptable with the exception of those specified within Appendix C-2. One hundred eighteen laboratory blanks had concentrations that were above the MDL but were less than the reporting limit (RL). Twenty blanks had detectable levels of analyte where the concentrations were above the RL.

5.2 Surrogate Spikes

Surrogate spikes are used to assess analyte losses during sample extraction and clean-up procedures, and must be added to every field and quality control sample prior to extraction. Whenever possible, isotopically-labeled analogs of the analytes should be used.

All surrogate percent recoveries were within the acceptance criteria with the exception of five polycyclic aromatic hydrocarbon batches. The affected data sets are summarized in Appendix C-3.

5.3 Matrix Spikes and Matrix Spike Duplicates

A laboratory-fortified sample matrix (matrix spike, or MS) and a laboratory-fortified sample matrix duplicate (matrix spike duplicate or MSD) are both used to evaluate the effect of the sample matrix on the recovery of the target analyte(s). Individually, these samples are used to assess the bias from an environmental sample matrix plus normal method performance. In addition, these duplicate samples can be used collectively to assess analytical precision.

Aliquots of randomly selected field samples were spiked with known amounts of target analytes. The percent R of each spike was calculated as follows:

%R = (MS Result – Sample Result)/ (Expected Concentration – Sample Result) * 100

This process was repeated for a subset of field samples to create MSDs. According to the QAMP for both organic and inorganic analyses, at least one MS/MSD pair should be performed per 20 samples or one per batch, whichever is more frequent. However, some batches did not include MS/MSDs performed at the required frequency. These batches are listed in Appendix C-4.

The MS/MSD relative percent differences (RPDs) were calculated as follows:

RPD = (|(Concentration1-Concentration2)|/ (AVERAGE(Concentration1+Concentration2)))*100
where
Concentration1 = matrix spike concentration
Concentration2 = matrix spike duplicate concentration

Data batches with MS/MSD percent R and RPD concentrations outside of acceptance criteria are summarize in Appendix C-5. All other MS/MSD percent Rs and RPDs were acceptable.

5.4 Certified Reference Materials and Laboratory Controls

Certified reference materials (CRMs), laboratory control samples (LCSs), and laboratory control materials (LCMs) were analyzed to assess the accuracy of a given analytical method. As required by the QAMP, one CRM, LCS, or LCM should be analyzed per 20 samples or one per batch, whichever is more frequent. However, there were some batches where CRMs, LCSs, or LCMs were not performed at this required frequency. These batches are listed in Appendix C-6.

Unacceptable CRM, LCS, and LCM recoveries are presented in Appendix C-7. All other recoveries were acceptable.

5.5 Field Blind Duplicates

Field blind duplicates were analyzed to assess field homogeneity and field sampling procedures. Field blind duplicates were sampled at sites 204ALP010, 205PER010, 206PET310 and 206WIL020. Field duplicate concentrations were compared to field sample concentrations from each site and relative percent difference (RPD) was calculated as follows:

RPD = (|(Concentration1-Concentration2)|/ (AVERAGE(Concentration1+Concentration2)))*100
where
Concentration1 = field sample concentration
Concentration2 = duplicate sample concentration

If either Concentration 1 or Concentration 2 was less than three times the MDL, the RPD was not calculated, because the concentrations were too low to produce a statistically valid result. RPDs less than 25 percent were considered acceptable as specified in the QAMP. RPDs greater than 25 percent are presented in the Appendix C-8. All other RPDs were acceptable.

5.6 Laboratory Replicates

Laboratory replicates were analyzed to assess laboratory precision. A replicate of at least one field sample per batch was processed and analyzed. However, the batches listed in Appendix C-9 did not include replicates.

The replicates were compared and an RPD was calculated as described in above in subsection 5.5. If either the sample result (Concentration1) or the replicate result (Concentration2) are less than three times the MDL, the RPD is not calculated as these concentrations would be too low to calculate a meaningful difference between them. RPDs less than 25 percent were considered acceptable as specified in the QAMP. RPDs greater than 25 percent are presented in Appendix C-10.

5.7 Toxicity Tests

There were minor deviations in water quality parameters or test conditions (conductivity, dissolved oxygen, temperature, light) in some replicates, and incoming sample temperature or holding times were exceeded in some cases. However, the data should be considered acceptable for their intended purpose.

5.8 QA/QC Summary

All data meeting specified control limits are considered usable without further evaluation. If data fail any portion of these criteria, they can be cross-checked against other quality control samples. If two of the following criteria are met, then the data are acceptable: laboratory replicate RPD, MS/MSD recovery and RPD, or CRM/LCS/LCM recovery. Therefore, if the laboratory replicate RPD is greater than 25 percent but the MS/MSD and the CRM for that analyte are acceptable, or if a MS/MSD is unacceptable but the laboratory replicate RPD and CRM for that analyte are acceptable, then the data are acceptable and can be used.

Data that meet all SWAMP method quality objectives (MQOs) as specified in the QAMP are classified as “SWAMP-compliant.” Data that fail to meet all program MQOs specified in the SWAMP QAMP, have analytes not covered in the SWAMP QAMP, or are insufficiently documented such that supplementary information is required for them to be used in reports are classified as “Estimated.” “Historical” data batches are generally missing the necessary quality control (QC) samples. During the data quality assessment phase of reporting, end users may find estimated and/or historical data batches meet project data quality objectives.

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6 Regional Trends in Water Quality

While each of the nine major watersheds has unique characteristics, some regional trends exist in terms of seasonality, relationships between water quality and land use, and in exceedances of water and sediment quality guidelines. These are discussed in detail in the sections that follow and are summarized briefly below.

When assessing streams in terms of aquatic habitat, the data indicate that elevated temperatures and depressed DO concentrations were the stressors with the greatest potential to negatively impact salmonids and other aquatic life (Section 6.2). These two parameters, in turn, appeared to be influenced by the overall condition of the riparian corridors through which the streams flow. Physical habitat features such as channel modification, width of the riparian zone, and canopy cover were related with significant trends in temperature and DO (*e.g.*, Figure 6-6 and Figure 6-7). These relationships may be of added importance because streams in areas with good riparian condition tended to have acceptable values for temperature and DO, while streams with poorer or more highly modified physical characteristics tended to have temperature and DO values that exceeded thresholds for salmonids and Basin Plan Objectives.

Chemical contaminant concentrations measured in grab samples tended to be relatively low, and observed water and sediment toxicity tended to be moderate. There were some exceptions, such as 100 percent amphipod mortality in sediments collected near the mouth of San Leandro Creek, and a number of chemicals did exceed guideline values for aquatic life protection in water or sediment. There were some significant seasonal trends in water chemistry, with concentrations of many trace metals and organics being highest in the dry season. Many of the highest chemical measurements were taken from samples collected at sites draining urban areas.

All measured nitrate concentrations were below the numeric Basin Plan Objective for drinking water and agricultural water supply of 10 mg-N/L. Currently there is no numeric nitrate Basin Plan Objective for aquatic life, but most measured nitrate values exceeded the U.S. EPA reference guideline of 0.155 mg/L, which was developed to protect against eutrophication. All reported total phosphorus and most orthophosphate concentrations were above the U.S. EPA guideline of 0.030 mg/L (Section 6.3.1.1). However, the reporting limit for total P was 0.040 mg/L—higher than the guideline concentration. Region-wide nitrate concentrations did not vary significantly with season, but total phosphorus and orthophosphate were significantly higher in the dry season. Nutrient concentrations were highest in samples collected at sites draining urban areas. Average nitrate concentrations at sites draining urban areas were more than twice those for sites draining agricultural areas, and nearly ten times those from streams in open space areas. No water samples collected during these watershed surveys measured concentrations of unionized ammonia above the Basin Plan objective of 0.025 mg/L.

Biological assessments of invertebrate communities showed a clear relationship with land use (Figure 6-4), and also appeared to be affected by channel modification (Section 6.1.1.2). In the absence of major human disturbance, invertebrate communities were most greatly affected by the intermittency of stream flow.

6.1 Macroinvertebrate Assemblages and Physical Habitat

Three major benthic assemblages were identified based on classification and ordination analyses of log transformed taxa abundances at sites. The first three groups of sites identified by the cluster analysis (Figure 6-1) are also identified on the ordination graph (Figure 6-2). Ordination graphs in this report are used to show biological difference or similarity among sampling sites. Non-metric multidimensional scaling (NMS) is a type of ordination—or multivariate analysis—that reduces the complexity of a data set in order to reveal the most important general trends or patterns. Ordination techniques are useful because, like metrics, they reduce the complexity in a list of taxa for numerous sites into data that can be easily visualized. Unlike metrics, ordination techniques summarize all of the taxa and sites into one easy-to-visualize graph.

An ordination graph consists of one, two, or three axes on which individual sites are plotted. The axes represent the most important gradients in the data set, representing the most variation in taxa presence between the sites. The proximity of sites to one another on the ordination graph is usually interpreted as an indication of their similarity. For example, sites close to one another would indicate that they tended to share similar taxa. Sites that are furthest away from one another on the graph indicate that they share very few or no taxa.

Although more than three groups can be identified in the dendrogram (Figure 6-1), this level of grouping provides a good tradeoff between retention of basic information (10 percent of total) and delineation of broad categories. As discussed below, the three groups generally represent broad land use classes that are likely to be an important control on benthic assemblages.

Assemblage Group 1 was numerically dominated by the pollution tolerant taxa Chironomidae (Diptera), Oligochaeta (aquatic worms), *Baetis* sp. (Ephemeroptera: Baetidae), and *Simulium* sp. (Diptera: Simuliidae) (Table 6-1). Together these taxa accounted for 89 percent of organisms found at sites in Assemblage Group 1. Only one other taxa, *Hyalella* (Amphipoda: Hyalellidae), accounted for more than 2 percent of all organisms. The total taxonomic richness of Assemblage Group 1 was 115 taxa. Several taxa were present in this assemblage that were not present in the other two assemblages, including *Corbicula* sp. (Veneroida: Corbiculidae) and *Psychoda* sp. (Diptera: Psychodidae).

Assemblage Group 2 was dominated by many of the same taxa as Assemblage Group 1 (Table 6-1), but taxonomic diversity was somewhat greater (129 taxa) even though the number of sites in this group was much less than Assemblage Group 1 (23 vs. 38). Assemblage Group 2 represents assemblages of intermediate composition between Assemblages Groups 1 and 3. The four dominant species in Assemblage Group 1 made up only 65 percent of individuals in Assemblage Group 2. Oligochaetes were much less abundant in Assemblage Group 2, making up less than 3 percent of total individuals. Seven taxa each accounted for more than 2 percent of the total individuals, including *Malenka* sp. (Plecoptera: Nemouridae), *Diphetor hageni* (Ephemeroptera: Baetidae), and *Cinygmula* sp. (Ephemeroptera: Heptageniidae).

Table 6-1. Dominant taxa in assemblage groups

These ten most abundant taxa (as measured by percent composition) in each of the three broad assemblage groups are identified in the multivariate cluster dendrogram.

	Assemblage Group 1 (n = 38)		Assemblage Group 2 (n = 23)		Assemblage Group 3 (n = 57)	
Abun-dance Rank	Taxa	% Comp.	Taxa	% Comp.	Taxa	% Comp.
1	Chironomidae	50.7	Chironomidae	35.8	Chironomidae	18
2	Oligochaeta	16.1	*Baetis* sp.	13.9	*Baetis* sp.	9.4
3	*Baetis* sp.	13.5	*Simulium* sp.	12.1	*Optioservus* sp.	5.2
4	*Simulium* sp.	8.7	*Malenka* sp.	3.8	*Ephemerella* sp.	5.2
5	*Hyalella*	2	Oligochaeta	2.8	*Malenka* sp.	5.2
6	Turbellaria	1.4	*Diphetor hageni*	2.6	*Simulium* sp.	5.1
7	*Paraleptophlebia* sp.	1.1	*Cinygmula* sp.	2.5	*Cinygmula* sp.	5
8	*Physa/ Physella*	0.6	*Paraleptophlebia* sp.	1.8	*Diphetor hageni*	3.3
9	*Sperchontidae*	0.4	*Lepidostoma* sp.	1.6	*Epeorus* sp.	2.6
10	*Isoperla* sp.	0.4	*Ephemerella* sp.	1.5	*Rhyacophila* sp.	2.5

Assemblage Group 3 was the most diverse benthic assemblage, with 199 taxa. This group also contained the most sites (57). Sites in this group are closely clustered in ordination space, suggesting that the sites are more similar taxonomically than those within the other two assemblages. The four dominant taxa from Assemblage Group 1 accounted for only 33 percent of individuals in Assemblage Group 3. Oligochaetes made up less than 1 percent of total individuals in this assemblage. Eleven taxa each accounted for more than 2 percent of the total individuals, including eight taxa from the EPT insect orders. Many taxa were found exclusively in this assemblage group, such as *Micrasema* sp. (Trichoptera: Brachycentridae), *Maruina lanceolata* (Diptera: Psychodidae), *Narpus* sp. (Coleoptera: Elmidae), and *Neothremma* sp. (Trichoptera: Uenoidae).

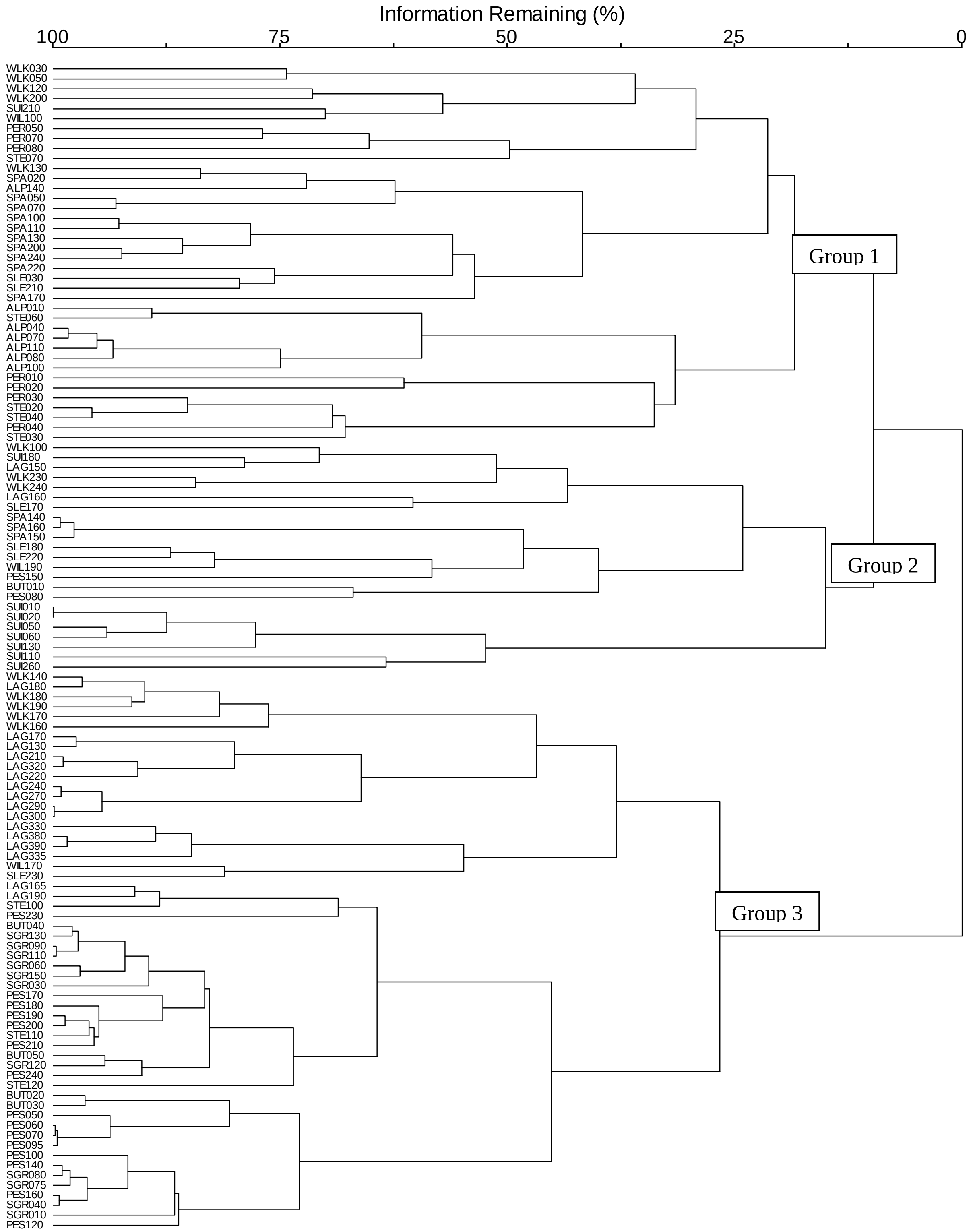

Figure 6-1. Cluster dendrogram of bioassessment sites

Bioassessment sites were classified into three broad assemblage groups based on taxa presence.

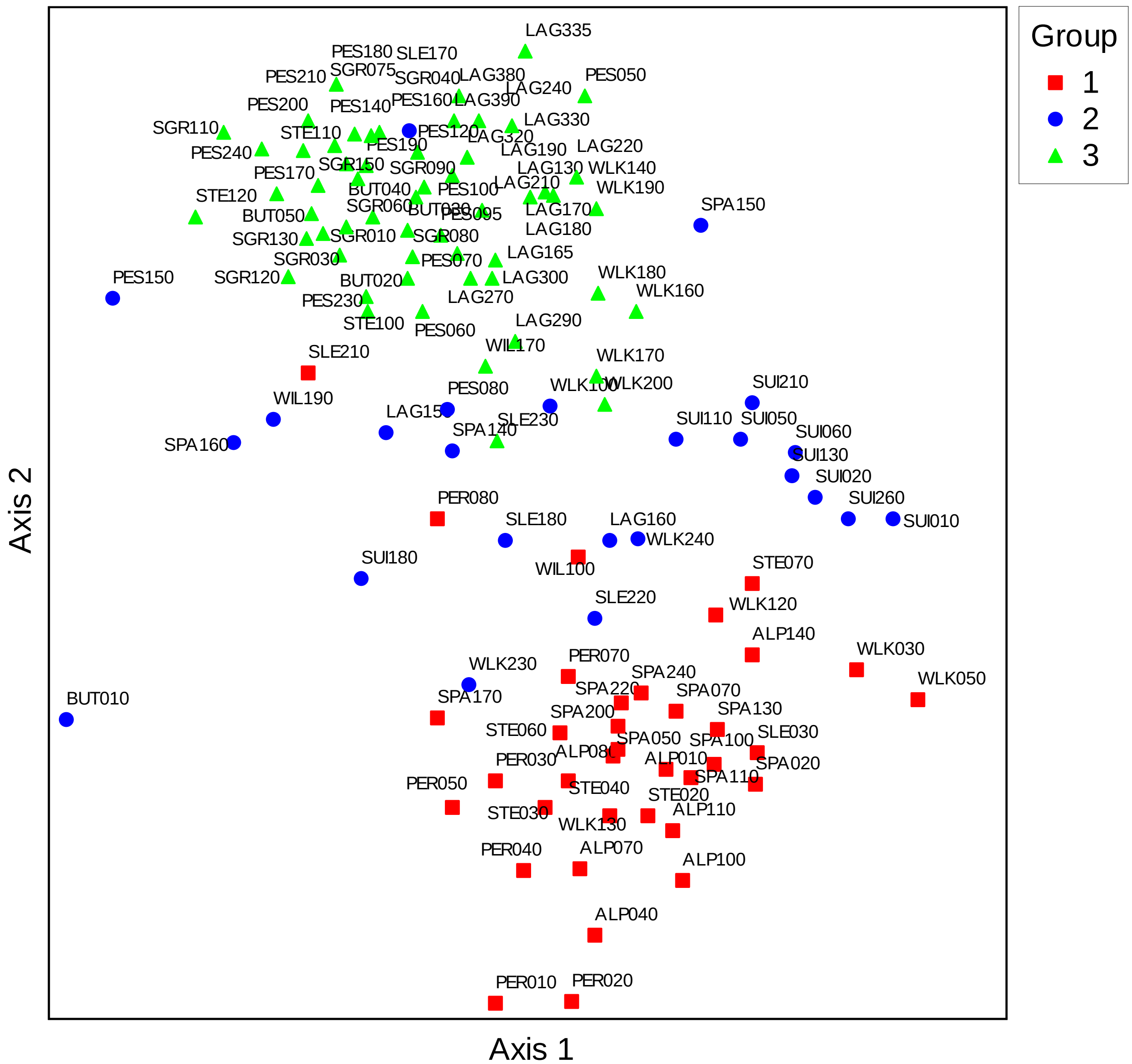

Figure 6-2. NMS ordination of bioassessment sites, labeled by assemblage group

The NMS (non-metric multidimensional scaling) ordination of sites by log-transformed taxa abundances produced a two dimensional solution. Axis 1 and Axis 2 explained 27 percent and 56 percent of original variability, respectively. Sites are coded by assemblage group membership, as determined from the cluster analysis (Figure 6-1).

6.1.1 Watershed Land Use

The assemblage groups described above generally reflect upstream land use. Sites in Assemblage Group 1 are dominated by urban land use, sites in Assemblage Group 2 primarily drain agricultural or grazing land, and Assemblage Group 3 sites include many open space and rural residential sites. This analysis suggests that watershed land use, and associated water quality and habitat conditions, may be an important factor affecting benthic assemblages in Bay Area streams.

6.1.1.1 Land Use Classes

The NMS ordination of log-transformed taxa abundance by site, grouped by land use class, shows clearly distinct clusters of sites within the same land use class (Figure 6-3). Most of the open space sites (red squares) are tightly clustered near the top of the figure. Variability within this class of sites reflects annual variability (as sites were sampled in different years) and geographic variability (due to factors such as flow intermittency, climate, and topography). The tight clustering of the open space sites suggests that, despite the large range in environmental conditions present at these sites, benthic assemblages are very similar relative to assemblages found in other land use classes. The two open space sites that are near the center of the figure, away from the other open space sites, are streams that dry up during the summer.

With the exception of several outliers, rural residential sites (yellow circles) cluster closely to open space sites, indicating that the benthic invertebrate assemblages are fairly similar. The cluster of rural residential sites is centered somewhat lower in the figure than the open space sites, however, suggesting that, on average, the rural residential sites may have slightly altered assemblages compared to the open space sites.

Grazing and agriculture sites are scattered throughout the ordination plot. Some of these sites are located near the open space and rural residential sites in the ordination, while others are more similar to the urban sites. The grazing and agriculture sites generally represent an intermediate level of disturbance between the open space and urban sites. Benthic assemblages at urban sites are consistently different from assemblages found at sites in all other land use classes, and are clustered together at the bottom of the figure.

Many biological metrics exhibited statistically significant differences (One-way ANOVA, paired comparisons using Student's t, alpha = 0.05) in the number of EPT taxa between sites draining open space/parkland and every other land use type except rural residential (Figure 6-4). The agriculture, grazing, and mixed land use classes were not significantly different from one another, but the urban land use class was significantly different from all other land use classes.

While the mean number of EPT taxa at all other land use classes ranged from 14 to 22, on average only 2 EPT taxa were found at urban sites. Other biological metrics showed similar patterns with land use. Mean values of selected metrics for each land use class are shown in

Table 6-2. The metrics taxa richness, EPT richness, percent sensitive EPT, percent Coleoptera, and percent intolerant were generally highest in the open space and rural residential land use types and lowest in the urban land use type. Conversely, the percent non-insect, percent Chironomidae, percent Oligochaeta, and tolerance value metrics were highest in the urban land use type and lowest in the open space land use type. The mean values of the non-insect taxa metric ranged between 5 and 7 and showed little variation between land use types.

Table 6-2. Biological metrics in different land use classes

The mean values of selected biological metric at sites from various land use classes are compared.

	Agriculture	Grazing	Mixed	Open Space	Rural Res.	Urban
Number of Sites (n)	9	10	38	13	22	25
Richness Metrics						
Taxa Richness	27	28	32	46	40	13
EPT Taxa	14	14	15	22	20	2
Non-Insect Taxa	6	5	7	5	5	6
Composition Metrics						
% Sensitive EPT	14	28	24	35	36	0
% Non-insect	7	9	9	4	5	26
% Chironomidae	37	30	28	14	20	56
% Coleoptera	4	3	7	14	8	0
% Oligochaeta	3	3	2	0	2	21
Tolerance Metrics						
Tolerance Value	5	4.6	4.5	3.6	3.8	5.7
% Intolerant	10	19	21	32	32	0
Functional Feeding Groups						
% Collector-gatherer	64	53	60	37	53	89
% Collector-filterer	17	12	10	5	8	8
% Scraper	10	9	15	28	18	1
% Shredder	4	14	7	13	7	0
% Predator	4	12	8	15	12	1

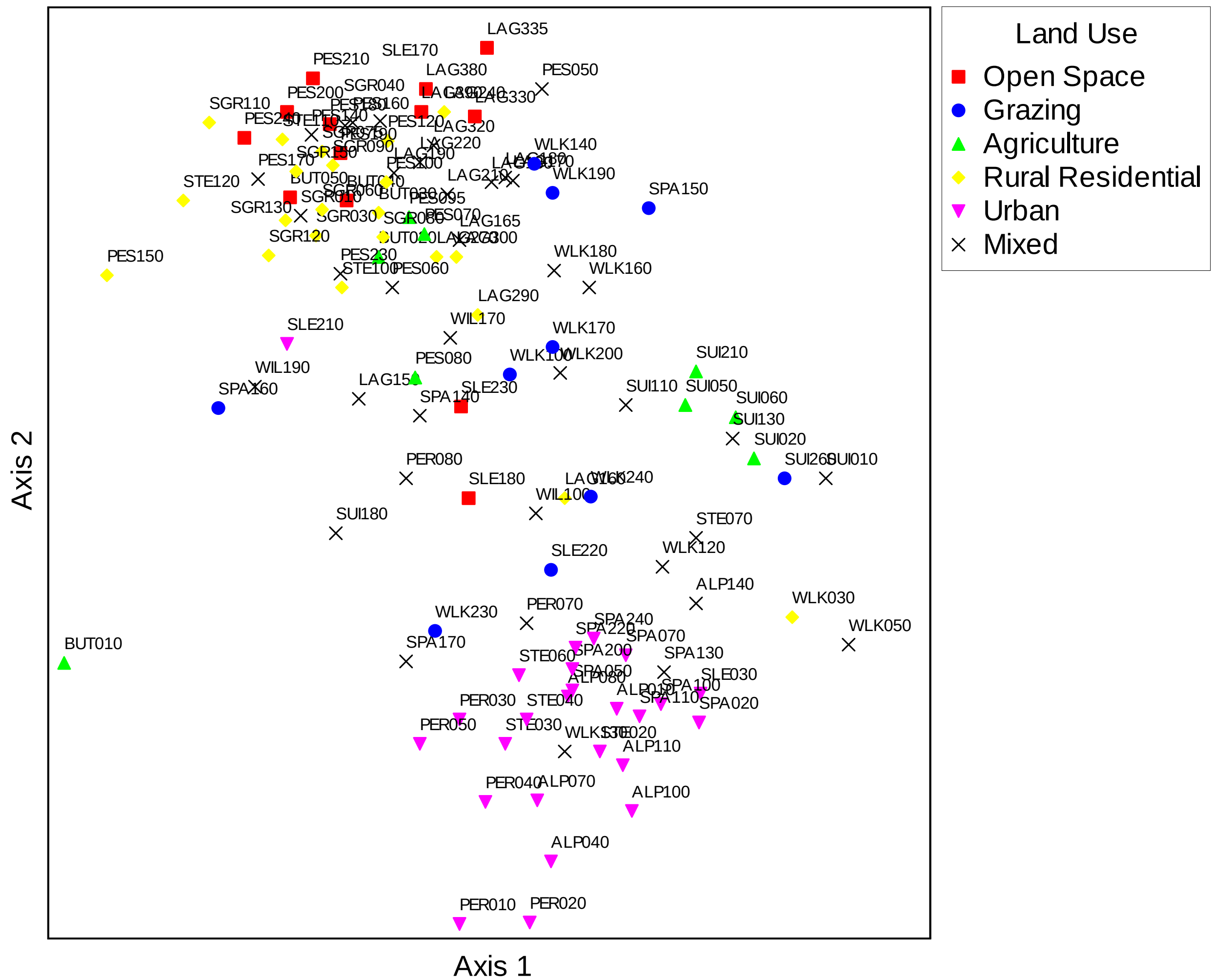

Figure 6-3. NMS ordination of bioassessment sites labeled by land use class

This NMS (non-metric multidimensional scaling) ordination is the same as in Figure 6-2, except sites are labeled by land use class.

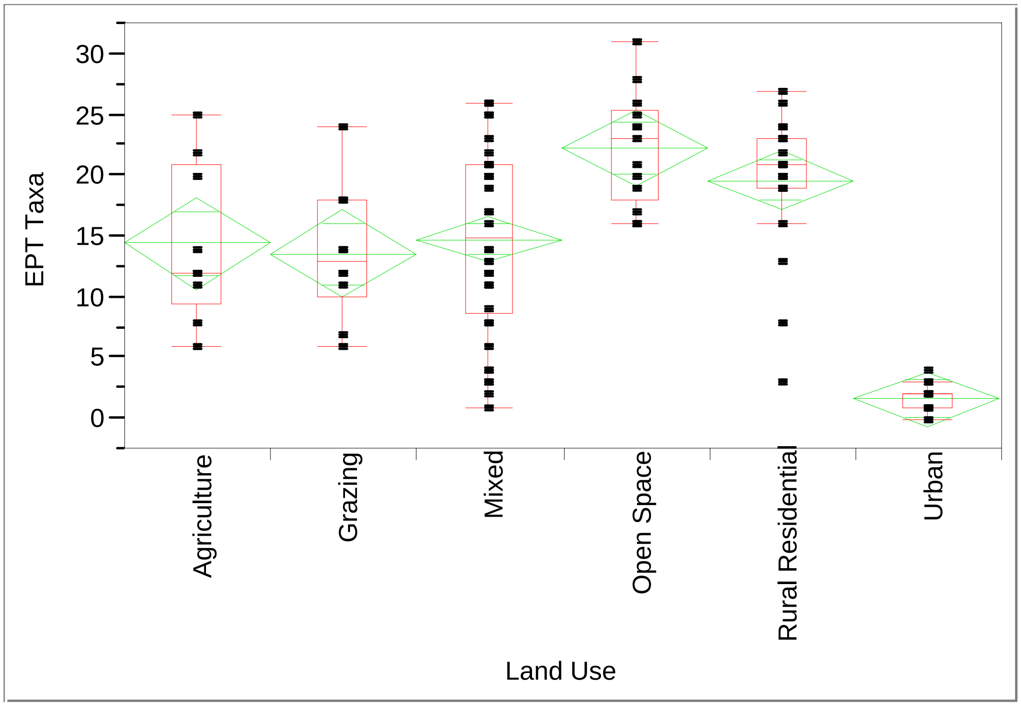

Figure 6-4. Boxplot of EPT taxa richness by land-use class

The box indicates the 75th percentile, 50th percentile (median), and 25th percentile, while the lines above and below the box indicate the 10th and 90th percentiles of the data. The diamond indicates the 95 percent confidence interval about the mean.

6.1.1.2 Channel and Riparian Conditions

To examine the relationships between local physical habitat conditions and benthic assemblages, correlations between P-HAB scores and taxa presence were examined using multivariate analyses. P-HAB scores are qualitative observations of reach-scale physical habitat quality and alteration. P-HAB scores were correlated with an NMS ordination of taxa presence at 87 sites that possessed complete P-HAB and benthic assemblage data (Figure 6-5).

Axis 1 of the ordination differentiates between the minimally disturbed sites (clustered on the right-hand side of the graph) and significantly disturbed sites in urban areas (on the left hand side of the graph). The bi-plot (the two red lines on Figure 6-5) shows the magnitude and direction of the correlation between two of the physical habitat variables and the ordination of sites. By convention, the origin of the lines of the bi-plot is the origin (mean score) of the ordination of sites. The bi-plot shows that the PHAB variables epifaunal substrate and channel alteration are positively correlated with Axis 1, and highest at the minimally disturbed sites (on the right hand side of the graph), meaning these sites tend to have the best epifaunal substrate and the least channel alteration. Stream channels in urban areas are often highly altered, while channels at minimally disturbed sites are rarely modified.

Many PHAB variables, such as epifaunal substrate, channel alteration, bank vegetation, and riparian zone width were correlated ($r^2 > 0.35$) with Axis 1 of the ordination, while channel flow status and bank stability were least correlated with the ordination of taxa presence(Table 6-3). Other than ‘channel flow status’, PHAB variables were not strongly correlated with Axis 2, suggesting that this axis of the ordination does not represent physical and biological integrity as well as Axis 1.

In a study of streams with a range of human impacts in the Santa Clara Valley, Kearns *et al.* (2001) found that riffle frequency and riparian zone width were most highly correlated with biological condition, while bank vegetation and channel alteration showed weak correlation. In contrast, channel alteration was the most highly correlated PHAB variable with biological conditions in this SWAMP study (Table 6-3). Although channel alteration is highly correlated with biological integrity, identifying causal factors is difficult, as other factors (such as water quality) may have equal or more significant impacts on benthic assemblages.

Table 6-3. Correlation of P-HAB scores with macroinvertebrate ordination axes

	Axis 1	Axis 2
Channel Alteration	0.456	0.002
Riparian Zone Width	0.366	0.053
Epifaunal Substrate	0.49	0.041
Embeddedness	0.278	0.015
Velocity/ Depth Regimes	0.172	0.032
Sediment Deposition	0.261	0.017
Channel Flow Status	0.047	0.299
Riffle Frequency	0.343	0.004
Bank Stability	0.048	0.05
Bank Vegetation	0.372	0.037

The values listed represent the correlation (r^2) of P-HAB variables with axes from an NMS ordination (Figure 6-5) of taxa presence at 87 sites where P-HAB scores were available.

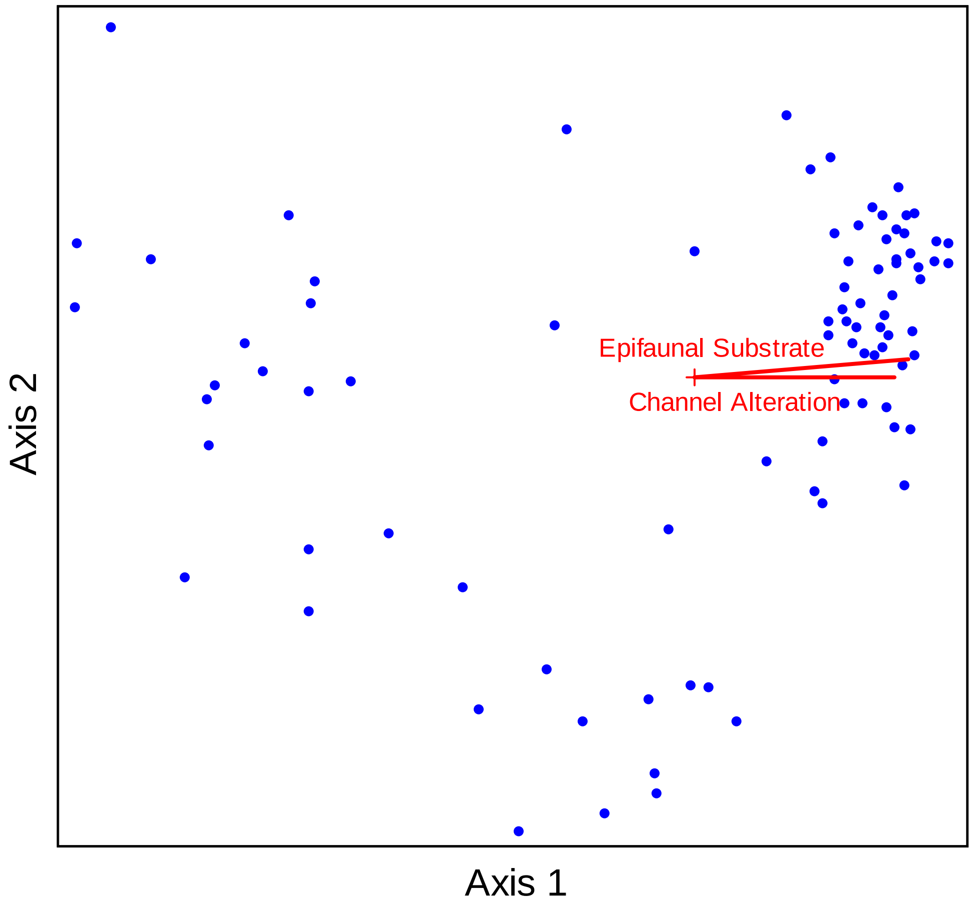

Figure 6-5. NMS ordination of bioassessment sites, with bi-plot of P-HAB variables

The NMS (non-metric multidimensional scaling) ordination of 87 sites by taxa presence produced a two dimensional solution. Axis 1 and 2 explained 74 percent and 13 percent of the variation in the original data, respectively. The sites clustered on the right-hand side of the graph are the minimally disturbed sites. The bi-plot (red lines) shows the magnitude and direction of the correlation between physical habitat variables and the ordination of sites. By convention, the origin of the lines of the bi-plot is the origin (mean score) of the ordination of sites. The bi-plot shows that the PHAB variables epifaunal substrate and channel alteration are highest at the minimally disturbed sites, meaning these sites tend to have the best epifaunal substrate and the least channel alteration. For clarity, the bi-plot only shows the P-HAB variables with correlation coefficients greater than 0.400. Other P-HAB variables were also highly correlated with axis 1 (see Table 6-3).

6.1.1.3 Water Operations/Impoundments

Sampling sites in several watersheds monitored by SWAMP were located immediately upstream and downstream of dams and reservoirs. In the Stevens Creek watershed, Stevens Creek Reservoir is located in the upper part of the watershed, draining mostly parkland. The reservoir serves as storage for groundwater recharge, in addition to providing recreational fishing and boating opportunities. Site STE100 was located above the reservoir in Stevens Creek County Park, while site STE070 was located directly downstream of the reservoir, also in Stevens Creek County Park. At the upstream site, 44 taxa were found; below the dam, taxa richness was only

17. Other common biological metrics followed this trend, with much lower values at the downstream site than the upstream site (Table 6-4). It is problematic to attribute downstream changes in biological condition directly to the effects of the reservoir, however, because a gravel quarry is located immediately adjacent to the reservoir. The dramatic decline in taxa of the order Ephemeroptera, generally believed to be intolerant of metals pollution, from 10 above the reservoir to 1 below the reservoir provides circumstantial evidence that runoff from the quarry may also have a significant effect on downstream biological conditions.

Four dams are located in the upper watershed of Lagunitas Creek, forming a sequence of four large reservoirs: Lake Lagunitas, Bon Tempe Lake, Alpine Lake, and Kent Lake. All four reservoirs, and their surrounding watershed lands, serve as water supply for southern Marin County. Four sites were located on undammed small tributaries to the reservoirs: LAG330, LAG335, LAG380, and LAG390. One site, LAG320, was located on Lagunitas Creek below the downstream dam, Shafter Dam. Although all 5 sites drain protected watershed lands, the upstream and downstream sites may not be directly comparable because of differences in stream size. Mean values of metrics from the upstream sites were very similar to values from the downstream sites (Table 6-4).

Other studies in the Bay Area have found that dams can have significant impacts on downstream biotic assemblages. Choy (2004) found that streams in the Santa Clara Valley below dams had higher levels of fine sediment and fewer EPT organisms than unregulated streams. Weissich (2005) observed that benthic invertebrate assemblages were much more variable over time in the same regulated streams in the Santa Clara Valley than in unregulated streams. Watersheds monitored by SWAMP contained dams, but upstream-downstream comparisons were less valid due to other confounding factors. A range of biological conditions are observed downstream of dams, suggesting that dam type and management play an important role in determining downstream biological effects.

Table 6-4. Biological metrics upstream and downstream of dams

Mean values of selected biological metrics are compared above and below dams.

	Stevens Creek		Lagunitas Creek	
Richness Metrics	**Up**	**Down**	**Up**	**Down**
Taxa Richness	44	17	42	41
EPT Taxa	20	4	19	20
Composition Metrics				
% EPT	53	33	50	60
% Sensitive EPT	44	4	28	38
% Chironomidae	30	53	20	23
% Coleoptera	2	0	11	9
Tolerance Metrics				
% Intolerant	40	4	26	41
% Tolerant	1	4	1	3
Tolerance Value	4	6	4	4
Functional Feeding Groups				
% Predator	9	6	18	5

% Collector-filterer	3	3	2	4
% Collector-gatherer	73	84	38	47
% Scraper	7	0	22	27
% Shredder	8	4	20	16

6.2 Field Measurements of Basic Water Quality

Multi-parameter probes on YSI 6600 sondes measured pH, specific conductance, temperature, and dissolved oxygen (DO) every 15 minutes at sites in each watershed during deployments. These data allow characterization of the temporal variability in water quality conditions that affect aquatic life, including salmonid species. The data from continuous monitoring of basic water quality field measurements are presented in Appendix D.

6.2.1 Regional Trends

Region-wide, highest weekly average temperatures (HWATs) exceeded 17°C, a threshold for steelhead, at 25 of 114 station-season combinations. Most exceedances occurred in summer. Of the 13 coastal sites with HWATs, 12 exceeded the 14.8°C limit for coho salmon. Fifty percent of the 54 sites monitored had DO concentrations below 7 mg/L, the Basin Plan objective for coldwater habitat. The San Gregorio Creek watershed had the lowest rate of DO violations with 17 percent, while Arroyo Las Positas had the highest rate, with 75 percent of sites measuring below the Basin Plan thresholds. The great majority of high temperature and low DO values occurred during the summer deployments.

There were statistically significant relationships between physical habitat parameters and the in-stream measures of temperature and DO. Four key parameters were analyzed for their relationships to DO and temperature, and correlations with all four were statistically significant ($p < 0.05$). These four physical habitat parameters were indices of channel alteration, average bank vegetation, average riparian zone width, and average canopy cover. The four physical habitat parameters tended to co-vary: channel alteration correlated significantly with bank vegetation and riparian zone width ($p < 0.001$), and bank vegetation also correlated significantly with riparian zone width and canopy cover ($p < 0.001$ and 0.05, respectively). The relationships of temperature and DO with channel alteration and canopy cover are shown below (Figure 6-6 and Figure 6-7), though similar trends occurred with average bank vegetation and average riparian zone width. The relationships appear important because the temperature and DO curves cross threshold lines. Sites with high indices for channel alteration (low alteration) and canopy cover tend to have acceptable temperature and DO values, while sites with more altered channels and less canopy cover tend to exceed salmonid temperature thresholds or violate Basin Plan DO objectives.

Values for continuously measured parameters were compared based on the land uses that characterized the areas draining to the measurement sites. The five sites draining open space land use were not sampled during the dry season, and of the three grazing sites, two have DO data for the dry season. Data are presented for the dry season monitoring, when the most guideline exceedances were measured. Rural residential areas produced the lowest dry season water temperatures, as indicated by 'highest weekly average temperature' values (HWAT), while agricultural and urban drainages had the highest water temperatures (Figure 6-8). Mixed land-use areas produced intermediate and more variable HWAT values. A similar pattern emerged from the dissolved oxygen data. Streams draining rural residential areas had higher minimum dissolved oxygen concentrations, while DO was lower in agricultural and urban drainages and intermediate in the mixed land use areas (Figure 6-9). Data from one site draining grazing land had a high minimum dry season DO concentration. The site, WLK140, is in a canyon which is well-shaded and has a wide riparian zone. The other grazing site with summer DO measurements, LAG085 (Five Brooks), just barely fell below the 7 mg/L minimum.

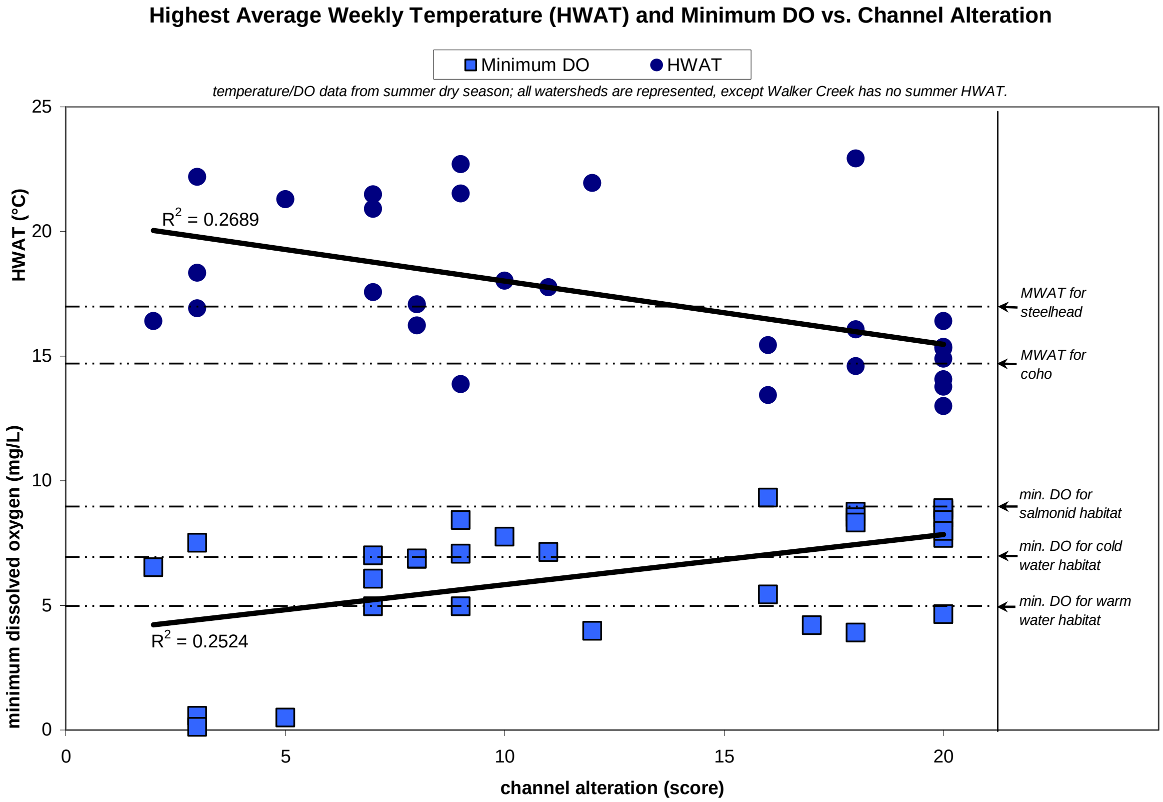

Figure 6-6. HWAT and minimum DO versus channel alteration

High channel alteration scores indicate channels that are least disturbed. Dashed lines indicate salmonid temperature and dissolved oxygen (9mg/L) thresholds and Basin Plan objectives for dissolved oxygen (7mg/L for cold water habitat, and 5mg/L for warm water habitat). Because sites on Walker Creek streams were monitored for less than seven days during the critical summer period, the HWAT for Walker is not represented; however the minimum DO from one Walker Creek site is included

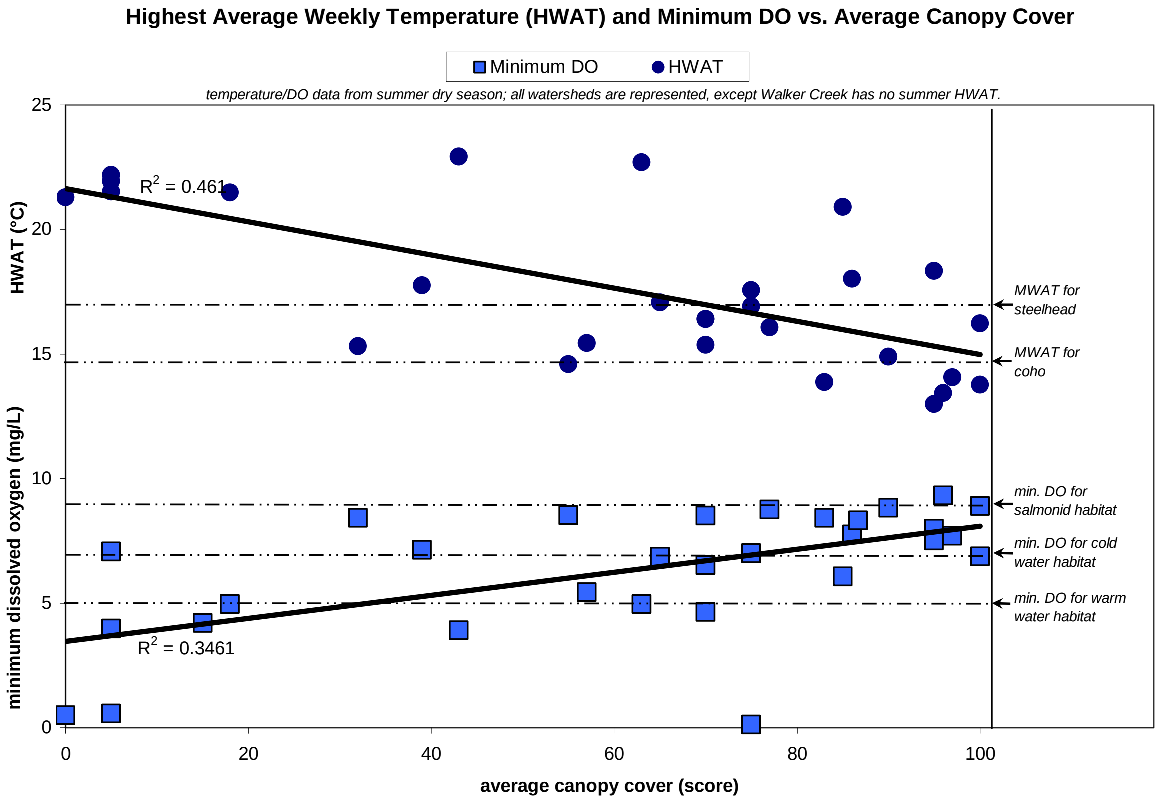

Figure 6-7. HWAT and minimum DO versus canopy cover

This graph represents relationships between average canopy-cover scores and continuously measured temperature and dissolved oxygen values. High average canopy cover scores indicate greater canopy cover. Dashed lines indicate salmonid temperature and dissolved oxygen (9mg/L) thresholds and Basin Plan objectives for dissolved oxygen (7mg/L for cold water habitat, and 5mg/L for warm water habitat).

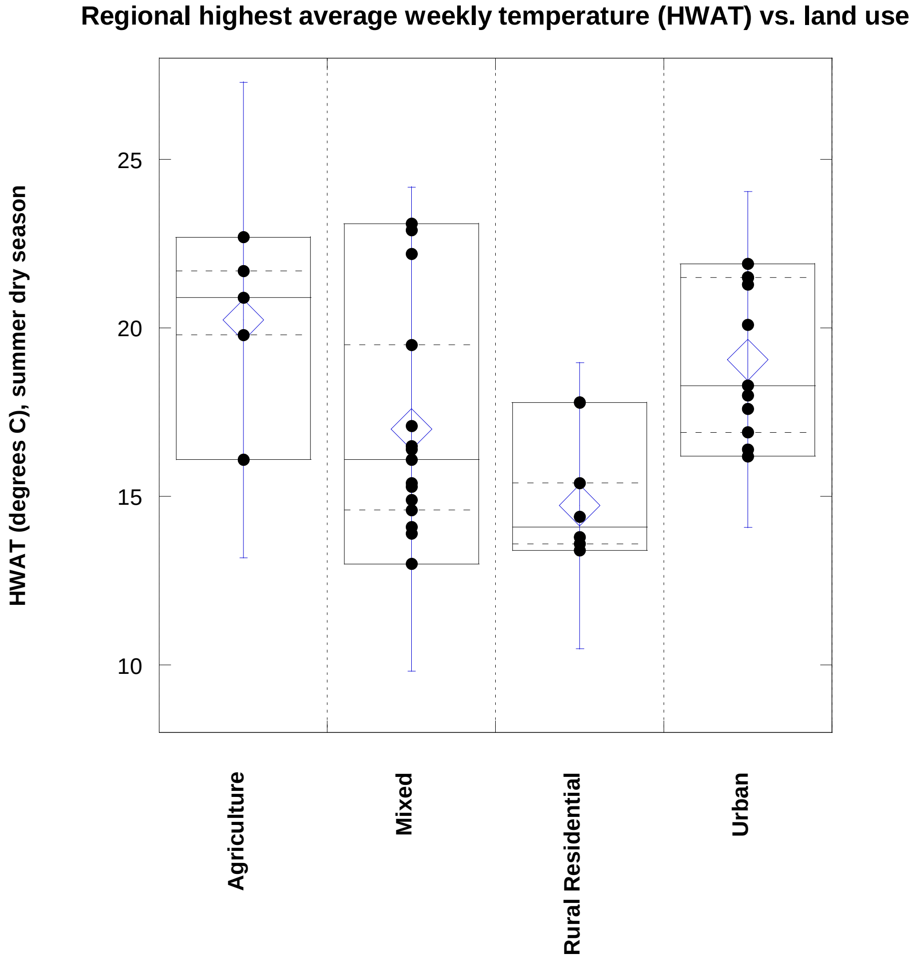

Figure 6-8. Regional HWAT versus land use

Highest average weekly temperature (HWAT) values are grouped by land-use category assigned to areas draining to the stream sampling site. Black dots represent all data points. Black boxes represent percentiles: 95, 75, 50, 25, 5. Center of the blue diamond represents the mean, with error bars representing the 95 percent confidence interval about the mean (two-tailed, a=0.05).

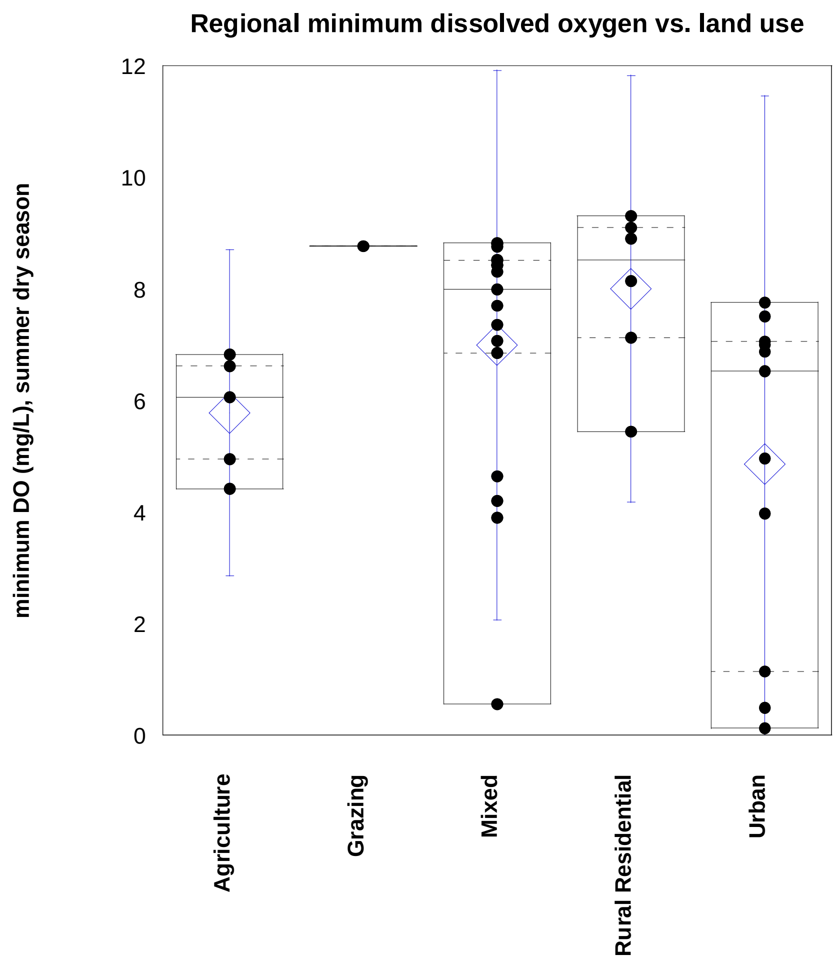

Figure 6-9. Regional minimum DO versus land use

Continuously monitored dissolved oxygen values are grouped by land-use category assigned to areas draining to the stream sampling site. Black dots represent all data points. Black boxes represent percentiles: 95, 75, 50, 25, and 5. Center of the blue diamond represents the mean, with error bars representing the 95 percent confidence interval about the mean (two-tailed, a=0.05).

6.2.2 Temporal Patterns

For parameters with high daily or seasonal variability such as temperature and DO, periodic, continuous monitoring captures ranges and extremes that would be missed by discrete samples. The field parameters' cyclical temporal variability is driven by solar radiation, resulting in characteristic daily and seasonal patterns. Stochastic events, both natural and anthropogenic, are often discernible against these background patterns. A generalized trend from upstream to downstream and from minimally impaired to degraded conditions is reflected by increasing temperature, pH, and specific conductance, and by decreasing DO. Human impacts to streams may alter the natural patterns, typically by increasing temporal variation and decreasing spatial variation (Poole, Dunham *et al.*

2001). The patterns of the temperature and DO cycles characterize the water quality of a site and indicate whether photosynthesis or temperature dominates the DO cycle. The timing of the DO minima and maxima differ between productive and non-productive sites.

The variability of water quality field parameters is summarized in boxplots that describe the distribution of data points for each sampling period, with extremes marked by the whiskers, a central tendency represented by the interquartile range or middle 50 percent of the distribution (from the 25^{th} to the 75^{th} percentile), and a median. In section 7, the results are represented by watershed using boxplots for each parameter, excluding sampling events with rejected data. In sections 6.2.2.5, 6.2.2.6 and 6.2.2.7, a few time series graphs illustrate interpretations of the temporal patterns. The temperature and DO curves compare minimally-impaired conditions to more degraded conditions with characteristic temporal patterns which indicate whether photosynthesis or temperature dominates the DO cycle.

6.2.2.1 Temperature

Of the core field parameters measured—temperature, DO, pH, and specific conductance—temperature is fundamental, affecting each of the other parameters. It has the widest range of influences and effects, a complexity of spatial and temporal variability, the most consistent daily cycle, and is easiest to measure. Daily temperature fluctuations may be higher in smaller tributaries because of lower flow volume, or stable if the stream is fed primarily by groundwater. Stream reaches without substantial groundwater supply and with minimal riparian canopy, whether naturally or from altered land use, will experience greater daily temperature fluctuations as well as elevated temperatures. As with each parameter, the many possible confounding influences call for individual sites to be evaluated according to their specific conditions. Seasonal stream temperature variations are essentially a dampened curve of the mean monthly air temperature (Stevens *et al.* 1975).

The Basin Plan water quality objective states that any alteration of water temperature must be demonstrated neither to adversely affect beneficial uses, nor to increase natural stream temperature by more than 2.8 C°. The requirements for salmonids, which constitute the most limiting beneficial use for most streams, are complex: thresholds are specific to species, life history stages, stream reaches, and varying seasonal time periods. In lieu of the current narrative water quality objectives, this report uses three screening threshold levels to evaluate time series temperature data throughout the region: a salmonid survival limit as a daily maximum of 24°C, a steelhead Maximum Weekly Average Temperature (MWAT) of 17°C, and a coho salmon MWAT of 14.8°C (see Appendix C). These thresholds are used only as comparative tools, not as substitute water quality objectives.

6.2.2.2 Dissolved Oxygen

Dissolved oxygen (DO), which is critical for aquatic life, is variable and dependent on temperature and photosynthesis, as well as respiration, nitrification, chemical oxidation, salinity, and atmospheric pressure. As with temperature, the DO requirements for salmonids and other aquatic life are complex and variable, both spatially and temporally.

The Basin Plan lists numeric water quality objectives for DO minima of 5 mg/L for warmwater habitats and 7 mg/L for coldwater habitats, with a 30-day average minimum of 80 percent saturation. The 9 mg/L threshold noted in the tables and maps of this report is an indication of good spawning habitat for salmonids, not a water quality objective.

Sites with high productivity tend to have low DO minima, whereas sites with moderate or low productivity tend to have higher DO minima and more stable overall water quality. Daily ranges of DO greater than 2 mg/L often indicate high productivity (excessive photosynthesis) with potential for nighttime hypoxia with associated fish kills. Four out of five sites in Arroyo Las Positas had DO levels below the minimum for warmwater habitat and maximum DO percent saturation levels above 120 percent, even up to 395 percent (ALP150 in the spring). Such supersaturation, together with high pH values, indicates high productivity associated with eutrophication.

Inspection of the DO curves yields additional understanding of ambient conditions at a specific site. The timing of the daily DO maxima tends to be distinctly earlier (before noon, just as the temperature rises) at temperature-dominated sites compared to photosynthesis-dominated ones, where the DO maxima tends to be at noon and up to a few hours later.

6.2.2.3 pH

The pH level provides an indirect measure of water quality by reflecting the status of chemical equilibrium reactions. Instream photosynthesis and respiration are the major drivers of the pH cycle through their effect on the concentration of carbon dioxide and the consequent equilibrium of the carbonate cycle (carbon dioxide ↔ carbonic acid ↔ bicarbonate ion ↔ carbonate ion). The buffering capacity of the carbonate system is the major regulator of the pH level. Typically, the pH cycle closely follows the DO cycle. The Basin Plan water quality objective for pH ranges between 6.5 and 8.5. None of the continuously monitored sites had pH below 6.5, but values above 8.5 occurred at 15 of 56 sites. Two sites had pH above 9 (WLK160 with 9.07, and ALP150 with 9.25). Most of the pH values above 8.5 occurred in the winter or spring seasons.

The Basin Plan Objective for pH states that “controllable water quality factors shall not cause changes greater than 0.5 units in normal ambient pH levels.” Normal ambient pH levels have not been established for Bay Area watersheds. Nevertheless, changes in pH greater than one unit and values above 8.5 suggest excessive photosynthesis and possible nutrient enrichment, especially when DO percent saturation is above 120 percent. All five sites in Arroyo Las Positas exceeded pH 8.5; four of them had DO saturation above 120 percent, and the fifth (ALP010) reached 119 percent.

6.2.2.4 Specific Conductance

Specific conductance provides an indirect measure of total dissolved solids (TDS) as an indicator of pollution or salinity levels. Electrical conductivity is a measure of how much electricity is conducted through one centimeter of water at a specified temperature. Because electrical conductivity changes with temperature, comparisons across seasons and streams would be confounding. The use of specific conductance avoids this confusion by compensating all conductivity to 25°C. The YSI meters used in this study measure electrical conductivity and from that calculate specific conductance using associated temperature and a temperature coefficient of 0.0191 (YSI 1999). Freshwater specific conductance is measured in microSiemens per centimeter (µS/cm).

The specific conductance of a site tends to be characteristic and not to vary much daily; however, winter and spring rains will lower the values and increase the range compared to summertime, and values tend to increase with lower summer flow. The Basin Plan has no water quality objectives for specific conductance to protect aquatic life, but typically values above 850 µS/cm are considered evidence of impact from land-use activity (Ketcham 2002). Sudden changes in specific conductance suggest a discharge, precipitation and runoff, or tidal influence (Figure 6-14). First flush after the dry season will typically show a spike in specific conductance, as accumulated residues are washed into streams before the diluting effect of freshwater lowers the levels.

6.2.2.5 Comparison of temporal patterns at two downstream sites

BUT010 (Bean Hollow) and PES060 (Community Church) are sites in comparable lower portions of adjacent watersheds (see map of Butano and Pescadero creeks, Figure 3-7). Only two and a half days of monitoring in early June, 2003, are compared in Figure 6-10. The monitoring probes were not post-calibrated for PES060, so the values were not used for official assessment in this report; nevertheless, the patterns are instructive. BUT010 has an impoverished invertebrate population and thus strikingly low bioassessment metrics compared to PES060. The pattern of temperature and DO timing, however, suggests that the water quality at BUT010 is better than PES060, perhaps because of full shade from riparian willows. Sedimentation with sand and fine sediment is likely the limiting factor affecting aquatic habitat for benthic macroinvertebrates and periphyton.

For the short time compared, the maximum temperature at BUT010 is equal to the minimum temperature at PES060 (16.32°C), and the average daily temperature range at PES060 (6.2 C°) is nearly 2 C° more than at BUT010 (4.3 C°). Although the sites are less than a mile from each other, PES060 has a two-hour delay in the average temperature minimum and about a one-and-a-half hour delay in the average temperature maximum in comparison to BUT010. The difference in riparian vegetative cover is most likely the predominant contributor to these differences.

The average daily DO range at PES060 (2.63 mg/L), more than six times the range at BUT010 (0.42 mg/L), suggests excessive photosynthesis. The average timing of DO maxima at PES060 is mid-afternoon (14:45), a typical pattern for a DO cycle dominated by photosynthesis, whereas the average time for maximum DO at BUT010 is before noon (11:15), a pattern more typical for a DO cycle dominated by temperature.

Inspection of the temperature and DO curves in Figure 6-10 provides the most straightforward clue to the difference between the sites: PES060 has a nearly flattened

DO curve at the bottom, rising very slowly in response to decreasing temperatures until after dawn when solar radiation powers photosynthesis and a steep rise in DO. In comparison, the DO curve for BUT010 rises as soon as it hits minimum sometime in the early evening (an average of 19:45 in this case), responding to decreasing temperatures. These patterns are characteristic of a site where photosynthesis dominates the DO pattern (PES060) and a site where temperature dominates the DO pattern (BUT010). Nutrient enrichment and lack of riparian cover are two prominent factors supporting the pattern of high productivity.

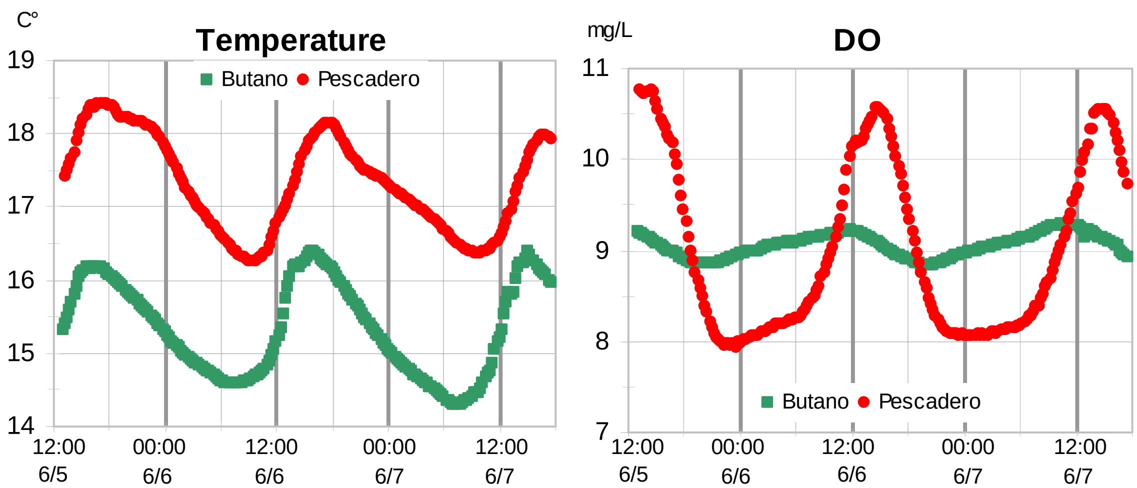

Figure 6-10. BUT010 and PES060 temperature and DO patterns

These are comparable downstream sites for Pescadero and Butano creeks (see map, Figure 3-7), monitored in June, 2003. The difference in DO patterns indicates photosynthesis-dominated timing at PES060 compared to the more shaded habitat at BUT010, where the effect of temperature on DO is evident**.**

6.2.2.6 Comparison of temporal patterns between upstream and downstream sites

A similar comparison of the temperature and DO patterns during the critical summer period illustrates a characteristic difference between an upstream, higher gradient, well-shaded site at LAG190 (Devils Gulch, a tributary with known coho salmon spawning habitat) and a downstream, lower gradient, less-shaded site at LAG050 (Bear Valley Road Bridge on Olema Creek, the most downstream station monitored for continuous field parameters in the Lagunitas Creek watershed).

For the 11.5-day period sampled in August, 2002, 82 percent of the DO maxima at downstream LAG050 occurred from 14:45 to 15:45, just before the temperature maxima, a timing characteristic of photosynthesis-dominated DO cycles. Upstream at LAG190, however, 64 percent of the maxima occurred from 08:30 to 09:45, just following the temperature minima, a timing characteristic of temperature-dominated DO cycles. At LAG050, 75 percent of the DO minima occurred from 21:45 to 23:30; upstream at LAG190, 92 percent of the DO minima occurred from 19:00 to 20:45. There is a consistent timing pattern of DO maxima before noon and minima in the early evening at minimally impaired, well-shaded sites. Photosynthesis-driven sites tend have DO maxima in mid-afternoon and minima later at night or early in the morning.

Graphically, the photosynthesis-dominated pattern more common at downstream sites is apparent as a DO curve that closely follows the temperature curve, but peaks slightly earlier and lingers at the bottom, rising slowly until dawn, when the increase is suddenly rapid (Figure 6-11).

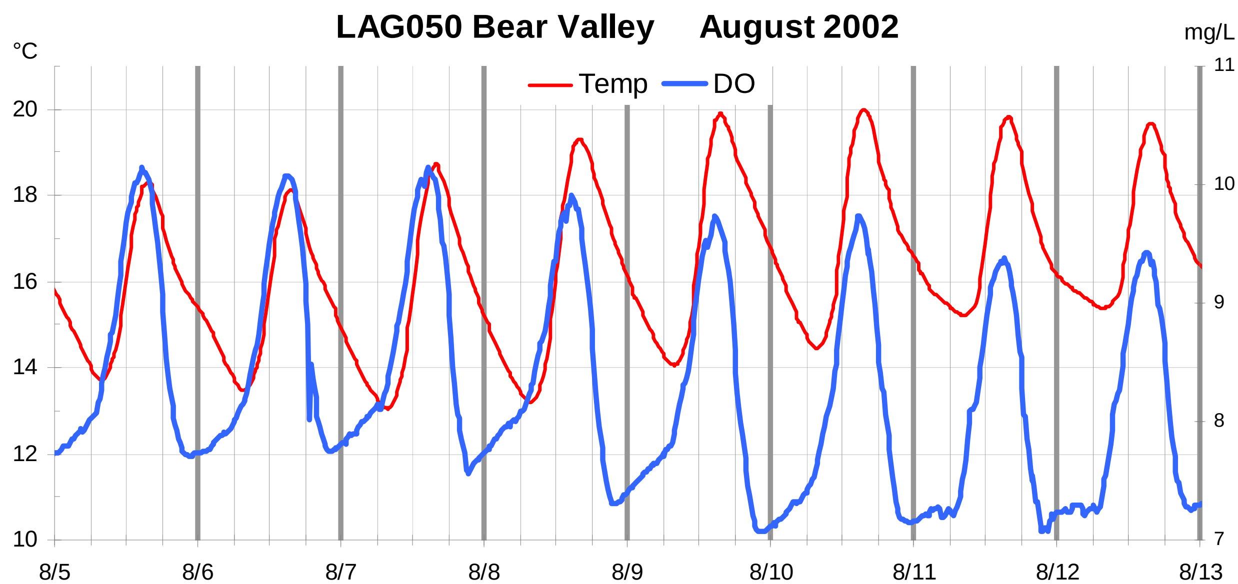

Figure 6-11. LAG050 temperature and DO patterns

By comparison, the temperature-dominated pattern of well-shaded sites more common at minimally disturbed sites upstream is apparent as a DO curve that is nearly the inverse of the temperature curve and recovers rapidly from its minimum (Figure 6-12).

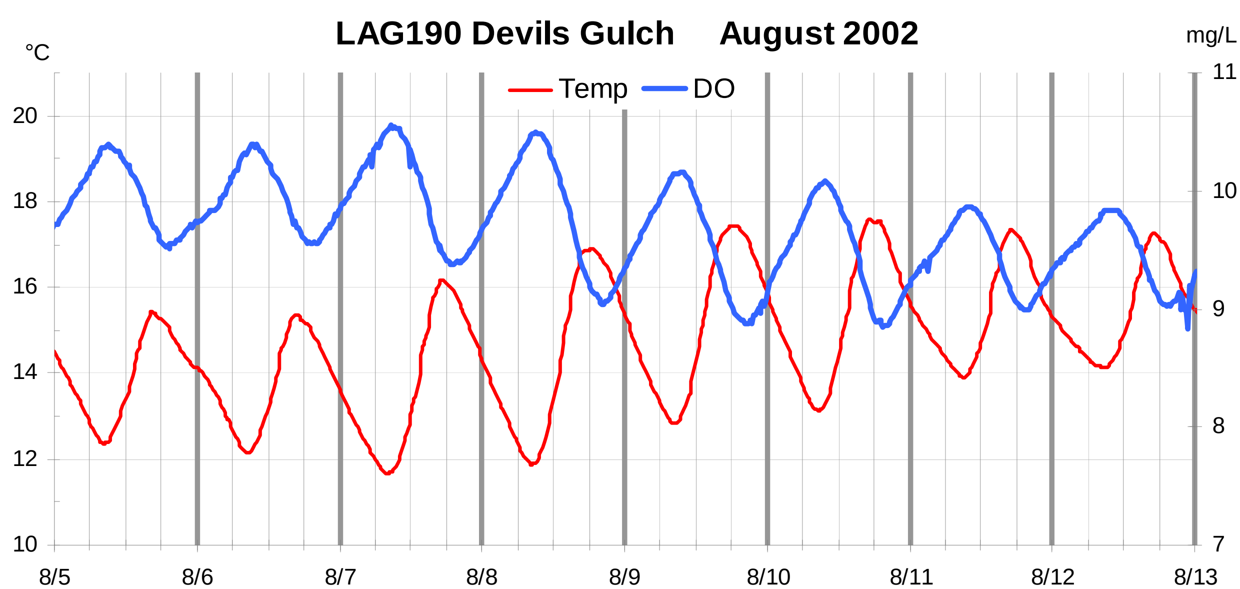

Figure 6-12. LAG190 temperature and DO patterns

6.2.2.7 Unusual temporal patterns

In the San Gregorio Creek watershed, SGR120 (Sky Londa, on La Honda Creek) had an unusual temperature and DO pattern from September 26 to October 4, 2002 (Figure 6-13). While the temperature range was not unusual, and a daily cycle is evident, the timing of the maxima raises concerns: six of nine maxima are within a half hour of midnight and the other three are also at uncharacteristic times (02:30, 09:45, and 20:15). The DO and pH ranges are inconsistently low compared with other sites in the watershed for the same time period, but the specific conductance levels are not (see boxplots in Figures 7-69, 7-70, and 7-71). The graph in Figure 6-13 reveals large and rapid declines and recoveries in the DO curve about the same time as the temperature maxima in the middle of the night, suggesting unnatural causes. The most dramatic event is a loss and recovery of more than 4 mg/L in less than two hours total, a rate unachievable by biological oxygen demand or photosynthesis, especially at night. A mechanical disturbance to the DO membrane would not be likely to recur so regularly.

Comparison of the specific conductance levels with DO in Figure 6-14 reveals distinctly coincident rapid changes. The patterns of the specific conductance measurements support the interpretation of a discharge, which was originally suggested by uncharacteristic timing of temperature maxima and DO minima. Evidence from more than one parameter highlights the value of multi-parameter continuous-monitoring interpretations of water quality. An incident such as this suspected discharge may occur just a few times for a brief period, but have a significant effect on aquatic life. By integrating over time, bioassessment metrics may reflect the impact of such events. Although the relationship is not necessarily causal, lower than expected bioassessment metrics were found at this site.

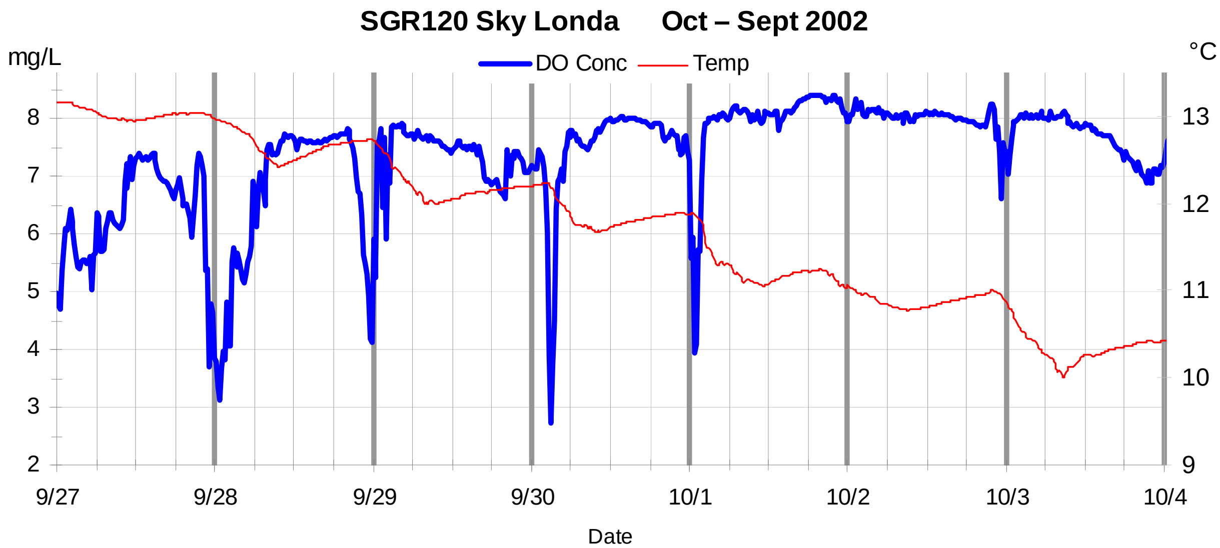

Figure 6-13. SGR120 temperature and DO patterns

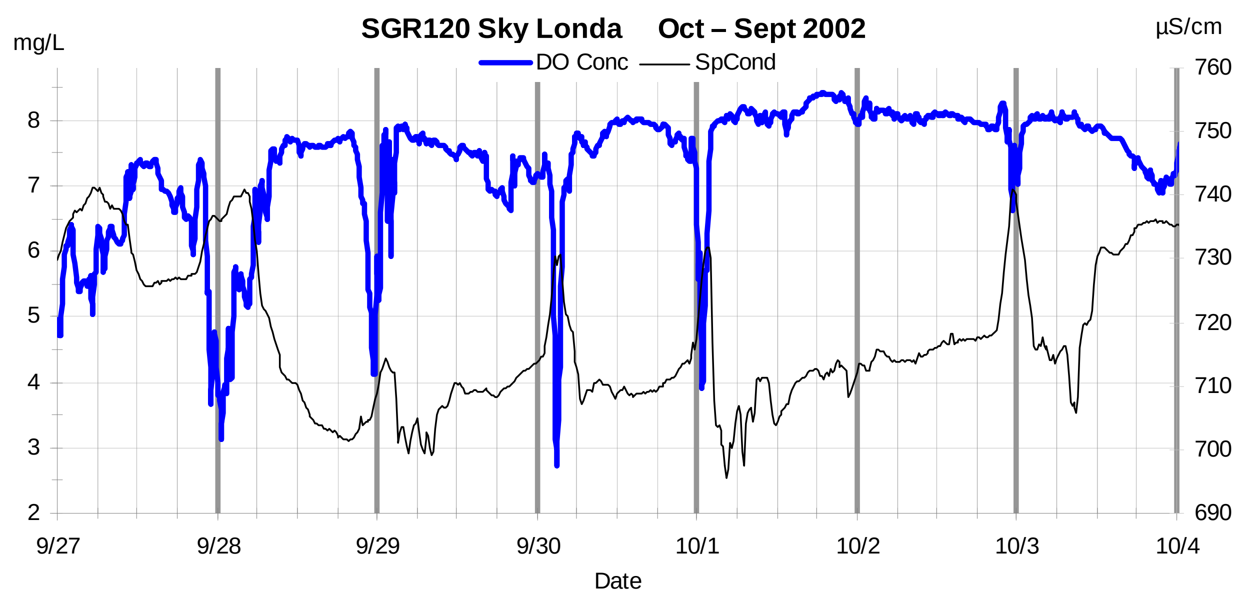

Figure 6-14. SGR120 specific conductance and DO patterns

6.3 Water, Sediment, and Clam Tissue Chemistry

6.3.1 Water Chemistry

Chemicals measured in regional water samples were compared to Basin Plan water quality objectives and/or guidelines established by other agencies to protect aquatic life beneficial uses.

6.3.1.1 Nutrients and Chlorophyll in Water

Nutrient concentrations were compared with U.S. EPA's reference guidelines for Aggregate Ecoregion III Ecoregion 6 (Southern and Central California Chaparral and Oak Woodlands) streams (U.S. EPA 2000). The guidelines are derived from 25th percentile values of stream monitoring data collected from 1990 through 1999, and are intended to represent reference conditions.

Approximately three-fourths of nitrate samples exceeded the U.S. EPA Ecoregion 6 reference guideline of 0.155 mg-N/L. For total phosphorus (as P), the reporting limit of 0.04 mg/L was above the Ecoregion 6 reference guideline of 0.030 mg/L. Ninety six samples exceeded the reporting limit, 41 samples were at the reporting limit of 0.04 mg/L and one sample was below the reporting limit. The minimum reporting limit for orthophosphorus (< 0.010 mg/L for most sample runs) is below the total phosphorus guideline value, and the majority of orthophosphorus values exceeded this guideline (Figure 6-15, Figure 6-16 and Figure 6-17). (U.S. EPA does not provide a reference guideline for orthophosphate. For this reason, measured orthophosphate concentrations will be compared to the total phosphorus guidelines throughout the remainder of this report.)

All samples in this study were below the Basin Plan objective for unionized ammonia. No samples collected upstream of municipal drinking water sources exceeded any standards for nitrite. The ten highest nitrate concentrations (all > 4 mg/L) were measured in the Arroyo Las Positas and San Leandro watersheds. Two sites, Arroyo Seco at Arroyo Las Positas (204ALP110) and San Leandro Creek at Empire Road (204SLE030) combined for the six highest concentrations measured (all > 6 mg/L), and the highest value for each site was measured in the spring (both > 7 mg/L).

The highest orthophosphate concentration (1.99 mg/L) was measured at Lauterwasser Creek in the San Pablo Creek watershed (206SPA200); all other measurements were less than 0.45 mg/L. Seven of the ten highest orthophosphate concentrations were measured in the San Pablo Creek watershed, with the other three from the San Leandro Creek (204SLE070; 0.36 mg/L), Permanente Creek (205PER010; 0.34 mg/L), and Stevens Creek (205STE020; 0.27 mg/L) watersheds (Appendix G; Figure 6-15, Figure 6-16, and Figure 6-17).

In the following graphs, where the analyte was detected but below the reporting limit, the reporting limit is represented.

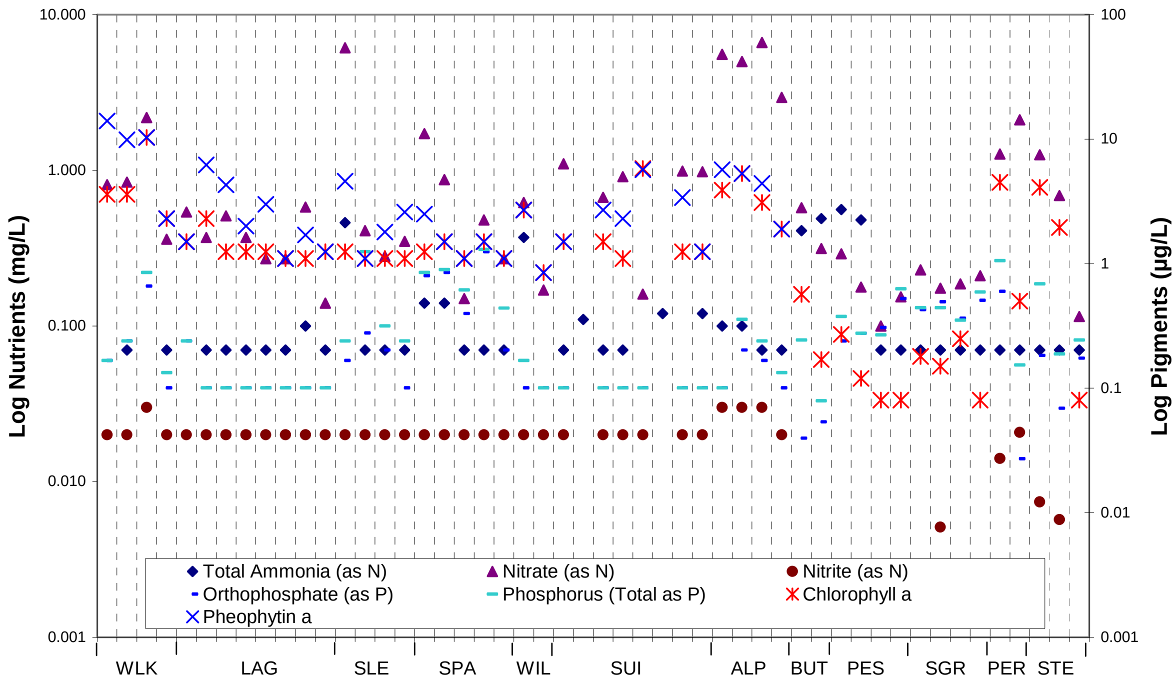

Figure 6-15. Wet season nutrients and chlorophyll

Wet season concentrations of nutrients and chlorophyll measured in water samples. Only watersheds are labeled below for readability. Sites are listed in the same order as in Appendix G. Analytes detected below the reporting limit are represented at the reporting limit.

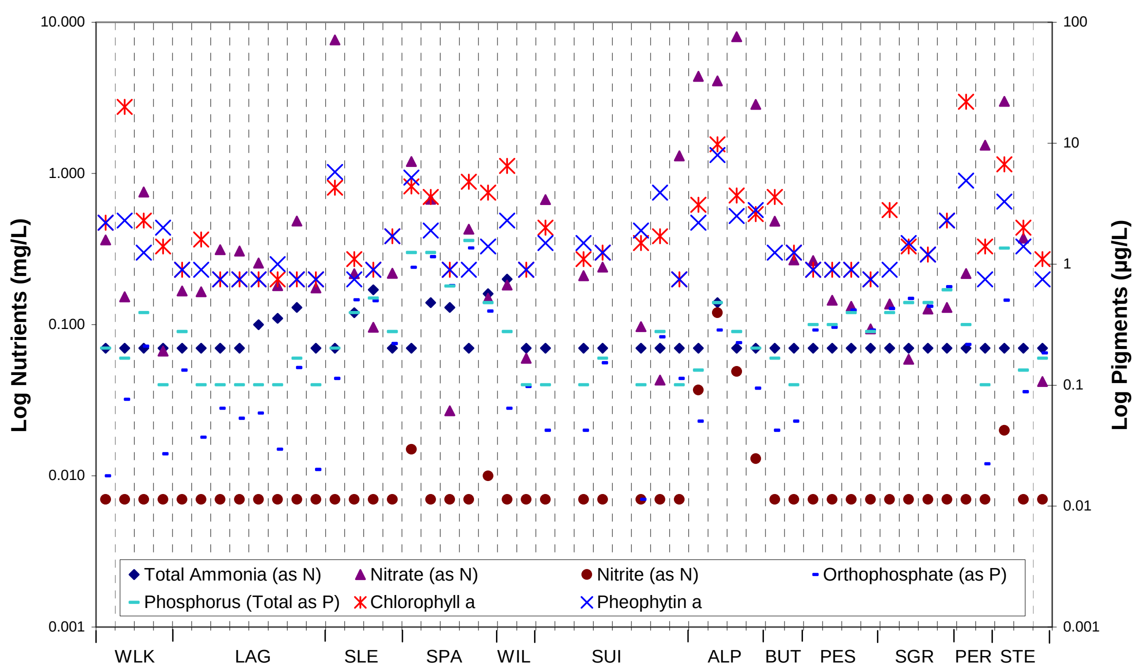

Figure 6-16. Spring season nutrients and chlorophyll

Spring season concentrations of nutrients and chlorophyll measured in water samples. Only watersheds are labeled below for readability. Sites are listed in the same order as in Appendix G. Analytes detected below the reporting limit are represented at the reporting limit.

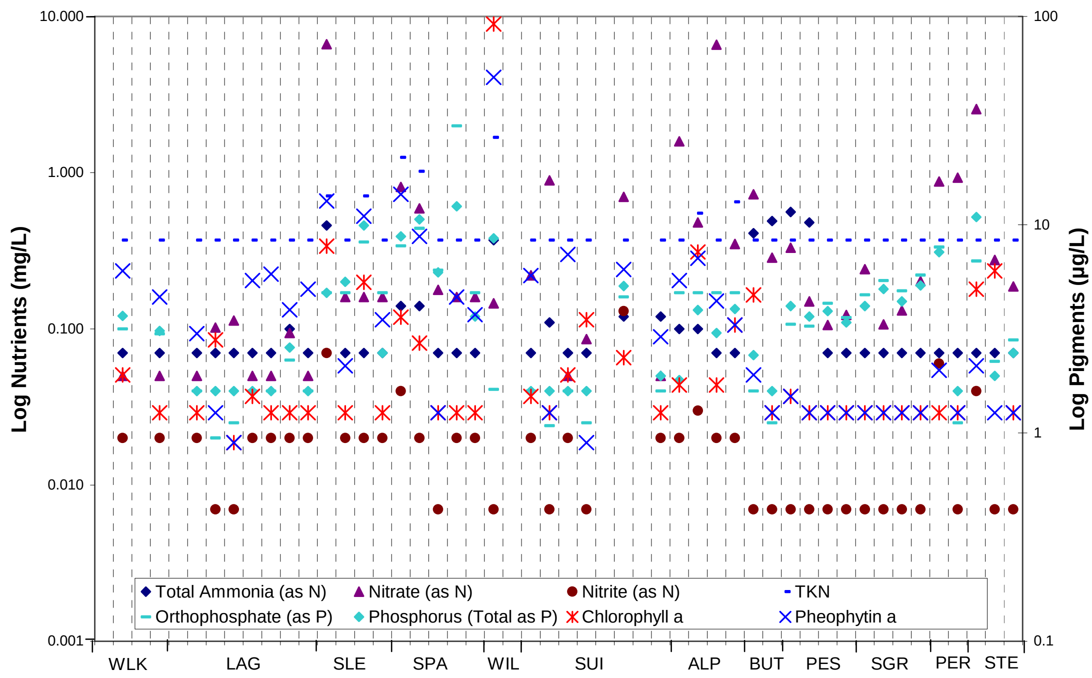

Figure 6-17. Dry season nutrients and chlorophyll

Dry season concentrations of nutrients and chlorophyll measured in water samples. Only watersheds are labeled below for readability. Sites are listed in the same order as in Appendix G. Analytes detected below the reporting limit are represented at the reporting limit. See Appendix G for detection limits.

There were no significant differences in nitrate values among the three seasons (ANOVA $p = 0.32$), with averages of 0.58 mg/L (dry season), 0.88 mg/L (spring season), and 1.04 mg/L (wet season). However, large seasonal differences were observed in some watersheds, as described later in this report.

There was a significant seasonal difference in orthophosphate values (ANOVA $p < 0.05$), with averages of 0.174 mg/L (dry season), 0.079 mg/L (spring season), and 0.078 mg/L (wet season). Total phosphorus results were similar, with dry season values significantly higher than spring and wet season values (ANOVA $p < 0.05$). Average total phosphorus concentrations were 0.153 mg/L (dry season), 0.101 mg/L (spring season), and 0.100 mg/L (wet season).

The ratio of nitrogen to phosphorus in aquatic systems determines which of these elements is most important in controlling eutrophication. Algae utilize nitrogen and phosphorus at a ratio of about 7:1 by mass (Redfield 1958). A ratio of these elements significantly narrower than 7:1 means that there is a greater supply of phosphorus than nitrogen, relative to algal needs, and that nitrogen is limiting growth. A wider ratio than 7:1 implies the opposite: phosphorus limits growth. A ratio close to 7:1 suggests that either or both elements may be limiting. Since the dissolved inorganic forms of nitrogen (nitrate + nitrite + ammonia) and phosphorus (orthophosphate) are the forms most available to algae, it is useful to compare these forms. The median ratio of inorganic nitrogen to inorganic phosphorus for all sampled streams in the region was 4.5, indicating that the streams are predominantly phosphorus-limited.

Region-wide, there were few significant, or even apparent, relationships between any of the discrete measures of parameters associated with eutrophication: DO, pH, nitrate, orthophosphate, total phosphorus, chlorophyll a, and pheophytin. There was a significant correlation between DO and pH in the wet season ($p < 0.01$). The other two significant correlations were perhaps more interesting: conflicting relationships between concentrations of dissolved oxygen (percent saturation) and total phosphorus. Region-wide, the dry season samples showed decreasing DO with increasing total phosphorus ($p < 0.005$). The reverse was seen for the wet season samples ($p < 0.02$). However, the trend in the wet season was driven by very high DO values (> 120 percent saturation), with few low DO measurements. The dry season relationship, however, was driven more by DO values at or below 50 percent saturation, and may have been reflective of DO depletion through algal respiration as a result of eutrophication.

Several factors may account for the general lack of relationships among these variables. The most important is that primary productivity in shallow streams is usually dominated by benthic algae (periphyton) in contrast to planktonic algae, therefore measurement of water column chlorophyll does not accurately reflect the trophic status or potential impacts on these streams. Periphyton bioassessment methods specific to California are currently being developed. SWAMP will sample periphyton in the future.

An additional factor is that DO data collected in conjunction with water chemistry data were single measurements, sometimes taken in the morning and sometimes in the afternoon, as determined by sampling team logistics. Inconsistent timing of DO sampling can result in the data set being confounded by the strong diel DO swings observed in eutrophic streams. The relationship between DO and algal productivity in streams are also confounded by differences in stream velocity and depth (and therefore reaeration rate). Relationships between ambient nutrient concentrations and algal density can also be obscured by the rapid rate of nutrient uptake during algal growth.

Nitrate values region-wide over all seasons were highest and most variable in streams draining urban areas (average 1.56 mg/L), followed by mixed land use (0.93 mg/L), agriculture (0.68 mg/L), grazing (0.47 mg/L), rural residential (0.26 mg/L), and open space (0.17 mg/L; Figure 6-18). This difference was statistically significant (ANOVA on sqrt transformed data: $p = 0.01$). Differences between individual land use categories were not resolved significantly (Newman-Keuls for unequal sample sizes, $p > 0.20$). The mean nitrate level for urban streams was more than twice that for streams draining agricultural areas, and nearly ten times that of streams in open space areas.

Dry season orthophosphate and total phosphorus data also indicated higher average concentrations and greater variability in streams draining urban sites. There was little apparent difference between concentrations in streams draining areas characterized by other land uses (Figure 6-19 and Figure 6-20). Nitrates and phosphates are routinely and professionally applied as fertilizers in conventional agriculture, but are also applied more variably for residential and urban landscaping. It appears that urban uses are either more intensive than agricultural uses, or that fertilizers are applied in ways that more directly lead to transport into aquatic habitats.

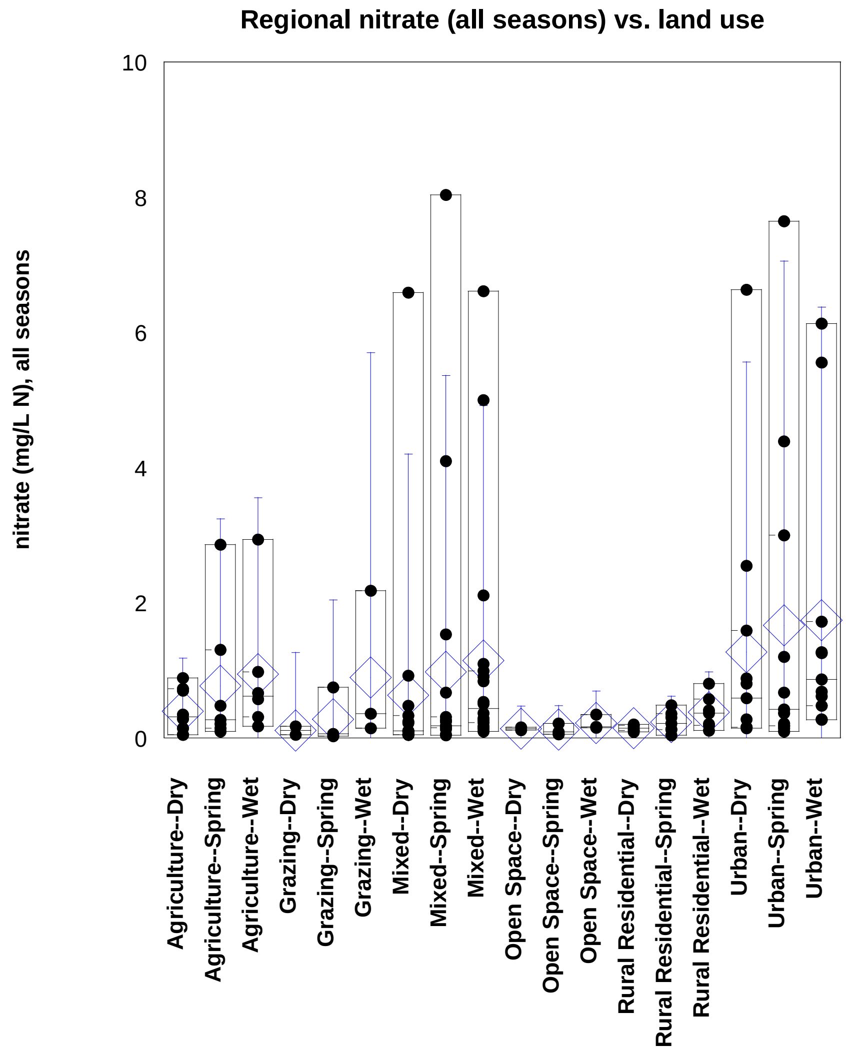

Figure 6-18. Nitrate (NO3-N)

Nitrate concentrations are grouped by land use category and season. Black dots represent all data points. Black boxes represent percentiles: 95, 75, 50, 25, and 5. Center of blue diamond represents mean, with error bars representing the 95 percent confidence interval about the mean (two-tailed, a=0.05).

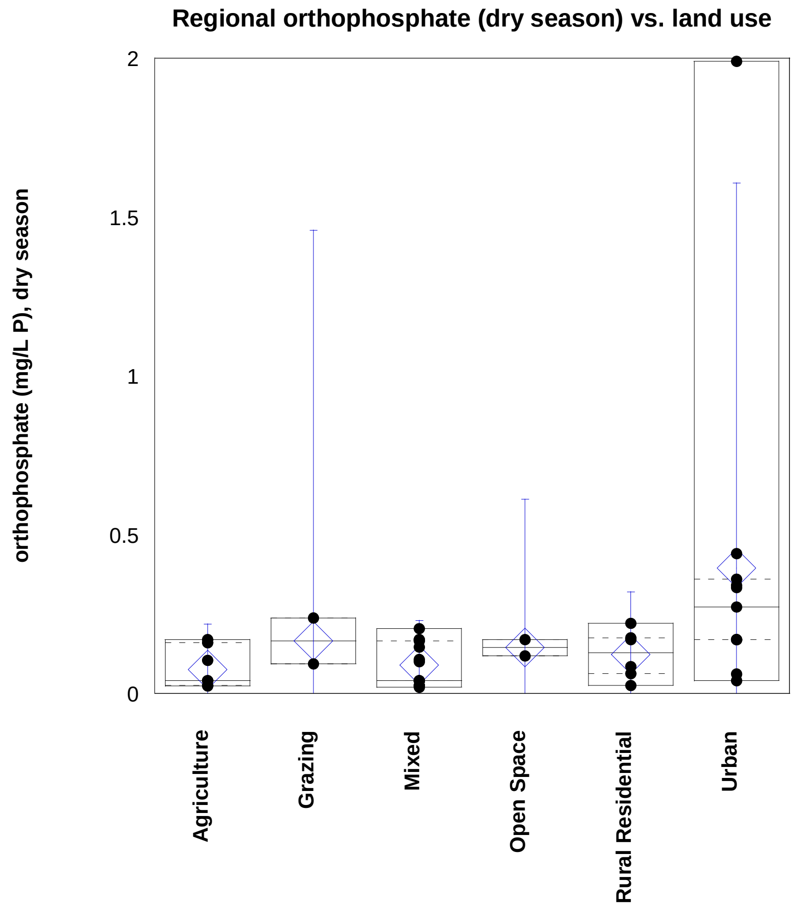

Figure 6-19. Orthophosphate (dry season)

Orthophosphate concentrations are grouped by land-use category during the dry season, when concentrations were highest. Black dots represent all data points. Black boxes represent percentiles: 95, 75, 50, 25, and 5. Center of blue diamond represents mean, with error bars representing the 95 percent confidence interval about the mean (two-tailed, a=0.05).

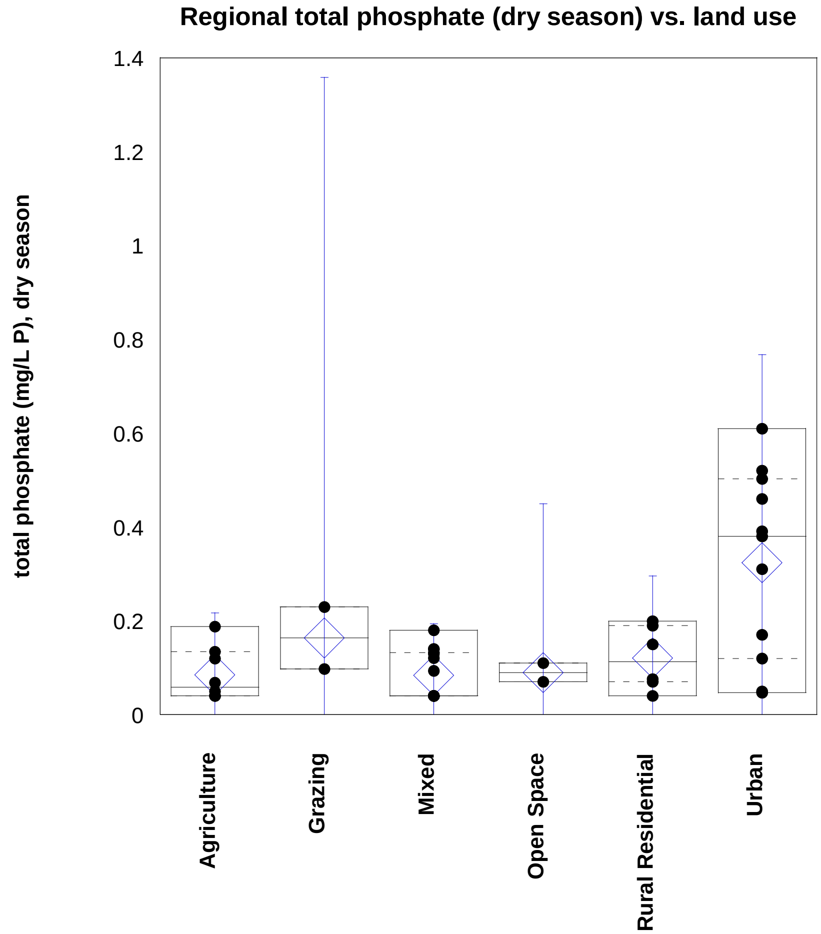

Figure 6-20. Total phosphorus (dry season)

Total phosphorus concentrations are grouped by land-use category during the dry season, when concentrations were highest. Black dots represent all data points. Black boxes represent percentiles: 95, 75, 50, 25, and 5. Center of blue diamond represents mean, with error bars representing the 95 percent confidence interval about the mean (two-tailed, a=0.05).

6.3.1.2 Metals in Water

Only two trace metals—dissolved chromium and total selenium—were found at concentrations exceeding guideline values for aquatic life (see Table 4-2 and Appendix G). Two types of Basin Plan Objectives were used as guidelines for assessing metals: the chronic water quality objective (WQO) based on a 4-day average, and the acute WQO, based on a 1-hour average. Results from grab samples are appropriate to compare to an acute WQO; however, they may not be applicable to a chronic WQO. The chronic WQO is used here only as a screening level for further investigation. Dissolved chromium was measured in this study, but the objective is based on hexavalent chromium, which is usually a small fraction of the dissolved chromium (Hem 1985). Thus, applying the chromium VI objective to the measured dissolved chromium is a conservative estimate. Further investigation may be warranted in San Leandro Creek to measure hexavalent chromium and possibly establish a ratio between total and hexavalent chromium.

Over the two years of this study, metals were measured in 59 water samples; though mercury was measured in only 44 of these. The chronic WQO was exceeded in 2 samples (3 percent) for dissolved chromium, both in samples from San Leandro Creek site SLE030. The chronic WQO was exceeded in 5 samples (8 percent) for total selenium, all in samples from Arroyo Las Positas (sites ALP010 and ALP100) and Permanente Creek (site PER070). The acute WQO was exceeded in only one sample, for dissolved chromium at SLE030. There were no water sample exceedances of aquatic life thresholds for arsenic, cadmium, copper, lead, mercury, nickel, silver, or zinc. There are no Basin Plan aquatic life objectives for aluminum or manganese.

The spatial distribution of these measurements is discussed in more detail in the sections below dealing with land use and individual watersheds.

There were some seasonal differences between the spring and dry season samples in the region-wide measurements of trace metals in water. Paired t-tests ($n = 25$) indicated that total and dissolved arsenic ($p < 0.1$), total copper ($p < 0.1$), dissolved manganese ($p < 0.1$), total mercury ($p < 0.1$), and total and dissolved zinc ($p < 0.05$) all had higher concentrations in the dry season compared to the spring season. Total and dissolved selenium ($p < 0.05$) were higher in the spring season. One possible explanation for these general region-wide trends is that metals are conserved in some streams and are concentrated during low flows, while higher flows tend to dilute their ambient concentrations. The exception to this is during discrete rain-related runoff events when the highest concentrations would be expected. However, since this is an ambient monitoring program, discrete events were not sampled. Stream flow data are not available to allow determination of the seasonal trends in metal loading and transport.

6.3.1.3 Organic Chemicals in Water

Detectable concentrations of 43 synthetic organic chemicals were measured in regional water samples. Only 7 compounds of the number listed in Table 4-1 were detected in 5 or more samples: benzo(b)fluoranthene (5 samples, all dry season), benzo(k)fluoranthene (same 5 samples), perylene (5 samples), p’,p’DDE (5), diazinon (20), disulfoton (11), and oxadiazon (15).

A limited number of pesticides were detected in a limited number of samples (Appendix G), but only two pesticides were measured above guideline values. The organophosphate pesticide chlorpyrifos was not detected by EPA analytical methods, but enzyme-linked immunosorbent assays (ELISAs) measured chlorpyrifos at concentrations above guidelines for aquatic life protection in water samples from four sites, all urban. Diazinon was detected in 20 samples by EPA methods and 8 samples by ELISA (Figure 6-9), and was found at concentrations above guidelines for aquatic life protection in water samples from three sites, all urban. Both pesticides were measured above guidelines at two of the sites. Diazinon was measured above guidelines by both EPA and ELISA methods in one sample, only by ELISA in a second, and only by EPA methods in the third. These two pesticides have been widely used in agricultural, residential and industrial applications.

Diazinon has previously been identified as causing toxicity to *Ceriodaphnia* in urban watersheds in the Bay Area. Urban creeks in the San Francisco Bay Region were listed on the 303(d) list for diazinon in 2002. As a result, a pesticide TMDL has been developed by the San Francisco Bay Regional Water Quality Control Board. SWAMP data were used in the TMDL to determine that toxicity due to diazinon has decreased in urban creeks since data were collected in the 1990s (SFBRWQCB 2005). The spatial distribution of these measurements is discussed in more detail in the sections below dealing with land use and individual watersheds. Oxadiazon was detected in 15 water samples from throughout the region. This herbicide was also found in clam tissues (see Section 6.3.3, below). Oxadiazon is used primarily for landscape maintenance, with this use accounting for about 50 percent of registered applications in California in 2004 (PAN 2004).

PCBs were detected in only two samples, both collected in the dry season from urban sites. Total PCBs did not exceed the standard (Table 4-2).

Polycyclic aromatic hydrocarbons (PAHs) were detected in a number of samples (Figure 6-10). Individual PAHs that were detected included benz(a)anthracene, benzo(a)pyrene, benzo(b)fluorathene, benzo(k)fluorathene, chrysene, and dibenz(a)anthracene. There are no regulatory aquatic life standards for PAHs, but in general, elevated PAHs were most prevalent at urban sites, and successively less frequent at mixed, rural residential, and agricultural land uses.

There were statistically significant seasonal trends in the concentrations of dissolved and total organic carbon in water samples region-wide (ANOVA, $p < 0.001$). At least 44 DOC/TOC measurements were taken in each of three seasons (dry, spring, wet). Mean DOC values were 6.6 mg/L (dry season), 5.3 mg/L (spring), and 1.6 mg/L (wet), while TOC means were 10.8 mg/L (dry season), 9.7 mg/L (spring), and 2.8 mg/L (wet). This pattern may be due to dilution and flushing of algae and accumulated organic debris during storms.

Seasonal trends in concentrations of organic compounds in water were difficult to quantify because of the relatively low number of detections region-wide. However, some patterns were apparent. Diazinon, the most frequently detected compound, was found in 9 dry season samples, 9 spring samples, and 2 wet season samples. PAHs were detected in 10 dry season samples, 2 spring samples, and no wet season samples. This pattern generally held for the other more commonly detected compounds (DDE, disulfoton, and oxadiazon), which, combined, had only one detection in the wet season (Appendix G). This may again be the result of dilution and/or lower rates of application in the winter for the currently used compounds.

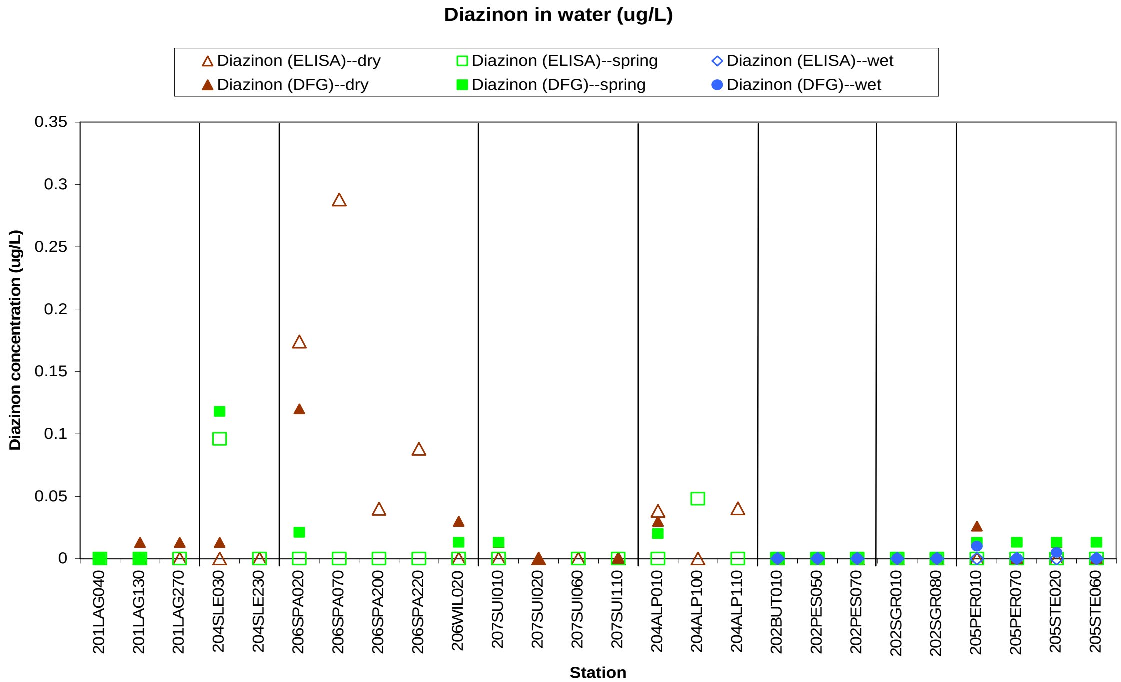

Figure 6-21. Diazinon in water

Concentrations of the organophosphate pesticide diazinon in water samples were measured by two techniques: gas chromatography (DFG Lab) and enzyme-linked immunosorbant assays (ELISA).

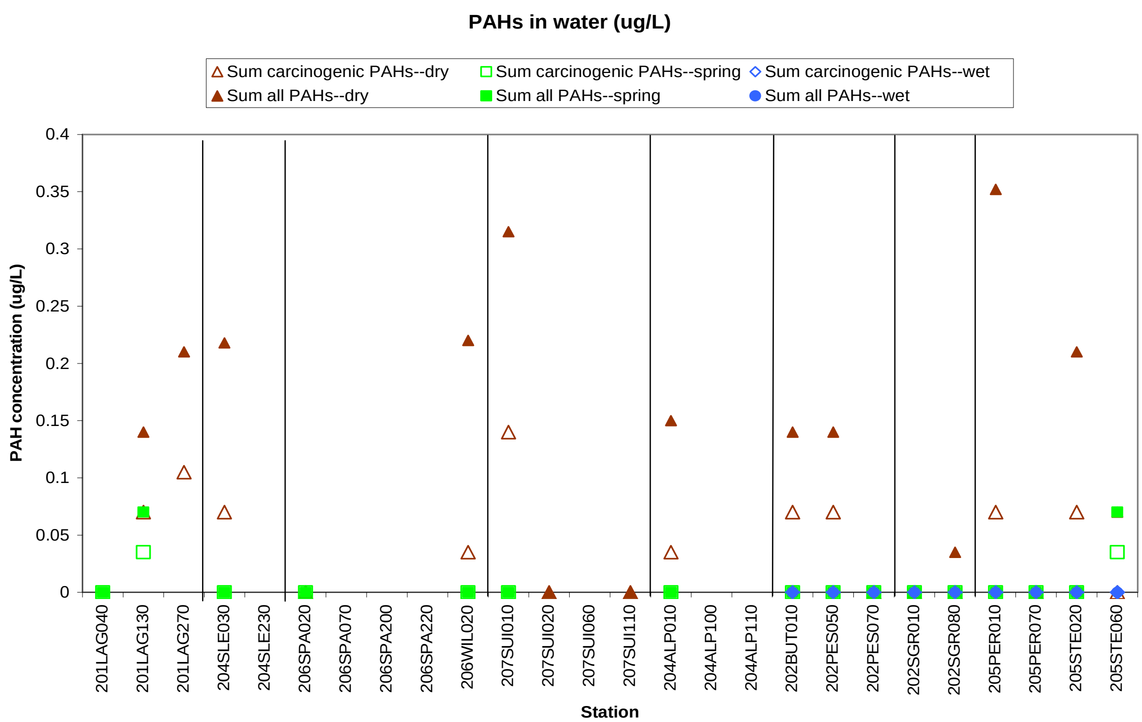

Figure 6-22. PAHs in water

Concentrations of polycyclic aromatic hydrocarbons (PAHs) were measured in water samples.

6.3.2 Sediment Chemistry

Sediments collected from 13 integrator sites at or near the mouths of all surveyed watersheds were analyzed for trace metal and trace organic chemicals (Figures 3-1 to 3-9). Concentrations were generally low relative to available sediment quality guidelines (Table 4-3). The two primary guidelines used for comparison were the threshold effects concentration (TEC), below which harmful biological effects are considered unlikely to be observed, and the probable effects concentration (PEC), above which harmful effects are considered likely to be observed (MacDonald *et al.* 2000). Two geologically abundant trace metals, chromium and nickel, had the largest number of guideline exceedances. Chromium exceeded the TEC in 11 of 13 samples, and the PEC in 5 of 13 samples, with no obvious relationship between concentration and land use. Nickel exceeded the TEC in 10 of 13 samples, and the PEC in 6 of 13 samples, also with no obvious relationship to land use. High concentrations of nickel and chromium are common due to the geology of this area. Lead exceeded the PEC in one sample (from the urban San Leandro site). No other chemicals were found at sediment concentrations exceeding their PEC values.

Of the 13 sites sampled, other chemicals found in exceedance of TEC values included the metals arsenic (3), cadmium (1), copper (4), mercury (5), and zinc (2); sum PCBs (2); and the pesticides DDD (2), DDE (3), DDT (2), and dieldrin (1). All but one of the pesticide exceedances were from two urban sites, near the mouths of San Leandro and Permanente Creeks. The sediment sample from San Leandro Creek was the only one in which amphipod survival was significantly reduced in the sediment toxicity tests (zero percent survival; other toxicity results discussed below by watershed). Permanente Creek was the only watershed with PAHs measured above a guideline value, with the TEC exceeded for benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a)anthracene, fluoranthene, phenanthrene, pyrene, and sum PAHs.

Sediment quality guideline quotients (SQGQ) were calculated as a way of comparing the watershed integrator sites in terms of contamination from chemical mixtures (see Section 4.6.3). These SQGQ values can be compared to ranges evaluated by MacDonald *et al.* (2000), who found that 85 percent of sediment samples with mean PEC quotients greater than 0.5 were toxic to sediment-dwelling organisms. Similarly, 92 percent of sediment samples with mean PEC quotients greater than 1.0 were toxic to one or more species of aquatic organisms.

Creamery Gulch, (LAG270), in Lagunitas Creek watershed, had the highest SQGQ (0.58). However, this value was driven primarily by concentrations of trace metals, especially the geologically abundant chromium and nickel. No chemicals other than metals were found there at concentrations above TEC levels. San Leandro Creek had the second highest SQGQ (0.44). This value was also driven by metals, with chromium, nickel, and lead above PEC levels, but also DDD, DDE, and DDT concentrations above TECs. When sum DDE was included in the mean PEC quotient (as recommended by MacDonald *et al*. 2000) the SQGQ increased slightly to 0.47. Samples from all other sites had SQGQ values less than 0.35 (with DDE included), indicating relatively low potential for sediment toxicity due to chemical mixtures.

Sediment grain size and total organic carbon (TOC) varied widely in samples from the integrator sites throughout the region. The San Leandro Creek sample had a very high TOC content (9.42 percent), and also had a relatively high percentage of fine grained sediment (75 percent). This sample had the second highest SQGQ value and was toxic to amphipods. TOC and fine grained sediments tend to retain contaminants, and numerous studies have documented correlations between these factors and chemical concentrations. The high TOC content of this sediment may also have contributed directly or indirectly to toxicity. The Creamery Gulch sample (LAG270), on the other hand, had low TOC (0.6 percent) and coarse sediment (3 percent fines), but still had high trace metal concentrations. This may indicate active metal loading into the stream, since the sediments there should not have had a high capacity for chemical retention. This loading consisted primarily of geologically abundant metals nickel and chromium, and may be more representative of increased erosion in the system rather than of anthropogenic sources of contaminants.

The San Pablo Creek integrator site sample had relatively high TOC (2.92 percent) and fine grain size (83 percent fines), but had a relatively low SQGQ, and generally low contaminant concentrations. Since this sediment would presumably have good chemical retention capacity, the low concentrations could be indicative of fairly low loading rates prior to the survey. There were no other distinct trends or patterns observed relative to sediment characteristics and contamination levels.

6.3.3 Clam Tissue Chemistry

Clams were deployed at the integrator sites near the mouths of all surveyed watersheds to help evaluate the bioavailability of specific chemicals and their potential to enter food webs. A number of chemicals were detected in clam tissues after one month deployments. However, concentrations of most chemicals were similar to those measured in tissues of control clams. Data are presented for a number of chemicals of concern previously identified in San Francisco Bay area studies.

Only two chemicals, copper and PCB aroclor 1248, were measured above the 85th percentile of the statewide clam tissue data base (Appendix I). Copper concentrations at watershed sites, however, generally fell within a narrow range about the control value (Figure 6-). Mercury tissue concentrations were highest in the Lagunitas watershed, perhaps reflecting geologic abundance, but these concentrations were all below the statewide 85th percentile (Figure 6-). Selenium tissue concentrations were similar to control values at all sites (Figure 6-). While selenium has been of concern in the Bay/Delta for many years, local watersheds are not assumed to be primary sources. These data tend to support that assumption.

Total PCB tissue concentrations were generally similar to control values, though tissues from clams deployed in Stevens and Permanente Creeks were about double the control value (Figure 6-). Stevens and Permanente Creeks were among three sites that produced sediment samples with total PCBs above TEC guidelines. Total chlordanes have been associated with toxicity in San Francisco Bay sediments (Thompson *et al*. 1999), and total chlordanes were highest in tissue samples from Stevens, Permanente, and San Pablo Creeks (Figure 6-). Chlordanes were not detected in control clams. DDT compounds were among the highest in control clams (Figure 6-) so it is difficult to assign trends to the site data. Dieldrin and oxadiazon were the only other pesticides detected in clam tissues. The distribution of oxadiazon is striking for the elevated value in the Arroyo Las Positas watershed, about 10 times the control value (Figure 6-). Oxadiazon was detected at relatively low levels in sediments and water at that site (Appendices G and H), but was detected in 15 water samples throughout the region, none at concentrations above drinking water standards. This herbicide is traditionally used for turf and ornamental plant applications.

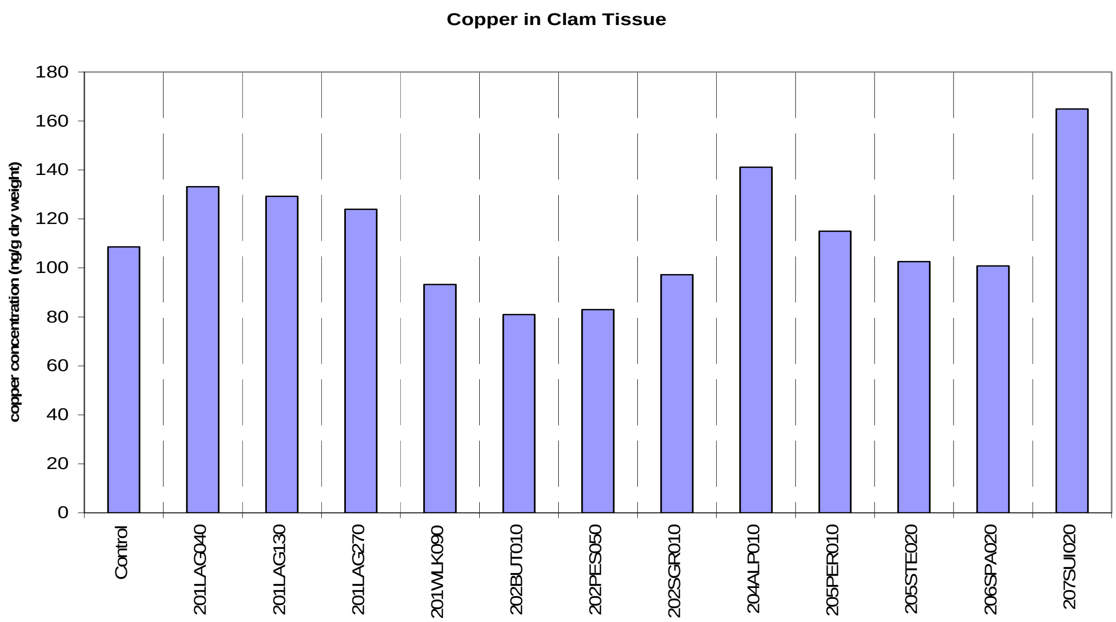

Figure 6-23. Copper in tissue

Concentrations of the trace metal copper were measured in tissues of clams deployed at integrator sites near the base of watersheds.

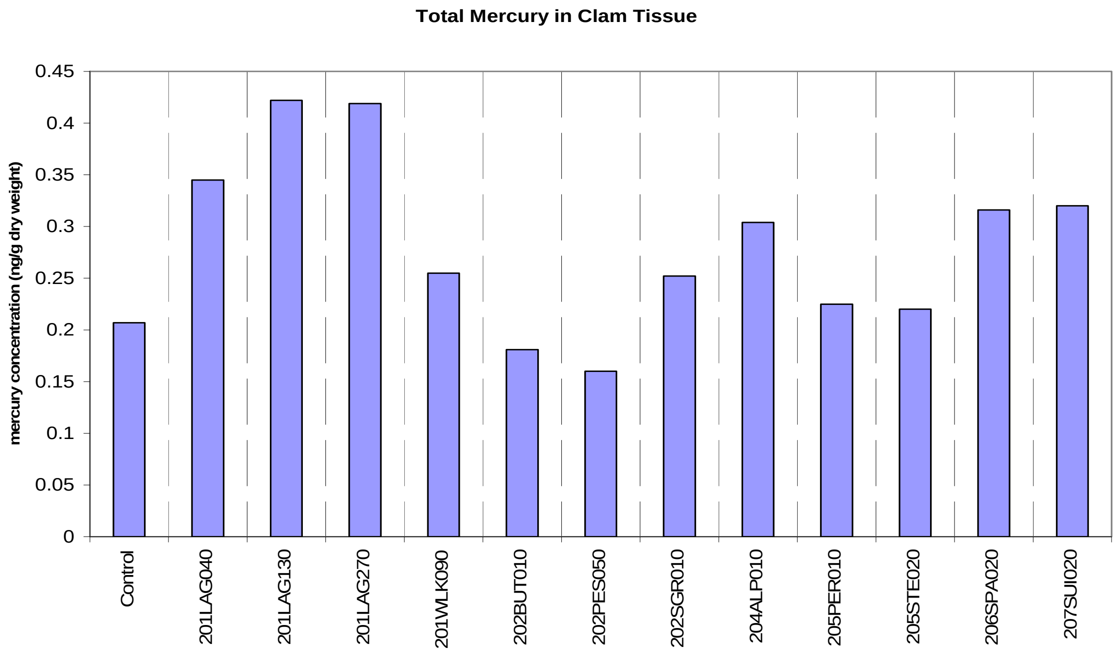

Figure 6-24. Mercury in tissue

Concentrations of the trace metal mercury were measured in tissues of clams deployed at integrator sites near the base of watersheds.

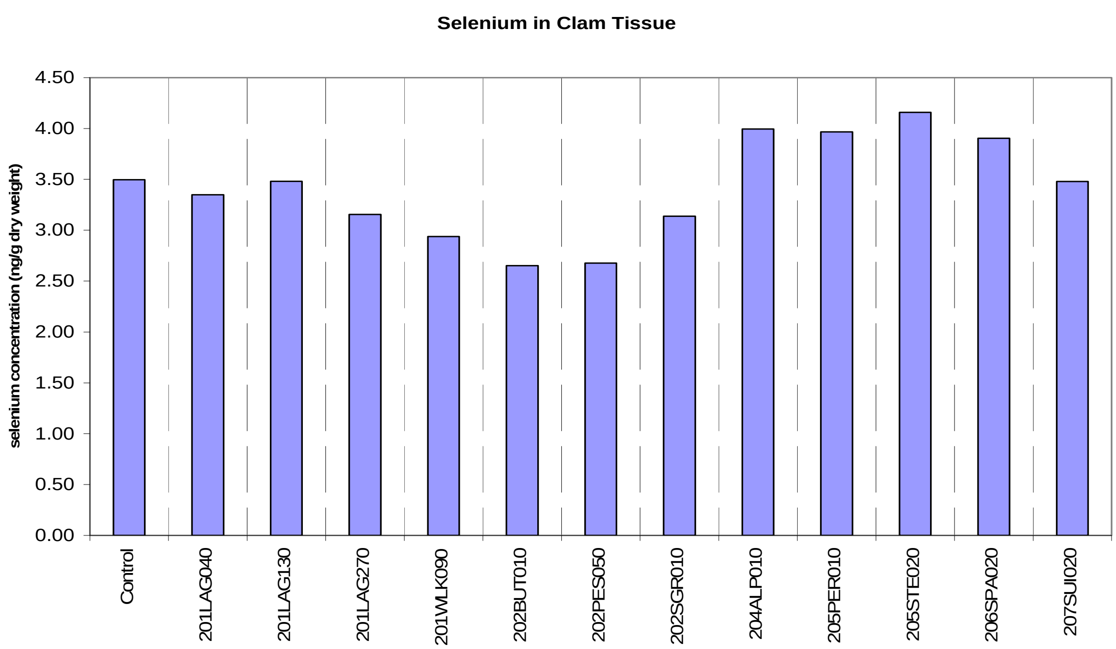

Figure 6-25. Selenium in tissue

Concentrations of the trace element selenium were measured in tissues of clams deployed at integrator sites near the base of watersheds.

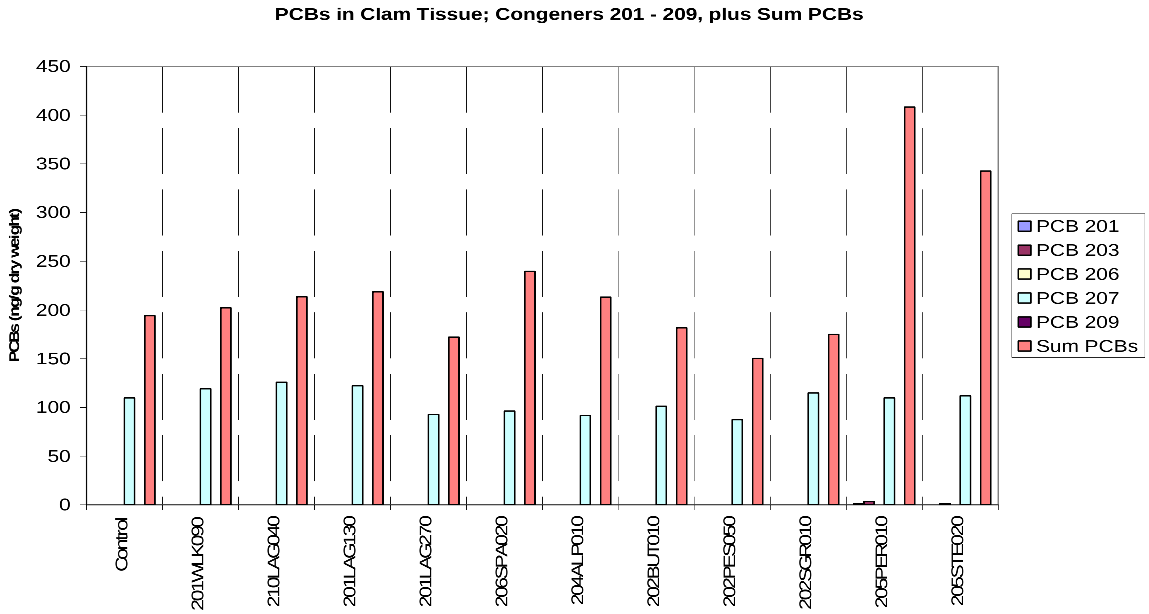

Figure 6-26. PCBs in tissue

Concentrations of the large PCB congeners and total PCBs were measured in tissues of clams deployed at integrator sites near the base of watersheds.

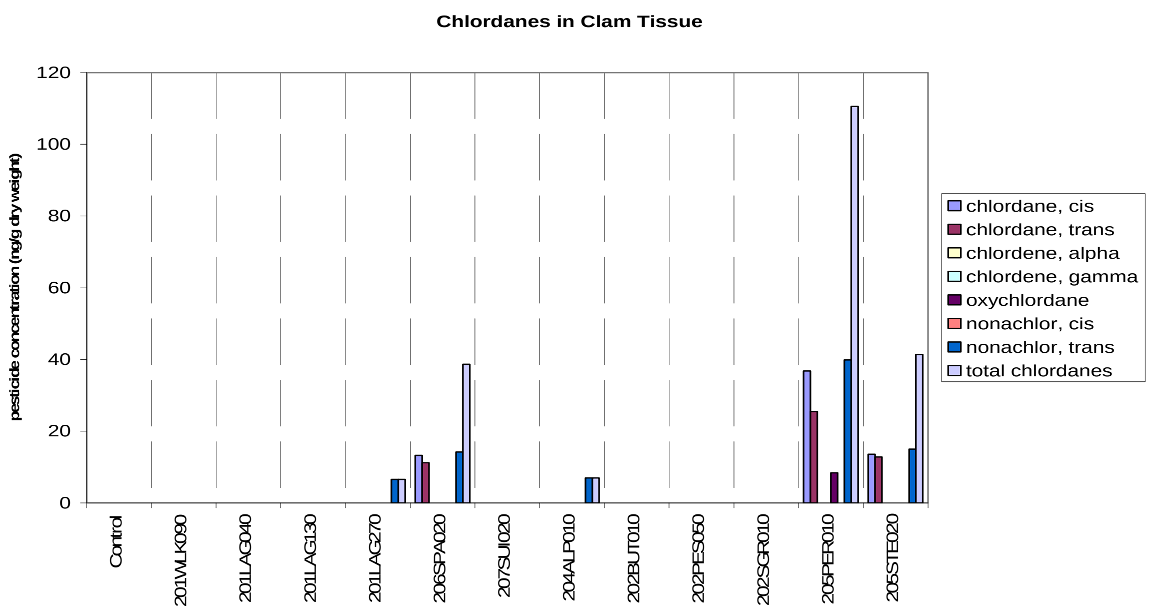

Figure 6-27. Chlordanes in tissue

Concentrations of chlordanes and total chlordane were measured in tissues of clams deployed at integrator sites near the base of watersheds.

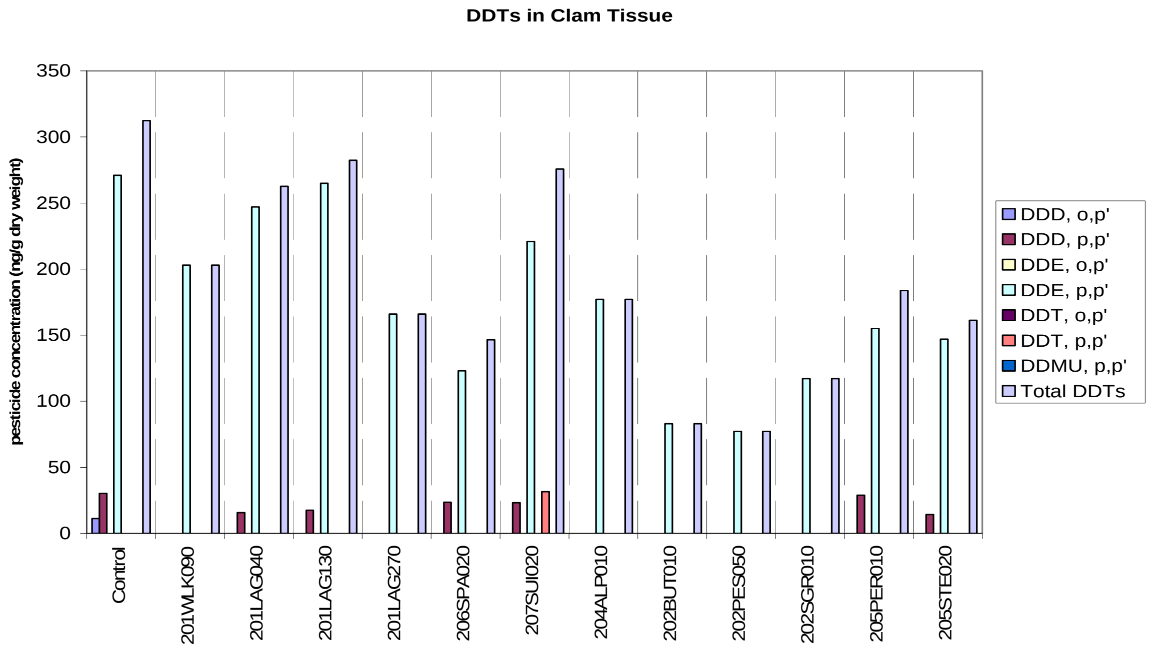

Figure 6-28. DDT in tissue

Concentrations of the pesticide DDT, DDT breakdown products, and total DDTs were measured in tissues of clams deployed at integrator sites near the base of watersheds.

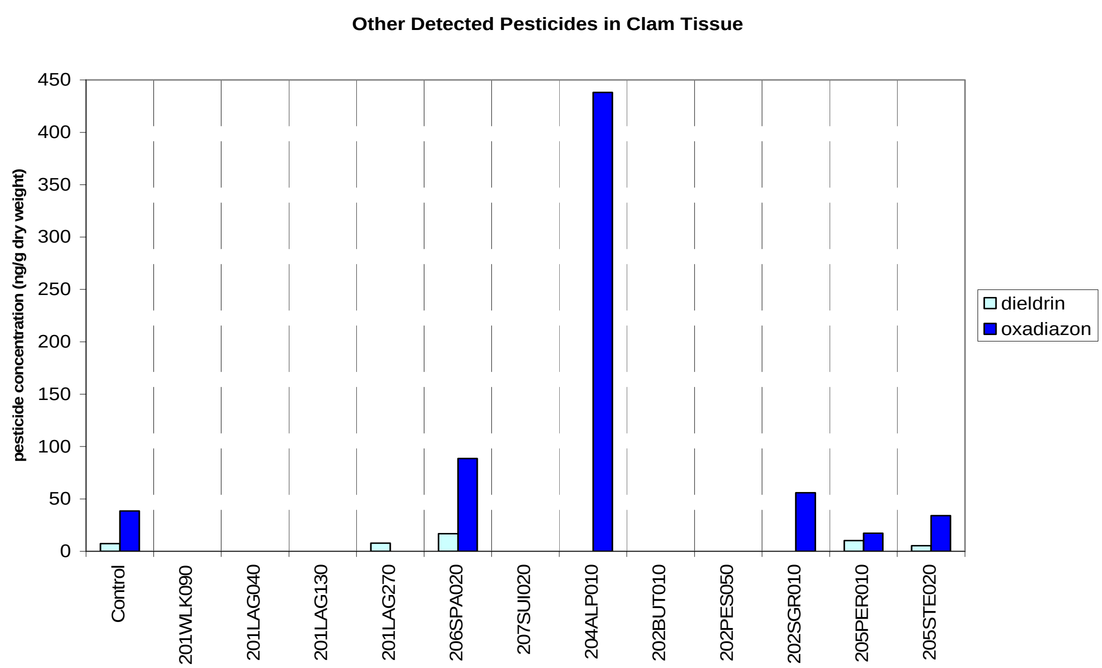

Figure 6-29. Other pesticides in tissue

Concentrations of other pesticides were detected in tissues of clams deployed at integrator sites near the base of watersheds.

6.4 Water and Sediment Toxicity

Three toxicity test species were exposed to grab water samples collected two to three times from 26 sites in the region, totaling 59 samples. Of these, significant reductions in survival, growth, or reproduction were observed in 19 samples from 10 sites. Algal growth was reduced in 15 samples, invertebrate reproduction or survival was adversely affected in three samples, and fish larval survival declined in one sample. All of the observed effects were relatively moderate, with the lowest observed responses (as a percent of the control) being 70 percent for *Ceriodaphnia* survival, 63 percent for *Ceriodaphnia* reproduction, 73 percent for fathead minnow survival, and 29 percent for algal growth.

Because toxicity to *Ceriodaphnia* has been linked to diazinon in many studies over the past 20 years, and because the herbicide oxadiazon was detected in a large number of samples during the present surveys, relationships were examined between these chemicals and water toxicity to *Ceriodaphnia* and *Selenastrum*, respectively. Diazinon was detected, either by ELISA or by GCMS, in 25 samples. However, the highest concentration measured, 0.288 µg/L by ELISA, was well below the *Ceriodaphnia* LC50 value of 0.32 (Bailey *et al*. 1997), and there was no apparent relationship with toxicity. Oxadiazon and toxicity to *Selenastrum* were measured synoptically in 43 samples, in which oxadiazon was detected in 15. Given the observed occurrence of this herbicide in water, sediment, and tissue samples, we investigated possible relationships with toxicity to the alga Selenastrum. The highest measured water concentration of oxadiazon in this study was 0.062 µg/L, about two orders of magnitude below published EC50 values for similar algae (4.1 to 126 µg/L; EPA ECOTOX data base, http://cfpub.epa.gov/ecotox/). Data from the present study showed no apparent relationship between measured oxadiazon concentration and observed toxicity to Selenastrum (R2= 0.13). While oxadiazon was commonly measured in water and sediment, and had among the highest measured concentrations for pesticides in clam tissues, it does not appear that there was any direct relationship between this herbicide and observed toxicity to the alga Selenastrum. See section 6.3.1.3 for regional trends of organic chemicals in water. Details are discussed by watershed in Section 7.

Sediment toxicity tests were conducted on samples collected during the dry season from the integrator sites near the mouth of each watershed. Observed adverse impacts were limited to moderate reductions in amphipod growth, with one exception. There was 100 percent amphipod mortality observed in a sediment sample collected near the mouth of San Leandro Creek, as discussed in section 6.3.2, below. Region-wide, 6 of 13 sites produced samples in which amphipod growth was significantly less than in controls, one site produced the sample with significant mortality, and no sediment toxicity was observed in samples from the other six sites (Appendix J). While toxicity was observed in samples with sediment chemical concentrations above guideline values, there was no significant or apparent linear relationship between the overall level of contamination and the degree of toxicity. Samples were collected at only one site per watershed during one season, so trends related to land use or seasonality cannot be evaluated.

6.5 Coliform Bacteria

The U.S. EPA *E. coli* limit of 126 MPN/100 mL applies to the geometric mean for all sites that could be used for recreation, which applies to all sites sampled; 235 MPN/100 mL applies only to designated beach sites. Four of the thirty sites sampled for coliforms in 2001 or 2002 are designated beaches that are used for water-contact recreation (Appendix K). One of these sites—Swimming Hole at Samuel P. Taylor State Park (LAG185)—had *E. coli* counts in excess of the Basin Plan objectives for water-contact recreation at designated beaches. Two other beaches—Memorial Park Swim 1 (PES134) and Swim 2 (PES135)—had total coliform counts in excess of Basin Plan objectives for water-contact recreation. The fourth beach, Turtle Pond (WLK162), did not exceed any coliform Basin Plan objectives for recreational use (Figure 6- through Figure 6-).

Twenty-six of the sites sampled for coliforms are not designated beaches; however, the beneficial use of REC-1 (body contact recreation) applies to these sites. Of these sites, 12 exceeded *E. coli* (and in some cases total and fecal coliform) Basin Plan objectives for water-contact recreation; 13 others exceeded at least one of the fecal or total coliform basin plan objectives for recreation. The Root Park site (SLE070), which is in a highly urbanized area, had the highest weekly *E. coli* count of any site (>16000 MPN/100 mL). The San Pablo City Park site (SPA060) had the highest *E. coli* geometric mean (872 MPN/100 mL); this site is also highly urbanized, and much trash and evidence of habitation was observed there during sampling. Another highly urbanized site, La Avenida (STE020), had the second highest *E. coli* geometric mean (796 MPN/100 mL) and the highest total coliform median value. Camp Cooley (STE090, misnamed for Cooley Picnic Area at Camp Costanoan) had extremely high total coliform counts on one day (30,000 MPN/100 mL). Although Camp Cooley has signs prohibiting swimming, swimmers were observed there at each sampling visit, and more than once, its *E. coli* counts exceeded the limit for designated beaches. One site, Cataract (LAG390), did not exceed any coliform Basin Plan objectives for recreational use. The site was included as a reference site, since no water contact is allowed and it is above a municipal drinking source, however it is accessible to hikers and wildlife, despite signs prohibiting swimming.

It is important to note that coliform detection limits varied with sampling date and site. Some sites had a maximum detection limit of 1600 MPN/100 mL, which limited the ability to accurately calculate mean and median values and interpret the maximum daily total coliform objective (10,000 MPN/100 mL).

With the exception of sites dominated by urban land use (see Appendix A), there were no obvious relationships between land use categories and coliform bacteria in recreational waters at the sites sampled. The Stevens/Permanente creeks watershed had consistently very high levels of total coliforms, even though land uses varied greatly between sites. Sites near grazing and horse-riding areas would be expected to have higher coliform counts; however, coliform counts at these sites were at the low end of the range across all sites. Of the seven major watersheds in which samples were collected for coliform bacteria measurement, only Walker Creek did not exceed the *E. coli* Basin Plan objective

(Figure 6-), however only one isolated swimming spot was sampled. Walker Creek watershed has been sampled more intensively for a pathogen TMDL (due to contamination of shellfish beds) and the results of that study are more indicative of general coliform bacteria conditions in the watershed. No water samples were collected in the Suisun or Arroyo Las Positas watersheds for coliform bacteria.

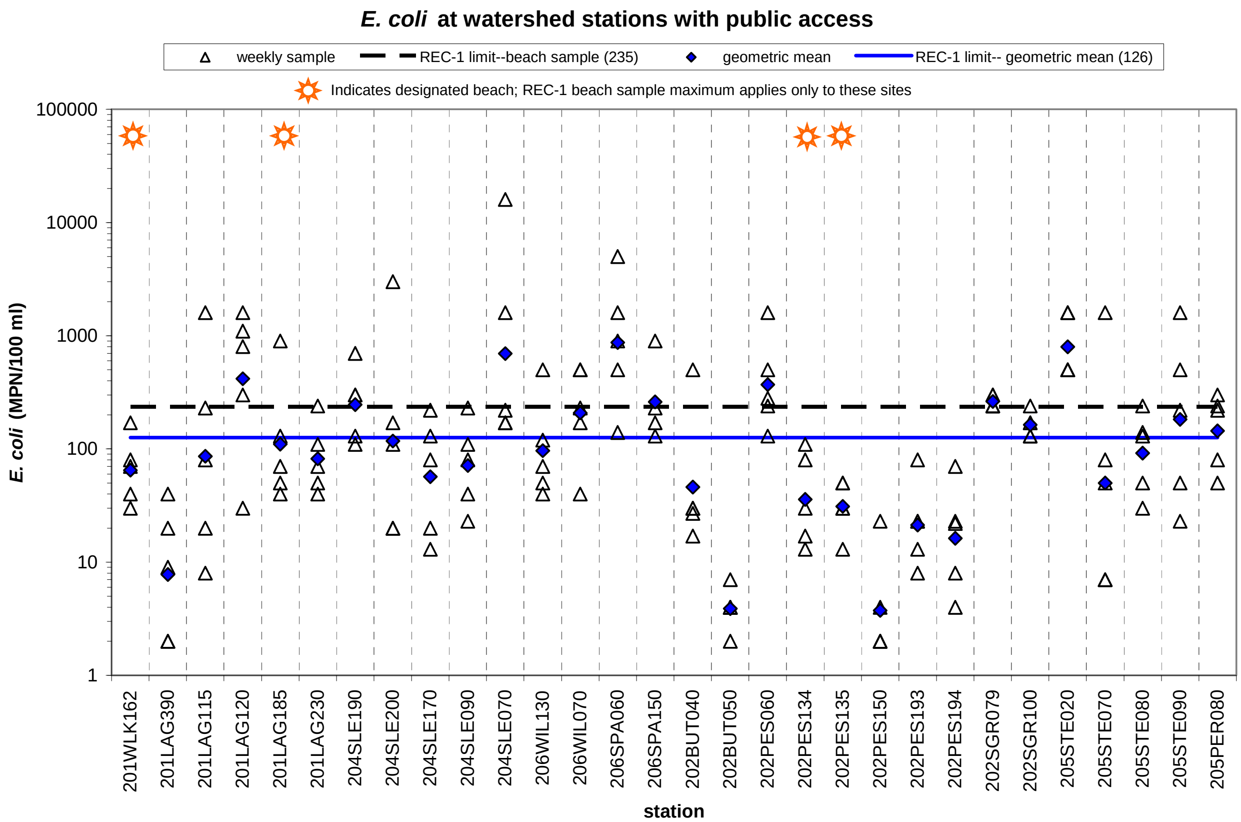

Figure 6-30. ***E. coli*** **counts**

Sites with blue diamonds (the geometric mean) above the blue line at 126 MPN/ 100 mL exceed the EPA steady state limit for E. coli. Sites with sun icons and triangles above the dashed line at 235 MPN/100 mL exceed the limit for designated beaches

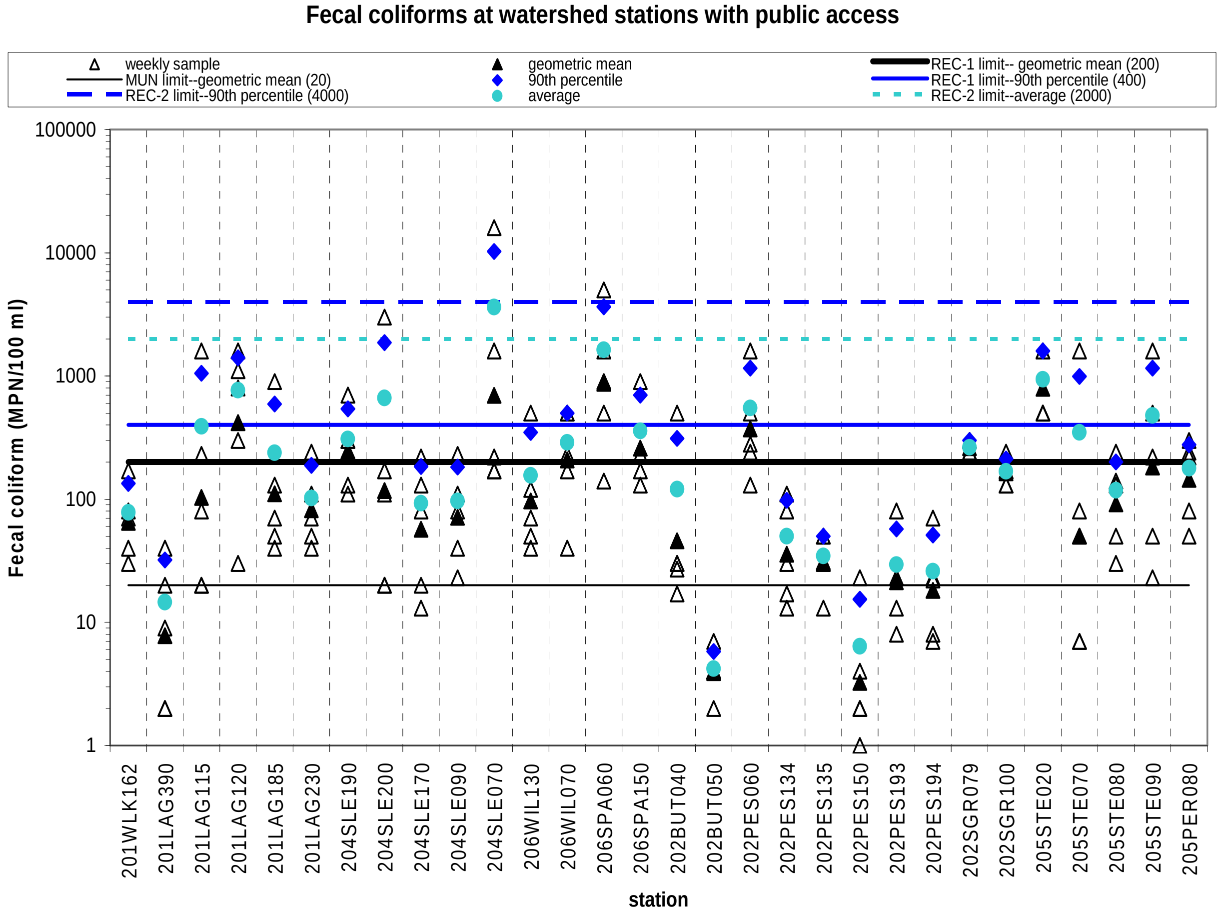

Figure 6-31. Fecal coliform bacteria counts

Counts of the most probable number (MPN) of fecal coliform bacteria measured in 100 milliliters of water samples collected from watershed sites.

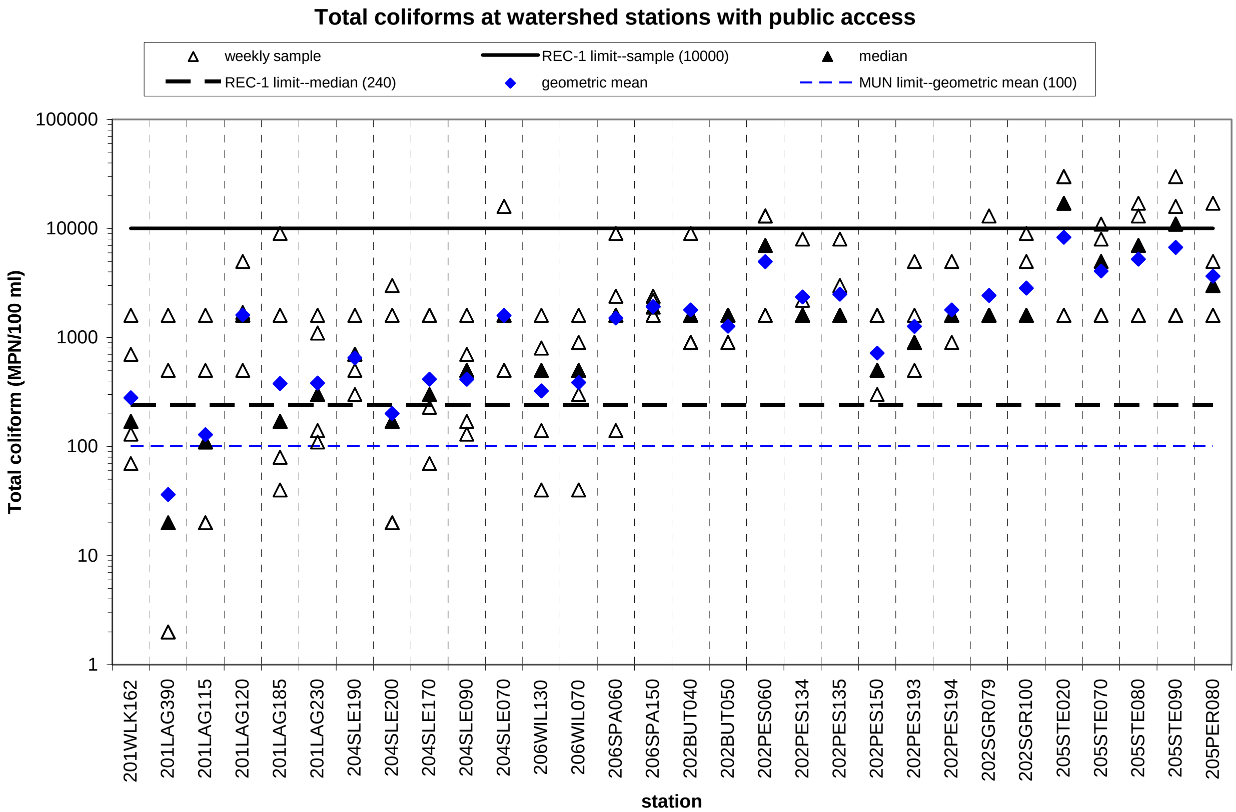

Figure 6-32. Total coliform bacteria counts

Counts of the most probable number (MPN) of total coliform bacteria measured in 100 mL water samples collected from watershed sites.

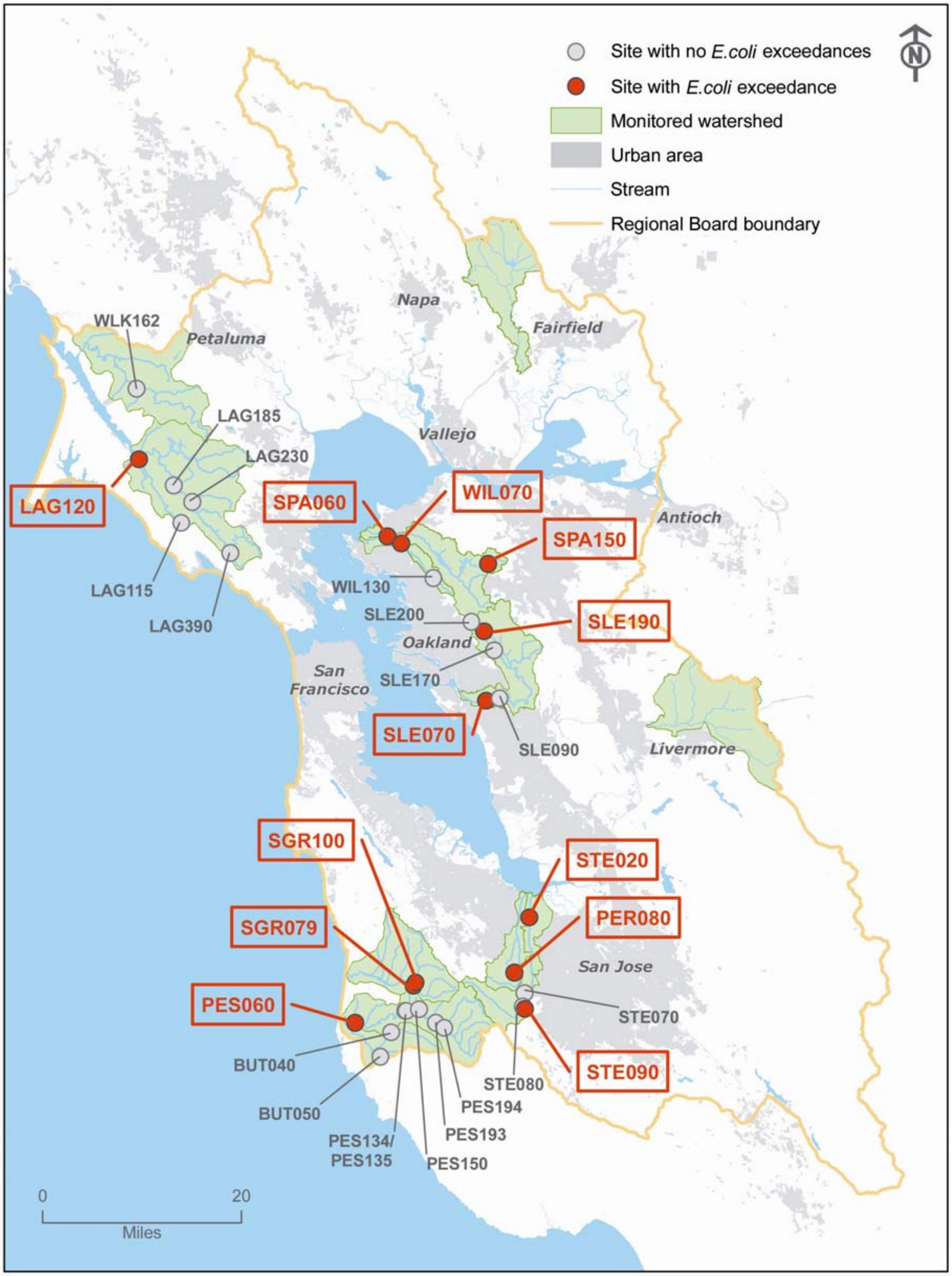

Figure 6-33. Map of *E. coli* bacteria exceedances

6.6 Regional Reference Conditions for Bay Area Streams

Expected background concentrations for certain pollutants (*i.e.* pesticides and other synthetic organics) in pristine, non-degraded systems are obvious: any detectable level of these substances is indicative of anthropogenic pollution. For most water quality indicators, however, it is not as simple to predict conditions in minimally disturbed systems. Biological systems are highly variable in both space and time. Likewise, the concentrations of organic and inorganic dissolved constituents in stream water depend greatly upon natural factors such as geology, hydrology, and vegetation. Defining reference conditions or the range of conditions expected in natural or minimally disturbed systems requires an understanding of the natural variability of a system. Careful descriptions of reference conditions are important in order to properly identify degraded conditions. Further detailed studies must be carried out in order to properly describe reference conditions. This section contains a brief description of approaches for defining reference conditions.

6.6.1 Benthic Macroinvertebrate Assemblages

6.6.1.1 Natural Variability

Detecting the effects of human disturbance on benthic assemblages requires setting appropriate expectations for biological conditions across a range of stream types. A necessary first step is to develop an understanding of the sources and ranges of natural variability in benthic assemblages. Here we consider (1) annual variability, generally associated with annual fluctuations in climate, and (2) geographic variability, due to spatial patterns in climate, topography, and geology.

6.6.1.1.1 Annual Variability

Although bioassessment samples in the Bay Area are all collected during the same April-May reference period, annual variation in climate can cause differences in benthic invertebrate assemblages from year to year. Annual rainfall is highly variable in Mediterranean climates, and changes in seasonal patterns (e.g. high rainfall totals in April and May) can greatly affect the timing of bed-scouring floods, summer baseflow, and water temperatures. These hydrologic factors, in turn, affect the survival, development, and timing of emergence of benthic assemblages. In order to compare data from sites sampled in different years we need to understand the year-to-year variability of benthic assemblages expected at a site. To date, biomonitoring programs in the Bay Area generally sample sites only once (SWAMP) or over two consecutive years (most county stormwater programs).

Four consecutive years of monitoring have been conducted in Sonoma Creek (by Sonoma Ecology Center) and Wildcat Creek and San Leandro Creek (Breaux *et al.* 2005). These sites represent a range of conditions from minimally disturbed to heavily urbanized sites.

In general, annual variability of metrics at minimally disturbed sites draining open space is much lower than variability at urban sites (Table 6-5). Six metrics exhibited low (C.V. < 0.25) inter-annual variability in minimally disturbed streams, while only 3 metrics had low variability between years at urban sites. The taxa richness, Shannon Diversity, and tolerance value metrics generally exhibited the least annual variability, while composition metrics tended to be more variable. Percent predators had low annual variability only at minimally disturbed sites, while variability in percent collectors was low at urban sites because metric values exhibit a small range (90 to 99 percent) relative to the mean. These measures of annual variability should be taken as conservative estimates, as only four years of data, all from moderate rainfall years (2000-2003), are represented.

Taxa presence/absence data from the four-year study of Wildcat Creek and San Leandro Creek were examined in a multivariate ordination analysis (Figure 6-). Consecutive years' samples are generally grouped by site, but there is some overlap between sites. For most sites the year 2000 samples are more dissimilar than the years 2001-2003. Given that year 2000 samples for all sites have systematically lower values on Axis 3 than subsequent years' samples, regional climatic differences in 2000 may be responsible. Of the four years, rainfall in the 1999-2000 wet season was the highest (30 inches), including several late spring storms. Rainfall in 2000-2001, 2001-2002, and 2002-2003 was 20, 24, and 26 inches respectively. Rainfall just prior to sampling might also have resulted in taxonomic differences between years. In the two days before sampling began in 2000, 1.5 inches of rain fell in Oakland. In 2001 and 2002 no precipitation was recorded in the two weeks prior to sampling, except for 0.1 inches on the first day of sampling in 2002. In 2003, 0.9 inches of rain fell 5 days prior to sampling, and 0.6 inches of rain fell the day before sampling (all rainfall data from the Oakland North weather station).

These analyses suggest that year-to-year variability in taxa presence and some metric values can be considerable. Given that the available data come from years that were not extremely wet or dry, it is expected that the long-term annual variability in benthic assemblages is even more significant than is represented here. The data used in this report, in analyses of geographic variability and correlations with land use, come from multiple years (2001-2003). Thus, annual variability is reflected in these analyses, meaning that measured differences between site groups (*e.g.* urban versus open-space land use) are detectable, despite annual variability. A better understanding of the effects of climatic variability on benthic assemblages, however, will allow for more precise conclusions to be drawn about the effects of geographic variability and water quality. Weissich (2005) observed that benthic invertebrate assemblages exhibited high temporal variability throughout the year, even within the April-May reference period. One of the recommendations of this report is that several long-term bioassessment monitoring stations should be established in the Bay Area, in order to gain a better understanding of temporal variability and the role of climate.

Table 6-5. Annual variability for select metrics

	Open Space (n = 4)	**Other** (n = 7)	**Urban** (n = 5)
Taxa Richness	**0.08**	**0.23**	**0.23**
EPT Taxa	**0.1**	**0.25**	0.77
% EPT	**0.22**	0.45	1.03
% Sensitive EPT	0.29	0.89	1.79
Shannon Diversity	**0.06**	**0.17**	0.26
Tolerance Value	**0.13**	**0.14**	**0.11**
% Intolerant Organisms	0.35	0.86	1.4
% Tolerant Organisms	0.92	0.73	0.5
% Dominant Taxon	0.3	0.35	0.35
Percent Collectors	0.46	0.47	**0.16**
Percent Filterers	0.46	0.65	0.87
Percent Scrapers	0.29	0.72	0.94
Percent Predators	**0.12**	0.56	1
Percent Shredders	0.47	1.2	1.64

The annual variability for select metrics is expressed as the average coefficient of variation (C.V.) for sites over four years. The number of sites in each site class is indicated by “n”. C.V.s less than 0.25 are in bold. “Other” sites include a mix of rural, agricultural, and mixed land use sites, and represent an intermediate level of disturbance. A subset of metrics is shown because not all metrics were calculated in the original datasets.

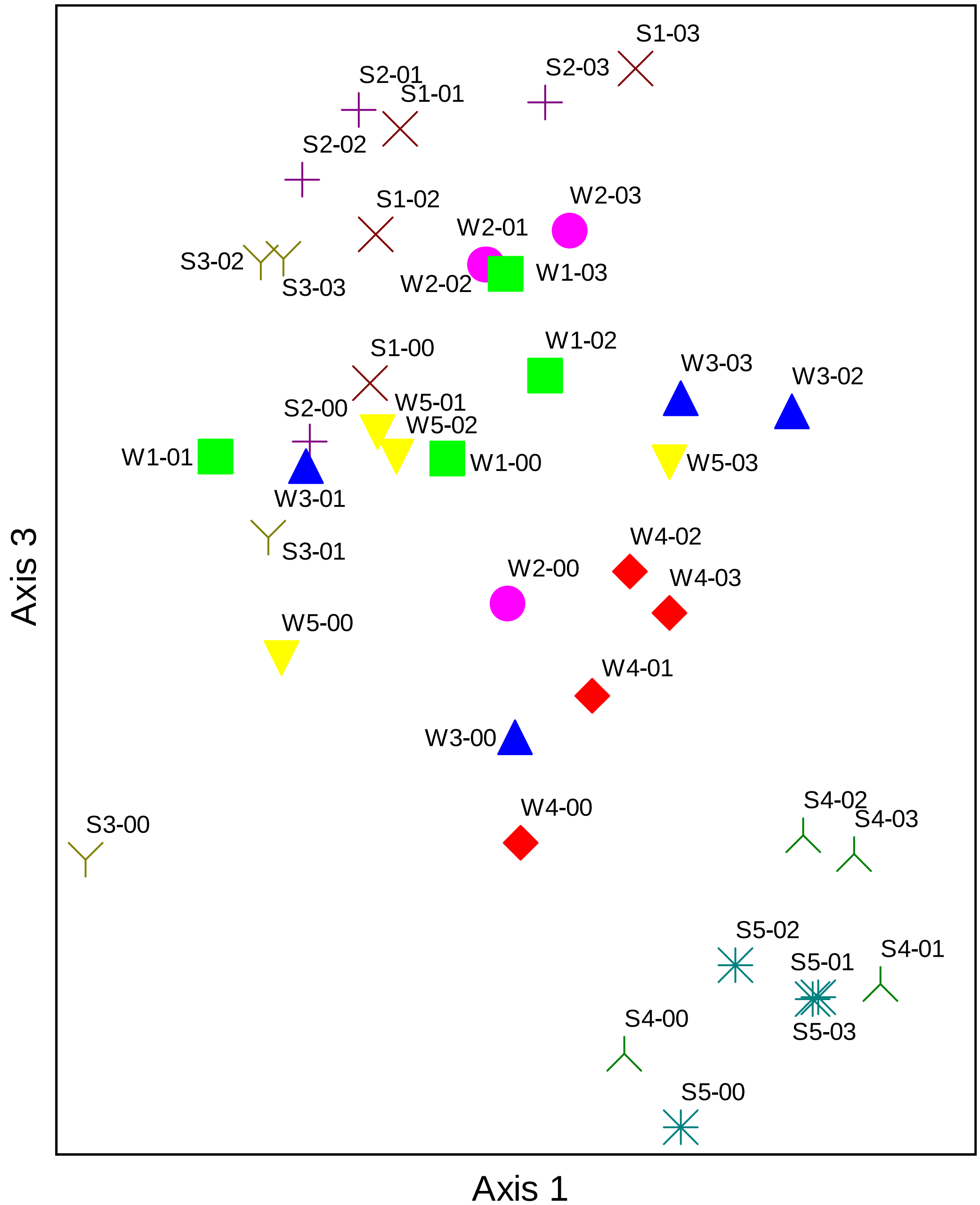

Figure 6-34. Taxa presence in Wildcat and San Leandro Creeks

NMS ordination of taxa presence at 5 sites in Wildcat Creek (W) and 5 sites in San Leandro Creek (S) with four consecutive years of data. Sites are numbered from downstream to upstream. The year of sampling is indicated by the last two digits of the year sampled (e.g., 2001 is -01). Each site is shown with a distinct symbol and color. Wildcat Creek sites are shown with filled symbols; San Leandro Creek sites are shown with unfilled symbols. Axis 3 represents 52 percent of the variation and Axis 1 represents 26 percent of the variation in the original data.

6.6.1.1.2 Geographic Variability

The pervasive, intense human land use in low elevation areas in the Bay Area presents a major difficulty in defining reference conditions. Minimally disturbed conditions are generally only present in the Bay Area in protected parklands in mountainous areas at high elevations. A longitudinal study of Santa Clara Valley streams by Fend et al. (2005) found a high degree of correlation between natural environmental variables (channel slope, elevation, temperature) and anthropogenic impacts (e.g., urban land use, reservoirs, reach habitat quality). Many studies have described natural variation in benthic invertebrate assemblages along longitudinal gradients (Alan 1995). Thus, teasing apart the covarying effects of natural factors and anthropogenic impacts is extremely difficult. Much more work is needed to define appropriate reference conditions for lowland streams in the Bay Area.

To examine the range of natural, undisturbed biological conditions across the Bay Area, biological metrics and community composition were examined from sites with minimal human influence. Minimal human influence was established using three criteria: (1) the absence of any urban, residential, grazing, or agricultural land use in the upstream watershed, (2) a P-HAB Channel Alteration score greater or equal than 17 (out of 20), and (3) P-HAB Riparian Zone Width scores for right and left bank greater or equal than 9 (out of 10). These two P-HAB scores were selected as criteria because they best represent local reach-scale habitat disturbance in the channel and riparian zone. Numerical criteria for these P-HAB scores were arbitrarily set to eliminate sites that scored lower than the upper range of the "optimal" condition category for each variable. The land use criteria limited the minimally disturbed sites to 13 sites classified as open space in the land use type classification (see above). The third criteria eliminated 1 of the sites, bringing the total number of minimally disturbed sites to 12.

Also included in this analysis were sites monitored by the Regional Board in 2003, as well as monitoring performed by other agencies within the Bay Area using the same field and laboratory protocols. The same criteria were used to identify sites with minimal human influence from these datasets. Four sites from the Regional Board's 2003 monitoring and 7 sites monitored by other agencies were identified, bringing the total number of minimally disturbed sites to 23 (Table 6-6). To ensure that the datasets were comparable, raw taxonomic data was combined together to resolve differences in taxonomic resolution prior to the re-calculation of metrics.

Table 6-6. Minimally disturbed sites used in the analysis of geographic variability

Site ID	Stream	Watershed	Monitoring Agency
BUT-050	Little Butano Creek	Butano Creek	SWAMP
LAG-330	Big Carson Creek	Lagunitas Creek	SWAMP
LAG-335	Big Carson Creek	Lagunitas Creek	SWAMP
LAG-380	Little Carson Creek	Lagunitas Creek	SWAMP
LAG-390	Cataract Creek	Lagunitas Creek	SWAMP
PES-180	Peters Creek	Pescadero Creek	SWAMP
PES-190	Pescadero Creek	Pescadero Creek	SWAMP
PES-200	Slate Creek	Pescadero Creek	SWAMP
PES-210	Oil Creek	Pescadero Creek	SWAMP
PES-240	Pescadero Creek	Pescadero Creek	SWAMP
SLE-180	East Fork Redwood Creek	San Leandro Creek	SWAMP
SLE-230	Kaiser Creek	San Leandro Creek	SWAMP
SPC-MF	Middle Fork San Pedro Creek	San Pedro Creek	San Mateo County Pollution Prevention Program
SPC-SF	South Fork San Pedro Creek	San Pedro Creek	San Mateo County Pollution Prevention Program
UP-6	Upper Penitencia Creek	Upper Penitencia Creek	Santa Clara Valley Urban Runoff Program
UMR 2	Upper Marsh Creek	Marsh Creek	Contra Costa County Clean Water Program (CCCCWP)
UMR 3	Upper Marsh Creek	Marsh Creek	CCCCWP
SMA-180	San Mateo Creek	San Mateo Creek	SWAMP
SMA-160	San Mateo Creek	San Mateo Creek	SWAMP
MTD-120	Mitchell Canyon Creek	Mt. Diablo Creek	SWAMP
MTD-140	Donner Canyon Creek	Mt. Diablo Creek	SWAMP
NAP-Red	Redwood Creek	Napa River	Friends of the Napa River
NAP-Se	Segassia Creek	Napa River	Friends of the Napa River

To determine if variation between benthic assemblages in minimally disturbed streams was ascribable to natural environmental factors, correlations between taxa presence and environmental variables were examined. At each minimally disturbed site, four environmental variables that play important roles in structuring stream communities (Allan 1995) were quantified at each minimally disturbed site: two climate/hydrology variables (flow intermittency, watershed annual precipitation) and two channel network variables (channel slope, drainage area). Flow intermittency was assessed during at least one late-summer (September) site visit, and was quantified as binary values (1 = intermittent, 0 = perennial), except one site with questionable intermittency that was coded as 0.5. Annual precipitation in the upstream drainage basin of each site was estimated from a precipitation contour map of the Bay Area by Rantz (1971). Channel slope and drainage area were estimated from digitized topographic maps (TOPO! v.2.0, Wildflower Productions, 1999). Note that flow intermittency and watershed annual precipitation generally reflect other geographic or landscape gradients: coastal watersheds have the highest precipitation levels and are almost always perennial, whereas watersheds east of the Oakland-Berkeley Hills have the lowest precipitation levels and are mostly intermittent. Thus, these two factors are well-correlated with each other and reflect vegetation gradients and ecoregion boundaries. There is very little published information available on spatial patterns of flow intermittency in the Bay Area, however.

Intermittency and annual precipitation were highly correlated with the first axis of an NMS ordination of taxa presence at minimally disturbed sites, while stream slope and drainage area exhibited minimal correlation (Figure 6-, Table 6-7). Intermittency and annual precipitation are highly correlated with each other, however. When only perennial sites are examined (17 of 23 minimally disturbed sites), there is very low correlation between annual precipitation and the first ordination axis.

Many biological metrics at intermittent streams are significantly different (paired comparisons using student's t, alpha = 0.05) from conditions at perennial streams (Table 6-7). In particular, many aquatic beetles (Order: Coleoptera) were absent from intermittent sites, probably due to their novel life history in which both the adult and larval stages of many taxa are aquatic. Likewise, caddisfly (Order: Trichoptera) richness was also significantly reduced at intermittent sites. In general, richness of most insect orders was lower at intermittent sites, reflected in the taxa richness and EPT richness metrics.

Watershed annual precipitation exhibited no relationship to any biological metrics. Watershed annual precipitation ranged from 400 to 1200 mm/yr (16 to 46 in/yr) at minimally disturbed sites, with a median value of 880 mm/yr (34 in/yr). Annual precipitation in the Bay Area ranges from 300 mm/yr (12 in/yr) east of Livermore to above 1300 mm/yr (50 in/yr) in the headwaters of the Napa River in the Mayacamas Mountains. Thus, it is probable that the range of watershed precipitation values in the set of minimally disturbed sites reflects the range of conditions in the Bay Area.

Channel slope varied from 1 to 15 percent among minimally disturbed sites, with most sites in the 2 to 6 percent range. Most streams in low elevation zones in the Bay Area, such as along the bayshore, have slopes less than 2%. Thus, the minimally disturbed streams discussed here may not reflect reference conditions for low gradient streams. Drainage area of the minimally disturbed streams ranged from 0.1 sq. km (0.1 sq. miles) to 40 sq. km (15 sq. miles), with most sites less than 10 sq. km. Test sites in the Bay Area tend to have larger drainage areas, on the order of 5-100 sq. km.

The biological expectations described in this analysis apply mainly to small, high-gradient streams in hilly or mountainous parts of the Bay Area. Minimally disturbed sites were exclusively gravel and cobble-bedded streams, and generally were located in mountainous terrain. In contrast, many streams in the Bay Area along the bay plain or in broad valleys have slopes less than one percent and are naturally sand-bedded streams. Whereas gravel-bedded streams share many common physical and ecological processes across their range of conditions, sand-bedded streams often have very different biological communities (Allan 1995). Additionally, streams with larger watersheds are expected to have different invertebrate communities than streams with small watersheds. Much more research is needed in order to define appropriate reference conditions for larger, lower gradient streams in the Bay Area.

Table 6-7. Minimally disturbed intermittent and perennial sites' metric scores

Richness Metrics	Mean Intermittent n = 6	Mean Perennial n = 17	T-test Probability > t
Taxa Richness	**32**	**46**	**<0.0001**
EPT Taxa	**16**	**23**	**0.002**
Ephemeroptera Taxa	7	9	0.0748
Plecoptera Taxa	5	6	0.6093
Trichoptera Taxa	**4**	**9**	**<0.0001**
Coleoptera Taxa	**2**	**7**	**<0.0001**
Diptera Taxa	8	10	0.1091
Non-Insect Taxa	5	6	0.2518
Composition Metrics			
% Sensitive EPT	33	38	0.2364
% Non-insect	3	5	0.315
% Chironomidae	**22**	**13**	**0.0228**
% Coleoptera	**1**	**12**	**0.0071**
% Oligochaeta	**2**	**1**	**0.0435**
Tolerance Metrics			
Tolerance Value	**4**	**3.6**	**0.0263**
% Intolerant	30	33	0.3342
Functional Feeding Groups			
% Collector-gatherer	**68**	**40**	**<0.0001**
% Collector-filterer	2	5	0.0511
% Scraper	**7**	**25**	**0.003**
% Shredder	**5**	**13**	**0.0228**
% Predator	17	17	0.7533

Mean metric scores at minimally disturbed intermittent and perennial sites, and results of Student's t-test. T-test values <0.05 are considered significant and are bolded.

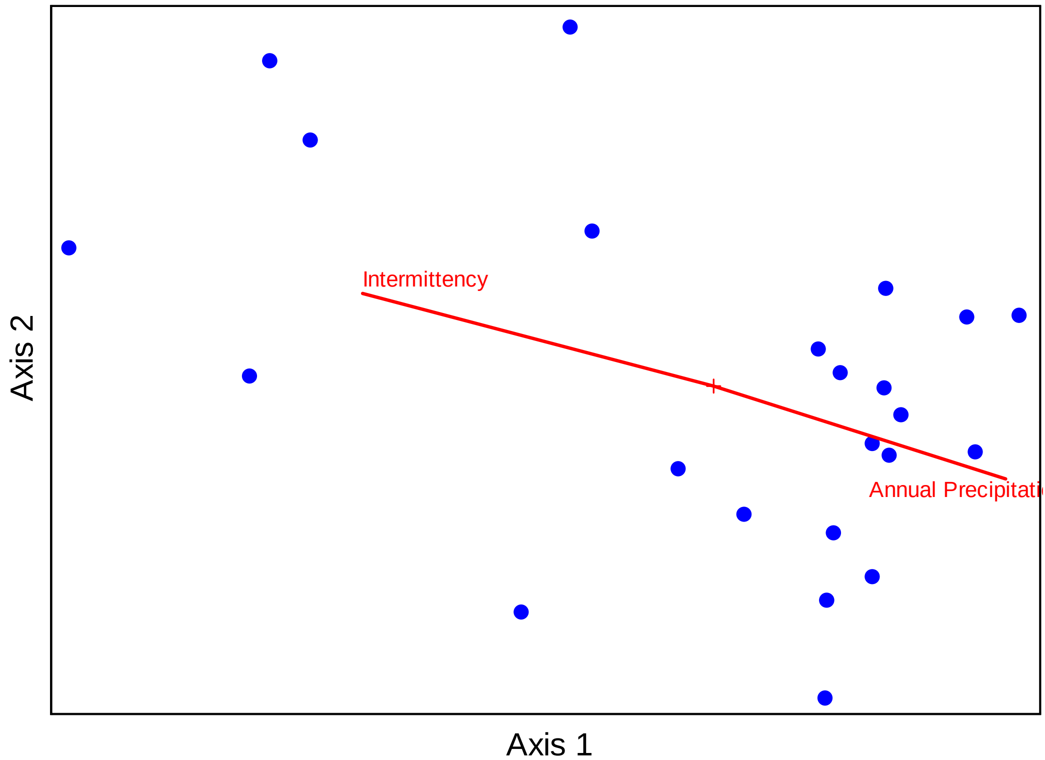

Figure 6-35. Correlation of environmental variables with taxa presence

Intermittency and annual precipitation are highly correlated with the first axis of this NMS ordination of BMI taxa presence at reference sites. Sites clustered on the right side of the graph have perennial flow, while sites on the left are intermittent.

6.6.1.2 Bioassessment Analytical Tools: Biological Metrics and Indicator Taxa

6.6.1.2.1 Biological Metrics

One major goal of bioassessment is to identify streams that have been negatively impacted by human activities relative to undisturbed conditions. An ideal analytical tool to accomplish this goal should be very sensitive to human disturbance, yet have low natural variability. Variability in metrics was examined within minimally disturbed perennial and intermittent sites.

Seven metrics from perennial sites and 8 metrics from intermittent sites had C.V.s less than 0.25 (Table 6-8). Metrics with low variability common to both site perennial and intermittent site classes were Diptera taxa, taxa richness, EPT taxa, percent EPT, and tolerance value.

Table 6-8. Coefficients of Variation from perennial and intermittent stream classes

	Perennial C.V.	Intermittent C.V.
Coleoptera Taxa	**0.23**	0.49
Diptera Taxa	**0.23**	**0.14**
Ephemeroptera Taxa	**0.24**	0.35
Plecoptera Taxa	0.32	0.28
Trichoptera Taxa	0.27	**0.22**
Non-Insect Taxa	0.38	0.4
Taxa Richness	**0.13**	**0.09**
EPT Taxa	**0.19**	**0.17**
% EPT	**0.19**	**0.16**
% Sensitive EPT	0.27	**0.23**
% Chironomidae	0.55	0.45
% Coleoptera	0.75	1.82
% Oligochaeta	1.13	1.08
% Non-insect	0.8	0.41
% Intolerant	0.27	**0.17**
% Tolerant	1.27	0.53
Tolerance Value	**0.1**	**0.08**
% Predator	0.38	0.36
% Collector-filterer	0.71	1.05
%Collector-gatherer	0.29	**0.14**
% Scraper	0.5	1.05
% Shredder	0.57	0.53
% Other	1.47	0.94

Coefficients of Variation for metrics that were less than 0.25 are in bold. Metrics are not included when the mean for the metric was 0.

To examine the ability of 26 common metrics to discriminate between natural and altered conditions, metric scores at minimally disturbed sites were compared to values from two groups of sites representing moderate and high levels of alteration. Assemblage Groups 1 and 2, identified in the multivariate analysis of assemblage groups (see Assemblage Groups, above), are interpreted to represent high and moderate levels of human disturbance. Eleven out of 12 sites identified as minimally disturbed were classified into Assemblage Group 3, while Assemblage Groups 1 and 2 are dominated by streams draining urban and agricultural land uses, respectively. Disturbed sites in assemblage groups 1 and 2 were classified as perennial or intermittent streams and compared to the range of values from minimally disturbed sites with the same flow status.

The discrimination efficiency of a metric was defined as the percentage of disturbed sites with metric scores outside of the range of values (minimum to maximum) of minimally disturbed sites. In cases where metric values at disturbed sites were both greater and less than the maximum and minimum values at minimally disturbed sites, only the higher discrimination efficiency is reported. Discrimination efficiencies of 26 metrics ranged from 0 to 100 percent (Table 6-9). In general, metrics had higher discrimination efficiencies between minimally disturbed sites and Assemblage Group 1 (urban sites) than Assemblage Group 2 (agricultural sites). Metrics with discrimination efficiencies both greater than 50 percent for Assemblage Group 2 and greater than 80 percent for Assemblage Group 1 are shown in bold in Table 6-9.

Table 6-9. Discrimination efficiencies of 26 metrics of inferred biological impairment

	Response to Disturbance	Intermittent A.G. 2	Intermittent A.G. 1	Perennial A.G. 2	Perennial A.G. 1
Richness Metrics					
Taxa Richness	-	**85**	**93**	**100**	**100**
EPT Taxa	-	31	93	**91**	**100**
Coleoptera Taxa	-	31	53	**91**	**100**
Diptera Taxa	-	**62**	**93**	**82**	**100**
Ephemeroptera Taxa	-	38	100	**73**	**100**
Plecoptera Taxa	-	23	100	45	100
Trichoptera Taxa	-	31	80	18	95
Non-Insect Taxa	+	23	40	0	0
Composition Metrics					
% EPT	-	**54**	**87**	**73**	**80**
% Sensitive EPT	-	**54**	**93**	**73**	**100**
% Chironomidae	+	38	73	**81**	**85**
% Coleoptera	-	31	53	**64**	**95**
% Oligochaeta	-	23	53	36	**80**
% Non-insect	+	31	80	9	60
Tolerance Metrics					
% Intolerant	-	**54**	**93**	**82**	**100**
% Tolerant	+	54	67	9	0
Tolerance Value	+	**54**	**93**	**90**	**100**
Functional Feeding Groups					
% Predator	-	46	80	**82**	**100**
% Collector-filterer	-	38	53	36	15
%Collector-gatherer	+	46	60	**64**	**95**
% Scraper	-	46	73	**73**	**100**
% Shredder	-	**54**	**87**	**64**	**90**
% Other	-	62	53	0	0

Metrics in bold had discrimination efficiencies greater than 50 percent for Assemblage Group 2 and greater than 80 percent for Assemblage Group 1.

For intermittent streams, six metrics exhibited low natural variation (C.V.<0.25) and high discrimination efficiency includes: taxa richness, Diptera taxa, percent EPT, percent sensitive EPT, percent intolerant, and tolerance value. Seven metrics had low variation and high discrimination efficiency for perennial streams: taxa richness, Diptera taxa, Coleoptera taxa, Ephemeroptera taxa, EPT taxa richness, percent EPT, and tolerance value.

Redundancy between selected metrics across all sites was established by examining Pearson product-moment correlation coefficients, which measure the strength of the linear relationship between two variables. Metrics with correlation coefficients $|r| \geq 0.90$ were considered to be redundant. Highly redundant metric pairs include: percent intolerant, tolerance value, and percent sensitive EPT; Ephemeroptera taxa, taxa richness, and EPT taxa; and Coleoptera taxa and taxa richness. Four metrics exhibited low redundancy at both perennial and intermittent sites: taxa richness, Diptera taxa richness, percent EPT, and tolerance value. These four metrics all exhibit low natural variability, high ability to discriminate disturbance, and relatively low redundancy. The range of values for these metrics from minimally disturbed streams is shown in Table 6-10.

This analysis suggests that certain biological metrics could be used to measure the response of stream biota to human disturbance in a subset of streams in the Bay Area. Further work is needed to (1) refine an develop this analytical approach and (2) carefully examine the range of physical settings that reference conditions can be developed for, given constraints on the availability of minimally disturbed streams in the Bay Area. This type of analytical tool could serve to further the utility of bioassessment in the Bay Area by establishing a set of standards that reflect minimally disturbed conditions with which to compare to biological conditions from test sites.

Table 6-10. Metrics for minimally disturbed streams in the San Francisco Bay Area

	Intermittent			Perennial		
	Minimum	Median	Maximum	Minimum	Median	Maximum
Taxa Richness	28	33	34	38	46	59
Diptera Taxa	7	8	10	7	9	14
% EPT	55	70	85	40	62	74
Tolerance Value	3.58	3.96	4.47	3.07	3.46	4.26

6.6.1.2.2 Indicator Taxa

Aquatic invertebrates exhibit a wide range of tolerances to natural habitat conditions and pollutants. Taxa that are commonly found in poor water quality conditions are considered to be tolerant of pollution. Benthic assemblages that are exclusively dominated by these tolerant taxa indicate low biological integrity. The taxa identified in this analysis could be useful taxa to focus on in future bioassessment projects in Bay Area streams.

Sites with poor water quality or habitat conditions at the time of invertebrate sampling (spring season) were identified using the following criteria:

1. Total pesticide concentrations (sum of 34 organochlorine and 44 organophosphate pesticides) in water greater than 0.05 ppb
2. Metals concentrations in water exceeding water quality standards
3. Nitrate concentrations greater than 4.0 mg/L, or ammonia or nitrite concentrations greater than 0.02 mg/L
4. Minimum dissolved oxygen concentrations below 1.0 mg/L
5. Concrete channels with little or no substrate or other habitat

Three sites exceeded the pesticide criteria: SLE030 (0.118 ppb), ALP010 (0.082 ppb), and SPA020 (0.063 ppb). One site exceeded a chronic standard for metals: SLE030 (30.6

ppb chromium). Five sites exceeded one or more of the criteria for nutrients: ALP010 (4.39 mg/L nitrate, 0.037 mg/L nitrite), ALP100 (4.10 mg/L nitrate, 0.120 mg/L nitrite), ALP110 (8.04 mg/L nitrate, 0.049 mg/L nitrite), SLE030 (7.65 mg/L nitrate), and STE020 (0.020 mg/L nitrite). One site failed to meet the minimum dissolved oxygen criteria: LAG160 (0.10 mg/L). At one site, PER020, the channel was a rectangular concrete channel with little available habitat. In summary, eight sites were identified as having poor water quality or habitat conditions out of all the BMI samples collected by SWAMP.

"Common tolerant taxa" are defined in this report as taxa that occur at 50 percent or more of sites identified as having poor water quality at the time of invertebrate sampling. Eight common tolerant taxa were identified:

1. Chironomidae, chironomid midges (Diptera)
2. Oligochaeta, segmented worms such as Naidids and Tubificids
3. *Simulium* sp., black fly larvae (Diptera: Simuliidae)
4. *Baetis* sp., a baetid mayfly (Ephemeroptera: Baetidae)
5. Ostracoda, seed shrimp
6. *Physa/Physella*, two genera of physid snails (Gastropoda)
7. Turbellaria, flatworms
8. Sperchontidae, water mites, including *Sperchon* sp. (Acari)

Together, these 8 taxa made up over 95 percent of the total number of organisms at the 8 sites with poor water quality (Note: these taxa represent operational taxonomic units for the purposes of identification, and may in fact include tens or hundreds of individual species). Because these taxa are the dominant organisms present at sites with poor water quality, benthic assemblages with a high percentage of the total number of organisms belonging to these taxa may indicate poor biological integrity. At sites draining urban land uses, over 90 percent of organisms were common tolerant taxa (Table 6-11). Less than 50 percent of organisms at sites draining open space were common tolerant taxa, while sites in other land use classes exhibited a wide range of common tolerant taxa.

Table 6-11. Occurrence of tolerant taxa at sites in different land use classes

	Common Tolerant Taxa		
	Min.	**Median**	**Max.**
Open Space	14%	29%	46%
Grazing	16%	62%	95%
Agriculture	47%	66%	89%
Rural Residential	6%	31%	96%
Urban	90%	99%	1%

"Common intolerant taxa" are defined in this report as taxa that occur at greater than 50 percent of minimally disturbed sites and are absent from sites with poor water quality (identified above). These taxa represent organisms that are widespread throughout the Bay Area but are sensitive to water quality degradation. Because intermittency of flow was found to be the most important natural factor affecting taxon occurrence, separate lists of intolerant taxa were developed for perennial and intermittent streams (Table 6-12 and Table 6-13).

Table 6-12. List of common intolerant taxa: perennial streams

1. *Rhyacophila* sp., a free-living caddisfly (Trichoptera: Rhyacophilidae)
2. *Malenka* sp., a nemourid stonefly (Plecoptera Nemouridae)
3. *Diphetor hageni*, a baetid mayfly (Ephemeroptera: Baetidae)
4. *Parthina* sp., a tube-case making caddisfly (Trichoptera: Odontoceridae)
5. *Zaitzevia* sp. (larvae), a riffle beetle (Coleoptera: Elmidae)
6. *Drunella* sp., an ephemerellid mayfly (Ephemeroptera: Epehemerellidae)
7. *Ironodes* sp., a heptageniid mayfly (Ephemeroptera: Heptageniidae)
8. *Paraleptophlebia* sp., a prong-gilled mayfly (Ephemeroptera: Leptophlebiidae)
9. *Calineuria californica*, a golden stonefly (Plecoptera: Perlidae)
10. *Neophylax* sp., a tube-case making caddisfly (Trichoptera: Uenoide)
11. *Zaitzevia* sp. (adults), a riffle beetle (Coleoptera: Elmidae)
12. *Lepidostoma* sp., a tube-case making caddisfly (Trichoptera: Lepidostoma)
13. *Eubrianax edwardsi*, a water penny beetle (Coleoptera: Psephenidae)
14. *Cinygmula* sp., a genus of heptageniid mayflies (Ephmereroptera: Heptageniidae)
15. *Sweltsa* sp., a chloroperlid stonefly (Plecoptera: Chloroperlidae)
16. *Maruina lanceolata*, a moth fly (Diptera: Psychodidae)
17. *Limnophila* sp., a crane fly (Diptera: Tipulidae)
18. *Serratella* sp., an ephemerellid mayfly (Ephemeroptera: Ephemerellidae)
19. *Wormaldia* sp., a retreat-making caddisfly (Trichoptera: Philopotamidae)
20. *Cordulegaster dorsalis,* the pacific spiketail dragonfly (Odonata: Cordulegastridae)
21. *Narpus* sp., a riffle beetle (Coleoptera: Elmidae)
22. *Hesperoperla* sp., a golden stonefly (Plecoptera: Perlidae)
23. *Micrasema* sp., a tube-case making caddisfly (Trichoptera: Brachycentridae)
24. *Polycentropus* sp., a trumpet-net caddisfly (Trichoptera: Ploycentropodidae)
25. *Torrenticola* sp., a water mite (Acari: Torrenticolidae)

Table 6-13. List of common intolerant taxa: intermittent streams

1. *Rhyacophila* sp., a free-living caddisfly (Trichoptera: Rhyacophilidae)
2. *Drunella* sp., an ephemerellid mayfly (Ephemeroptera: Epehemerellidae)
3. *Paraleptophlebia* sp., a prong-gilled mayfly (Ephemeroptera: Leptophlebiidae)
4. *Sweltsa* sp., a chloroperlid stonefly (Plecoptera: Chloroperlidae)
5. Capniidae, a family of stoneflies (Plecoptera)
6. *Neohermes* sp., a fishfly (Megaloptera: Corydalidae)
7. *Malenka* sp., a nemourid stonefly (Plecoptera Nemouridae)
8. *Lepidostoma* sp., a tube-case making caddisfly (Trichoptera: Lepidostoma)
9. *Dicranota* sp., a crane fly (Diptera: Tipulidae)
10. Hydrobiidae, pebblesnails (Gastropoda)
11. *Meringodixa* sp., a dixid fly (Diptera: Dixidae)
12. *Baumannella alameda*, a perlodid stonefly (Plecoptera: Perlodidae)
13. *Taenionema* sp., a stonefly (Plecoptera: Taeniopterigydae)

Tolerance values (from the CAMLnet STE) assigned to these taxa are generally low (less than 3), indicating pollution intolerance, with several exceptions. Hydrobiidae was found exclusively at sites with excellent water quality and habitat conditions, despite its tolerance value of 8. *Polycentropus* sp. was given a tolerance value of 6, but in the Bay Area all 11 sites where it was found are believed to exhibit excellent biological integrity. *Diphetor hageni* was assigned a tolerance value of 5, but was absent from urban sites and sites with poor water quality. *Paraleptophlebia* sp., *Ironodes* sp., *Zaitzevia* sp., and *Cinygmula* sp., which were assigned tolerance values of 4, were found at many sites with low to moderate levels of disturbance but not at sites with poor water quality.

Although most of the intolerant taxa from intermittent sites were also common at perennial sites, several taxa were found more frequently or exclusively at intermittent sites, including Capniidae, *Neohermes* sp., *Dicranota* sp., *Meringodixa* sp., *Baumannella alameda*, and *Taenionema* sp.

Although these 26 taxa are fairly widespread, occurring at 10 to 50 percent of sites, they often represent a small percentage of the total number of organisms collected at a site. Consequently, the number of “common intolerant taxa” found at a site, rather than the percentage of the total number of organisms made up of these taxa, may be an excellent indicator of biological integrity.

6.6.2 Water and Sediment Chemistry

The geology of the San Francisco Bay region is such that watersheds contain mineral deposits and ultramafic rocks that are naturally enriched in metals relative to the mean composition of the continental crust. Relatively high concentrations of chromium, nickel, and vanadium have eroded from the watersheds and deposited in San Francisco Bay sediments. Hornberger *et al.* (1998) found that concentrations of these metals have remained fairly constant since before major anthropogenic activities in the mid-1800s.

Chromium and nickel frequently exceed sediment quality guidelines throughout the region. However, these metals do not seem to be highly biologically available.

Although other metals are also naturally occurring, anthropogenic activities have increased their concentrations in sediments. Watersheds in the San Francisco Bay region contain some of the richest geologic deposits of mercury in the world. Mining activities that occurred primarily between 1850 and 1900 mobilized these deposits, thereby increasing concentrations in the San Francisco estuary and many of its watersheds. Guadalupe Creek, downstream from the second largest historical mercury mine in the world, has high concentrations of mercury that are contributing to fish contamination in San Francisco Bay.

6.6.3 Nutrients Reference Conditions

As noted in Section 6.3.1.1, nutrient concentrations in this report were compared with U.S. EPA's reference guidelines for Aggregate Ecoregion III, Ecoregion 6 (Southern and Central California Chaparral and Oak Woodlands) streams (U.S. EPA 2000a). The guidelines were derived from 25th percentile values of stream monitoring data collected from 1990 through 1999. U.S. EPA made the somewhat arbitrary assumption that the 25th percentile represents reference conditions, but encouraged states and tribes to establish more informed reference conditions and criteria.

In 2003, Tetra Tech, Inc. conducted a pilot study for U.S. EPA to, among other objectives, identify more meaningful reference conditions for nutrients in Ecoregion 6 streams. The study utilized data collected by a variety of sources from 1975 through 2002. Reference or "minimally impacted" streams were defined as those meeting the following criteria (U.S. EPA 2003):

- Beneficial uses met
- No field indicators of hydrological disturbance
- Land use predominantly natural
- Natural flow levels maintained (i.e. minimal flow diversions)
- Stable channel with well developed riparian zone and intact substrate

Median nutrient concentrations for these streams were reported as 0.02, 0.05, 0.25, 0.04, and 0.08 mg/L for NH3-N, NO3-N, TKN, ortho-P, and total P, respectively. These values are similar to, but somewhat higher than U.S. EPA reference values. Maximum concentrations reported for the minimally impacted streams were 3.25, 2.85, 1.20, 0.23, and 0.30 mg/L for the respective constituents.

In this study, only two sites designated as open space were sampled for nutrients: SLE230 in EBMUD protected-watershed land above Upper San Leandro Reservoir and PES190 on upper Pescadero Creek in Portola State Park. At both sites, results for NH3-N and NO3-N were above Tetra Tech's median concentration for reference streams in all seasons. In at least one season, concentrations for TKN, ortho-P, and total P were also above the median. However, all concentrations were notable below Tetra Tech's maximum for minimally impacted streams. Nutrient data collected by SWAMP at reference sites add to our understanding of regional reference concentrations and can be used to support development of nutrient WQOs.

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7 Results by Watershed

For a comprehensive understanding of the results presented in this section, review Section 6 for background on the study's analytical approach.

To more thoroughly understand the results for each watershed, refer to:

- Section 1: Map notes explaining the categories used in the maps
- Section 2: Watershed descriptions
- Section 3: Watershed maps and Table 3-4, which lists what was monitored where and general land use categories
- Section 4: Methods; Tables 4-2 and 4-3 for thresholds; Table 4-4 for biological metrics
- Section 6: Overview of regional results and context for watershed-specific results

Organization of this section

7.x.1: Brief summary of the sites of concern identified in this study. A table summarizes threshold exceedances for each watershed (See Table 4-2 and Table 4-3).

7.x.2: Summary description of water quality in relation to land use.

7.x.3: Analysis of bioassessment results based on findings related to benthic macroinvertebrate assemblages and physical habitat. Tables and figures follow the narrative:

- Map of index scores
- List of sampling sites
- Cluster dendrogram
- Ordination graph
- Table of bioassessment metrics

7.x.4: Summary of results for basic water quality field parameters from continuous monitoring followed by:

- Map of temperature and dissolved oxygen (DO) levels
- Boxplots summarizing temperature, DO, pH, and specific conductance

7.x.5: Summary of results for water, sediment, and tissue chemistry

7.x.6: Summary of results for water and sediment toxicity

7.x.7: Summary of results for coliform bacteria

Figures summarizing results in all watersheds for sections 7.x.5, 7.x.6, and 7.x.7 are presented and discussed in Section 6.

Refer to Appendices D through K for the original data.

7.1 Walker Creek Watershed

7.1.1 Sites of Concern

Exceedances noted in the summary table (Table 7-1) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites.

Invertebrate communities were in poor condition in some sites, particularly Keys Creek at Tomales (WLK030), below Laguna Lake (WLK130) and the two most upstream sites, at Arroyo Sausal (WLK230) and the Cheese Factory (WLK240). These are discussed in Regional Trends, Section 6.1. The Walker Creek Ranch (WLK160) and Gambonini Mine (WLK180) sites had elevated water temperatures and either low DO or high pH in at least some measurements. Nickel and chromium are elevated in Walker Creek sediments due to high levels in geologic deposits. In general, mercury contamination from mining activities is the main chemical concern in this watershed, although the samples collected in this study were not highly elevated. Erosion and sedimentation caused by lack of riparian habitat protection and exacerbated by grazing operations appear to be primary issues affecting water quality in this watershed.

Table 7-1. Summary of sites with exceedances in Walker Creek watershed

Analyte	***Standard***	***# of sites***
FIELD MEASURES *of 5 sites sampled*		
Temperature	MWAT, coho	2
Oxygen, dissolved	minimum, COLD	1
	minimum, WARM	1
	3-month median	1
pH	range	1
CONVENTIONAL WATER QUALITY *of 4 sites sampled*		
Nitrate as N	maximum	4
Phosphorus, total as P	maximum	4
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Chromium	PEC	1
Mercury	TEC	1
Nickel	PEC	1

7.1.2 Water Quality in Relation to Land Use

With the exception of the swimming beach at Turtle Pond, all sites drained areas used for grazing. Mining, agriculture, and residential uses were also common. There was generally insufficient data to analyze trends in any of the parameters relative to land use, with the exception of the bioassessment data discussed in Section 6.1 above. Benthic macroinvertebrate sample analyses from Chileno Creek provided a good example of improved water quality associated with a restoration effort that included grazing exclusion and riparian zone planting. Primary water quality stressors appear to be related to temperature and DO, parameters that vary region-wide with riparian habitat condition. Grazing practices that enhance riparian condition should translate into improved water quality.

7.1.3 Macroinvertebrate Assemblages and Physical Habitat

Three groups of similar sites were identified from the cluster dendrogram (Figure 7-2) and ordination graph (Figure 7-3).

- The Walker Creek/Salmon Creek group (WS) includes sites on Walker Creek above the confluence with Chileno Creek (WLK140, WLK160), Salmon Creek (WLK180, WLK190), and Verde Canyon Creek (WLK170). Sites in this group are the most closely related on the cluster dendrogram (Figure 7-2) and ordination graph (Figure 7-3), suggesting they are the most taxonomically similar.
- The Keys Creek (KC) group includes two sites on Keys Creek (WLK030, WLK050).
- The Upper Arroyo Sausal (UAS) group includes two sites on Arroyo Sausal above Soulajule Reservoir (WLK230, WLK240).

Sites that do not fall into these three groups, including those on Chileno Creek (WLK100, WLK120, WLK130) and Arroyo Sausal (WLK200), are discussed separately.

Walker Creek/Salmon Creek group

Metric values for four sites in this group (WLK140, WLK170, WLK180, and WLK190) are within or near the range of values from minimally disturbed perennial streams (Table 6-10). This suggests that benthic invertebrate assemblages in these locations were relatively undisturbed.

Metric values for the fifth site, WLK160, are well outside of this range. While invertebrate diversity was fairly high, the numerical dominance of pollution-tolerant taxa suggests that the invertebrate assemblage was moderately impacted from human-caused disturbances.

Abundant taxa found in the Walker Creek/Salmon Creek group (WS) of sites include:

Chironomidae	24%
Baetis sp. (Baetidae)	14%
Gumaga sp. (Sericostomatidae)	11%
Malenka sp. (Nemouridae)	7%

Simulium sp. (Simuliidae)	6%
Optioservus sp. (Elmidae)	5%
Suwallia sp. (Chloroperlidae)	4%
Diphetor hageni (Baetidae)	3%
Agapetus sp. (Glossosomatidae)	3%

Other rare intolerant taxa found at the sites include *Paracymus* sp. (Coleoptera: Hydrophilidae), *Protoptila* sp. (Glossosomatidae), and *Onocosmoecus* sp. (Limnephilidae). Two taxa from WLK140, *Acentrella* sp. (Baetidae) and *Culoptila* sp. (Glossosomatidae), have not been found elsewhere in the Bay Area.

Although these five sites were quite similar taxonomically, the relative abundance of taxa was quite different at WLK160 than at the other four sites.

- Chironomids composed less than 10 percent of organisms at WLK140 and WLK180, but nearly 50 percent at WLK160.
- *Simulium* sp. made up 20 percent of individuals at WLK160, but was much less abundant at other sites.

The percentage of common tolerant taxa ranged from 23 percent at WLK190 to 77 percent at WLK160. These compositional differences are reflected in the tolerance value metric, which ranged from 3.6 at WLK190 to 5.2 at WLK160. These differences suggest that the benthic assemblage at WLK160 was affected by water quality or habitat impacts, but the impacts were not severe enough to completely eliminate pollution-sensitive taxa.

Keys Creek group

The high percentages of common tolerant taxa observed at the Keys Creek sites are similar to conditions observed at sites in urban areas with very poor biological integrity.

Abundant taxa at two sites on Keys Creek (WLK030 and WLK050) included

Chironomidae	39%
Oligochaeta	19%
Simulium sp. (Simuliidae)	16%
Baetis sp. (Baetidae)	13%.

Together, these common tolerant taxa made up 94 percent and 78 percent of all organisms at WLK030 and WLK050, respectively. Also abundant at WLK050 was *Hyalella* sp. (Amphipoda: Hyalellidae), a pollution tolerant organism (tolerance value = 8) that made up 15 percent of the sample.

Despite the numerical dominance of four tolerant taxa, diversity at these sites, especially WLK050, was higher than observed at urban sites. Less abundant (<1 percent) taxa found at both sites included a dytiscid beetle (*Agabus* sp.), an empid fly (*Clinocera* sp.), a relatively rare and intolerant hydroptilid caddisfly (*Oxyethira* sp.), the water mite Lebertiidae (Acari), and the bivalve Sphaeriidae (Veneroida). One common intolerant taxa was collected at each site, a single individual *Rhyacophila* sp. (Trichoptera: Rhyacophilidae) at WLK030 and one individual *Paraleptophlebia* sp. (Ephemeroptera: Leptophlebiidae) at WLK050. Several uncommon beetles, usually associated with lentic habitats, were found at WLK050: *Stictotarsus* sp. (Dytiscidae), *Tropisternus* sp. (Hydrophilidae), and *Cymbiodyta* sp. (Hydrophilidae). Although the taxa richness value at WLK050 (27) was very close to the range observed at intermittent minimally disturbed sites (28-34 taxa), all other metric values from both sites were very different from minimally disturbed conditions, suggesting that moderate anthropogenic impacts have altered the benthic communities at these sites.

Upper Arroyo Sausal group

The two sites in the Upper Arroyo Sausal (UAS) group (WLK230 and WLK240) were dominated by tolerant taxa, suggesting poor biological integrity:

Chironomidae	63%
Simulium sp. (Simuliidae)	21%
Baetis sp. (Baetidae)	4%
Hygrobatidae (Acari)	4%
Oligochaeta	3%.

The percentages of common tolerant taxa at WLK230 and WLK240 were 87 percent and 95 percent, respectively. Other taxa found at both sites included *Laccobius* sp. (Coleoptera: Hydrophilidae), *Bezzia/ Palpomyia* (Diptera: Ceratopogonidae), and three intolerant taxa: the mayfly *Serratella* sp. (Ephemerellidae) and the perlodid stoneflies *Isoperla* sp. and *Kogotus* sp. Several other sensitive taxa were found at one site including *Sweltsa* sp. (Plecoptera: Chloroperlidae), *Malenka* sp. (Plecoptera: Nemouridae), *Agapetus* sp. (Trichoptera: Glossosomatidae), and *Rhyacophila* sp. (Trichoptera: Rhyacophilidae).

While assemblages at WLK230 and WLK240 were numerically dominated by tolerant taxa, both sites contained several highly intolerant taxa, similar to the assemblages in the Keys Creek group. The presence of sensitive taxa indicates that toxic pollutant loads are not the primary cause of altered benthic assemblages. Rather, nutrient enrichment or habitat alteration may exclude taxa with specific habitat or food requirements, resulting in high relative abundances of common tolerant taxa. For example, lack of riparian vegetation and low inputs of leaf litter limits the abundance of shredders, invertebrates that feed on decomposing leaves and wood. Shredders, such as the caddisflies *Gumaga* sp. (Sericostomatidae) and *Lepidostoma* sp. (Lepidostomatidae), the nemourid stonefly *Malenka* sp., and craneflies (Tipulidae), were abundant at sites in the Walker Creek/Salmon Creek group (WS) but were virtually absent from sites in the Keys Creek (KC) and Upper Arroyo Sausal (UAS) groups.

Chileno Creek sites

Sites on Chileno Creek, the largest tributary of Walker Creek, had very dissimilar benthic assemblages. The most upstream site on Chileno Creek, WLK130, is located just downstream of shallow, eutrophic Laguna Lake, and is surrounded by grazing land. The benthic assemblage was completely dominated by four taxa: Chironomidae, 58 percent; *Hyalella* sp. (Amphipoda:

Hyalellidae), 30 percent; *Simulium* sp., 7 percent; and Oligochaeta, 5 percent. Only two other taxa were found: three individual *Baetis* sp. mayflies and one individual planorbid snail. The low taxa richness (just six taxa) and taxonomic composition of WLK130 is similar to the most highly disturbed sites in urban streams in the Bay Area (such as WIL050, Wildcat Creek; and PER020, Permanente Creek).

The site downstream of WLK130 on Chileno Creek, WLK120, has undergone physical habitat restoration by the landowners. Cows have been excluded from the stream and riparian vegetation has been restored, resulting in much improved habitat conditions that are reflected in the benthic invertebrate assemblage. Biological metrics are substantially better at WLK120 than at WLK130, such as taxa richness (25 taxa vs. 6), percent EPT (37 percent vs. 0), and tolerance value (5.1 vs. 6.5). The percentage of common tolerant taxa dropped from 70 percent (100 percent if *Hyalella* sp. is included) at WLK130 to 43 percent (67 percent if *Hyalella* sp. is included) at WLK120. Numerically dominant taxa at WLK120 included:

Chironomidae	24%
Hyalella sp. (Hyalellidae)	24%
Isoperla sp. (Perlodidae)	16%
Ephemerella sp. (Ephemerellidae)	12%
Oligochaeta	10%
Baetis sp. (Baetidae)	9%

In addition to the pollution intolerant taxa *Isoperla* sp. and *Ephemerella* sp., other sensitive taxa collected at WLK120 but not found at WLK130 include the caddisflies *Gumaga* sp. (Sericostomatidae) and *Lepidostoma* sp. (Lepidostomatidae) and the mayfly *Paraleptophlebia* sp. (Leptophlebiidae). Numerous molluscs were found at WLK120, including the bivalve Sphaeriidae as well as physid (*Physa/ Physella*) and planorbid (*Gyraulus* sp. and *Menetus* sp.) snails.

WLK100 is located further downstream on Chileno Creek, just above the confluence with Walker Creek. The benthic assemblage at WLK100 was also dominated by a mix of tolerant and intolerant taxa:

Simulium sp. (Simulium sp.)	37%
Baetis sp. (Baetidae)	29%
Chironomide	15%
Serratella sp. (Ephemerellidae)	4%
Malenka sp. (Nemouridae)	4%
Oligochaeta	3%
Wormaldia sp. (Philopotamidae)	3%
Paraleptophlebia sp. (Leptophlebiidae)	2%

Other sensitive taxa found at WLK100 include the riffle beetle *Optioservus* sp.; the mayflies *Diphetor hageni*, *Ephemerella* sp., and *Ironodes* sp.; the stoneflies *Suwallia* sp., *Isoperla* sp., and *Kogotus* sp.; and the caddisflies *Hydroptila* sp., *Rhyacophila* sp., and *Gumaga* sp. Biological metrics such as taxa richness, percent EPT, and tolerance value were similar between WLK100 and WLK120, while there were far more EPT taxa at WLK100 (14) than at WLK120 (6). Metric values were slightly outside of the range of values observed at minimally disturbed intermittent sites, suggesting that biological integrity does not fully recover from upstream disturbances in the Chileno Creek watershed.

Arroyo Sausal below Soulajule Reservoir

The benthic assemblage at WLK200 included many intolerant taxa, suggesting that biological integrity in Arroyo Sausal was higher below the reservoir than at upstream sites (WLK230 and WLK240).

Dominant taxa at WLK200 included a mix of tolerant and intolerant taxa:

Chironomidae	33%
Malenka sp. (Nemouridae)	12%
Baetis sp. (Baetidae)	11%
Diphetor hageni (Baetidae)	6%
Planorbidae	6%
Menetus sp. (Planorbidae)	5%
Neophylax sp. (Uenoidae)	5%
Gumaga sp. (Sericostomatidae)	3%
Hydropsyche sp. (Hydropsychidae)	3%
Oligochaeta	3%

Many sensitive or rare caddisflies were present, including *Amiocentrus aspilus* (Brachycentridae), *Heteroplectron* (Calamoceratidae), *Glossosoma* sp. (Glossosomatidae), *Lepidostoma* sp. (Lepidostomatidae), and *Rhyacophila* sp. (Rhyacophilidae). Despite the relatively high EPT taxa richness (14) and total taxa richness (31), no beetles were found at WLK200. Releases from Soulajule Reservoir are believed to result in perennial flow downstream in Arroyo Sausal. Several taxa that require perennial flow are present, so it is unclear what environmental factors are causing the absence of Coleoptera.

Biological metric values at WLK200 are generally within the lower range of values from minimally disturbed sites, except percent EPT is lower than the range observed at intermittent streams and taxa richness is lower than perennial streams. This indicates that Arroyo Sausal below Soulajule Reservoir has fairly high biological integrity, but the invertebrate assemblage shows some evidence of anthropogenic disturbance.

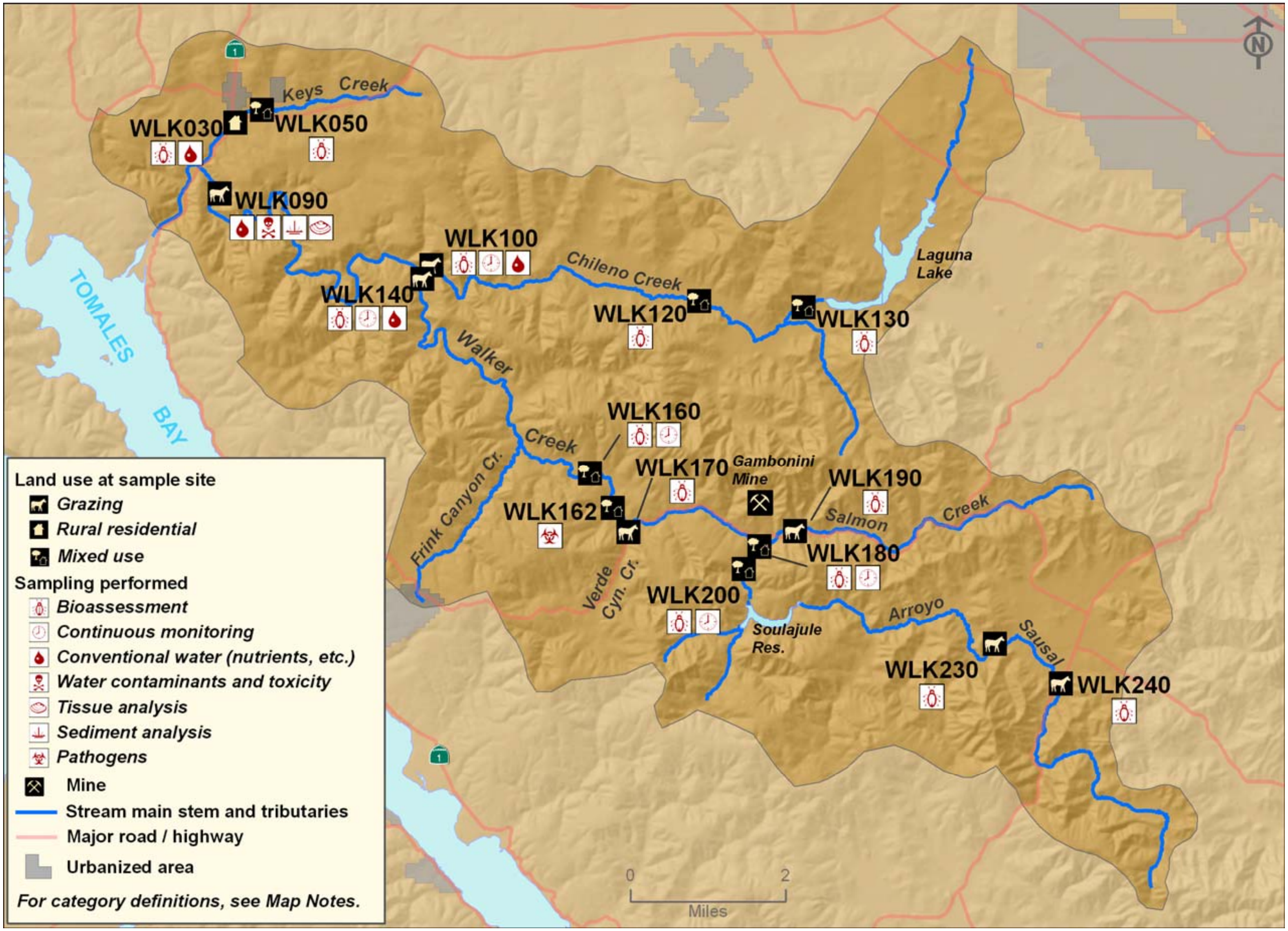

Figure 7-1. Map of Walker Creek benthic macroinvertebrate index scores

Table 7-2. Bioassessment sites in the Walker Creek watershed

Site ID	Site Name	Stream
WLK030	Keys at Tomales	Keys Creek
WLK050	Keys at Irvin Road	Keys Creek
WLK090	Walker Creek	Walker Creek
WLK100	Chileno Canyon	Chileno Creek
WLK120	Chileno Valley	Chileno Creek
WLK130	Laguna Lake	Chileno Creek
WLK140	Walker Canyon	Walker Creek
WLK160	Walker Creek Ranch	Walker Creek
WLK170	Verde Canyon	Verde Canyon Creek
WLK180	Gambonini Mine	Salmon Creek
WLK190	Salmon Creek	Salmon Creek
WLK200	Soulajule	Arroyo Sausal
WLK230	Arroyo Sausal	Arroyo Sausal
WLK240	Cheese Factory	Arroyo Sausal

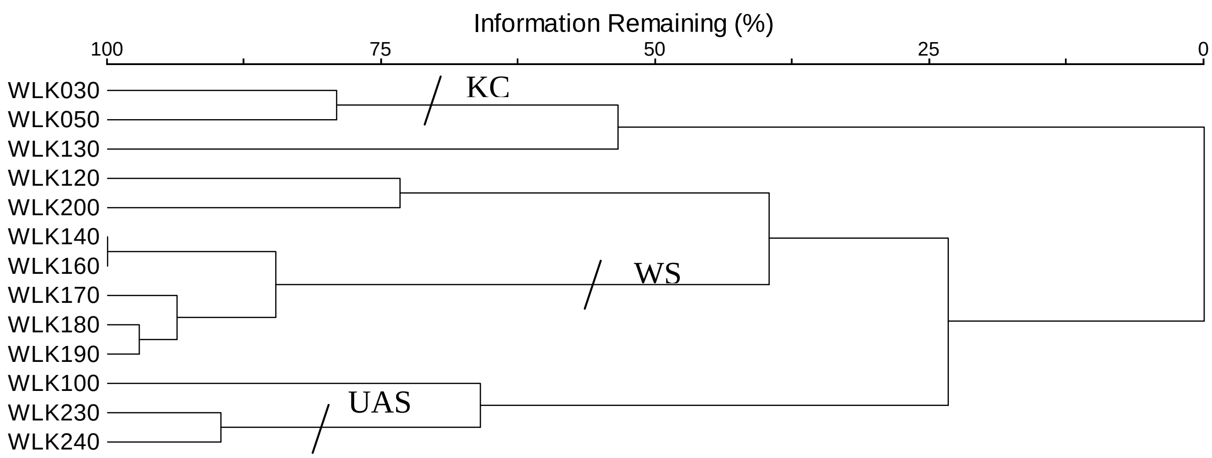

Figure 7-2. Cluster dendrogram of sites in the Walker Creek watershed

This cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the Walker Creek watershed. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at the top signifies how similar the sites are with respect to taxa presence. Abbreviations: KC, Keys Creek; WS, Walker Creek/Salmon Creek; UAS, Upper Arroyo Sausal.

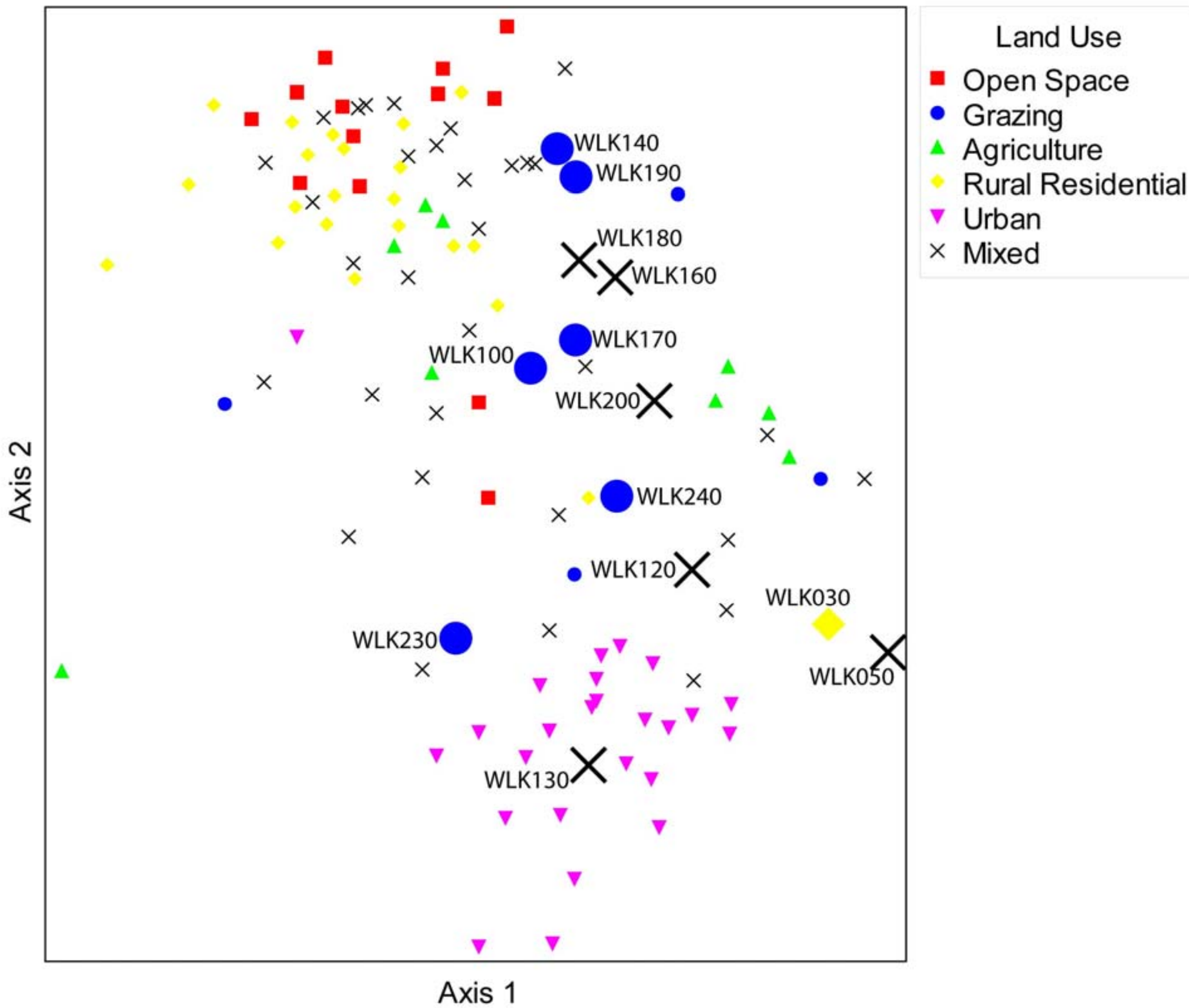

Figure 7-3. NMS ordination of sites in the Walker Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Walker Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-3. Biological metrics from Walker Creek watershed

	WLK 030	WLK 050	WLK 100	WLK 120	WLK 130	WLK 140	WLK 160	WLK 170	WLK 180	WLK 190	WLK 200	WLK 230	WLK 240
Coleoptera Taxa	1	9	2	1	0	6	4	3	3	4	0	2	1
Diptera Taxa	4	4	4	5	2	5	3	5	4	7	7	4	4
Ephemeroptera Taxa	1	2	6	3	1	7	5	5	6	5	3	2	3
Plecoptera Taxa	0	0	4	1	0	5	3	4	4	4	2	3	3
Trichoptera Taxa	2	1	4	2	0	12	12	9	10	9	9	1	1
Non-Insect Taxa	7	10	2	13	3	6	9	10	12	7	10	4	3
EPT Taxa	3	3	14	6	1	24	20	18	20	18	14	6	7
Taxa Richness	15	27	22	25	6	41	36	36	39	36	31	16	15
% EPT	5	23	45	37	0	70	23	52	74	59	47	4	9
% Sensitive EPT	0	1	13	28	0	47	13	26	54	53	32	1	2
% Chironomidae	44	31	15	24	58	9	49	33	9	18	32	63	64
% Coleoptera	1	3	0	0	0	16	5	0	3	7	0	1	0
% Oligochaeta	21	17	3	10	5	0	0	4	1	0	3	4	3
% Non-insect	25	35	3	37	35	2	2	9	7	10	18	12	3
% Intolerant	0	0	10	28	0	25	7	21	31	24	17	1	2
% Tolerant	4	18	0	26	30	1	1	3	2	2	4	7	0
Tolerance Value	5.8	5.9	5.1	5.1	6.5	3.7	5.2	4.7	3.6	3.6	4.8	6.0	5.8
% Predator	3	4	2	18	0	14	4	14	4	25	5	11	2
% Collector-filterer	26	8	40	1	7	13	21	2	11	1	6	18	23
%Collector-gatherer	71	86	53	79	93	41	58	65	37	26	58	70	74
% Scraper	0	0	1	2	0	25	7	2	15	13	14	1	1
% Shredder	0	0	5	0	0	8	6	17	33	35	17	0	0
% Other	0	2	0	0	0	0	3	1	0	0	0	1	0
% Common Tolerant	94	78	83	43	70	32	77	64	33	23	50	87	95
Common Intol. Taxa	1	1	7	2	0	12	7	7	9	11	6	3	3

7.1.4 Basic Water Quality Field Measurements

Continuously measured variables were within acceptable ranges (Appendix D; Figure 7-7 and Figure 7-8), with three exceptions:

- Late spring temperatures (May 23-30, 2002) measured at the Walker Creek Ranch (WLK160) and Gambonini Mine (WLK180) sites produced Highest Weekly Average Temperature (HWAT) values above 14.8°C, the threshold for coho salmon. Temperatures measured in the watershed during the summer (August 16-21, 2002) did not exceed threshold values (Appendix D; and Figure 7-5).
- The Gambonini Mine site (WLK180) had low DO values during the late spring and summer deployments (Figure 7-6).
- The maximum pH value from the Walker Creek Ranch site in late spring was 9.07, well above the Basin Plan maximum for all uses.

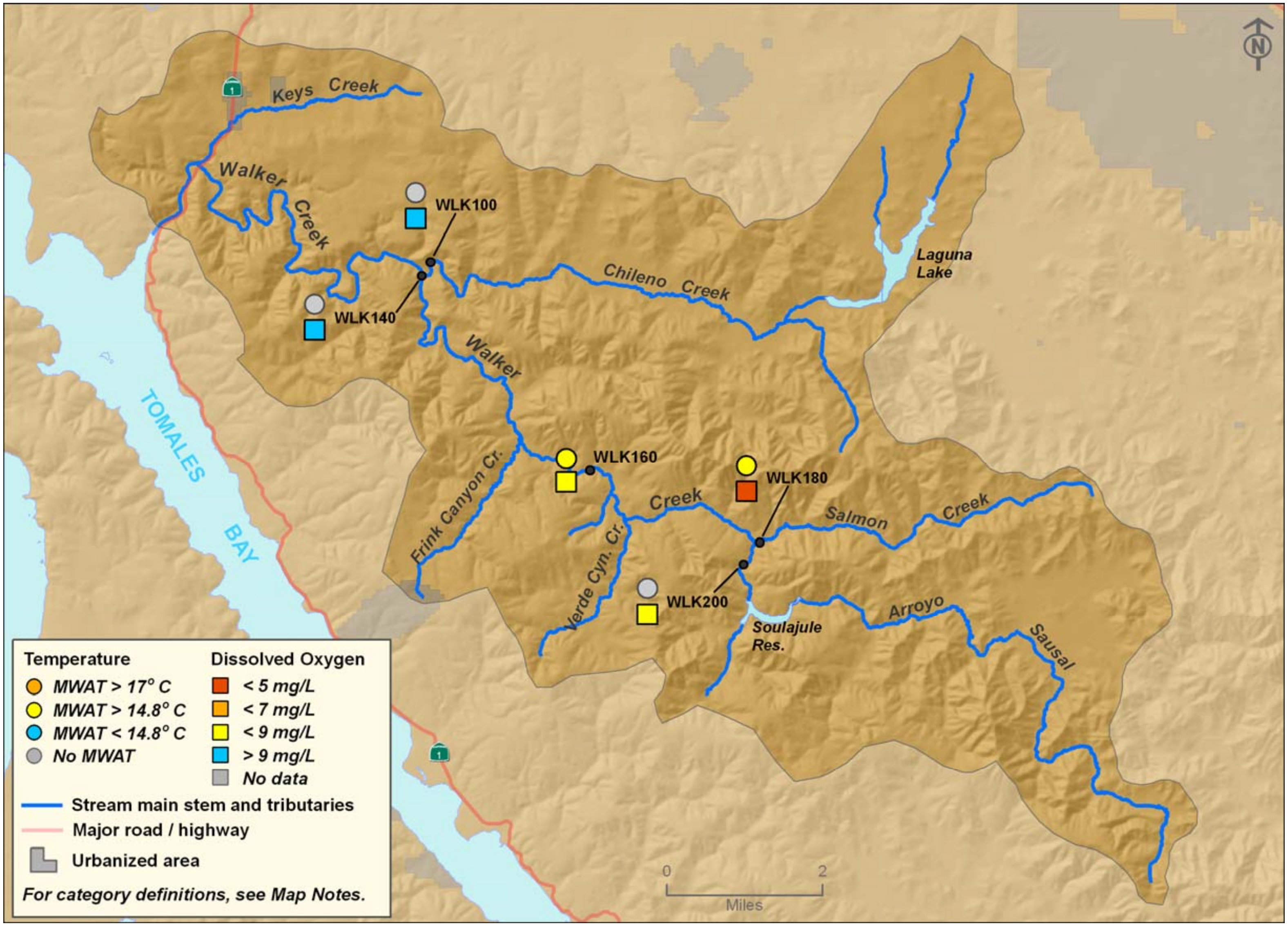

Figure 7-4. Map of temperature and DO levels in Walker Creek watershed

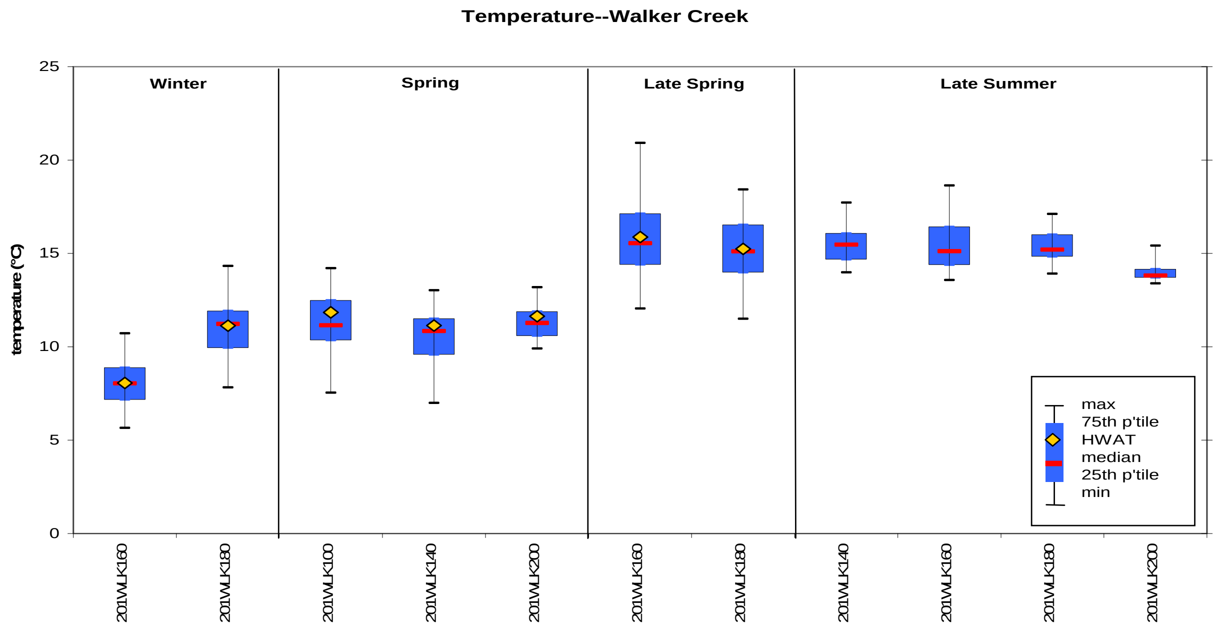

Figure 7-5. Temperature monitoring in Walker Creek watershed

The sites monitored in late summer were sampled for less than a week, so do not have HWAT values.

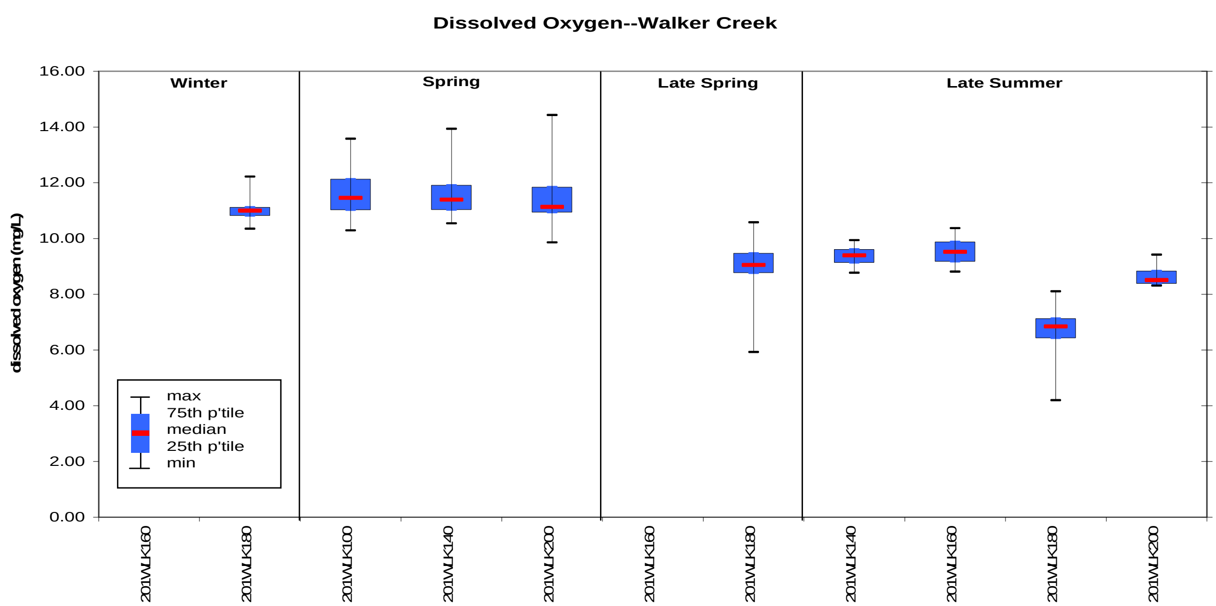

Figure 7-6. DO monitoring in Walker Creek watershed

Data were rejected for WLK160 in winter and late spring.

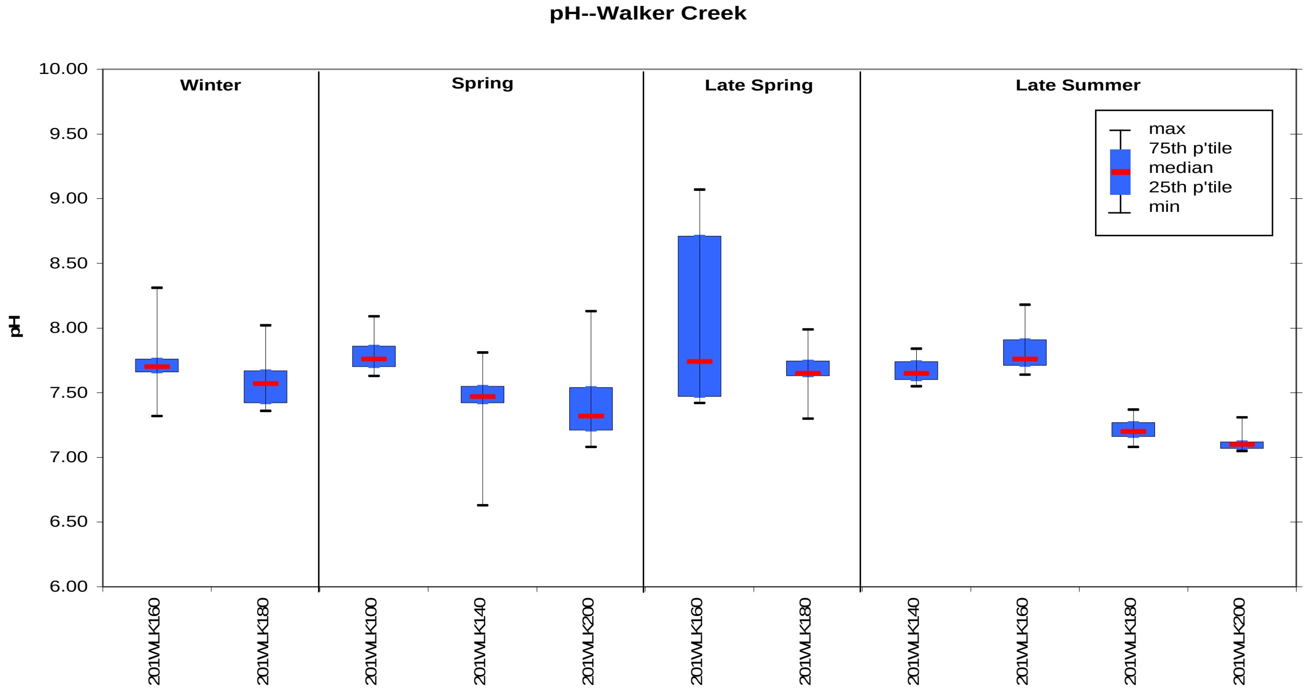

Figure 7-7. pH monitoring in Walker Creek watershed

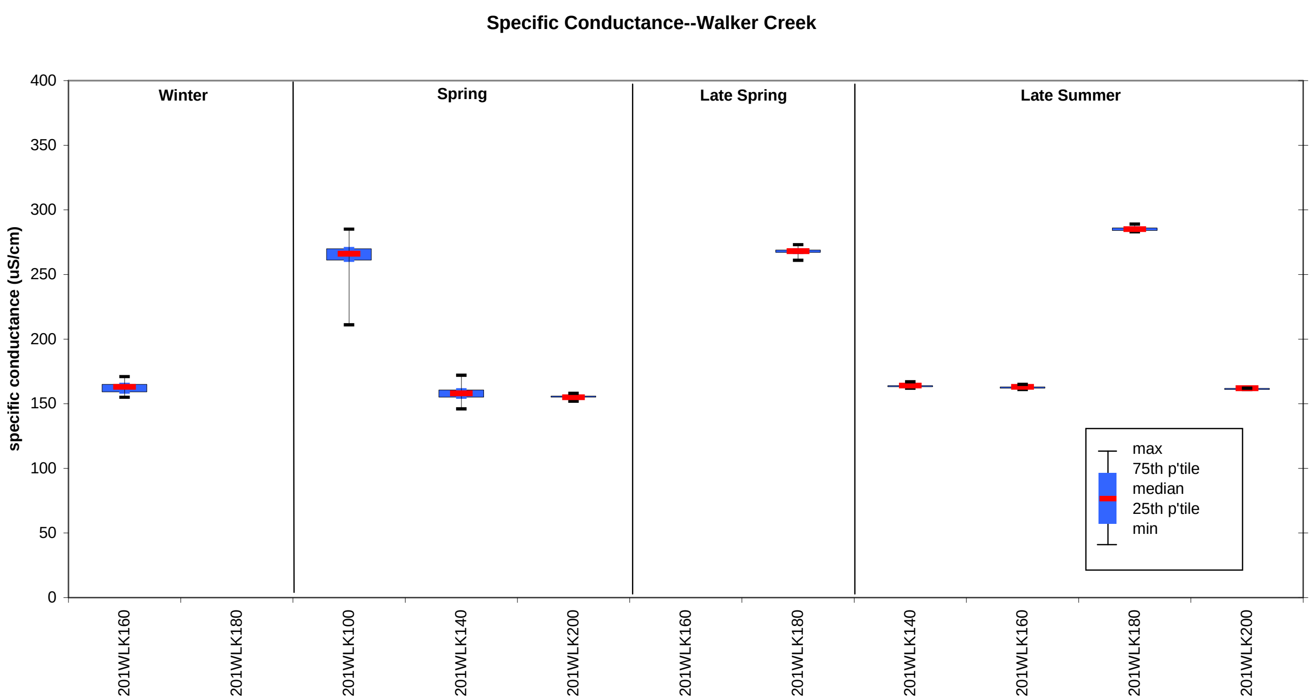

Figure 7-8. Specific conductance monitoring in Walker Creek watershed

Data were rejected for WLK180 in the winter and WLK160 in the late spring.

7.1.5 Water, Sediment, and Clam Tissue Chemistry

Nitrate concentrations in the water column were generally fairly low. While no dry season concentrations exceeded the U.S. EPA ecoregional reference guideline of 0.155 mg /L, most wet season concentrations exceeded the guideline. The highest nitrate concentration for this watershed was the wet season sample from Chileno Canyon (2.18 mg/L).

The highest orthophosphate concentration measured was 0.18 mg/L, and orthophosphorus values exceeded the U.S. EPA total phosphorus guideline for aquatic life of 0.030 mg/L at all sites in at least one season. Total phosphorus values exceeded the U.S. EPA guideline at most sites, with a maximum of 0.2 mg/L (Appendix G).

No samples were analyzed for water chemistry in this watershed. Sediment was collected from the Walker Creek site (WLK090) in October 2001. Three geologically abundant trace metals were measured at concentrations above guideline values: chromium and nickel (above the probable effects concentration), and mercury (above the threshold effects concentration; Appendix H). Although elevated levels of nickel and chromium are common due to serpentine deposits in the area, elevated mercury concentrations reflect mineral mobilization from past mining activities.

Clams deployed at the Walker Creek site yielded tissue concentrations similar to control values for all detected analytes (Figures 6-21 through 6-27). Even mercury concentrations were elevated only slightly relative to controls and were lower than in many other watersheds. This is of interest because of the historic mercury mining upstream and the concern for fish contamination in Tomales Bay receiving waters. It has been shown, however, that clams do not concentrate high levels of mercury even in Tomales Bay (Gunther 1999; Gassel *et al*. 2004).

7.1.6 Water and Sediment Toxicity

No water samples from the Walker Creek watershed were analyzed for toxicity. The sediment sample collected at WLK 090 was not toxic to test amphipods. For the graph of toxicity tests in Walker Creek, see Lagunitas Creek section 7.2.4 (Figure 7-17).

7.1.7 Coliform Bacteria

The single sampling site at Turtle Pond (WLK 162) is isolated from Walker Creek proper, and is not representative of overall conditions in the watershed. The Tomales Bay Pathogen TMDL reported numerous exceedances in Walker Creek during the rainy season (SFBRWQCB 2005). Turtle Pond is a designated swimming beach used heavily for water-contact recreation during camping season, which took place before—not during—the period sampled. Samples from this site did not exceed any coliform Basin Plan objectives for recreational use (Figures 6-28 through 6-30).

7.2 Lagunitas Creek Watershed

7.2.1 Sites of Concern

Exceedances noted in the summary table (Table 7-4) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

- Upper San Geronimo Creek sites had poorer benthic invertebrate metric scores than sites downstream.
- The Creamery Gulch site (LAG 270) had elevated water PAHs and metals, although none exceeded thresholds. Sediments from this site had the highest Sediment Quality Guideline Quotient found anywhere in the region—mainly due to metals, some of which were likely of geologic origin.
- Clam tissues at Creamery Gulch (LAG270), Olema Creek (LAG040), and Gallagher's Ranch (LAG130) had the highest mercury concentrations measured in this study.
- Lagunitas Creek at Hwy 1 (Green Bridge) had the highest bacterial counts in the watershed.
- Nicasio (LAG160) had significantly degraded biological integrity in its benthic community. Continuous monitoring results showed unusual timing patterns and DO levels below survivability for most organisms during the spring (not a typically stressful season even for intermittent streams).

Table 7-4. Summary of sites with exceedances in Lagunitas Creek watershed

Analyte	***Standard***	***# of sites***
FIELD MEASURES *of 6 sites sampled*		
Temperature	MWAT, coho	5
Oxygen, dissolved	minimum, COLD	2
	minimum, WARM	1
	3-month median	4
CONVENTIONAL WATER QUALITY *of 8 sites sampled*		
Nitrate as N	maximum	8
Phosphorus, total as P	maximum	3
SEDIMENT CHEMISTRY *of 2 sites sampled*		
Metals		
Arsenic	TEC	1
Chromium	TEC	2
Copper	TEC	1
Mercury	TEC	1
Nickel	PEC	2
COLIFORMS *of 5 sites sampled*		
E. coli	steady state	1
	designated beach	1
Fecal coliform	log mean	1
	90th percentile	3
Total coliform	median	2

7.2.2 Water Quality in Relation to Land Use

None of the sampling sites in the watershed drain land areas characterized as urban; most sites for which multiple indicators were measured were mixed use or rural residential. There was generally insufficient data to analyze trends in any of the parameters relative to land use, with the exception of the bioassessment data discussed in Section 6.1.1. The presence of elevated levels of PAHs and copper, usually associated with automobile traffic (combustion and brake pads) is unexpected in these rural residential areas. The Creamery Gulch site (LAG270) may have been influenced by the upstream treatment plant as well as local sources.

7.2.3 Macroinvertebrate Assemblages and Physical Habitat

Benthic assemblages in Lagunitas Creek generally indicate excellent water quality conditions, but conditions in several tributaries are less than optimal. It should be noted that benthic invertebrates are valuable indicators of gross levels of pollution, but they respond to physical habitat conditions at different spatial scales than fish. Habitat conditions required by populations of coho salmon and steelhead in Lagunitas Creek, such as deep pools and woody debris, cannot be evaluated using benthic invertebrate assemblages. Although invertebrate assemblages suggest that water quality conditions in Lagunitas Creek are generally excellent, habitat conditions for salmonids or other wildlife could be less than optimal.

From the cluster dendrogram (Figure 7-10) and NMS ordination (Figure 7-11) of taxa presence, five groups of sites are apparent:

- The mainstem of Lagunitas Creek, including the Cheda Creek and Devils Gulch tributaries (MSL)
- The San Geronimo Creek watershed, including Woodacre Creek (SG)
- Tributaries in the upper Lagunitas Creek watershed (ULT)
- Nicasio Creek and Halleck Creek (NH).
- Olema Creek (OL)

Mainstem Lagunitas Creek
Sites on the mainstem of Lagunitas Creek (LAG130, LAG165, LAG170, LAG210, LAG220, LAG320), from near the mouth above the town of Point Reyes Station (LAG130) to downstream of Shafter Dam (LAG320), exhibited similar benthic assemblages. All six sites were closely clustered on the NMS ordination graph (Figure 7-11) and the cluster dendrogram (Figure 7-10).

Biological metric values were very similar among the six sites (Table 7-4), and generally fall between the minimum and median values observed at perennial minimally disturbed sites (Table 7-4). This is somewhat surprising, given the significant differences in physical habitat conditions between downstream and upstream sites: sites near the mouth (LAG130, LAG165) have high amounts of fine sediment (40-50%), while sites further upstream have little fine sediment. Biological assemblages suggest that water quality conditions in the mainstem of Lagunitas Creek are generally good. Benthic assemblages from the mainstem of Lagunitas Creek closely resemble minimally disturbed conditions, and, with San Gregorio Creek, represent the best biological conditions yet sampled from large streams in the Bay Area. Less than 50 percent of organisms at all six sites belonged to common tolerant taxa (Table 7-4)**,** which is within the range of conditions at sites draining open space (Table 6-12).

Taken together, these six sites were numerically dominated by the following taxa:

Chironomid midges	20%
Optioservus sp. (Elmidae)	11%
Simulium sp. (Simuliidae)	8%
Malenka sp. (Nemouridae)	8%
Baetis sp.	5%

Many common intolerant taxa were present at all six sites including *Rhyacophila* sp., *Sweltsa* sp., *Zaitzevia* sp., *Neophylax sp*., and *Calinueria californica.* Also notable was collection of a single endangered California Freshwater Shrimp, *Syncaris pacifica* (Decapoda), from LAG220. The California Freshwater Shrimp, restricted to streams in Marin, Sonoma, and Napa counties, was not expected in benthic samples from riffles because it prefers pools and bank-side habitat.

The Devils Gulch (LAG190) and Cheda Creek (LAG180) tributaries were taxonomically similar to sites on the Lagunitas Creek mainstem. On the cluster dendrogram (Figure 7-10), these two sites are most closely related to a mainstem Lagunitas Creek site (LAG165) and are grouped together with the mainstem sites (MSL, Mainstem Lagunitas Creek and tributaries). Taxa richness at LAG180 and LAG190 was 45 and 47 taxa, respectively, the highest values in the Lagunitas Creek watershed (Table 7-4). Cheda Creek had the greatest number of Coleoptera taxa (8) and non-insect taxa (10) in the entire watershed, as a result of the presence of many genera of riffle beetles (Elmidae) and water mites (Acari). The greatest number of mayfly (10) and caddisfly (10) taxa in the watershed were found at Devils Gulch, including less common taxa such as *Ecclisomyia* sp. (Trichoptera: Limnephilidae) and *Cinygma* (Ephemeroptera: Heptageniidae). Low percentages of common tolerant organisms and high numbers of common intolerant taxa (Table 7-6) indicate that Devils Gulch and Cheda Creek exhibit excellent biological integrity.

San Geronimo Creek watershed

Sites in the San Geronimo Creek watershed (LAG240, LAG270, LAG290, LAG300) clustered together both on the NMS ordination graph (Figure 6-33) and on the cluster dendrogram (Figure 7-11). This is the most densely developed portion of the Lagunitas Creek basin. While benthic assemblages at these sites exhibited some signs of reduced biological integrity, conditions were significantly better than in other urbanized watersheds in the Bay Area.

Unlike many other watersheds in the Bay Area, where biological conditions generally decline from upstream to downstream, San Geronimo Creek showed recovery in the downstream direction. The farthest upstream site on San Geronimo Creek, at the water treatment plant (LAG290), appears the most degraded, with low taxa richness and low EPT composition metrics relative to the rest of the watershed (Figure 7-11). Woodacre Creek (LAG300), a tributary to San

Geronimo Creek, had similarly low EPT composition metrics, but taxa richness values were within the range of minimally disturbed conditions (Figure 7-11). Assemblages at both sites were numerically dominated by chironomid midges. Functional differences are also evident, including low representation of predator, scraper, and shredder feeding groups at LAG290 and LAG300.

Richness, composition, tolerance, and functional metrics at the downstream sites on San Geronimo Creek (LAG240 and LAG270) more closely resemble values from sites on the mainstem of Lagunitas Creek (Table 7-4). Taxonomically, LAG240 and LAG270 are notable for high abundances of the crane fly *Linophila* sp. (Diptera: Tipulidae) and the presence of the stonefly nymph *Paraperla* sp. (Plecoptera: Chloroperlidae), which has not been found elsewhere in the Bay Area.

Tributaries in the upper Lagunitas Creek watershed

Big Carson Creek (LAG330 and LAG335) and Little Carson Creek (LAG380) are small tributaries that flow into Kent Lake, the lowest of four reservoirs in the upper Lagunitas Creek watershed. Cataract Creek (LAG390) is a steep tributary that empties into Alpine Lake, the next highest reservoir. These four sites exhibited metric values within the range of minimally disturbed conditions, and very high numbers of common intolerant taxa (17-20). More Plecoptera taxa, including the rare intolerant taxa *Despaxia augusta* (Leuctridae) and *Soliperla* sp. (Peltoplerlidae), were found at Cataract Creek than at other sites in the watershed. The greatest number of Diptera taxa in the watershed was found at LAG335, including the uncommon blephariceridae *Agathon* sp. and the tipulid *Erioptera* sp.

Nicasio Creek and Halleck Creek

Benthic assemblages in Nicasio Creek (LAG160) and Halleck Creek (LAG150) were taxonomically distinct from other sites in the watershed, as shown in the ordination graph (Figure 7-11) and cluster dendrogram (Figure 7-10). The dissimilarity may be due in part to the fact that both streams usually go dry during the summer.

Biological metrics from Halleck Creek (Table 7-6) are very similar to mean metric values from minimally disturbed intermittent streams (Table 6-10). Taxa with life cycles greater than one-year were virtually absent from Halleck Creek, with the possible exception of the chloroperlid stonefly *Suwallia* sp. Additionally, only three individual beetles were found (two larvae and one adult of *Optioservus* sp.), suggesting that the periodic disturbance of drying may preclude taxa that require stable habitat conditions for more than one year. There is anecdotal evidence that the channel bed at the Halleck Creek sampling site is annually excavated in an effort to reduce flooding from channel aggradation. This management practice is likely partly responsible for the unusual benthic assemblage at this site.

When compared to conditions at minimally disturbed intermittent streams (Table 6-10) the benthic assemblage of Nicasio Creek appears significantly degraded. The sample was numerically dominated by chironomid midges (80 percent of individuals), and only 8 EPT taxa were present. The benthic assemblage at this site, although better than conditions found in heavily urbanized areas, was very different from other sites in the watershed and indicative or poor water quality.

Olema Creek

Sites on Olema Creek (LAG040, LAG050, LAG060, LAG075, LAG085, LAG100; described as OL1, OL2, OL3, OL4, OL5, OL6 in Lee and Ketcham (2001) are more similar to each other taxonomically than to other sites in the Lagunitas Creek watershed, although they more closely resemble sites in the San Geronimo Creek watershed than other sites in the basin. Metric values were not calculated for Olema Creek sites because (unlike other sites in the Lagunitas Creek watershed) samples were collected from one riffle only. Common tolerant taxa made up 46 to79 percent of organisms at the six sites, higher than the range of conditions at minimally disturbed sites. Olema Creek sites are located between the San Geronimo Creek sites and Halleck Creek on the ordination graph (Figure 7-11), suggesting a low to moderate level of degradation.

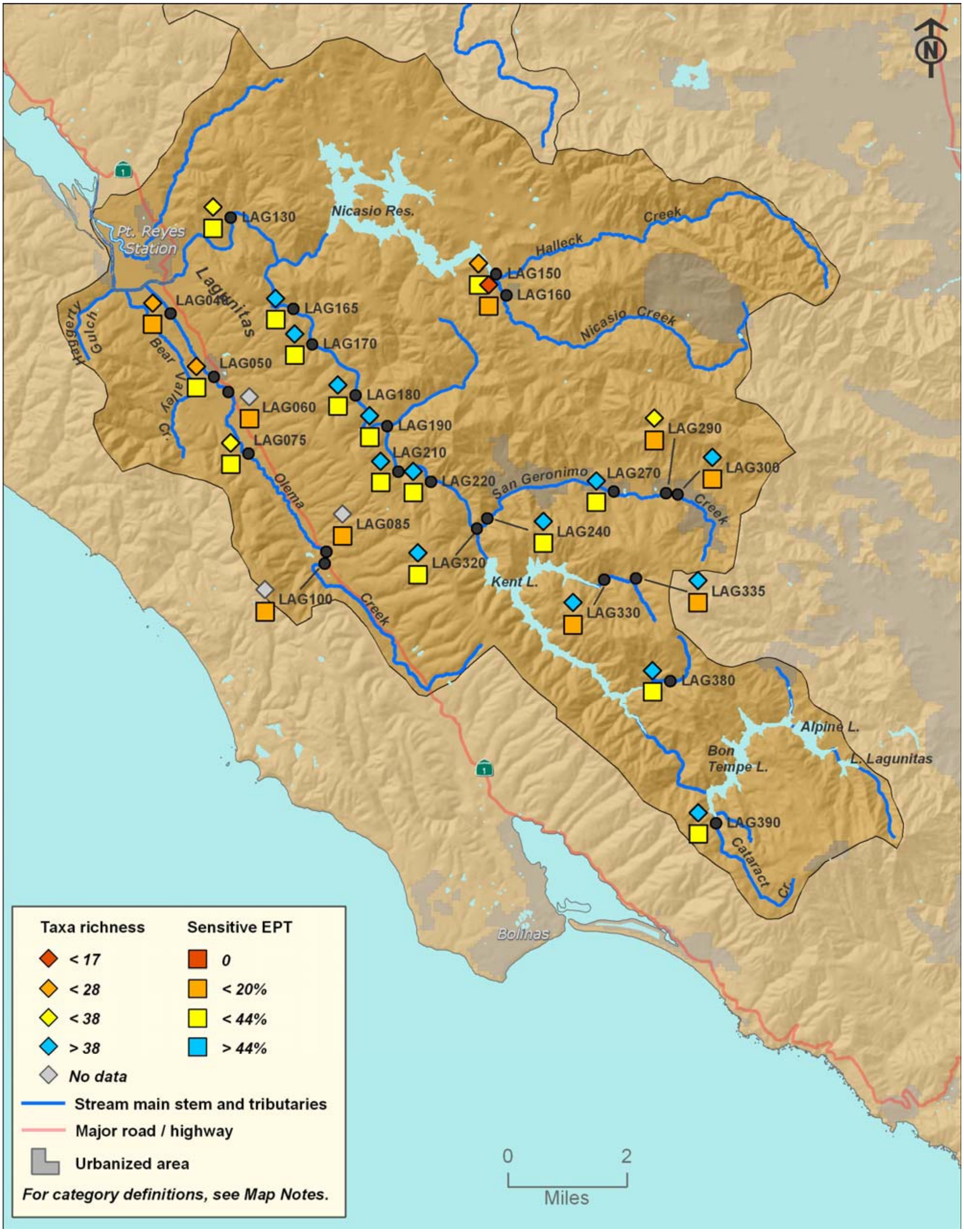

Figure 7-9. Map of Lagunitas Creek benthic macroinvertebrate index scores

Table 7-5. Bioassessment sites in the Lagunitas Creek watershed

Site Code	Site Name	Stream
LAG040	Olema Low	Olema Creek
LAG050	Bear Valley Road Bridge	Olema Creek
LAG060	Vedanta	Olema Creek
LAG075	Truttman	Olema Creek
LAG085	Five Brooks	Olema Creek
LAG100	Blue Line	Olema Creek
LAG130	Gallagher's Ranch	Lagunitas Creek
LAG150	Halleck	Halleck Creek
LAG160	Nicasio	Nicasio Creek
LAG165	Below Tocaloma	Lagunitas Creek
LAG170	Tocaloma Bridge	Lagunitas Creek
LAG180	Cheda	Cheda Creek
LAG190	Devils Gulch	Devils Gulch
LAG210	Taylor Park	Lagunitas Creek
LAG220	Irving Bridge	Lagunitas Creek
LAG240	White Horse Bridge	San Geronimo Creek
LAG270	Creamery Gulch	San Geronimo Creek
LAG290	Water Treatment Plant	San Geronimo Creek
LAG300	Woodacre Creek	Woodacre Creek
LAG320	Shafter Bridge	Lagunitas Creek
LAG330	Big Carson 1	Big Carson Creek
LAG335	Big Carson 2	Big Carson Creek Tributary
LAG380	Little Carson	Little Carson Creek
LAG390	Cataract	Cataract Creek

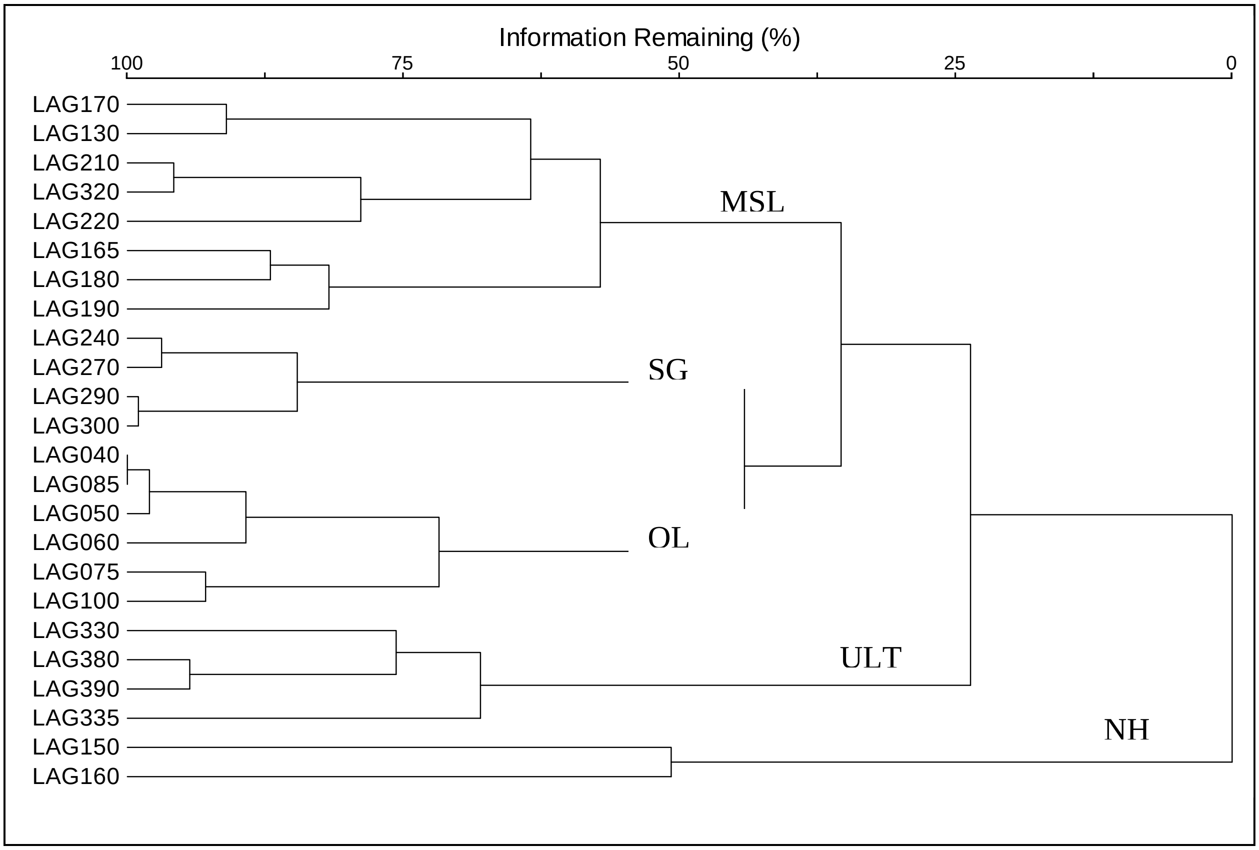

Figure 7-10. Cluster dendrogram of sites in the Lagunitas Creek watershed

This cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the Lagunitas Creek watershed. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at the top signifies how similar the sites are with respect to taxa presence. Abbreviations: MSL, Mainstem Lagunitas Creek and tributaries; SG, San Geronimo Creek watershed; OL, Olema Creek watershed; ULT, Upper Lagunitas Creek tributaries; NH, Nicasio Creek and Halleck Creek.

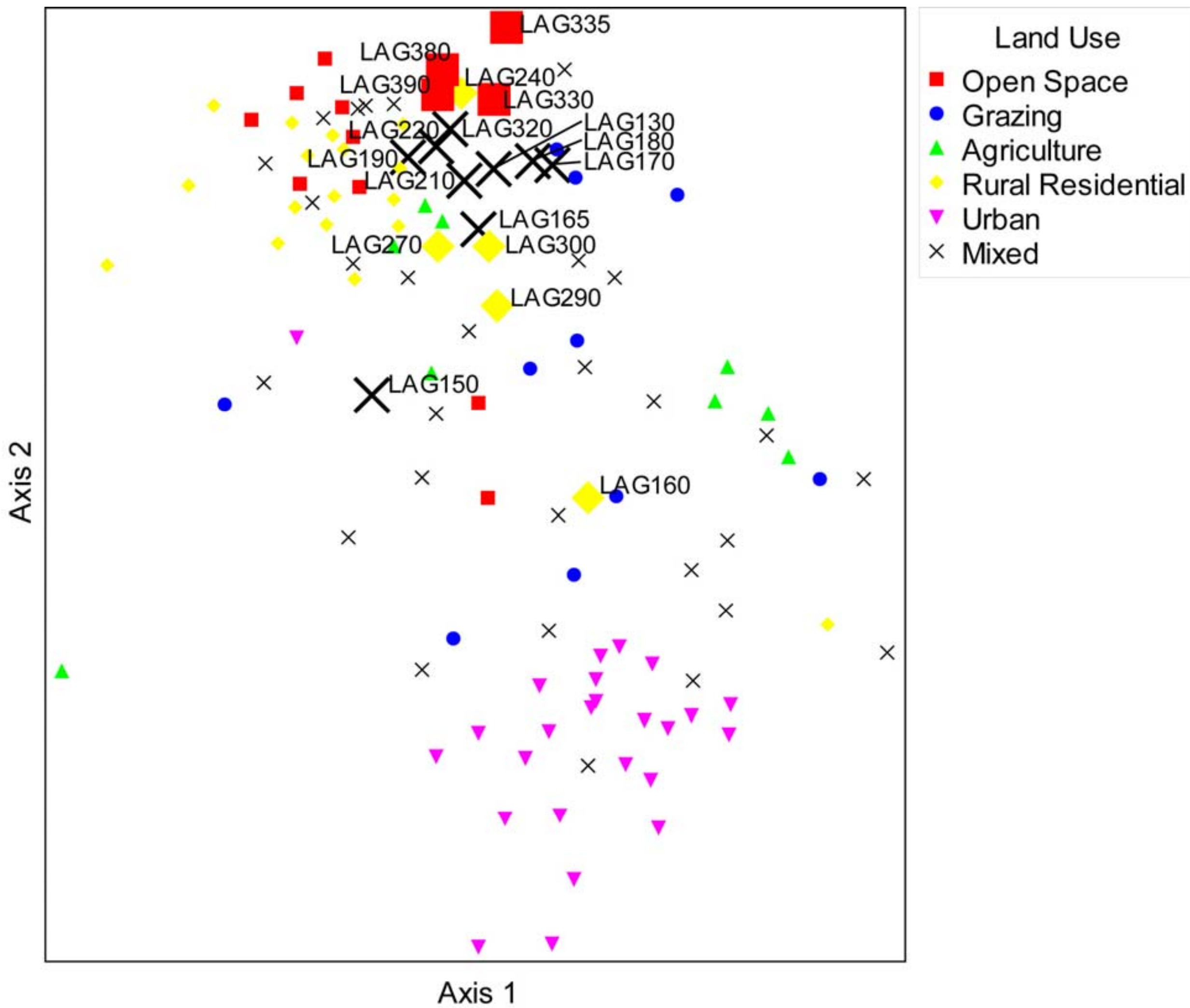

Figure 7-11. NMS ordination of sites in the Lagunitas Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Lagunitas Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-6. Biological metrics from the Lagunitas Creek watershed

The biological metrics are from benthic macroinvertebrate assemblages in the Lagunitas Creek watershed. Data from Olema Creek are available in a separate report (see Ketcham 2001).

LAG	130	150	160	165	170	180	190	210	220	240	270	290	300	320	330	335	380	390
Coleoptera Taxa	6	2	0	8	4	8	7	5	7	6	7	7	6	5	7	4	7	6
Diptera Taxa	3	4	3	5	7	6	11	8	7	7	7	4	7	9	8	13	10	9
Ephemeroptera Taxa	8	8	4	8	8	9	10	8	8	7	7	5	8	8	7	7	6	8
Plecoptera Taxa	5	5	3	6	6	4	5	6	4	6	6	4	5	6	3	2	5	7
Trichoptera Taxa	8	3	1	8	7	8	10	7	7	6	7	4	7	6	6	8	9	8
Non-Insect Taxa	5	4	3	5	6	10	4	5	9	6	5	7	8	7	7	5	7	7
EPT Taxa	21	16	8	22	21	21	25	21	19	19	20	13	20	20	16	17	20	23
Taxa Richness	35	26	14	40	38	45	47	39	42	38	39	31	41	41	38	40	44	45
% EPT	43	58	17	51	34	43	51	47	49	49	41	23	21	60	60	40	43	58
% Sensitive EPT	21	44	10	37	21	32	36	24	34	32	28	10	11	38	34	14	30	35
% Chironomidae	16	37	80	20	20	19	30	22	25	17	38	53	58	23	20	25	23	11
% Coleoptera	30	0	0	16	22	28	11	10	18	14	9	10	12	9	7	13	18	5
% Oligochaeta	0	1	0	4	0	0	2	0	0	0	1	1	0	0	1	0	0	0
% Non-insect	9	3	0	5	2	4	5	3	4	1	2	5	2	5	5	4	7	9
% Intolerant	17	44	10	33	18	26	33	25	24	29	25	8	6	41	33	19	23	31
% Tolerant	1	1	0	0	1	1	0	1	1	0	0	0	1	3	1	0	1	3
Tolerance Value	4.0	3.6	5.5	3.9	4.4	4.0	3.8	4.2	3.9	3.5	4.2	5.1	5.2	3.6	3.6	4.3	3.9	3.5
% Predator	2	28	9	14	10	10	14	7	12	20	12	5	5	5	16	21	18	16
% Collector-filterer	8	0	1	10	22	5	5	19	3	1	4	9	4	4	2	0	2	5
%Collector-gatherer	35	61	90	41	34	34	56	40	43	43	63	71	73	47	45	43	38	25
% Scraper	44	10	0	26	30	33	16	28	35	17	10	13	13	27	12	21	30	24
% Shredder	10	1	0	9	3	18	7	5	7	18	11	2	4	16	25	13	12	30
% Other	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0

7.2.4 Basic Water Quality Field Measurements

Patterns in the basic water quality data at continuously monitored sites in the Lagunitas Creek watershed are in agreement with the assemblage groups identified using bioassessment data. In the MSL bioassessment group, the Lagunitas Creek mainstem site (LAG165) and Devils Gulch (LAG190) both have narrow ranges for temperature, DO, pH, and specific conductance, indicating stable habitats. Sites in the OL bioassessment group (LAG050 and LAG085) have slightly greater ranges of temperature, DO, pH, and specific conductance in the summer dry season. The lower Olema Creek site (LAG050) also showed greater ranges in the spring season for each parameter. The site in the SG bioassessment group (LAG270), which showed lower biological integrity than the mainstem group, had low DO, and both a wide range and high values of specific conductance in the summer (Figure 7-14 and Figure 7-16).

Similar to the pattern seen in the invertebrate assemblages, the Nicasio site (LAG160) exhibited unusually stressful conditions in May, particularly DO levels that ranged from 0.1 to 8.76 mg/L. While the temperature range at LAG160 in the spring was not unusual, the timing of the maximum temperature (at night) and the DO pattern were anomalous, with no obvious explanation. In the winter, however, DO levels were high with full saturation (Figure 7-14). While this reach of stream is dry in summer, the exceedingly low DO in spring and the poor benthic invertebrate assemblage are uncharacteristic of properly functioning, healthy intermittent streams.

Stream temperatures exceeded some thresholds at all continuously monitored sites (Figure 7-12, Figure 7-13, and Appendix D). Highest Weekly Average Temperature (HWAT) values exceeded the Maximum Weekly Average Temperature (MWAT) threshold for coho salmon (14.8ºC) during the spring wet season at Bear Valley Road Bridge (LAG050), and during the summer dry season at all five sites (LAG050, LAG085, LAG165, LAG190, and LAG270). Physical habitat scores were available for three of these sites (LAG165, LAG190, and LAG270), but varied little among them. Scores for channel alteration, bank vegetation, riparian zone width, and canopy cover ranged from the 57^{th} to the 100^{th} percentile for all categories (Appendix E).

Dissolved oxygen concentrations fell below Basin Plan objectives and/or salmonid thresholds at all continuously monitored sites during at least one season (Figure 7-12, Figure 7-14, and Appendix D). The measured pH at Bear Valley Road Bridge (LAG050) during the spring wet season varied from a minimum pH value of 6.60 to a maximum of 7.71, a notable variation of more than one pH unit (Figure 7-15). Such a wide variation usually indicates high photosynthetic activity, often with a high biological oxygen demand. This was the lowest pH value measured in the watershed.

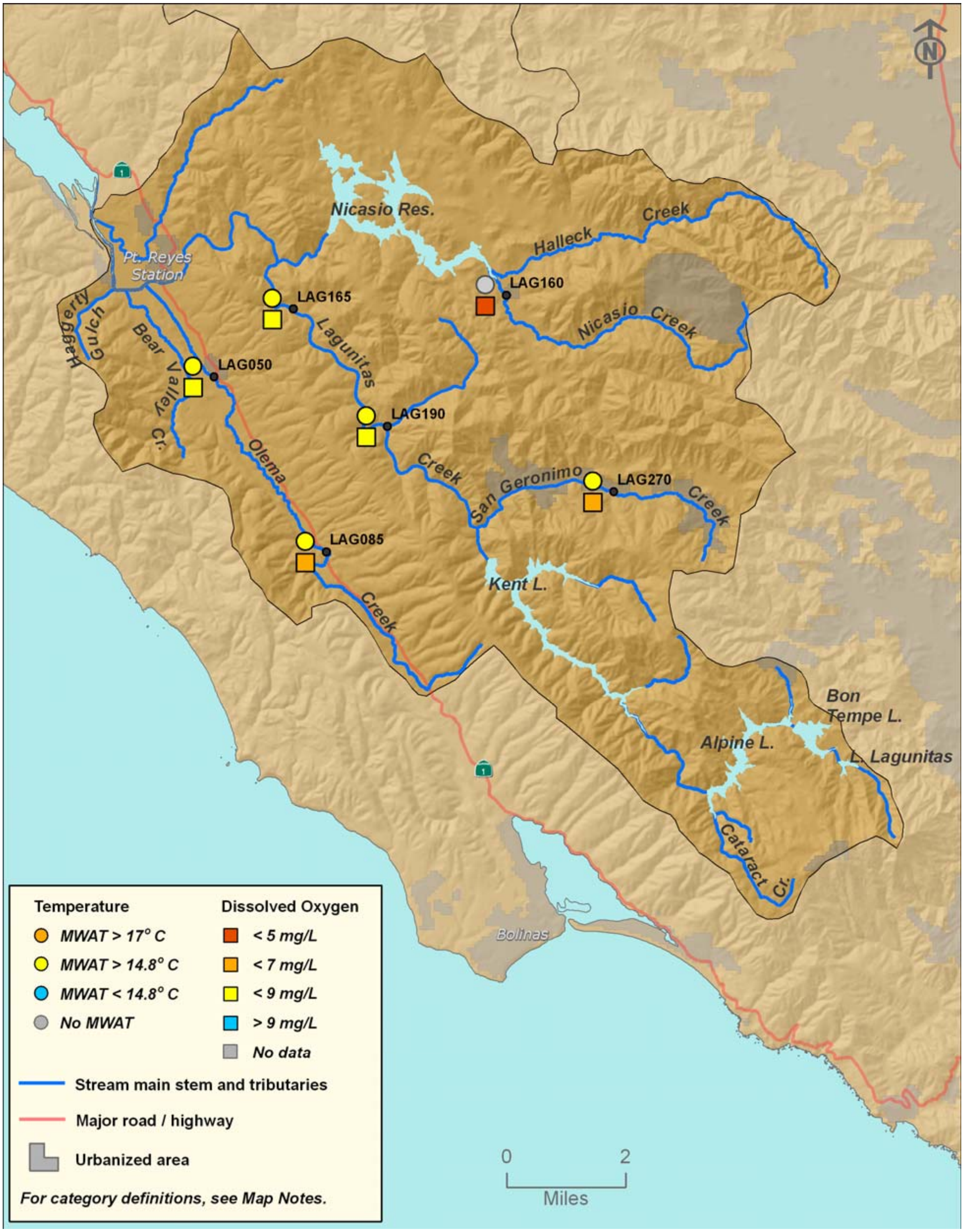

Figure 7-12. Map of temperature and DO levels in Lagunitas Creek

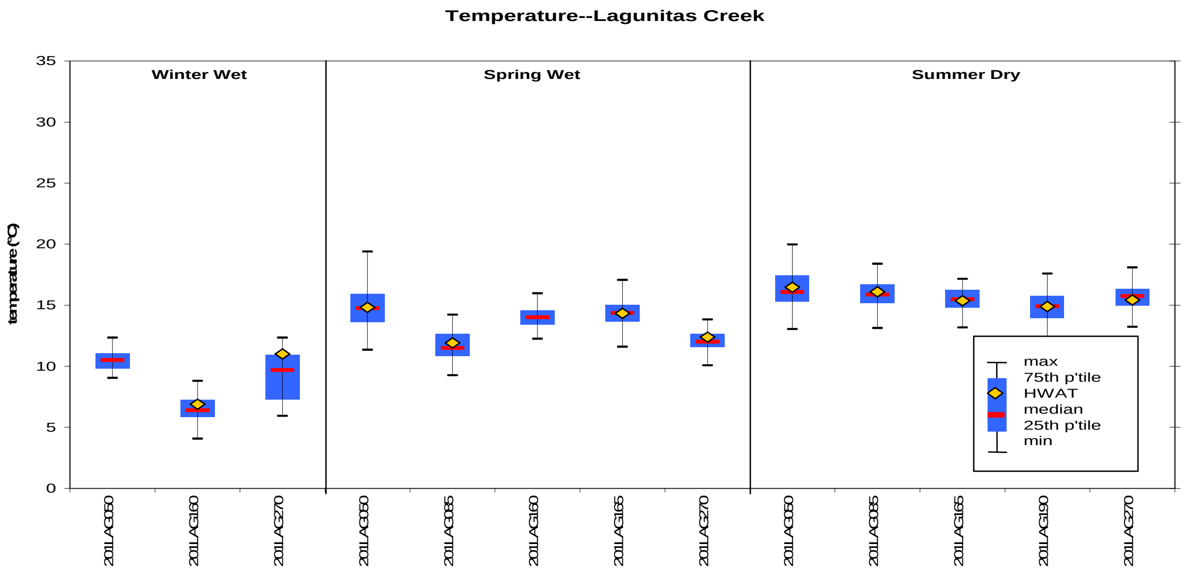

Figure 7-13. Temperature monitoring in Lagunitas Creek watershed

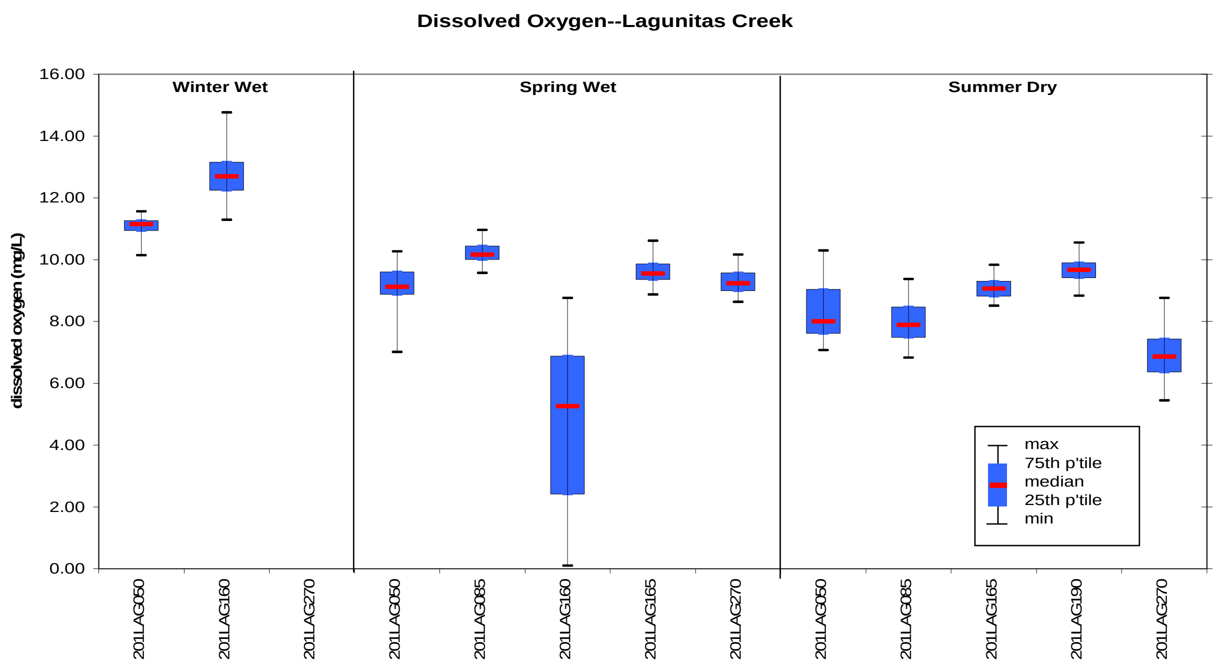

Figure 7-14. DO monitoring in Lagunitas Creek watershed

Data were rejected for LAG270 in the winter.

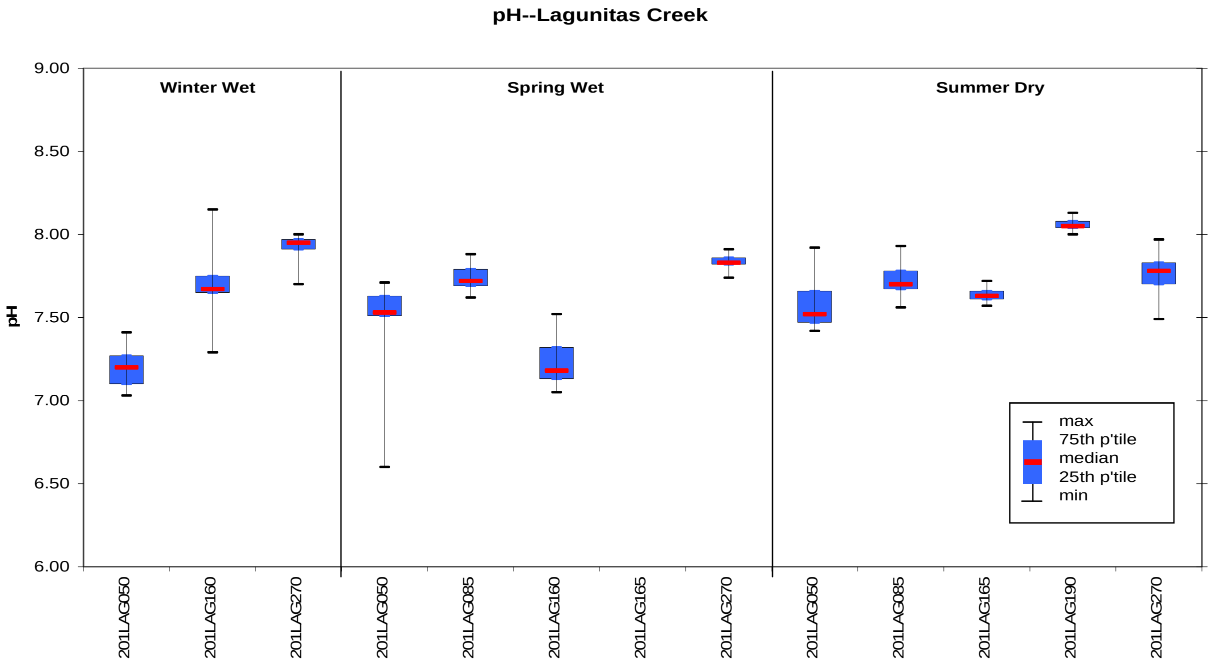

Figure 7-15. pH monitoring in Lagunitas Creek watershed

Data were rejected for LAG165 in the spring.

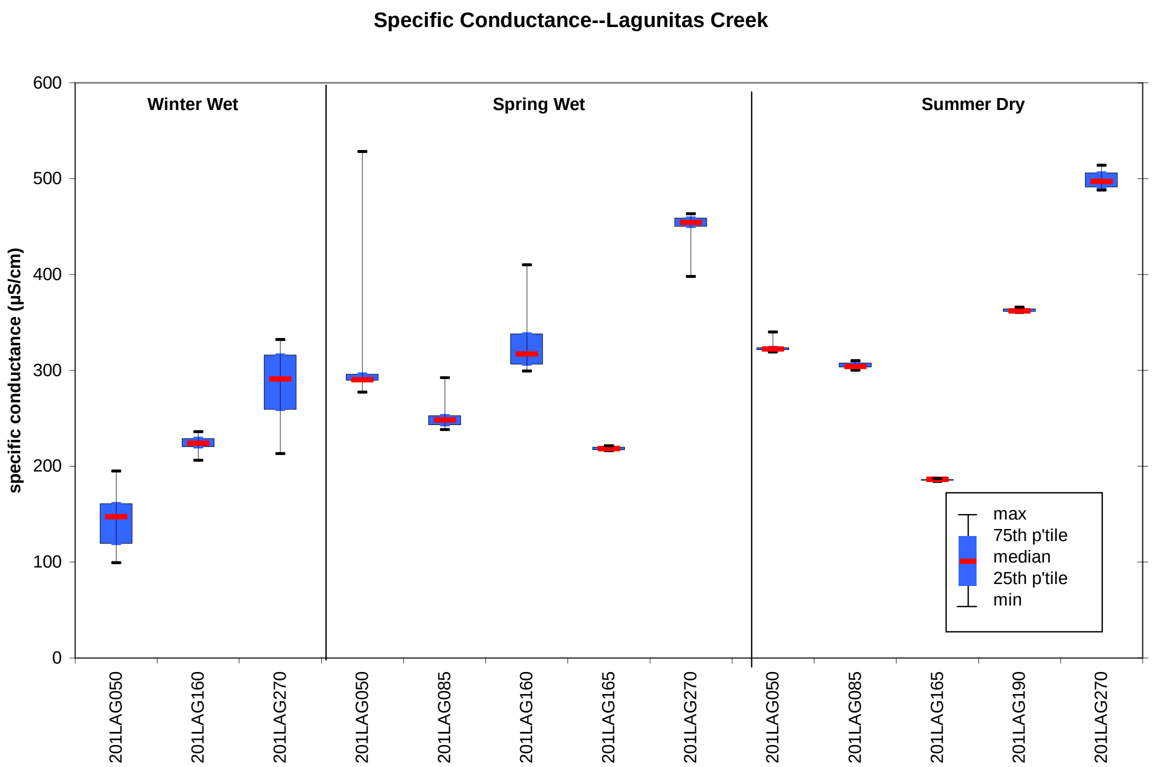

Figure 7-16. Specific conductance monitoring in Lagunitas Creek watershed

7.2.5 Water, Sediment, and Clam Tissue Chemistry

Water samples from the Lagunitas Creek watershed all had relatively low nitrate concentrations, with all dry season values falling below the U.S. EPA reference guideline. Wet season concentrations were significantly higher than those measured in the dry season; all wet season values exceeded the U.S. EPA guideline (Figures 6-15 through 6-17; Appendix G). There was little variation among sites.

Chlorophyll-a values were also generally low, with only two measurements above the 1.78 µg/L guideline value (Appendix G). Those two measurements above guideline values came from samples collected in the dry season at Halleck Creek (LAG 150) and the wet season at Gallagher's Ranch (LAG130). Total phosphorus measurements were all low, 0.09 mg/L or less, with many values at the minimum reporting limit of 0.04 mg/L.

Orthophosphate values were among the lowest in the region; however only four measurements were below the 0.030 mg/L U.S. EPA region-specific guideline for total phosphorus.

Metal and organic contaminants were measured at three sites: Lower Olema Creek (LAG040), Gallagher's Ranch (LAG130), and Creamery Gulch (LAG270). Land use at these sites was characterized as mixed at the first two and rural residential at the third (Table 3-4). Basin Plan water quality objectives (WQOs) for protection of aquatic life were not exceeded in any water samples from this watershed.

Sediments were collected for analysis from two sites: Green Bridge on Lagunitas Creek at Hwy 1 (LAG120, mixed land use), and Creamery Gulch on San Geronimo Creek (LAG270, rural residential), both during the dry season. No organic chemicals were measured at concentrations above sediment quality guidelines (Table 4-3).

However, geologically abundant chromium and nickel were measured above the probable effects concentration (PEC) in sediments from both sites, and arsenic, copper, and mercury were measured above the threshold effects concentrations (TECs) in sediments from San Geronimo Creek (LAG270). These elevated metals concentrations gave the San Geronimo Creek site a sediment quality guideline quotient (SQGQ) value 0.58, the highest of any site measured in the region during this study. In comparison, the SQGQ value for Lagunitas Creek at Hwy 1 was 0.18. Generally, SQGQ values greater than 0.5 tend to be associated with acute toxicity to infaunal invertebrates (MacDonald *et al*. 2000). However, the bioavailability and toxicity of these geologically available metals is uncertain in this setting. These concentrations may be more representative of increased erosion in the watershed than of anthropogenic sources of toxicants.

Tissues of clams deployed at lower Olema Creek (LAG040), Gallagher's Ranch (LAG130), and Creamery Gulch (LAG270) had the highest mercury concentrations measured anywhere in the region (Figure 6-22). Copper concentrations were higher than in controls (Figure 6-21), but selenium and organic chemicals were similar to control values. These tissue results reflect the sediment chemistry measurements of elevated metals and lower concentrations of organics.

7.2.6 Water and Sediment Toxicity

Toxicity tests were conducted on water samples from lower Olema Creek (LAG040), Gallagher's Ranch (LAG130), and Creamery Gulch (LAG270); and on sediment samples from Lagunitas Creek at Hwy 1 (LAG120) and Creamery Gulch on San Geronimo Creek (LAG270). No significant toxicity was observed in any of these samples (Figure 7-17). This is worth noting because of the elevated trace metal concentrations in San Geronimo Creek sediments, and indicates that these metals were not highly bioavailable.

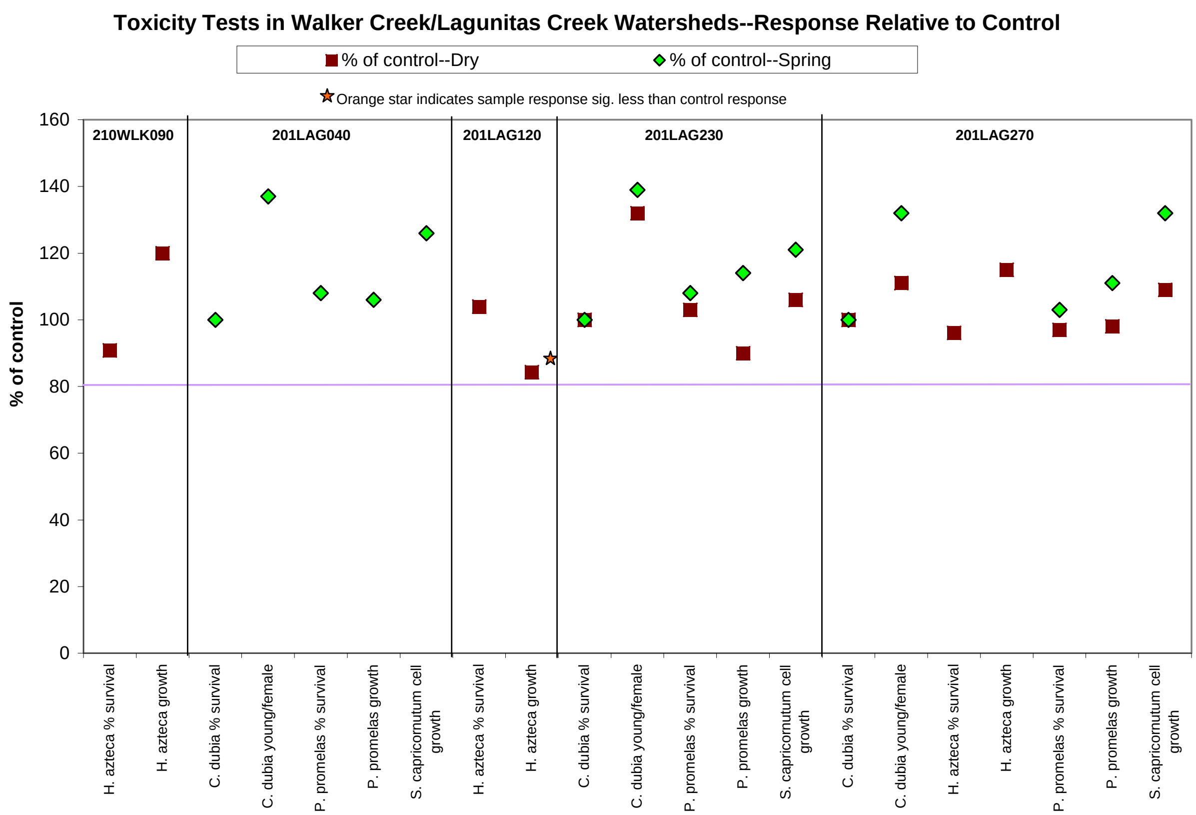

Figure 7-17. Toxicity tests in Walker and Lagunitas creeks

Results of toxicity tests are shown with three species in water samples and one species in sediment samples from Walker and Lagunitas Creeks. See text for description of species, endpoints, and seasons. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.2.7 Coliform Bacteria

Bacterial counts were made in water samples from five sites in the watershed (Figures 6-28 through 6-30).

- Hagmaier Pond (LAG115) had acceptable levels of *E. coli* and total coliforms, but exceeded the Basin Plan objective for 90^{th} percentile fecal coliform.
- Lagunitas Creek at Hwy 1 (Green Bridge, LAG120) exceeded Basin Plan objectives for all bacterial types.
- Inkwells (LAG230) exceeded only the objective for total coliforms.
- The Swimming Hole at Samuel P. Taylor State Park (LAG185) exceeded only the *E. coli* Basin Plan objective for water-contact recreation.
- Cataract (LAG390), a site above a municipal water source in the Lagunitas Creek headwaters, did not exceed any Basin Plan coliform objectives for recreational use.

7.3 San Leandro Creek Watershed

7.3.1 Sites of Concern

Exceedances noted in the summary table (Table 7-7) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

The most contaminated site measured in the watershed was the most downstream site, Lower San Leandro Creek at Empire Road (SLE030). Measured concentrations of numerous chemicals exceeded guideline values, water was toxic to invertebrate reproduction, and sediment was highly toxic to amphipods. This urban site had the highest nutrient and chlorophyll values in the watershed as well.

Coliform indicator concentrations exceeded at least one Basin Plan objective at all recreational sites. Contaminants appear to be a concern in this watershed along with conventional parameters such as temperature and DO.

Ongoing deployment of temperature loggers at key sites would help clarify conditions for salmonids, and continued monitoring of sediment contamination is recommended to help identify chemicals of concern in the watershed and possible sources to the Bay.

Table 7-7. Summary of sites with exceedances in San Leandro Creek watershed

Analyte	***Standard***	***# of sites***
FIELD MEASURES *of 7 sites sampled*		
Temperature	MWAT, coho	1
Oxygen, dissolved	minimum, COLD	5
	3-month median	5
pH	range	1
CONVENTIONAL WATER QUALITY *of 4 sites sampled*		
Nitrate as N	maximum	4
Phosphorus, total as P	maximum	4
WATER METALS *of 2 sites sampled*		
Chromium VI, dissolved	acute	1
	chronic	1
WATER ORGANICS *of 2 sites sampled*		
Diazinon	acute	1
WATER TOXICITY *of 2 sites sampled*		
Ceriodaphnia	reproduction	1
SEDIMENT CHEMISTRY *of 1 site sampled*		

Analyte	Standard	# of sites
Metals		
Arsenic	TEC	1
Cadmium	TEC	1
Chromium	PEC	1
Copper	TEC	1
Lead	PEC	1
Mercury	TEC	1
Nickel	PEC	1
Zinc	TEC	1
Organics		
Chlordane	TEC	1
DDD (sum op + pp)	TEC	1
DDE (sum op + pp)	TEC	1
DDT (total)	TEC	1
SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	survival	1
COLIFORMS *of 5 sites sampled*		
E. coli	steady state	2
Fecal coliform	log mean	2
	90th percentile	3
Total coliform	median	5
	maximum	1

7.3.2 Water Quality in Relation to Land Use

The most urban site at the downstream end of the watershed had high contaminant and nutrient concentrations, but since contaminants were measured at few sites, it is not possible to determine statistical relationships with land use. Samples from the upstream site on Moraga Creek (SLE210), which drains an urban area, had relatively high nutrient and algal concentrations. Benthic invertebrate assemblages at sites in urban areas were severely degraded relative to conditions at sites draining open space parkland. Relationships between bioassessment data and land use are further discussed in Section 6.1.1 above.

7.3.3 Macroinvertebrate Assemblages and Physical Habitat

Three benthic assemblage groups were identified in the San Leandro Creek watershed from the cluster dendrogram (Figure 7-19):

- The Middle Mainstem (MM) group included two sites located on the mainstem of San Leandro Creek in the heavily urbanized City of San Leandro (SLE050 and SLE070).
- The Undeveloped Tributaries (UD) group included five sites on small tributaries draining watersheds with relatively low intensity human land use (SLE180, SLE190, SLE200, SLE220, and SLE230).
- The third assemblage group included sites from throughout the watershed.
    - SLE030 is located at the bottom of the watershed near the maximum extent of tidal influence.
    - SLE090 is on the mainstem of San Leandro Creek below Chabot Dam.
    - SLE170 is on the West Fork of Redwood Creek, a small tributary to Upper San Leandro Reservoir, in Redwood Regional Park.
    - SLE210 is located on Moraga Creek, a small tributary to Upper San Leandro Reservoir, in suburban Moraga..

These sites all possess an intermediate to high level of human land use in their upstream watersheds.

Middle Mainstem group
Benthic assemblages at sites in the Middle Mainstem Group (MM) were dominated by the following taxa:

Oligochaeta	82%
Chironomidae	12%

Other taxa present at both sites include the mothfly *Psychoda* sp., Ostracoda, the water mite family Libertiidae, and the pond snail *Fossaria* sp. No specimens from the Ephemeroptera, Plecoptera, Trichoptera, or Coleoptera insect orders were collected at either site.

The assemblage composition suggests extremely poor water quality. Mothflies feed on microorganisms associated with raw sewage, while Oligochaetes and Chironomids are often dominant when poor conditions inhibit other insects such as the mayflies, stoneflies, and caddisflies.

Undeveloped Tributaries group
The Undeveloped Tributaries (UD) group contained a diverse assemblage of invertebrates, with taxa richness values at sites ranging from 27 to 39. The benthic assemblages at these five sites reflect excellent water quality conditions. Differences in taxonomic composition most likely reflect minor environmental differences among the sites. The numerically dominant taxa at these sites were:

Chironomidae	30%
Optioservus sp. (Elmidae)	8%
Baetis sp. (Baetidae)	7%
Parthina sp. (Odontoceridae)	6%
Simulium sp. (Simuliidae)	3%
Malenka sp. (Nemouridae)	2%
Paraleptophlebia sp. (Leptophlebiidae)	2%

Many other EPT taxa were abundant and found at a majority of sites, including *Calineuria californica*, *Diphetor hageni*, and *Lepidostoma* sp.

Other sites throughout the watershed
Sites in the third assemblage group were dominated by four common tolerant taxa that are usually the most abundant invertebrates in highly disturbed streams:

Chironomidae	58%
Simulium sp. (Simuliidae)	16%
Baetis sp. (Baetidae)	6%
Oligochaeta	4%

Few other EPT taxa were found, other than several caddisflies and stoneflies at SLE170.

The four sites in this group reflect a moderate to high level of disturbance, although not as high as the Middle Mainstem (MM) sites. Given the range of land uses that drain these sites, these results indicate that a small amount of intensive land use can drastically alter benthic communities. For example, the West Fork of Redwood Creek (SLE170) drains a forested watershed partly in a regional park. Human land use in the watershed is relatively minor, but includes roads, horse stables, and several residences. Moraga Creek (SLE210) drains a suburban residential neighborhood. SLE090 is located on San Leandro Creek just below the dam at Lake Chabot. Benthic assemblages at these three sites are similar to those found at SLE030, the site on the mainstem of San Leandro Creek below the heavily urbanized City of San Leandro.

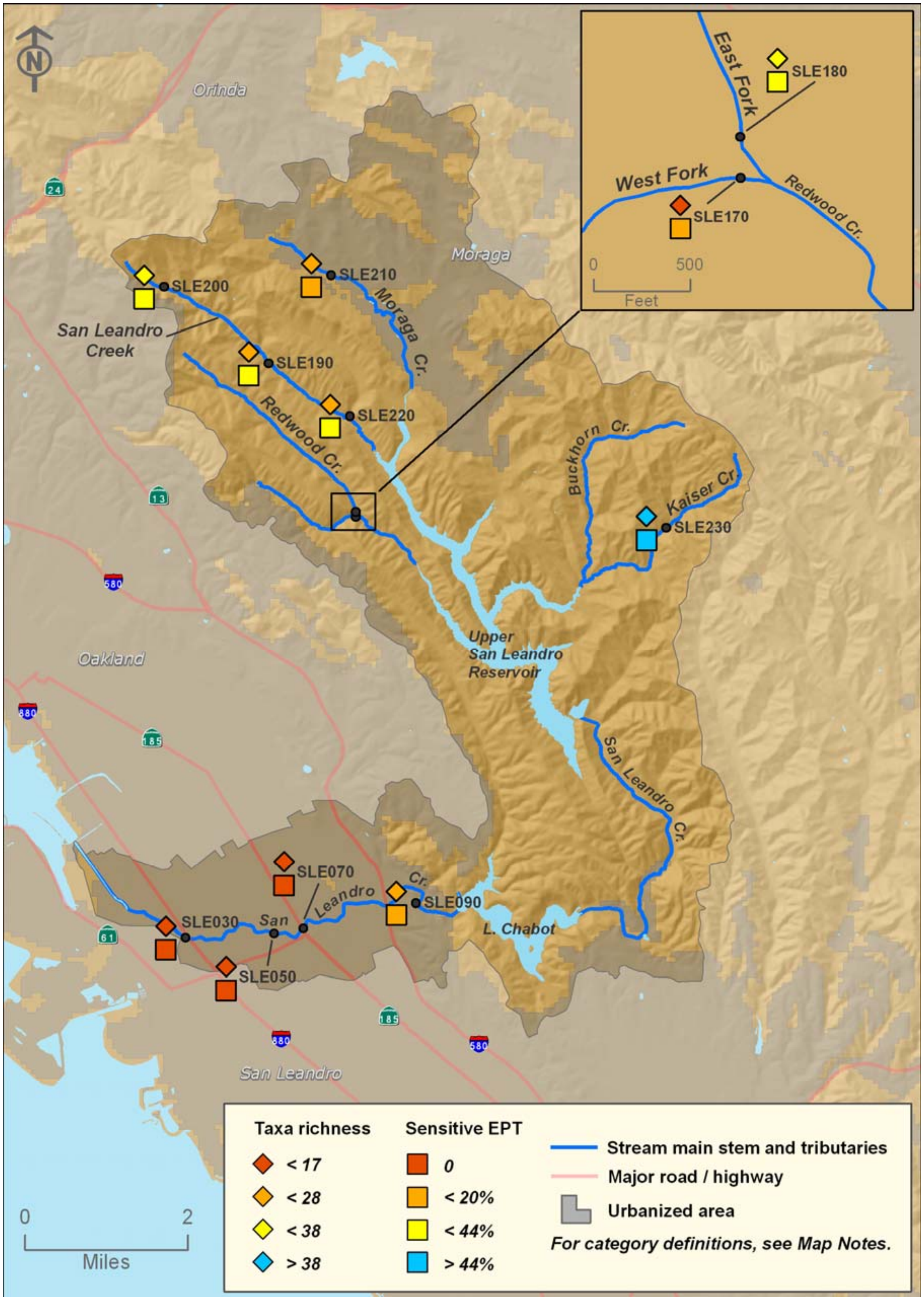

Figure 7-18. Map of index scores for macroinvertebrates in San Leandro Creek

Table 7-8. Bioassessment sites in the San Leandro Creek watershed

Site Code	Site Name	Stream
SLE030	Empire Road	Lower San Leandro Creek
SLE050	San Leandro BART	Lower San Leandro Creek
SLE070	Root Park	Lower San Leandro Creek
SLE090	Chabot Park	Lower San Leandro Creek
SLE170	West Fork Redwood	West Fork Redwood Creek
SLE180	East Fork Redwood	East Fork Redwood Creek
SLE190	Canyon School	Upper San Leandro Creek
SLE200	Huckleberry	Upper San Leandro Creek
SLE210	Moraga	Moraga Creek
SLE220	Indian	Indian Creek
SLE230	Kaiser	Kaiser Creek

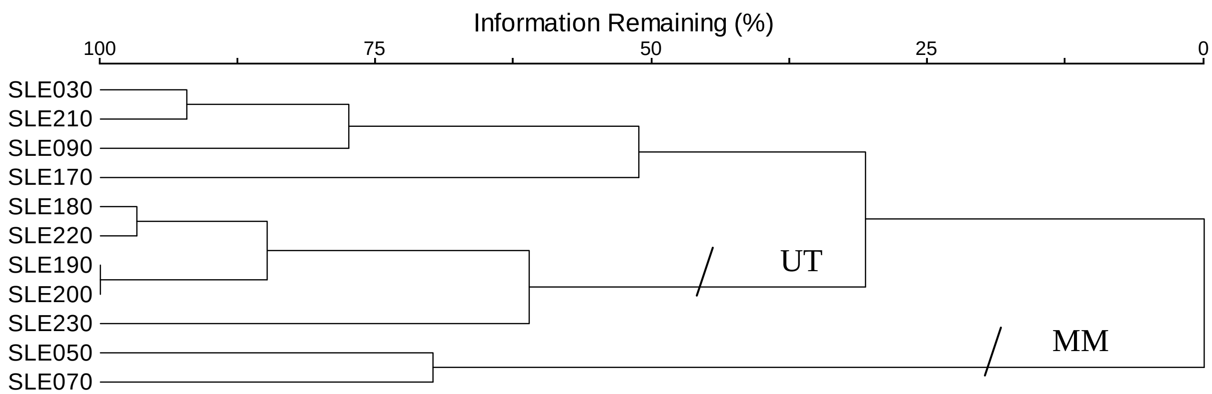

Figure 7-19. Cluster dendrogram of sites in the San Leandro Creek watershed

The cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at top signifies how similar the sites are with respect to taxa presence. Abbreviations: UT, Undeveloped Tributaries; MM, Middle Mainstem.

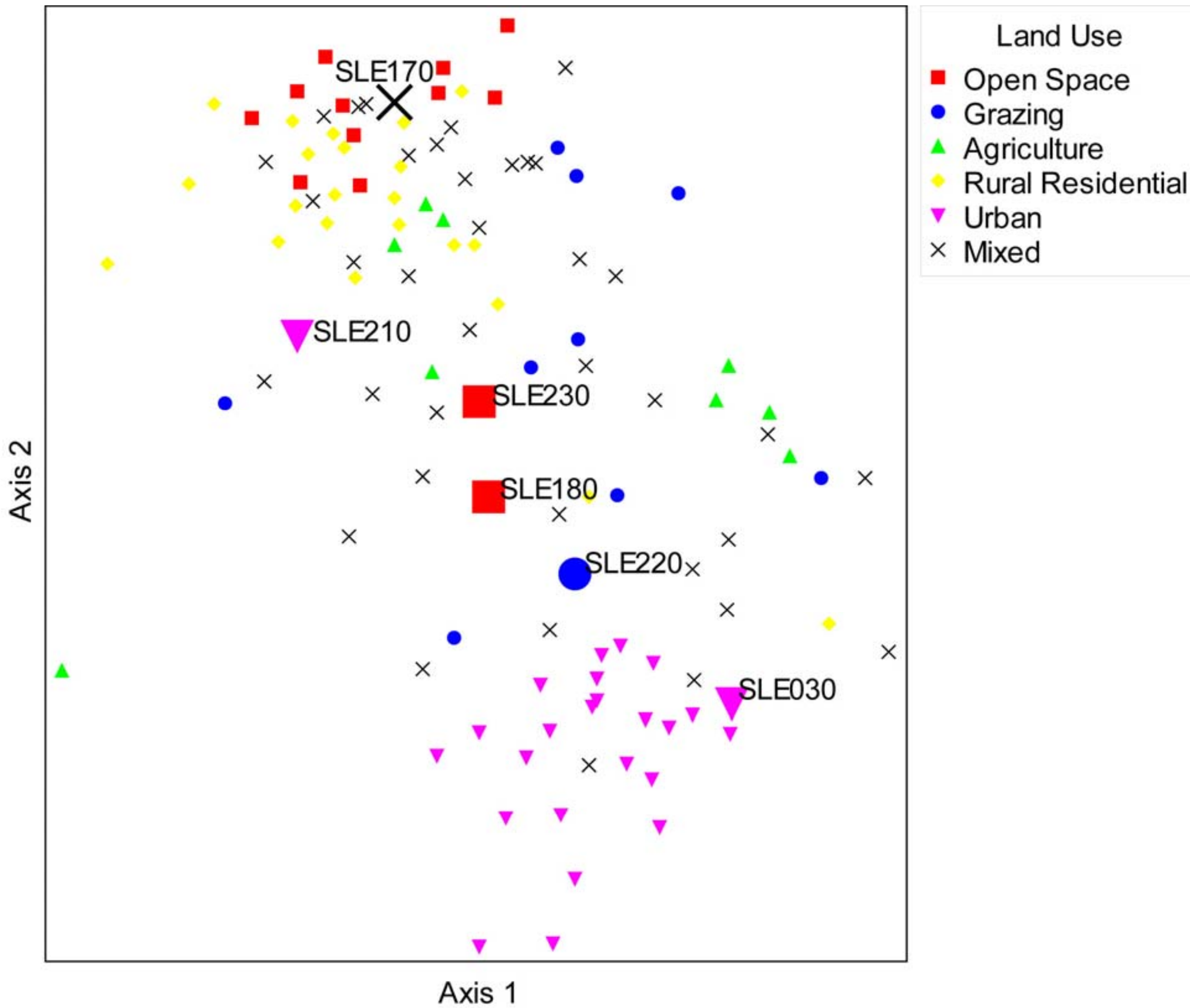

Figure 7-20. NMS ordination of sites in the San Leandro Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the San Leandro Creek watershed are labeled and symbols are enlarged. Note that several sites are not included in the ordination because the sites were sampled as part of a different study (see Breaux et al. 2005). For an explanation of ordination graphs, refer to Section 6.1.

Table 7-9. Biological metrics from the San Leandro Creek watershed

	SLE030	SLE050	SLE070	SLE090	SLE170	SLE180	SLE190	SLE200	SLE210	SLE220	SLE230
Coleoptera Taxa	0	0	0	1	2	2	6	4	2	2	7
Diptera Taxa	2	5	7	8	3	10	7	11	5	7	7
Ephemeroptera Taxa	1	0	0	1	2	5	6	8	1	5	6
Odonata Taxa	0	0	0	1	0	1	1	1	1	0	0
Plecoptera Taxa	0	0	0	0	2	7	5	3	1	3	4
Trichoptera Taxa	0	0	0	2	4	4	6	5	0	4	9
Non-Insect Taxa	9	6	6	13	3	6	3	5	8	6	5
Taxa Richness	12	12	13	26	16	35	35	37	18	27	39
EPT Taxa	1	0	0	3	8	16	17	16	2	12	19
% EPT	0	0	0	2	12	55	44	46	14	47	66
% Sensitive EPT	0	0	0	0	3	28	42	37	0	27	48
% Chironomidae	48	35	7	57	67	30	22	46	60	28	22
% Coleoptera	0	0	0	0	6	4	29	3	1	1	9
% Oligochaeta	1	52	88	9	2	0	1	0	9	3	0
% Non-insect	31	61	90	21	2	4	2	1	12	6	2
% Intolerant	0	0	0	0	3	27	29	35	0	26	35
% Tolerant	8	90	89	13	0	1	1	1	1	1	1
Tolerance Value	5.8	7.8	7.7	6.0	5.6	4.1	3.6	3.6	5.7	4.2	3.4
% Predator	9	4	4	9	2	23	17	14	1	18	7
% Collector-filterer	24	0	0	55	11	1	12	16	14	13	3
%Collector-gatherer	60	95	94	30	79	55	26	38	84	57	54
% Scraper	7	1	2	7	6	14	31	9	1	5	15
% Shredder	0	0	0	1	2	7	14	23	0	7	18
% Other	0	0	0	0	0	0	0	0	0	0	2

7.3.4 Basic Water Quality Field Measurements

Stream temperature data were not available to calculate HWAT values in the urbanized sites in lower San Leandro Creek because deployments were less than seven days. In the upper creek above the reservoir, only Moraga Creek at Moraga (SLE210) exceeded a threshold value—the MWAT threshold for coho salmon (14.8ºC) during the summer dry season (see Figure 7-**,** Figure 7-, and Appendix D). Even in the absence of HWAT values, there appeared to be the potential for temperature stress at other sites, such as Lower San Leandro Creek at Root Park (SLE070) and Chabot Park (SLE090), where the median dry season measured temperatures exceeded 15ºC.

Dissolved oxygen concentrations failed to meet Basin Plan objectives (7 mg/L) on Lower San Leandro Creek at San Leandro BART (SLE050); Root Park (SLE070); Chabot Park (SLE090); West Fork Redwood Creek (SLE170), and Moraga Creek (SLE210), mostly during the dry season. Upper San Leandro Creek at Canyon School (SLE190) had DO values below 9 mg/L during two dry season measurements (Figure 7-, Figure 7-, and Appendix D). The Moraga Creek site (SLE210) had maximum pH measured above the Basin Plan objective during the spring wet season, with a maximum pH value of 8.66 (Figure 7-).

Dry season physical habitat scores were available for West Fork Redwood Creek (SLE170) and Moraga Creek (SLE210). Both had high canopy cover scores and relatively low scores for channel modification and riparian zone width.

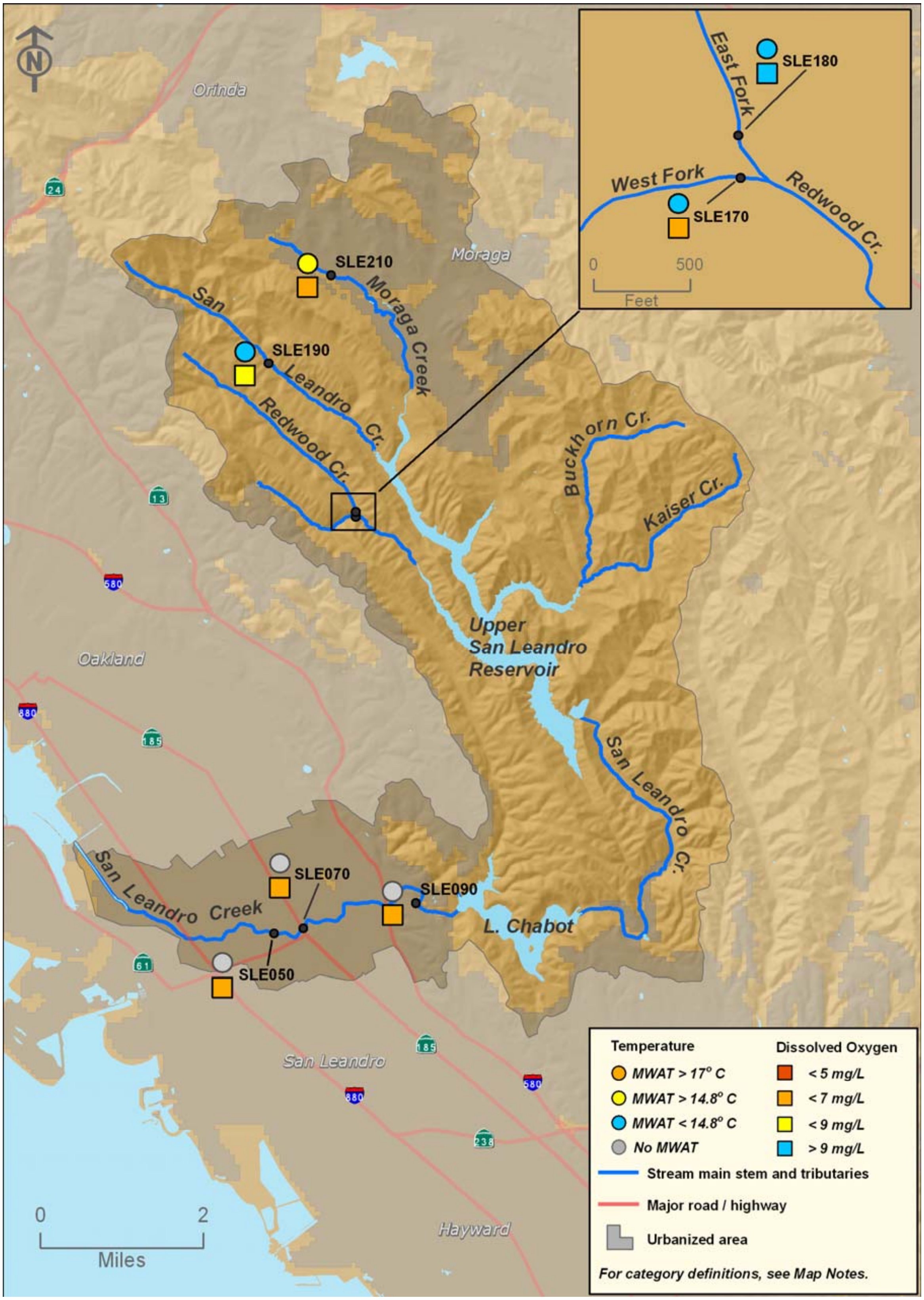

Figure 7-21. Map of temperature and DO levels in San Leandro Creek

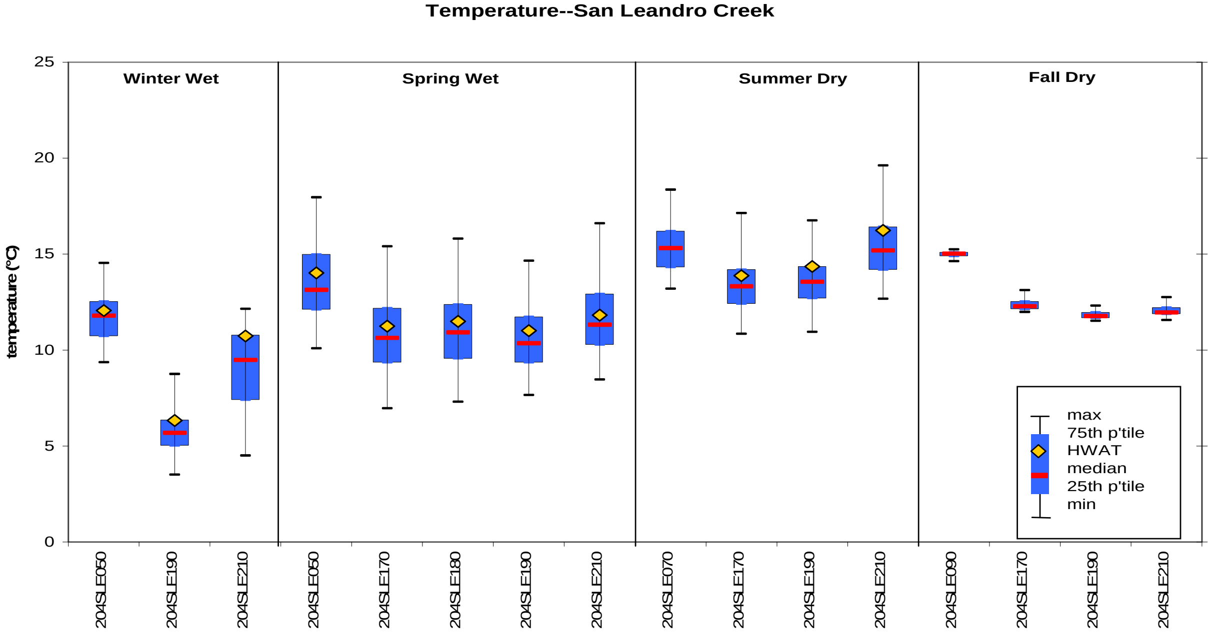

Figure 7-22. Temperature monitoring in San Leandro Creek

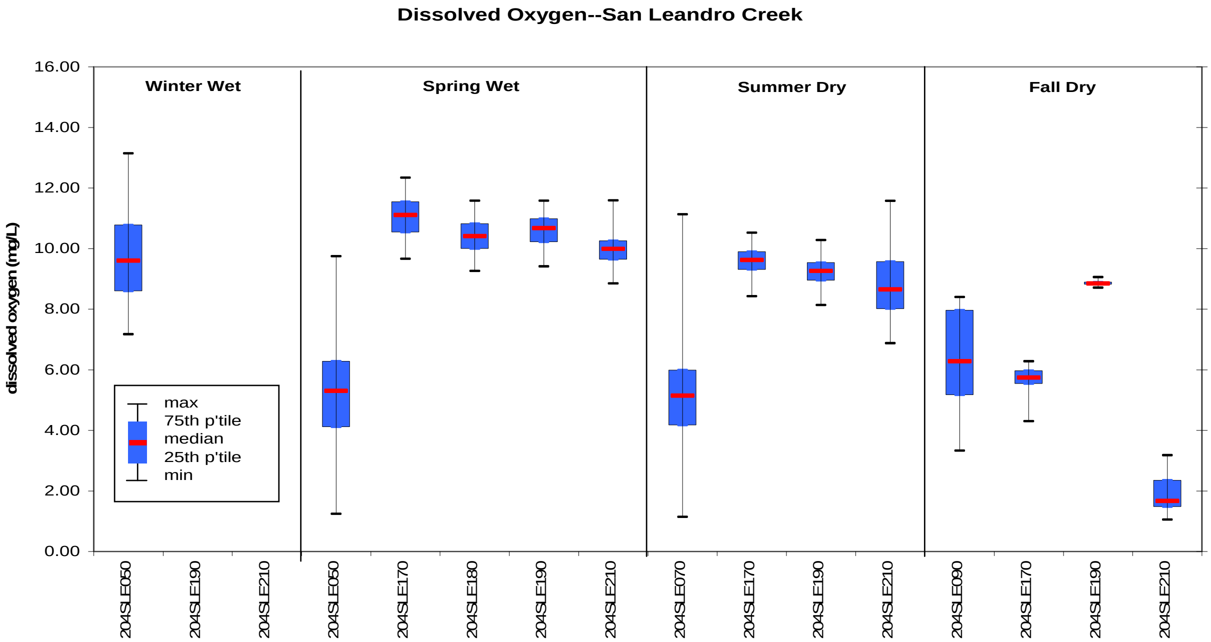

Figure 7-23. DO monitoring in San Leandro Creek

Data were rejected for SLE190 and SLE210 in the winter season.

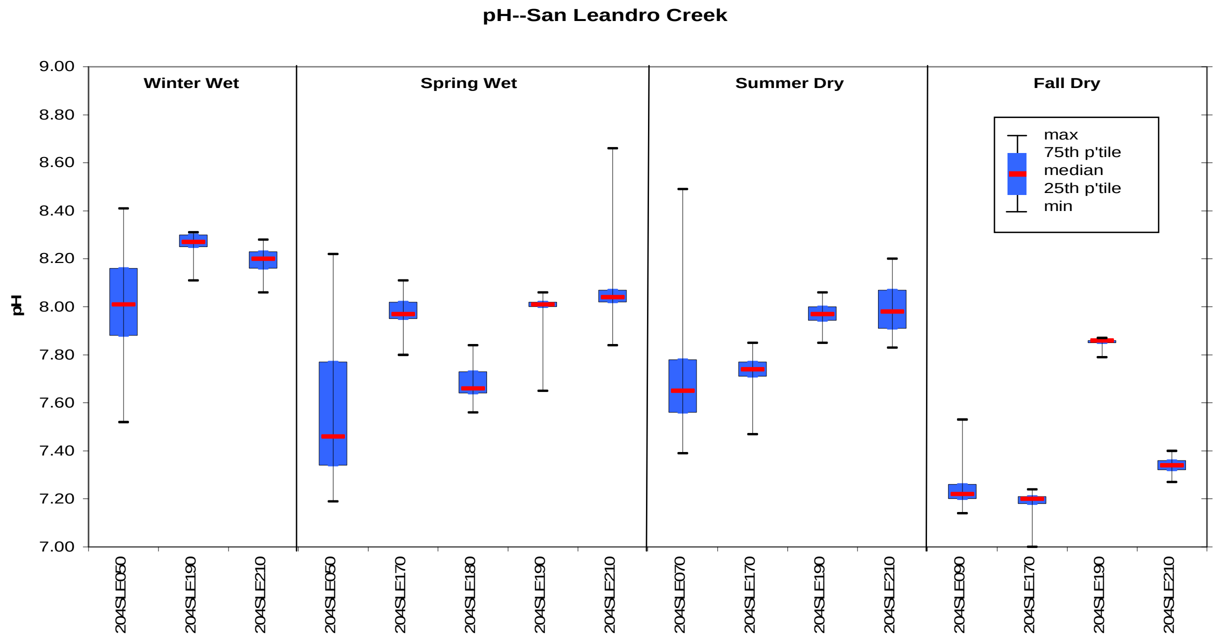

Figure 7-24. pH monitoring in San Leandro Creek

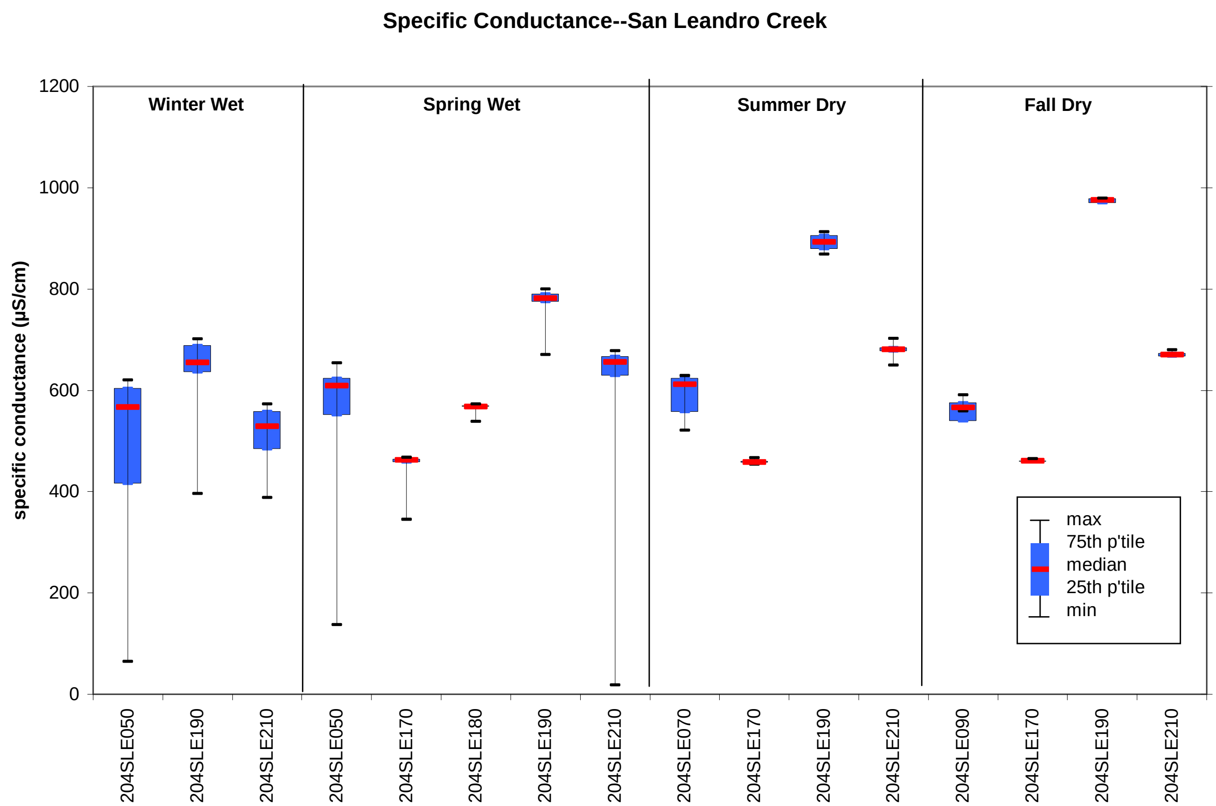

Figure 7-25. Specific conductance monitoring in San Leandro Creek

7.3.5 Water, Sediment, and Clam Tissue Chemistry

Water samples from the upper San Leandro watershed had moderately low nitrate concentrations, but most values exceeded 0.16 mg/L, the U.S. EPA reference guideline. Lower San Leandro Creek at Empire Road (SLE030) had very high nitrate concentrations between 6 and 8 mg/L (Figures 6-15 to 6-17; Appendix G).

Chlorophyll-a values were relatively high at SLE030 as well, with the dry season concentration of 7.9 µg/L being among the highest measured region-wide. The Moraga Creek site (SLE210) also had a relatively high dry season chlorophyll-a measurement of 5.3 µg/L. All others were below the 1.78 µg/L guideline value (Appendix G). (Care should be taken in interpreting water column chlorophyll values in these streams, since benthic algae are often dominant but not represented in water column samples.)

Total phosphorus measurements were highest at the Moraga Creek site (SLE210), with a dry season concentration of 0.46 mg/L. As with all samples in this study, values in the San Leandro Creek watershed were above the 0.030 mg/L U.S. EPA reference guideline value.

Orthophosphate values were also highest at the Moraga Creek site (SLE210), with a dry season concentration of 0.36 mg/L. All orthophosphate measurements in the watershed exceeded the 0.030 mg/L U.S. EPA guideline for total phosphorus.

Trace metal and organic contaminants were measured in water samples from Lower San Leandro Creek at Empire Road (SLE030), and metals were measured at Kaiser Creek (SLE230). Basin Plan objectives for aquatic life protection were exceeded for chromium and diazinon at SLE030. The chronic WQO was exceeded for chromium in the dry season, and both the acute and chronic WQOs were exceeded in the spring sample. Diazinon was measured above the WQO in the spring.

Sediments were collected for analysis from the most downstream site in the watershed, Lower San Leandro Creek at Empire Road (SLE030). Geologically abundant chromium and nickel were measured above the Probable Effects Concentration in sediments from this site, as was lead. The sediment lead concentration of 130 mg/kg was about 10 times higher than for any other sediment sample measured in this study. Sediment arsenic, cadmium, copper, lead, mercury, zinc, sum DDD, sum DDE and sum all DDTs were measured above the Threshold Effects Concentrations. This Lower San Leandro Creek sediment had the second highest sediment quality guideline quotient (SQGQ) value measured in the region during this study at 0.44 (0.47 with DDE included). These SQOQ values approach the 0.5 value evaluated by MacDonald *et al*., 2000, but are not likely to be associated with acute sediment toxicity due to contaminant mixtures.

Clam deployments were unsuccessful in this watershed, and tissue data are unavailable.

7.3.6 Water and Sediment Toxicity

Three-species toxicity tests were conducted on water samples from Lower San Leandro Creek at Empire Road (SLE030), and Kaiser Creek (SLE230); amphipod tests were conducted on a sediment sample from SLE030. Diazinon has been commonly linked to lethal effects on *C. dubia*. There was a significant adverse effect on *C. dubia* reproduction in a dry season water sample from the Lower San Leandro Creek site (Figure 7-). Diazinon was measured in this sample below the lethal concentration. Other compounds were measured in this sample as well, and toxicity may be the result of a mixture of chemicals. No toxicity was observed in any of the other water samples.

The sediment sample from SLE030 was highly toxic, with 100 percent mortality in all replicates. It is important to note the very high total organic carbon concentration in this sample (9.4 percent), which may have negatively affected the test organisms directly, and which may be indicative of high contaminant loading rates. Of the chemicals measured for which probable effects concentration (PEC) guidelines are available, only lead exceeded the PEC value, while the legacy pesticides DDE, DDD, and DDT exceeded the threshold effects concentrations (TECs). The SQGQ for this sample was 0.44 (0.47 with DDE included), which is just below the 0.5 value evaluated by MacDonald *et al*. (2000) for association with acute toxicity.

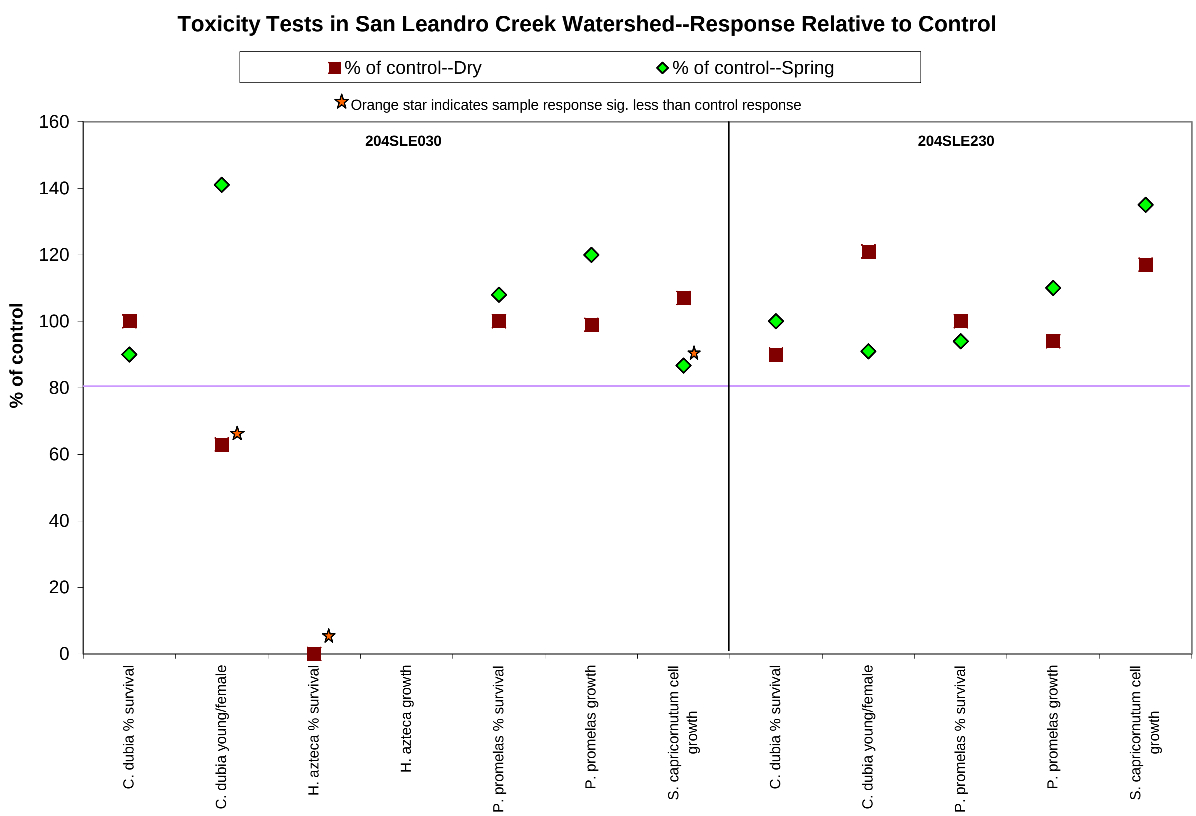

Figure 7-26. Toxicity tests in San Leandro Creek

Results of toxicity tests are shown, with three species in water samples and one species in sediment samples from San Leandro Creek. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.3.7 Coliform Bacteria

Bacterial counts were made in water samples from five sites in the watershed (Figures 6-28 through 6-30). Basin Plan objectives for all three indicators (*E. coli*, fecal coliforms, and total coliforms) were exceeded at both the Lower San Leandro Creek site at Root Park (SLE070) and the Upper San Leandro Creek site at Canyon School (SLE190); the counts were considerably higher at the lower creek site. Basin Plan objectives for total coliforms only were exceeded at both the Lower San Leandro Creek site at Chabot Park (SLE090) and the W. Fork Redwood Creek site (SLE170), where the concentrations were comparable. Basin Plan objectives for fecal coliforms only were exceeded at Upper San Leandro Creek at Huckleberry (SLE200).

7.4 Wildcat/San Pablo Creek Watershed

7.4.1 Sites of Concern

Exceedances noted in the summary tables (Table 7-10 and
Table 7-11) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

Benthic invertebrate assemblages generally reflected poor conditions throughout the watershed. Urban sites in the lower watershed had moderate concentrations of contaminants. Measurements from the Lauterwasser Creek site (SPA200) exceeded the short-term maximum salmonid temperature of 24ºC, had dissolved oxygen concentrations below the salmonid threshold during the dry season, and had the highest orthophosphate concentration in the region.

Table 7-10. Summary of sites with exceedances in Wildcat Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 3 sites sampled*		
Temperature	MWAT, coho	2
Oxygen, dissolved	minimum, WARM	2
	3-month median	3
pH	range	1
CONVENTIONAL WATER QUALITY *of 2 sites sampled*		
Nitrate as N	maximum	2
Phosphorus, total as P	maximum	1
WATER METALS *of 1 site sampled*		
Mercury, total	chronic	1
WATER ORGANICS *of 1 site sampled*		
Chlorpyrifos	chronic	1
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Chromium	PEC	1
Nickel	PEC	1
Organics		
Chlordance	TEC	1
PCB (total)	TEC	1
SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	**growth**	**1**
COLIFORMS *of 2 sites sampled*		
E. coli	steady state	1
Fecal coliform	log mean	1

Analyte	Standard	# of sites
	90th percentile	1
Total coliform	median	2
	max	1

Table 7-11. Summary of sites with exceedances in San Pablo Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 5 sites sampled*		
Temperature	maximum, salmonid	1
	MWAT, steelhead	2
	MWAT, coho	4
Oxygen, dissolved	minimum, WARM	1
	3-month median	2
pH	range	1
CONVENTIONAL WATER QUALITY *of 5 sites sampled*		
Nitrate as N	maximum	5
Phosphorus, total as P	maximum	5
WATER ORGANICS *of 4 sites sampled*		
Chlorpyrifos	chronic	2
Diazinon	acute	2
WATER TOXICITY *of 4 sites sampled*		
Selenastrum	growth	2
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Chromium	TEC	1
Mercury	TEC	1
Nickel	TEC	1
Organics		
Chlordane	TEC	1
COLIFORMS *of 2 sites sampled*		
E. coli	steady state	2
Fecal coliform	log mean	2
	90th percentile	2
Total coliform	median	2
	max	1

7.4.2 Water Quality in Relation to Land Use

High manganese and highly variable nickel concentrations in water samples from the Wildcat Creek site at Richmond Parkway (WIL020) may be the result of industrial activities in this urban area, or they may result from mobilization of geologic sources caused by activities such as grading for housing development. Concentrations of the herbicide oxadiazon found in clam tissues at 3rd St. Bridge on San Pablo Creek (SPA020), where toxicity to algae was observed, may indicate excessive herbicide use possibly in residential, nursery, or golf course applications. High orthophosphate concentrations in the Lauterwasser Creek site (SPA200) likely result from residential fertilizer applications in the Lafayette/Orinda suburban areas.

7.4.3 Macroinvertebrate Assemblages and Physical Habitat

Four benthic assemblage groups were identified in the San Pablo Creek/Wildcat Creek planning watershed from the cluster dendrogram (Figure 7-):

- The Urban Mainstem (UMS) group included six sites located near the mouths of San Pablo Creek (SPA020, SPA050, SPA070) and Wildcat Creek (WIL030, WIL050, WIL060), in the Richmond-San Pablo urban area. One site on San Pablo Creek in Orinda (SPA220) had a similar benthic assemblage and was classified into this group as well.
- The San Pablo Creek Tributaries (SPT) group consisted of sites on small tributary streams in the San Pablo Creek watershed including Appian Creek (SPA100), Wilkie Creek (SPA110), Castro Creek (SPA130), Lauterwasser Creek (SPA200), and the San Pablo Creek headwaters (SPA240).
- The Wildcat Canyon (WC) group included a site at the mouth of Wildcat Canyon at Alvarado Park (WIL070); a site downstream of Jewel Lake in Tilden Park (WIL100); and a site at the Lone Oak Picnic area in Tilden Park (WIL130).
- The Bear Creek and Wildcat Headwaters (BCWH) group consisted of three sites on Bear Creek (SPA140, SPA150, SPA160), a tributary to San Pablo Creek that drains into Briones Reservoir, and two sites in upper Wildcat Creek (WIL170, WIL190).

One site (SPA170) was dissimilar and did not fit into the four assemblage groups.

Urban Mainstem group
Benthic assemblages at sites in the Urban Mainstem group (UMG) are indicative of highly disturbed conditions common in urban streams in the Bay Area. Assemblages at these sites were dominated by common tolerant taxa. Oligochaetes (35 percent of the total number of organisms) and Chironomidae (34 percent) were both very abundant at every site. *Baetis* sp. (18 percent) was very abundant at most sites except WIL040 and WIL050. Similarly, *Simulium* sp. (9 percent) was abundant at four sites but not at three others (SPA020, WIL040, WIL060). No other taxa made up greater than one percent of benthic organisms.

Other taxa found at a majority of sites include the relatively tolerant caddisfly *Hydroptila* sp. (Hydroptilidae), the water mite family Sperchontidae (Acari), and the tolerant snail taxa Physa/Physella (Gastropoda: Physidae).

Several moderately intolerant taxa, including the stonefly *Kogotus* sp. (Perlodidae) and the caddisfly *Lepidostoma* sp. (Lepidostomatidae) were found at two sites, WIL060 and SPA220. *Lepidostoma* is commonly found in less impacted urban creeks in the Bay Area.

Many common moderately intolerant taxa were completely absent from all sites, including the caddisfly family Hydropyschidae, the mayfly families Heptageniidae and Leptophlebiidae, and the stonefly *Malenka* sp. (Nemouridae).

San Pablo Creek Tributaries

The San Pablo Creek Tributary (SPT) sites were dominated by the same common intolerant taxa, but differences in taxa abundance suggest significant ecological differences between the tributary streams. Chironomid midges were the dominant taxa at the lower San Pablo Creek tributaries, but present at lower abundances at the upper sites. The most common taxon at the upper tributaries was the mayfly *Baetis* sp., which was present at very low numbers at the lower tributaries:

	Chironomidae	*Baetis* sp. (Baetidae)
Lower tributaries		
SPA100	52%	<1%
SPA 110	59%	<1%
SPA130	64%	<1%
Upper tributaries		
SPA200	20%	48%
SPA240	30%	48%

Other EPT taxa were largely absent; no other mayflies or stoneflies were found at any site. The moderately tolerant caddisfly *Hydroptila* sp. was present in low numbers at SPA110 and SPA200.

Wildcat Canyon group

Benthic macroinvertebrate assemblages at sites in the Wildcat Canyon Group suggest some upstream water quality impacts at WIL130 and WIL100, but improved biological conditions at the lowest site in this group, WIL070. WIL130 is located in Tilden Park downstream of a golf course and botanic garden. WIL100 is located below the outlet of Jewel Lake, a small dammed pond. WIL070 is located approximately four miles downstream near the mouth of the canyon at the urban boundary.

The assemblage at WIL130 was dominated by the tolerant taxa Oligochaeta (48 percent), Chironomidae (32 percent), and *Baetis* sp. (15 percent). *Baetis* and chironomids were also abundant at WIL100 and WIL070, but Oligochaetes were present at those sites only in low abundances (4 percent and 8 percent, respectively). In contrast, the assemblage at WIL100 was dominated by the blackfly *Simulium* sp., a filter-feeding organism that is often observed at high abundances below reservoirs (41%).

The benthic assemblage at WIL070 was in better condition than at upstream sites, based on the higher taxa richness (26) and greater numbers of pollution intolerant taxa such as the caddisflies *Rhyacophila* sp., *Arctopsyche* sp., and *Agapetus* sp. The rare beetle *Elodes* sp. (Scirtidae) was also found at WIL070.

Bear Creek and Wildcat Headwaters group

Sites in the Bear Creek and Wildcat Headwaters (BCWH) group had the highest biological integrity in the San Pablo Creek/Wildcat Creek watershed. Taxonomic richness was high (>25) at all sites, and the assemblages were generally dominated by EPT taxa. Metric values were similar or slightly lower than values from intermittent minimally disturbed sites. The flow status of the Bear Creek sites and Wildcat Creek headwater sites is unknown, although there is anecdotal evidence that the Bear Creek sites may dry up and the Wildcat Creek sites are perennial. There were fewer more-sensitive EPT organisms at SPA140 and WIL170 (<18 percent) than at the other sites (>47 percent), suggesting that there may be slightly more anthropogenic disturbance at these two sites, possibly due to impacts from the Tilden Park golf course and botanical garden (WIL170) and forest management activities (SPA140). Overall, however, the sites in this group exhibit low levels of water quality impacts.

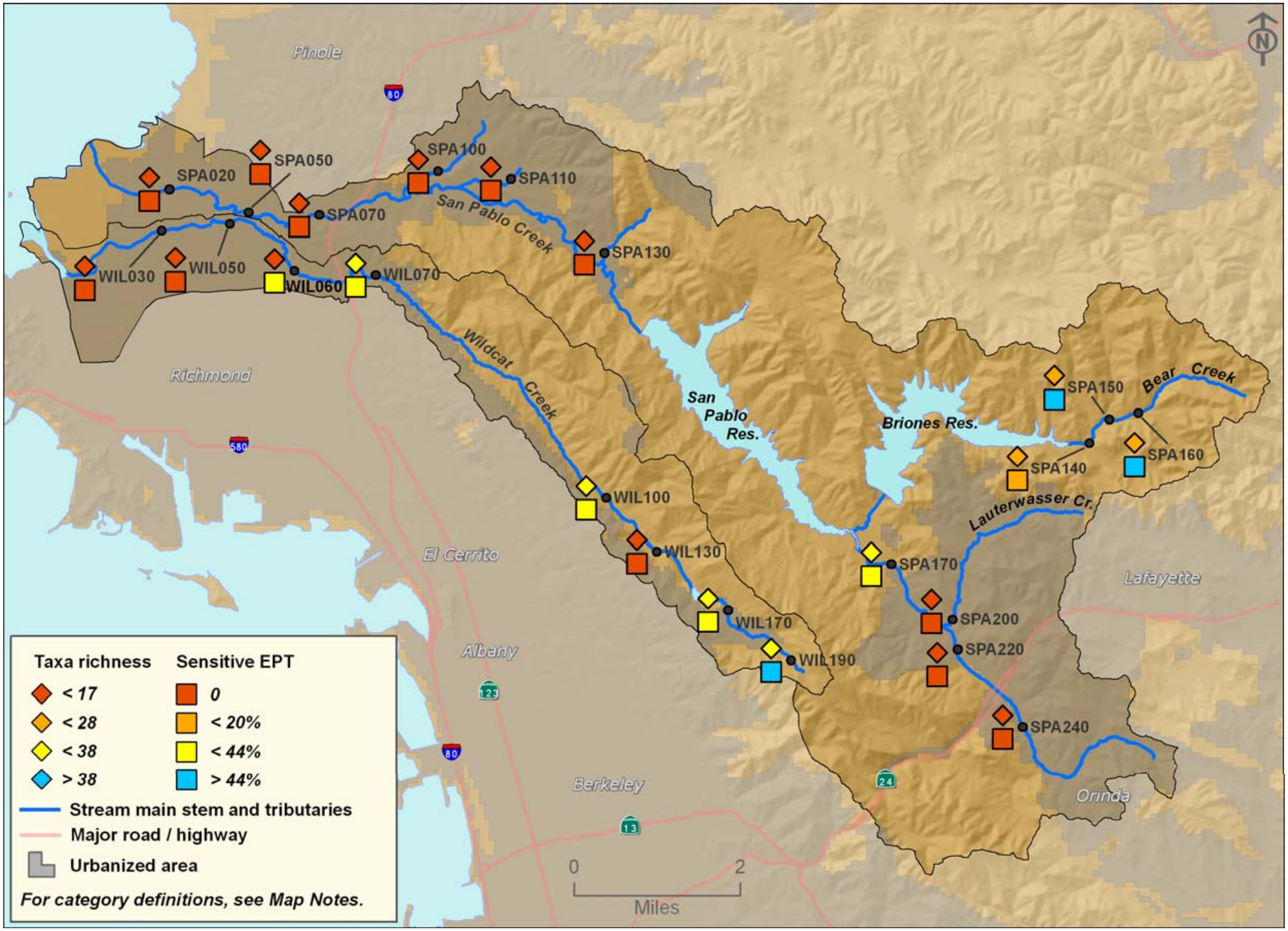

Figure 7-27. Map of Wildcat and San Pablo creeks benthic macroinvertebrates index scores

Table 7-12. Bioassessment sites in the Wildcat/San Pablo Creek watershed

Site ID	Site Name	Stream
SPA020	3rd St Bridge	San Pablo Creek
SPA050	20th St. at Road 20	San Pablo Creek
SPA070	Cemetery Bridge	San Pablo Creek
SPA100	Appian Way	Appian Way Creek
SPA110	De Anza School	Wilkie Creek
SPA130	Castro Ranch	Castro Creek
SPA140	Xmas Tree Farm	South Fork Bear Creek
SPA150	Briones 1	Bear Creek
SPA160	Briones 2	Bear Creek
SPA170	Bear Cr. Road	San Pablo Creek
SPA200	Lauterwasser	Lauterwasser Creek
SPA220	Orinda Village	San Pablo Creek
SPA240	Camino Encinas	San Pablo Creek
WIL030	3rd St.	Wildcat Creek
WIL050	Davis Park	Wildcat Creek
WIL060	Vale Road	Wildcat Creek
WIL070	Alvarado Park	Wildcat Creek
WIL100	Jewel Lake Outlet	Wildcat Creek
WIL130	Lone Oak	Wildcat Creek
WIL170	Botanic Garden	Wildcat Creek
WIL190	Possum Picnic Area	Wildcat Creek

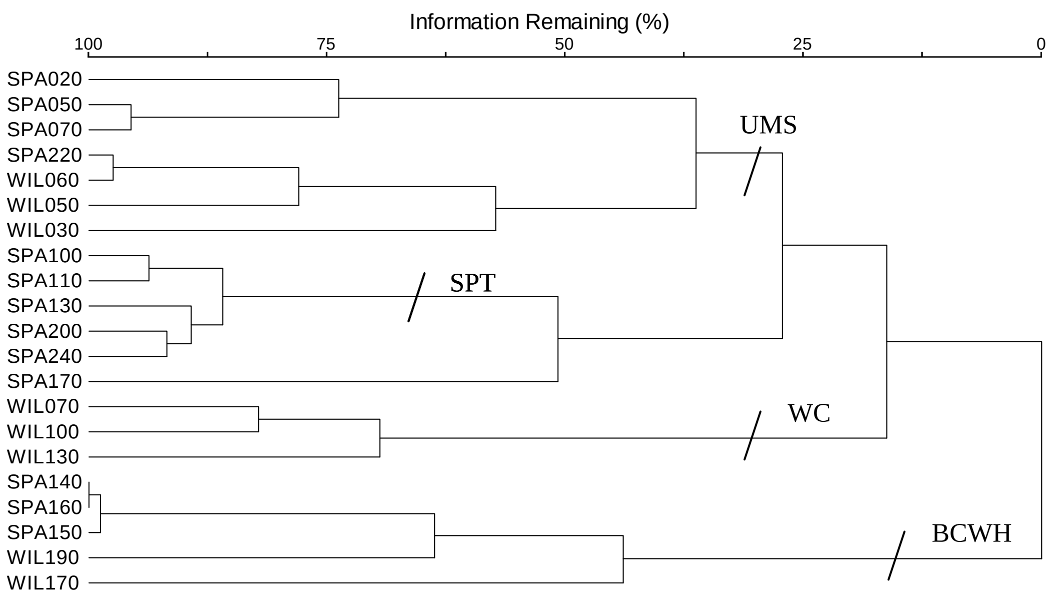

Figure 7-28. Cluster dendrogram sites in the Wildcat/San Pablo Creek watershed

The cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the Wildcat Creek/San Pablo Creek watershed. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at top signifies how similar the sites are with respect to taxa presence. Abbreviations: UMS, Upper Mainstem; SPT, San Pablo Creek Tributaries; WC, Wildcat Canyon; BCWH, Bear Creek Headwaters.

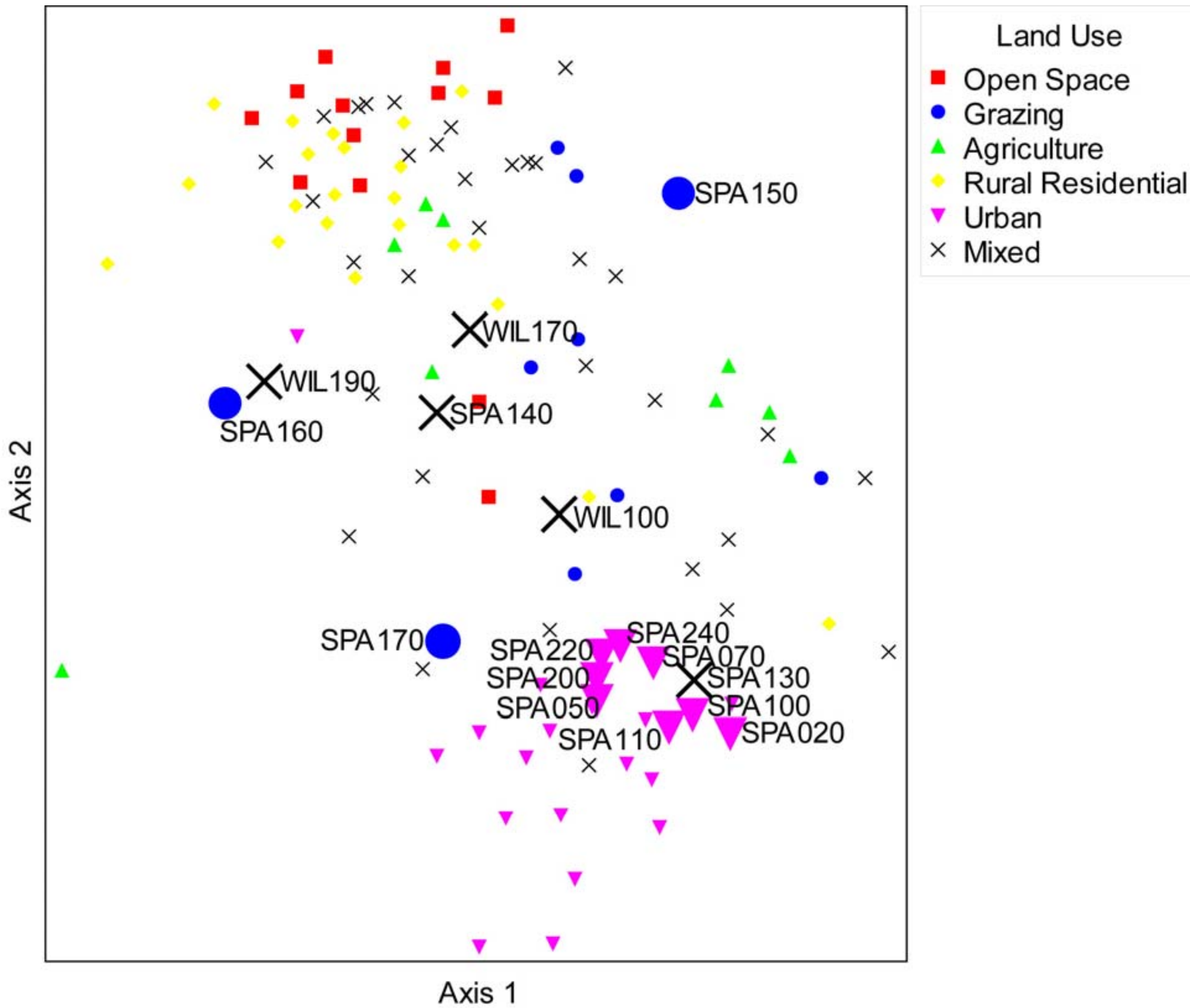

Figure 7-29. NMS ordination of San Pablo Creek/Wildcat Creek sites

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Wildcat/San Pablo watershed are labeled and symbols are enlarged. Note that several sites are not included in the ordination because the sites were sampled as part of a different study (see Breaux et al. 2005). For an explanation of ordination graphs, refer to Section 6.1.

Table 7-13. Biological metrics from the San Pablo Creek/Wildcat Creek watershed

	SPA 020	SPA 050	SPA 070	SPA 100	SPA 110	SPA 130	SPA 140	SPA 150	SPA 160	SPA 170	SPA 200	SPA 220	SPA 240	WIL 030	WIL 050	WIL 060	WIL 070	WIL 100	WIL 130	WIL 170	WIL 190
Coleoptera Taxa	0	0	0	0	0	1	0	2	0	2	1	0	0	2	0	1	3	2	2	2	1
Diptera Taxa	2	2	5	5	5	7	9	6	8	6	3	4	4	4	2	3	4	3	2	5	9
Ephemeroptera Taxa	1	1	1	1	1	1	4	4	5	1	1	1	1	1	1	1	4	2	1	6	5
Plecoptera Taxa	0	0	0	0	0	0	4	4	5	1	0	1	0	0	0	1	3	1	1	1	3
Trichoptera Taxa	1	1	1	0	1	1	4	4	4	1	1	2	0	0	0	2	5	5	1	4	5
Non-Insect Taxa	6	4	4	6	6	5	3	3	4	7	7	7	7	7	3	7	5	6	6	8	3
Taxa Richness	10	9	13	15	14	18	26	26	28	19	16	15	13	15	6	15	24	19	14	26	26
EPT Taxa	2	2	2	1	2	2	12	12	14	3	2	4	1	1	1	4	12	8	3	11	13
% EPT	18	32	12	1	1	0	39	78	79	56	48	46	48	2	1	17	47	23	16	34	84
% Sensitive EPT	0	0	0	0	0	0	18	51	47	1	0	0	0	0	0	1	22	3	0	15	61
% Chironomidae	32	25	45	52	59	64	26	12	11	36	20	21	30	57	43	18	37	28	32	41	10
% Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	2	0
% Oligochaeta	40	36	9	39	36	3	0	0	2	3	3	22	8	34	42	62	8	4	48	0	0
% Non-insect	51	36	11	42	38	4	3	5	8	5	6	23	16	39	42	64	9	7	50	2	2
% Intolerant	0	0	0	0	0	0	14	40	33	1	0	0	0	0	0	1	21	3	0	7	46
% Tolerant	0	0	2	1	1	1	3	5	4	1	2	1	1	46	42	63	8	1	48	2	0
Tolerance Value	5.4	5.3	5.8	5.5	5.6	6.0	5.0	3.6	3.8	5.4	5.5	5.3	5.3	6.6	6.5	6.9	4.7	5.6	6.5	5.2	3.1
% Predator	0	0	2	2	1	3	4	9	7	4	1	1	1	7	2	1	10	1	1	4	20
% Collector-filterer	0	6	31	5	1	28	31	3	4	0	25	9	6	2	15	2	14	42	8	20	5
%Collector-gatherer	99	93	67	93	97	67	34	28	32	96	72	89	92	88	82	95	51	53	89	64	48
% Scraper	0	0	0	0	0	0	17	20	26	0	1	0	0	4	0	1	16	0	2	8	0
% Shredder	0	0	0	0	0	0	13	39	31	0	0	0	0	0	0	0	9	3	0	4	28
% Other	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

7.4.4 Basic Water Quality Field Measurements

Stream temperatures exceeded some thresholds at a number of continuously monitored sites (Figure 7-, Figure 7-, and Appendix D). During the spring wet season (May 9-21, 2002) HWAT values exceeded the MWAT threshold for coho salmon (14.8ºC) on Wildcat Creek at Richmond Parkway (WIL020) and on San Pablo Creek at Road 20 (SPA050). This threshold was also exceeded in the summer dry season at 5 stations. On Wildcat Creek at Jewel Lake Outlet (WIL100), from May 31-June 18, 2002, the temperature exceeded 14.8 for a total of 94.5 hours. The maximum measured temperature at San Pablo Creek at Road 20 (SPA050) exceeded the short-term maximum salmonid temperature of 24ºC. This site, along with sites WIL100, SPA070, SPA200, and SPA220 had HWAT values ranging from 16.4 to 18.3 ºC.

Temperature measurements in San Pablo Creek did not follow the regional pattern of increasing temperature with decreasing riparian habitat. Instead, the lower temperature values were recorded at sites below the San Pablo Dam and reservoir, and the higher temperatures were recorded at sites above the reservoir, which are on the other side of the coastal hills and thus in a warmer climate. Other relationships between physical habitat scores and continuously monitored variables were difficult to determine because of the low sample size.

During the spring and summer season deployments, DO concentrations failed to meet Basin Plan objectives (7 mg/L) on Wildcat Creek at Richmond Parkway (WIL020), Alvarado Park (WIL070), Jewel Lake Outlet (WIL100), and on San Pablo Creek at Road 20 (SPA050). San Pablo Creek at Cemetery Bridge (SPA070), Orinda Village (SPA220), Camino Encinas (SPA240), and Lauterwasser Creek (SPA200) all had DO values below the salmonid threshold during the dry season deployment (Figure 7-, Figure 7-, and Appendix D).

The Basin Plan maximum pH objective was exceeded by measurements of 8.56 at both Wildcat Creek at Richmond Parkway (WIL020) and San Pablo Creek at Orinda Village (SPA220; Figure 7-).

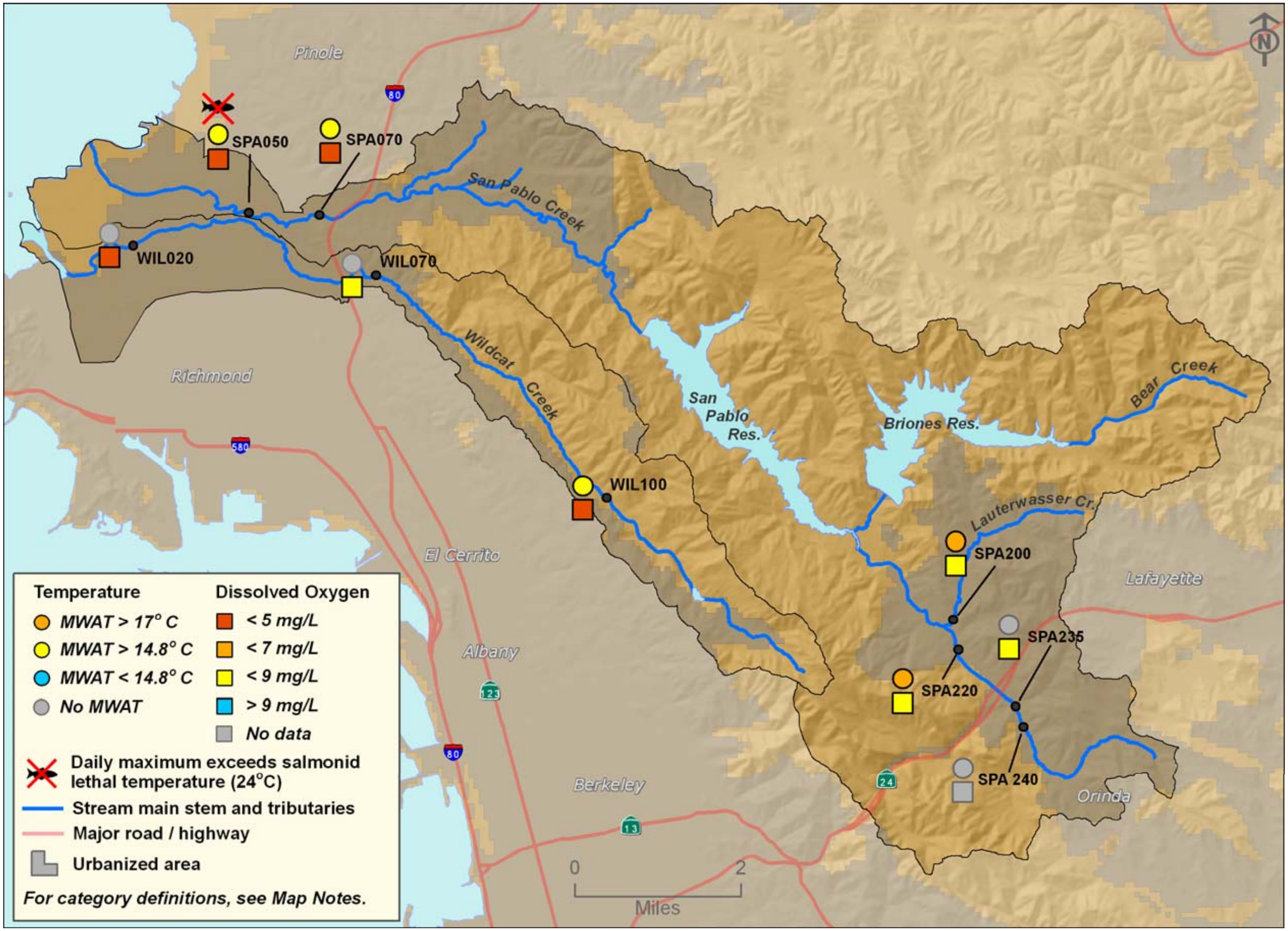

Figure 7-30. Map of temperature and DO levels in Wildcat and San Pablo creeks

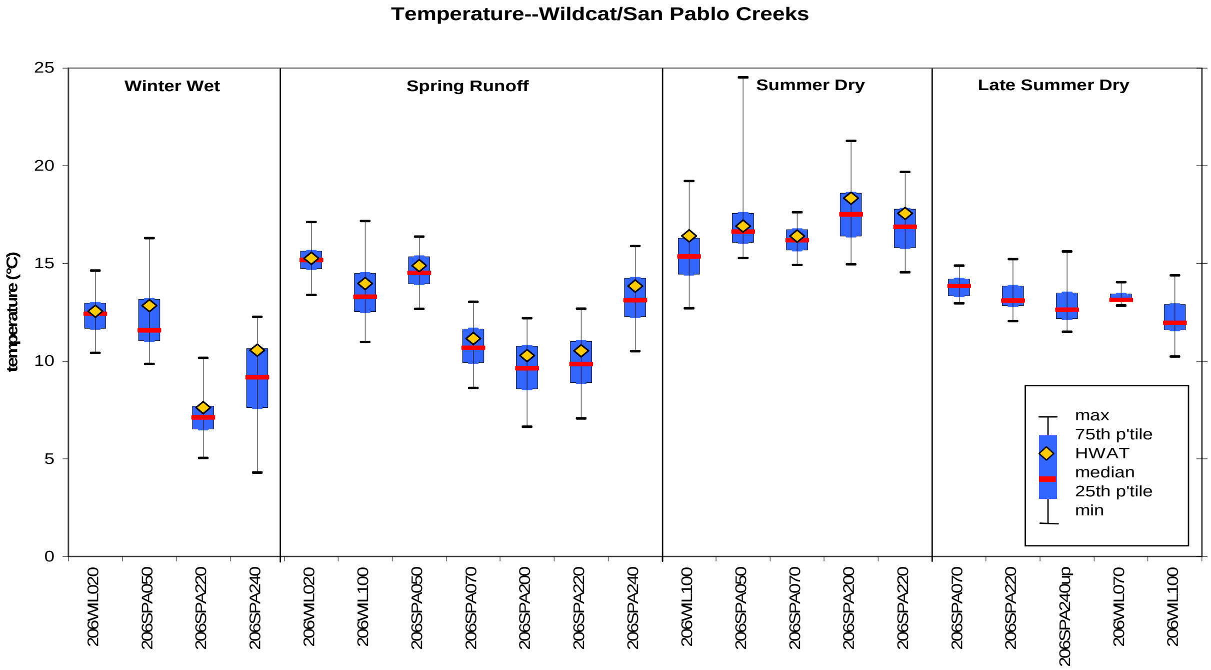

Figure 7-31. Temperature monitoring in Wildcat and San Pablo creeks

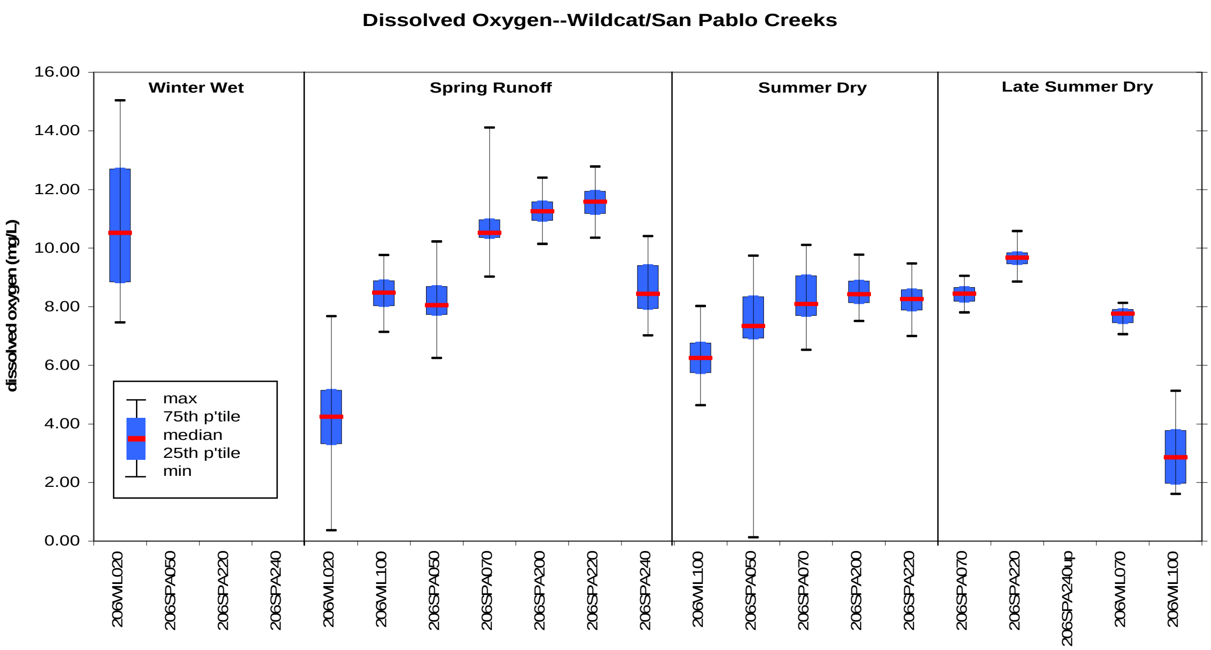

Figure 7-32. DO monitoring in Wildcat and San Pablo creeks

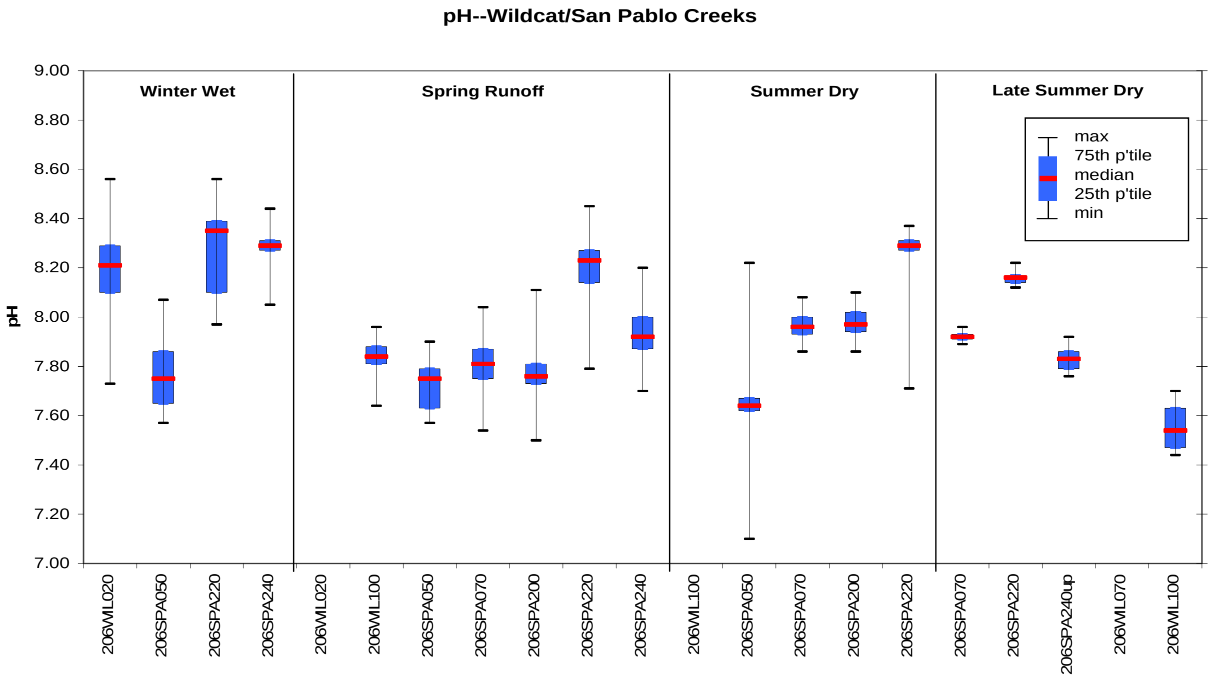

Figure 7-33. pH monitoring in Wildcat and San Pablo creeks

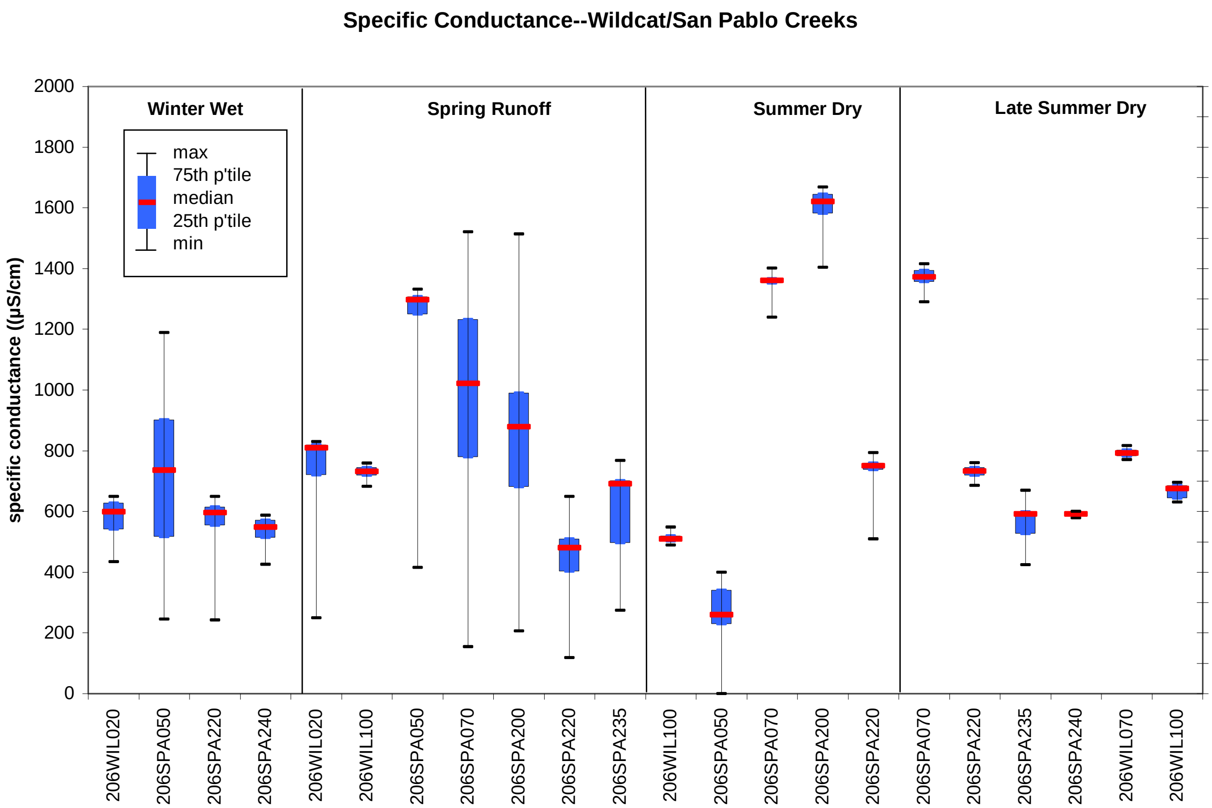

Figure 7-34. Specific conductance monitoring in Wildcat and San Pablo creeks

7.4.5 *Water, Sediment, and Clam Tissue Chemistry*

Water samples from the San Pablo and Wildcat Creek watersheds had generally low to moderate nitrate concentrations, with only three samples falling below the U.S. EPA reference guideline. The San Pablo Creek at 3rd St Bridge site (SPA020) had spring and wet season nitrate values of 1.2 and 1.7 mg/L (Figures 6-15 to 6-17; Appendix G). There were no apparent seasonal trends and only modest variation among sites.

Chlorophyll-a values were high relative to other watersheds in the region, with most spring and dry season samples measuring above the 1.78 µg/l guideline value (Appendix G). There was one extremely high chlorophyll-a value: 92 µg/L was recorded in a dry season sample from Wildcat Creek at the Richmond Parkway site (WIL020). This value is about four times greater than the second highest regional value (20 µg/L in Walker Creek). Nitrate and orthophosphate concentrations were low in this sample, and total phosphorus was not exceptionally high.

Total phosphorus measurements were the highest in the region, with an average of 0.24 mg/L. This was about twice the average concentration in the watershed with the next highest measurements, Stevens/Permanente. All samples from San Pablo/Wildcat were substantially above the 0.030 U.S. EPA guideline value.

Orthophosphate values were also the highest in the region, averaging 0.27 mg/L. The highest orthophosphate concentration was 1.99 mg/L at Lauterwasser Creek (SPA200), the highest value measured in the region. All of the orthophosphate guideline exceedances came from San Pablo Creek sites. Phosphorus measurements from the two Wildcat Creek sites were below the 0.030 mg/L total phosphorus guideline value.

Trace metals in water were measured at five sites: Wildcat Creek at Richmond Parkway (WIL020); San Pablo Creek at 3rd St Bridge (SPA020); Cemetery Bridge (SPA070); Orinda Village (SPA220); and Lauterwasser Creek (SPA200). Values were much higher in the dry season than in spring (Appendix G).No Basin Plan objectives for aquatic life protection were exceeded for any metals in samples from this watershed. Total manganese was very high at all sites, though there are no aquatic life water quality objectives (WQOs) for this metal. Concentrations ranged from 109 to 1356 µg/L, with the high value from a Wildcat Creek sample (WIL020). (Note that the next highest concentration measured in the region was 67 µg/L in Butano Creek.) Nickel concentrations in water samples were higher in this watershed than elsewhere in the region. The mercury concentration in water at Richmond Parkway (WIL020) for the dry season was the highest in this study (23.1 ng/L). The results for mercury, nickel, and manganese may be indicative of urban sources and transport mechanisms such as atmospheric deposition, traffic from industrial sites, illicit discharge, sheet flow, wind dust blow and spills.

Organic contaminants were measured at five sites. The ELISA measurement of the spring season sample from Wildcat Creek at Richmond Parkway (WIL020) exceeded the Central Valley Regional Water Quality Control Board's aquatic life objective for chlorpyrifos (0.057 µg/L). The dry season measurement from San Pablo Creek at 3rd St Bridge (SPA020) exceeded both the Central Valley Water Board's objective for chlorpyrifos (0.079 µg/L by ELISA) and the San Francisco Bay Basin Plan objective for diazinon (0.174 µg/L by ELISA and 0.120 µg/L by

GCMS). Similarly, WQOs for chlorpyrifos (0.071 µg/L) and diazinon (0.288 µg/L) were exceeded in ELISA measurements of the dry season sample from Cemetery Bridge (SPA070). Land use in areas draining to all of these sites was characterized as urban.

Sediments were collected for analysis from two sites, WIL020 and SPA020. No organic compounds exceeded available sediment quality guidelines at either site. WIL020 had sediment concentrations of chromium above the TEC and nickel above the PEC guidelines, while SPA020 had chromium, mercury, and nickel above the TEC guidelines. The sediment quality guideline quotient values for these sites were relatively low, at 0.14 and 0.11, respectively.

Tissues of clams deployed at lower San Pablo Creek at 3rd St Bridge (SPA020) had about average concentrations of copper, mercury, selenium, and PCBs, compared to the rest of the region (Figures 6-22 through 6-24). However, concentrations were higher than average for the pesticides chlordane, DDT, dieldrin, and oxadiazon (Figures 6-25 through 6-27).

7.4.6 Water and Sediment Toxicity

Toxicity tests were conducted on water samples from Wildcat Creek at Richmond Parkway (WIL020); San Pablo Creek at 3rd St Bridge (SPA020), Cemetery Bridge (SPA070), Orinda Village (SPA220); and Lauterwasser Creek (SPA200); and on sediment samples from WIL020 and SPA 020. There were significant decreases in algal population growth in the spring sample from SPA070, and in both spring and dry season samples from SPA020. SPA020 had elevated clam tissue concentrations of oxadiazon. No significant toxicity was observed in any other water samples (Figure 7-).

Amphipod growth in the sediment sample from WIL020 was significantly less than in controls. While growth integrates a number of physiological processes, the relationship of the amphipod growth endpoint to specific stressors is not well established. Concentrations of contaminants for which guideline values have been established were relatively low in this sediment sample.

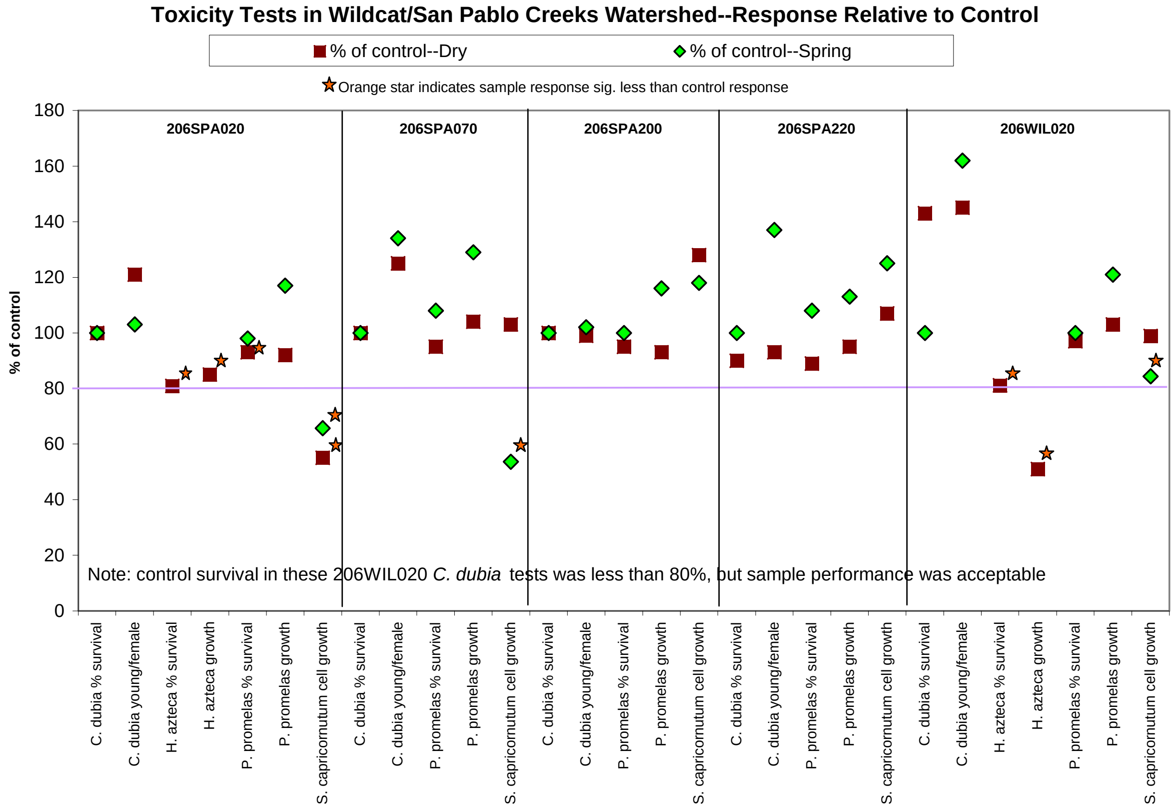

Figure 7-35. Toxicity tests in Wildcat and San Pablo creeks

Results of toxicity tests are shown with three species in water samples and one species in sediment samples from Wildcat and San Pablo Creeks. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.4.7 Coliform Bacteria

Bacterial counts were recorded in water samples from four sites in the watershed (Figures 6-28 through 6-30). Basin Plan objectives for all three indicators (*E. coli*, fecal coliforms, and total coliforms) were exceeded at three sites: Wildcat Creek at Alvarado Park (WIL070), San Pablo Creek at San Pablo City Park (SPA060), and Bear Creek at Briones 1 (SPA150). Basin Plan objectives for total coliforms only were exceeded at Wildcat Creek at Lone Oak (WIL130).

7.5 Suisun Creek Watershed

7.5.1 Sites of Concern

Exceedances noted in the summary table (Table 7-14) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

Bioassessment scores indicated fair condition for benthic invertebrate communities throughout the watershed. Temperature and dissolved oxygen measurements exceeded thresholds at most sites, and pH was elevated at over half of the continuously monitored sites. There was no toxicity in this watershed and no individual sites stood out as being of specific concern. It is interesting to note, however, that the highest concentration of copper in tissue reported in this study was at Rockville (SUI020) on Suisun Creek, upstream from Suisun Slough. Consistent toxicity attributable to copper has been found in Grizzly Bay near the mouth of Suisun Slough (Phillips *et al.* 2003).

Table 7-14. Summary of sites with exceedances in Suisun Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 7 sites sampled*		
Temperature	maximum, salmonid	4
	MWAT, steelhead	6
Oxygen, dissolved	minimum, COLD	5
	minimum, WARM	3
	3-month median	2
pH	range	4
CONVENTIONAL WATER QUALITY *of 8 sites sampled*		
Nitrate as N	maximum	7
Phosphorus, total as P	maximum	8
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Arsenic	TEC	1
Chromium	TEC	1
Copper	TEC	1
Nickel	TEC	1
TISSUE CHEMISTRY *of 1 site sampled*		
Copper	EDL 85	1
PCB 1248 aroclor	EDL 85	1

7.5.2 Water Quality in Relation to Land Use

Land use throughout the watershed is a combination of grazing, agriculture, and mixed use. As there was minimal variability among sites in terms of most measured parameters, relationships with specific land uses could not be resolved definitively. Because degraded stream habitat conditions exist in much of the watershed, improved riparian management is recommended to reduce the potential for temperature and dissolved oxygen stress on aquatic populations.

7.5.3 Macroinvertebrate Assemblages and Physical Habitat

Two major benthic assemblages were identified in the Suisun Creek watershed based on the cluster dendrogram (Figure 6-58).

- The Lower Suisun Creek (LS) group includes sites on the mainstem of Suisun Creek below Lake Curry (SUI010, SUI020, SUI050, SUI060, SUI130).
- The Wooden Valley (WV) group includes sites on Wooden Valley Creek (SUI110, SUI210) and White Creek (SUI180), an intermittent tributary to Wooden Valley Creek.

Although the site on Suisun Creek above Lake Curry (SUI260) is located near other Suisun Creek sites on the ordination plot (Figure 6-59), it is the most dissimilar site on the cluster dendrogram (Figure 6-58) and is discussed separately.

Lower Suisun Creek group
Biological metrics were fairly consistent among the five sites, but metric values were outside the range observed at minimally disturbed sites. Sites in the Lower Suisun Creek group exhibit a moderate level of biological integrity. Benthic assemblages have retained many features characteristic of natural systems, but taxonomic diversity has been reduced relative to minimally disturbed streams.

Common tolerant taxa made up 81–89 percent of organisms at these sites, a relatively high proportion relative to minimally disturbed sites but less than sites in urban areas. While common tolerant taxa were the four most abundant taxa, intolerant taxa such as the mayfly family Ephemerellidae and the caddisfly *Agapetus* sp. were fairly abundant:

Chironomidae	39%
Baetis sp. (Baetidae)	26%
Simulium sp. (Simuliidae)	12%
Oligochaeta	4%
Ephemerellidae	3%
Agapetus sp. (Glossosomatidae)	2%

Many other intolerant taxa were present at low abundances, including *Serratella* sp. (Ephemerellidae), the mayfly family Heptageniidae, *Malenka* sp. (Plecoptera: Nemouridae), *Isoperla* sp. (Plecoptera: Perlodidae), *Wormaldia* sp. (Trichoptera: Philopotamidae), *Tinodes* sp. (Diptera: Psychomyiidae), and *Gumaga* sp. (Trichoptera: Sericostomatidae).

Rare taxa found at these sites include the uncommon baetid *Fallceon quilleri*, the riffle beetle *Dubiraphia* sp., and the amphipod *Corophium* sp. (Corophiidae).

Wooden Valley group
Biological metrics from the site on White Creek (SUI180), such as percent EPT and tolerance value, were within the range of values from minimally disturbed intermittent streams, while the taxa richness metric was slightly outside of the range. Taxa richness, percent EPT, and Diptera taxa richness metric values at SUI110 were close to the lower end of values from minimally disturbed intermittent sites, but the tolerance value metric was more dissimilar. Metrics at SUI210 were significantly different from minimally disturbed conditions. Overall, metric scores suggest that the biological integrity of White Creek was high, but possibly slightly impacted, while Wooden Valley Creek was moderately impacted by human disturbances.

The most abundant taxa in this group of sites were:

Chironomidae	25%
Baetis sp. (Baetidae)	21%
Simulium sp. (Simuliidae)	19%
Ephemerella sp. (Ephemerellidae)	9%
Paraleptophlebia sp. (Leptophlebiidae)	7%
Planorbidae	3%

Other common intolerant taxa included *Drunella* sp., *Serratella* sp., *Malenka* sp., and *Wormaldia* sp. Stream flow at two of the sites (SUI110 and SUI180) is known to be intermittent, while the status of the third site is uncertain. Noticeably absent from all three sites were long-lived taxa, perlid stoneflies, and taxa with fully aquatic life cycles, such as riffle beetles (Elmidae).

Upper Suisun Creek site
The taxa richness and Diptera taxa richness values were within the range of minimally disturbed conditions for intermittent streams, but because of the abundance of non-EPT tolerant taxa, such as chironomids and worms, the percent EPT and tolerance value metrics were considerably different from minimally disturbed conditions. Low physical habitat scores for epifaunal substrate (5), embeddedness (5), and sediment deposition (5) suggest that fine sediment may be partly responsible for the high relative abundances of chironomids and worms

Abundant taxa in the benthic assemblage from upper Suisun Creek (SUI260) included:

Chironomidae	51%
Oligochaeta	15%
Torrenticolidae (Acari)	8%
Serratella sp. (Ephemerellidae)	7%
Simulium sp. (Simuliidae)	4%
Hygrobatidae (Acari)	4%

Four genera of Baetidae were present, including *Centroptilum/ Procloeon*, *Baetis* sp., *Diphetor hageni*, and *Fallceon quilleri*. Several intolerant taxa were found, including the stonefly *Isoperla* sp. (Perlodidae), the caddisflies *Agapetus* sp. (Glossosomatidae), *Glossosoma* sp. (Glossosomatidae), and *Wormaldia* sp. (Philopotamidae), and the tipulids *Hexatoma* sp. and *Molophilus* sp.

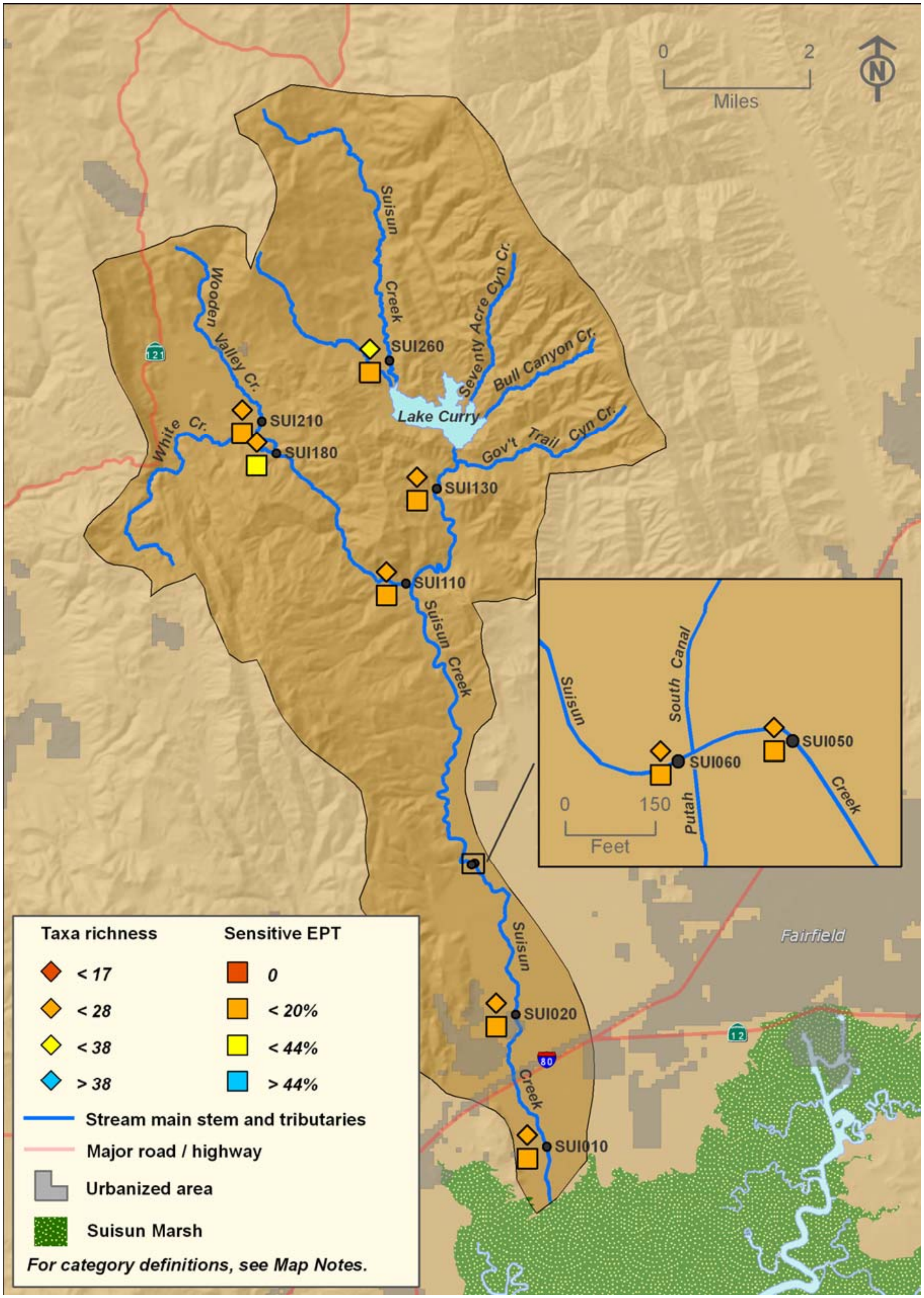

Figure 7-36. Map of Suisun Creek benthic macroinvertebrates index scores

Table 7-15. Bioassessment sites in the Suisun Creek watershed

Site ID	Site Name	Stream
SUI010	Cordelia	Suisun Creek
SUI020	Rockville	Suisun Creek
SUI050	Putah South Canal - Downstream	Suisun Creek
SUI060	Putah South Canal - Upstream	Suisun Creek
SUI110	Wooden Valley	Wooden Valley Creek
SUI130	Lake Curry Road	Suisun Creek
SUI180	White Creek	White Creek
SUI210	East Wooden Valley	Wooden Valley Creek
SUI260	Upper Suisun	Suisun Creek

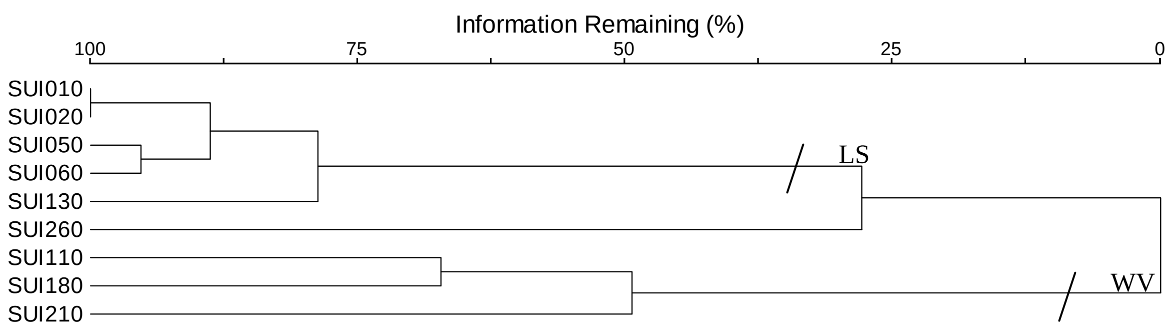

Figure 7-37. Custer dendrogram of sites in the Suisun Creek watershed

This cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the Suisun Creek watershed. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at top signifies how similar the sites are with respect to taxa presence. Abbreviations: LS, Lower Suisun; WV, Wooden Valley.

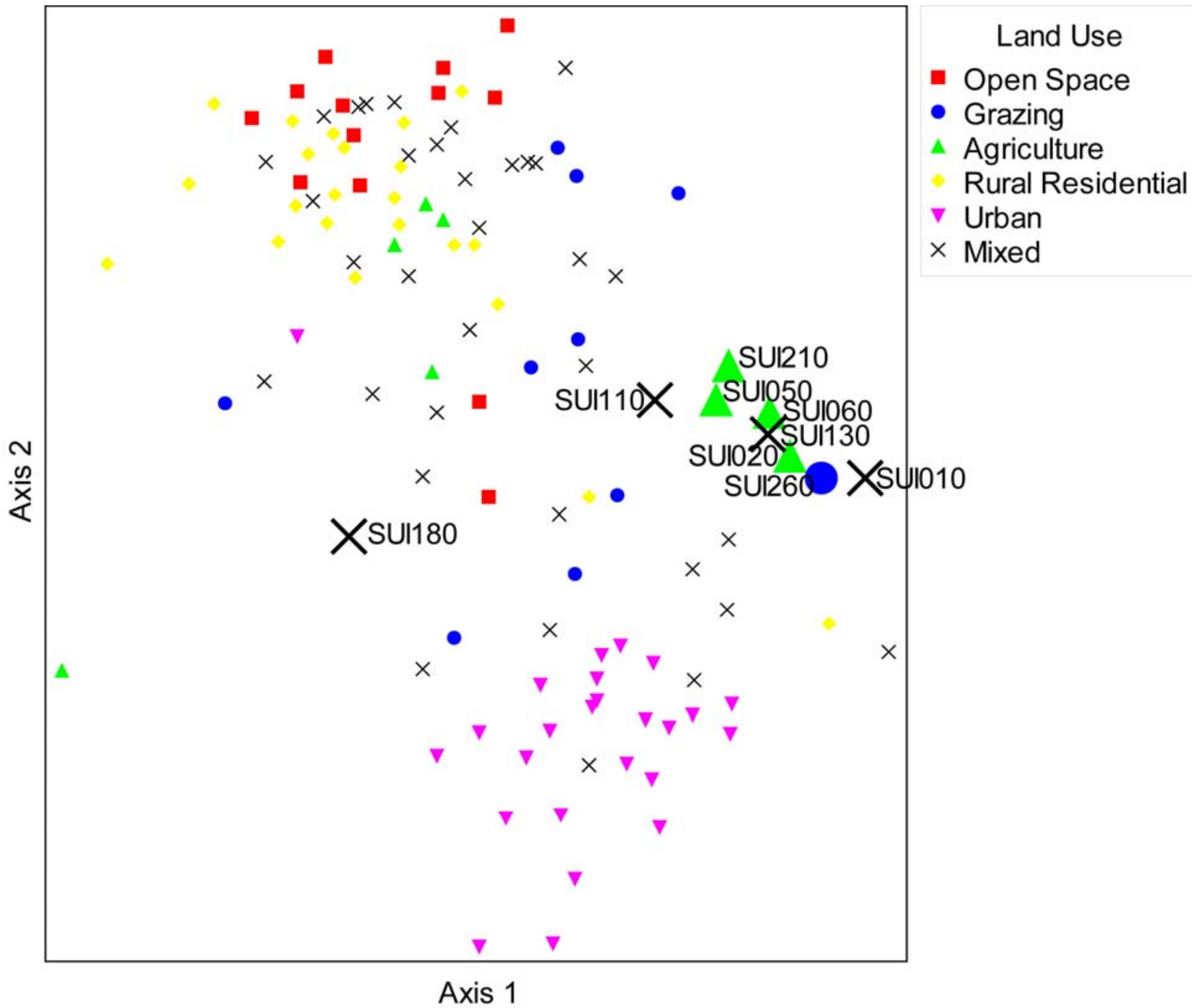

Figure 7-38. NMS ordination of sites in the Suisun Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Suisun Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-16. Biological metrics from the Suisun Creek watershed

	SUI010	SUI020	SUI050	SUI060	SUI110	SUI130	SUI180	SUI210	SUI260
Coleoptera Taxa	2	1	1	0	1	1	0	1	1
Diptera Taxa	2	3	2	2	6	5	3	4	9
Ephemeroptera Taxa	4	5	6	4	7	3	8	3	6
Plecoptera Taxa	1	1	2	1	1	2	2	2	1
Trichoptera Taxa	6	6	6	6	5	9	2	3	4
Non-Insect Taxa	9	9	5	7	7	6	10	5	7
EPT Taxa	11	12	14	11	13	14	12	8	11
Taxa Richness	24	25	22	20	27	26	25	19	28
% EPT	25	36	35	43	57	52	61	25	11
% Sensitive EPT	3	9	6	8	11	11	37	4	8
% Chironomidae	52	42	37	37	18	23	23	34	51
% Coleoptera	0	0	0	0	0	0	0	0	0
% Oligochaeta	11	5	2	0	1	3	3	0	15
% Non-insect	18	18	6	4	4	6	15	1	30
% Intolerant	1	7	5	7	11	11	36	3	9
% Tolerant	5	3	3	3	2	2	2	1	8
Tolerance Value	5.6	5.1	5.4	5.2	5.0	4.9	3.9	5.4	5.5
% Predator	5	3	3	3	1	3	5	4	16
% Collector-filterer	10	7	25	19	22	20	1	39	4
%Collector-gatherer	83	84	67	72	73	75	80	53	78
% Scraper	0	4	3	5	4	1	12	2	1
% Shredder	0	0	0	0	0	0	0	2	0
% Other	2	1	2	1	0	1	2	0	0
% Common Tolerant	88	78	89	86	83	81	42	74	74
Common Intolerant Taxa	2	2	3	4	5	3	6	4	3

7.5.4 Basic Water Quality Field Measurements

Stream temperatures exceeded some thresholds at all continuously monitored sites (see Figure 7-, Figure 7-, and Appendix D). HWAT values exceeded the MWAT threshold for coho salmon (14.8ºC) during the spring season at the following sites:

- Suisun Creek at Rockville (SUI020)
- Putah South Canal - Downstream (SUI050)
- Capp Confluence (SUI090)
- Middle Suisun (SUI125)
- Wooden Valley Creek at Wooden Valley (SUI110)
- Above White Creek (SUI185)
- White Creek (SUI180)

All of these sites except SUI180, which wasn't monitored in the summer dry period, had HWAT values above the higher MWAT threshold for steelhead (17ºC) in the dry season. Four sites (SUI020, SUI110, SUI050, and SUI185) had recorded maximum temperatures above 24ºC, the maximum temperature for salmonid survival.

Minimum dissolved oxygen concentrations in spring fell below 9 mg/L at all of the above sites except SUI185 (see Figure 7-, Figure 7-, and Appendix D). The median percent saturation fell below 80 percent in dry season measurements at SUI020 and SUI050. Dry season measurements failed to meet the coldwater Basin Plan objectives for DO at SUI020, SUI110, SUI050, SUI090, and SUI185.

The Basin Plan objective for maximum pH (8.5) was exceeded at SUI050, SUI110, SUI125, and SUI185 (Figure 7-).

Physical habitat scores were available for three of these sites (SUI020, SUI050, and SUI110). The two downstream sites had poor scores for channel alteration and riparian zone width, but moderate to good scores for canopy cover and bank vegetation. The upstream site (SUI110) had the opposite: better scores for channel alteration and riparian zone width, but poor scores for canopy cover and bank vegetation. All three had similar HWAT values and DO violations.

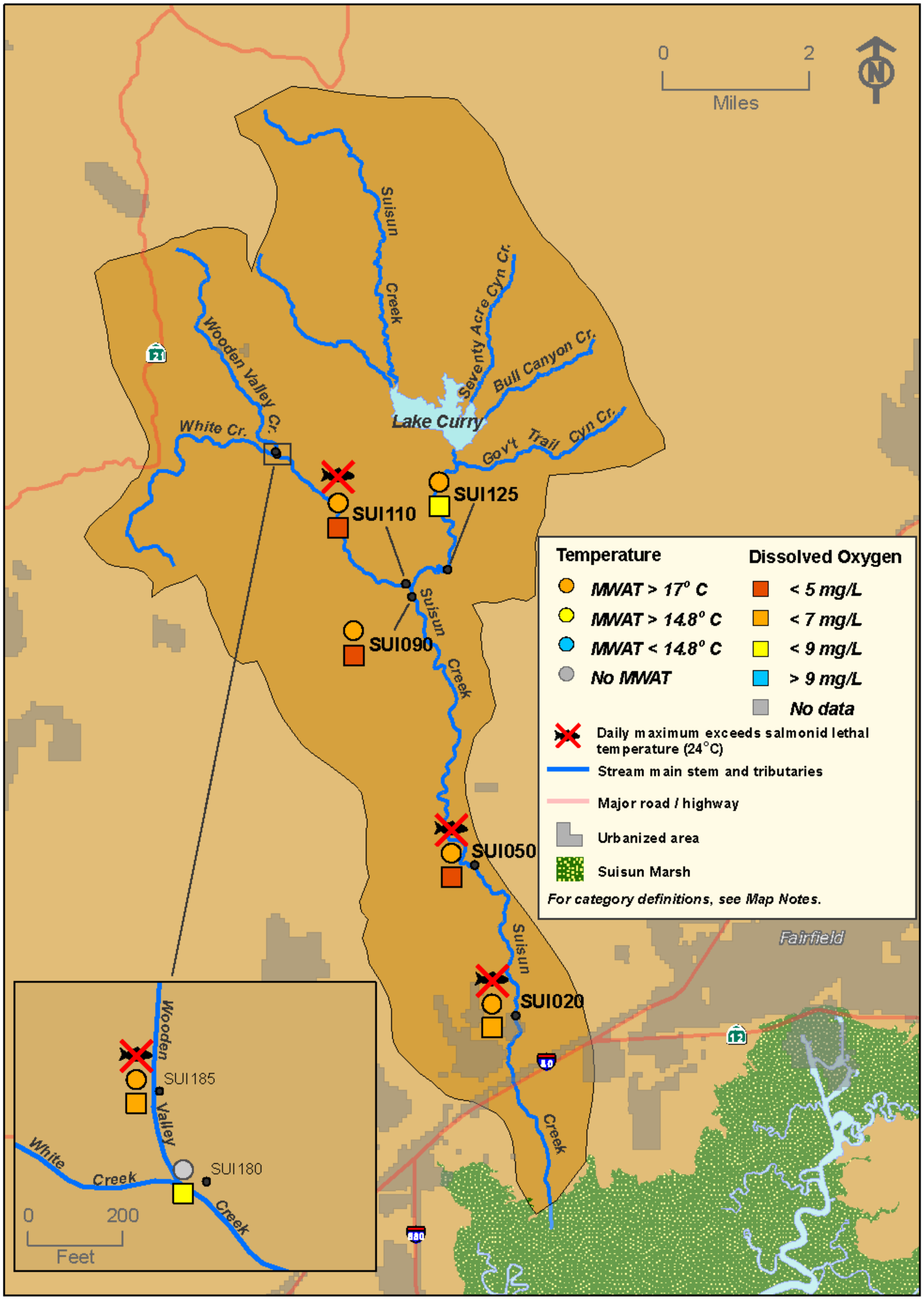

Figure 7-39. Map of temperature and DO levels in Suisun Creek

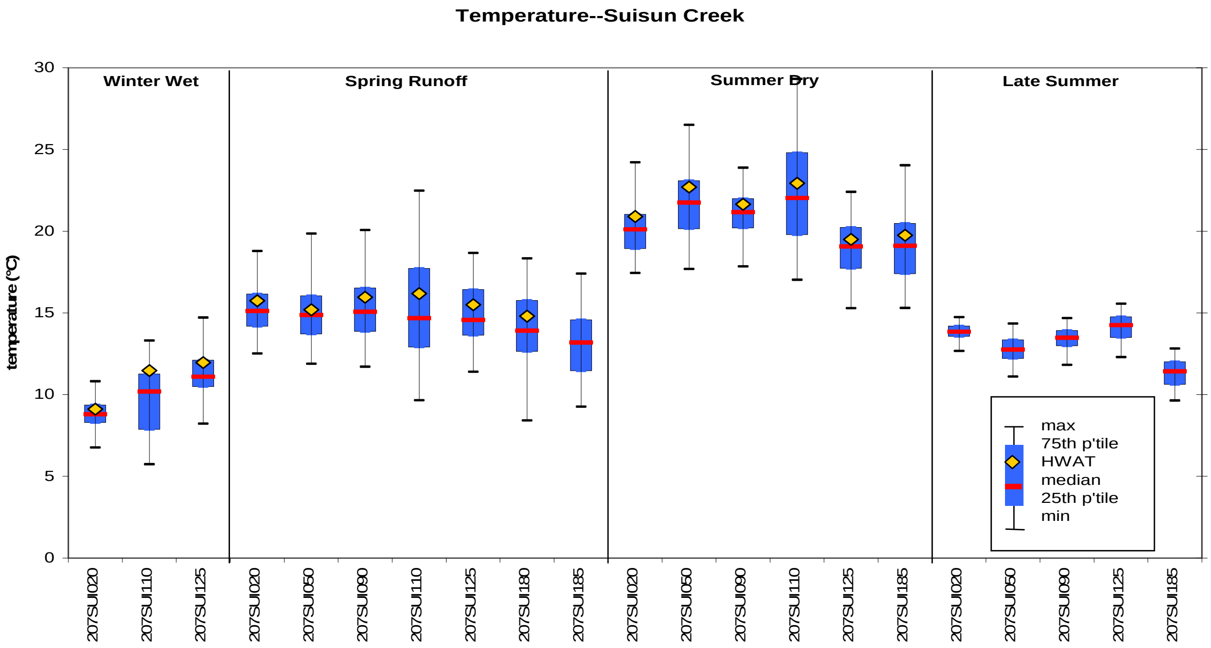

Figure 7-40. Temperature monitoring in Suisun Creek

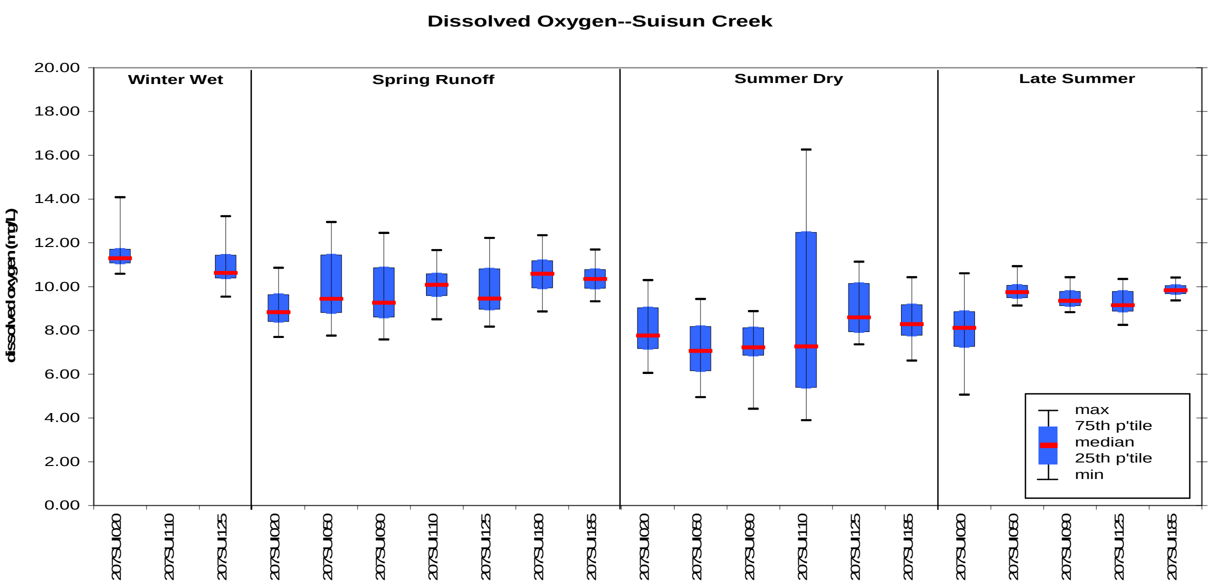

Figure 7-41. DO monitoring in Suisun Creek

Data were rejected for SUI110 in the winter.

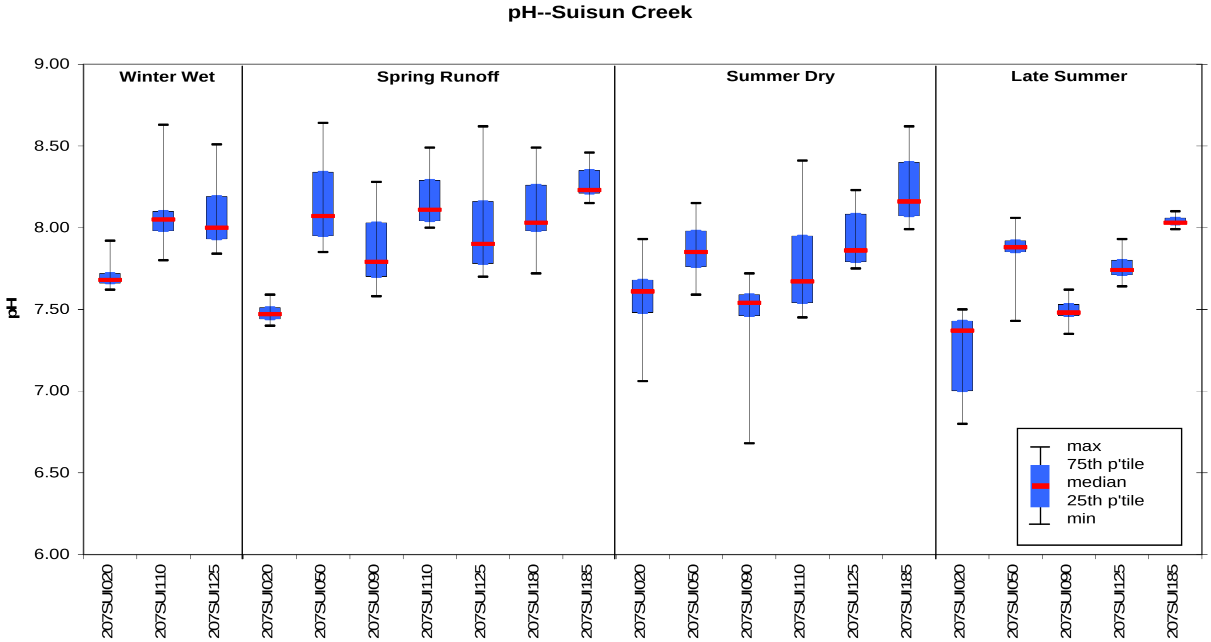

Figure 7-42. pH monitoring in Suisun Creek

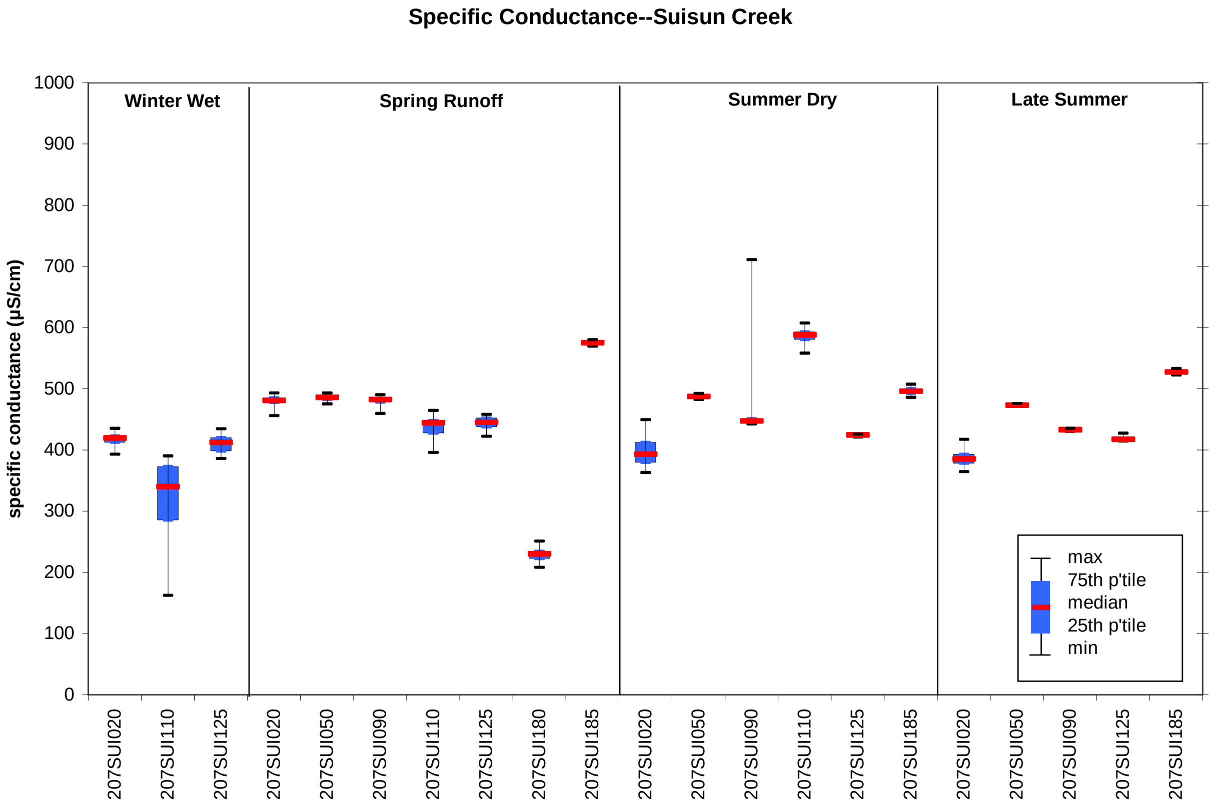

Figure 7-43. Specific conductance monitoring in Suisun Creek

7.5.5 Water, Sediment, and Clam Tissue Chemistry

Water samples from the Suisun Creek watershed had relatively low nitrate concentrations, although most exceeded 0.16 mg/L, the U.S. EPA reference guideline (Figure 6-15, Figure 6-16, Figure 6-17, and Appendix G).

Chlorophyll-a values were also generally low, only exceeding the 1.78 µg/L guideline value in the wet season sample from SUI125, a spring sample from SUI010, and dry season samples from SUI 060, SUI110, and SUI130 (Appendix G).

Most total phosphorus measurements were equal to the minimum reporting limit, with a few high values such as the dry season SUI130 value of 0.188 mg/L. Most orthophosphate values modestly exceeded the U.S. EPA total phosphorus guideline.

No Basin Plan objectives for metals or organics in water were exceeded in samples from this watershed. Trace metals were measured in water sampled at four sites.

Sediments were collected for analysis from only one site, the Suisun Creek site at Rockville (SUI020). No probable effects concentrations (PECs) were exceeded in this sample, but the lower threshold effects concentrations (TECs) were exceeded for arsenic, chromium, copper, and nickel. The sediment quality guideline quotient (SQGQ) value was low at 0.11 (Appendix H).

Tissues of clams deployed at the Suisun Creek site at Rockville (SUI020) had values near the regional average for mercury, selenium and DDT, and the highest copper concentrations region-wide. (This copper value was still less than 50 percent higher than the control, so the significance of this result is uncertain.) No detectable pesticides except DDT were found.

7.5.6 Water and Sediment Toxicity

Water toxicity was tested with three species in samples from Suisun Creek at Cordelia (SUI010), at Rockville (SUI020), at Putah South Canal – Upstream (SUI060), and Wooden Valley Creek at Wooden Valley (SUI110). Sediment toxicity was tested in a sample from the Rockville site (SUI020). No significant toxicity was detected in any of these samples.

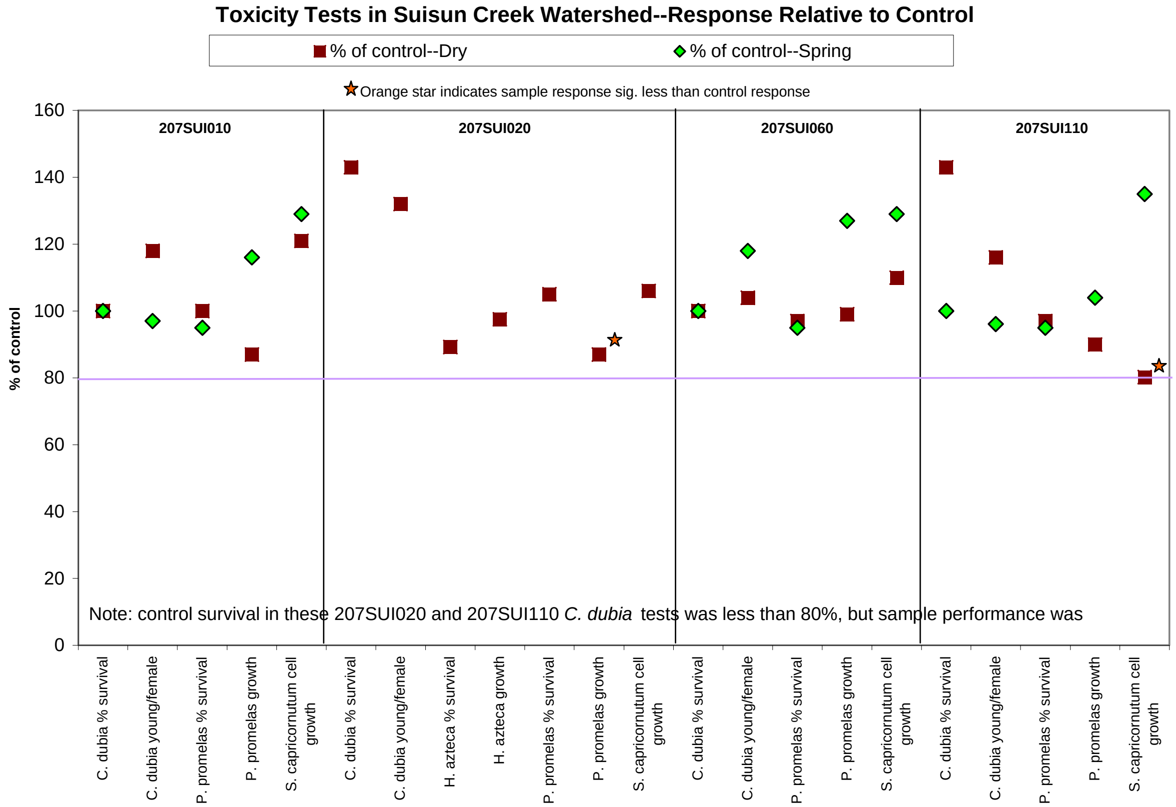

Figure 7-44. Toxicity tests in Suisun Creek

The graph shows results of toxicity tests with three species in water samples and one species in sediment samples from Suisun Creek. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic in this assessment.

7.5.7 Coliform Bacteria

Coliforms were not measured in the Suisun Creek watershed.

7.6 Arroyo Las Positas Watershed

7.6.1 Sites of Concern

Exceedances noted in the summary table (Table 7-17) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

Temperature, DO, pH, and specific conductance levels are of concern throughout this watershed. Measured conditions are unsuitable for salmonids, and benthic macroinvertebrate communities were degraded at all sampling sites. Nutrient concentrations were elevated throughout the watershed.

Elevated concentrations of oxadiazon were measured in clam tissues at Arroyo Las Positas at El Charro (ALP010). There were also numerous indicators of eutrophication at this site. At ALP150, DO saturation reached an unusual high of 395 percent, indicating eutrophic conditions.

Table 7-17. Summary of sites with exceedances in Arroyo Las Positas

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 7 sites sampled*		
Temperature	maximum, salmonid	5
	MWAT, steelhead	5
Oxygen, dissolved	minimum, COLD	4
	minimum, WARM	3
	3-month median	1
pH	range	5
CONVENTIONAL WATER QUALITY *of 4 sites sampled*		
Nitrate as N	maximum	4
Phosphorus, total as P	maximum	4
WATER METALS *of 3 sites sampled*		
Selenium	**chronic**	**2**
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Chromium	TEC	1
Copper	TEC	1
Mercury	TEC	1
Nickel	TEC	1

7.6.2 Water Quality in Relation to Land Use

Land use in the watershed is primarily urban, with some agriculture and mixed use. Measured nutrient concentrations were somewhat elevated, perhaps from residential fertilizer application. Riparian habitat restoration would appear to be the highest priority land management strategy to improve water quality. Riparian corridors throughout the watershed had poor physical habitat scores, and thresholds for temperature and dissolved oxygen were exceeded at all stream sites.

7.6.3 Macroinvertebrate Assemblages and Physical Habitat

Benthic assemblages at sites in the Arroyo Las Positas watershed exhibited uniformly low faunal diversity and high pollution tolerance. None of the 29 taxa identified as common intolerant taxa were found at any sites in the Arroyo Las Positas watershed. Taken together, the lack of these taxa and the abundance of midges and worms indicate that aquatic habitat conditions in Arroyo Las Positas were very poor.

All seven sites were classified in Assemblage Group 1 (the assemblage group dominated by highly degraded urban sites) and were closely clustered in the ordination graph and cluster analysis (Figure 7- and Figure 7-). Total taxa richness ranged between 11 and 16, well below the values observed at minimally disturbed sites, which ranged from 28 to 59 (Table 6-10). Most of these taxa were non-insects; the number of insect taxa ranged from 3 (ALP080) to 8 (ALP010).

The taxa present at sites throughout the mainstem of Arroyo Las Positas (ALP010, ALP040, ALP070, ALP080, ALP110) suggest that benthic invertebrate assemblages are significantly affected by poor water quality and habitat conditions.

- Chironomid midges (mostly Orthocladiinae) were the numerically dominant taxa at four of the five sites, and composed between 44 percent and 81 percent of organisms collected (Figure 7-).
- Oligochaete worms (dominated by the tubificid Naididae) occurred in high numbers at sites ALP070 and ALP110, where they made up 47 percent and 35 percent of total individuals.

Together, chironomids and oligochaetes composed the vast majority of organisms collected (82-94 percent). These two taxa are highly tolerant of pollution and are found in a wide range of lotic habitats, although oligochaetes are especially abundant in patches of fine sediment. Oligochaetes and midges were also the dominant taxa in low gradient effluent-dominated waterways in the lower Sacramento River watershed (de Vlaming et al 2004) and degraded urban streams in Santa Rosa (Sonoma County) (Sustainable Lands Stewardship Institute 2002).

Also common in the lower watershed sites was *Corbicula*, a non-native Asian clam. *Corbicula* was not collected in any of the other watersheds sampled by SWAMP. *Corbicula* is common in San Francisco Bay and the Sacramento/San Joaquin Delta, and has also been found in streams in the Santa Clara Valley (Carter and Fend 1997). Passive dispersal of *Corbicula* occurs only in the downstream direction by water currents, suggesting that the clam was introduced into the Arroyo Las Positas drainage by humans.

Baetis is a ubiquitous mayfly found in most flowing water habitat except the most severely degraded conditions; it has been found at all other sites monitored by SWAMP in the Bay Area except two channelized, urbanized sites in lower Permanente Creek (Santa Clara County) and three sites in the Arroyo Las Positas watershed: ALP040, ALP100, and ALP110.

Many beetles (Coleoptera) re-colonize very slowly following disturbance, because the larval and adult stages of many species are entirely aquatic. Only one individual beetle (Coleoptera) was collected from the entire watershed, a single riffle beetle (*Optioservus*) from ALP010. Stoneflies (Plecoptera), which require cool, clean water, were completely absent from all seven sites in the watershed.

Although all sites in the watershed were taxonomically similar, the site on upper Altamont Creek (ALP140) was the most dissimilar on the cluster analysis and ordination (Figure 7- and Figure 7-). While biological metrics at this site were generally similar to values at other sites in the watershed, some differences suggest that this site may possess slightly greater biological integrity. The mayfly *Baetis* sp. was the dominant taxa (72 percent of total organisms) at ALP140, while chironomids (14 percent) and oligochaetes (<1 percent) were less abundant (Figure 6-68). In addition to *Baetis*, three other EPT taxa were collected at ALP140: *Hydropsyche* sp. (Trichoptera: Hydropsychidae), *Hydroptila* sp. (Trichoptera: Hydroptilidae), and the uncommon, pollution intolerant caddisfly *Tinodes* sp. (Trichoptera: Psychomiidae). The tolerance value at ALP-140 was 5.1, well below values at other sites in the watershed (range: 5.7 to 6.1), but still greater than values at minimally disturbed sites (range 3.07 to 4.47).

Flow conditions in the Arroyo Las Positas watershed are generally good, but other habitat factors may limit benthic assemblages. Qualitative P-HAB scores for velocity/depth regimes and channel flow status were excellent across the seven sites, ranging from 13 to 18 and 16 to 19 (on a 0-20 scale), respectively. P-HAB scores relating to substrate quality, such as epifaunal substrate, embeddedness, and sediment deposition, indicated that substrate conditions are generally poor and high levels of fine sediment are present. Based on substrate size estimates, more than 50 percent of the area of the channel bed surface was composed of fine sediment at four of the seven sites. Deposition of fine sediment fills in crevices and interstitial spaces around gravel and cobble sized clasts, eliminating habitat required by many species of benthic insects.

Riparian conditions were also found to be poor throughout the watershed. Total riparian zone P-HAB scores ranged from 1 to 10 (0-20 scale) across the seven sites, while canopy cover was 5 percent or less at four sites. Much of the drainage network has been channelized, resulting in simplified channel forms and sparse or non-existent riparian vegetation. These changes in channel and riparian habitat may be partly responsible for high stream temperatures (see below, section 7.6.4)

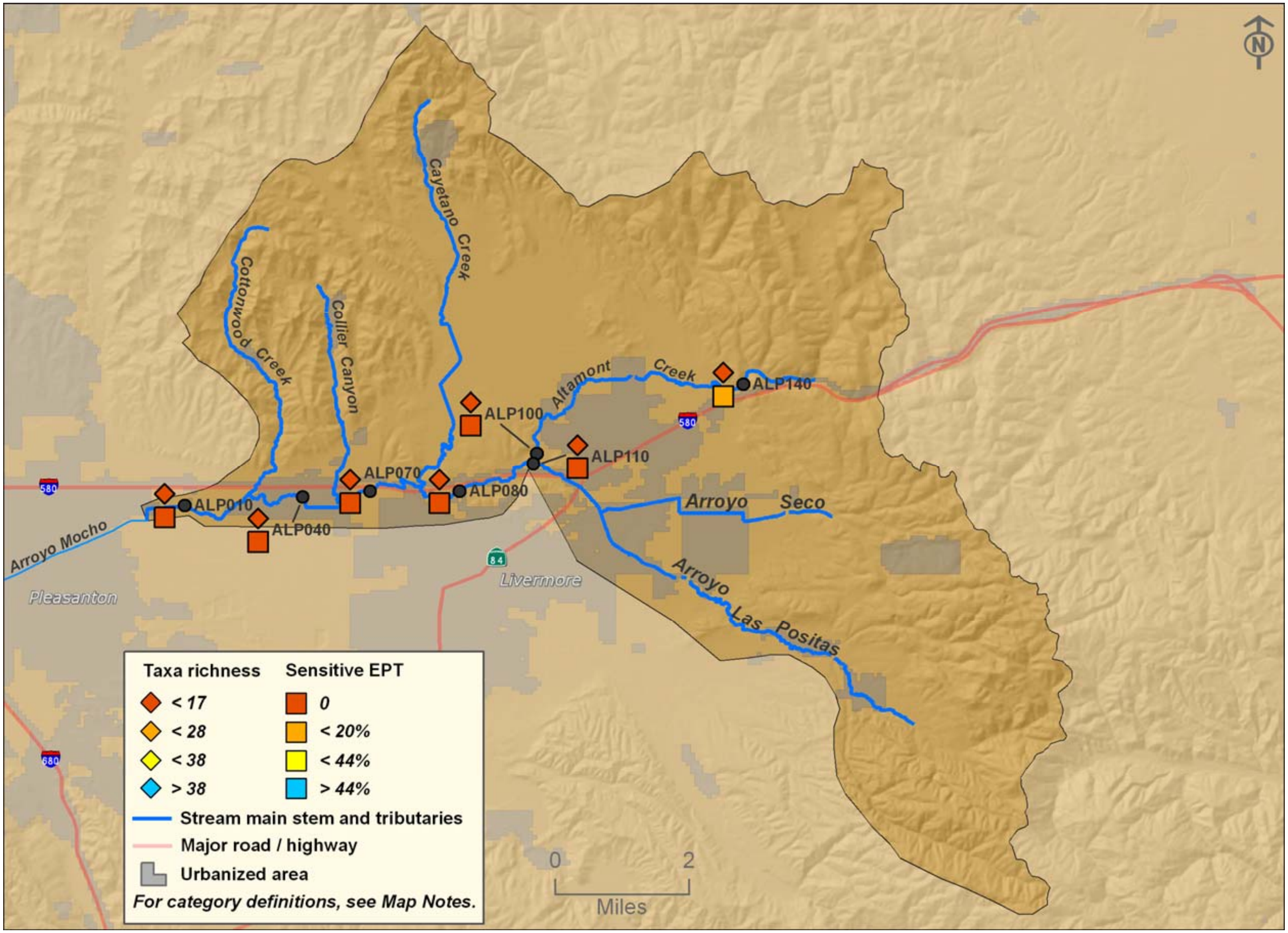

Figure 7-45. Map of Arroyo Las Positas benthic macroinvertebrate index scores

Table 7-18. Bioassessment sites in the Arroyo Las Positas watershed

Site Code	Site Name	Stream
ALP010	El Charro	Arroyo Las Positas
ALP040	Airway Blvd. Exit	Arroyo Las Positas
ALP070	Airway 2	Arroyo Las Positas
ALP080	N. Livermore Ave.	Arroyo Las Positas
ALP100	Altamont Creek	Altamont Creek
ALP110	Arroyo Las Positas	Arroyo Las Positas
ALP140	Altamont Pass	Altamont Creek

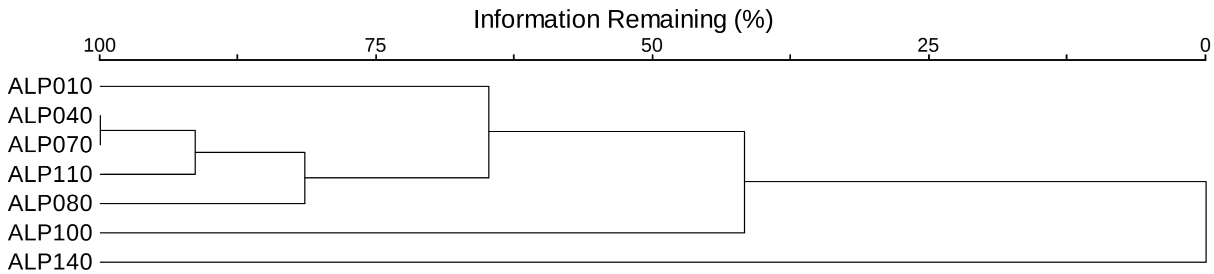

Figure 7-46. Cluster dendrogram of sites in the Arroyo Las Positas watershed

This cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the Arroyo Las Positas watershed. Sites that are closely joined together have many similar taxa present, while groups with longer chain lengths are more dissimilar. The Information Remaining axis at top signifies how similar the sites are with respect to taxa presence.

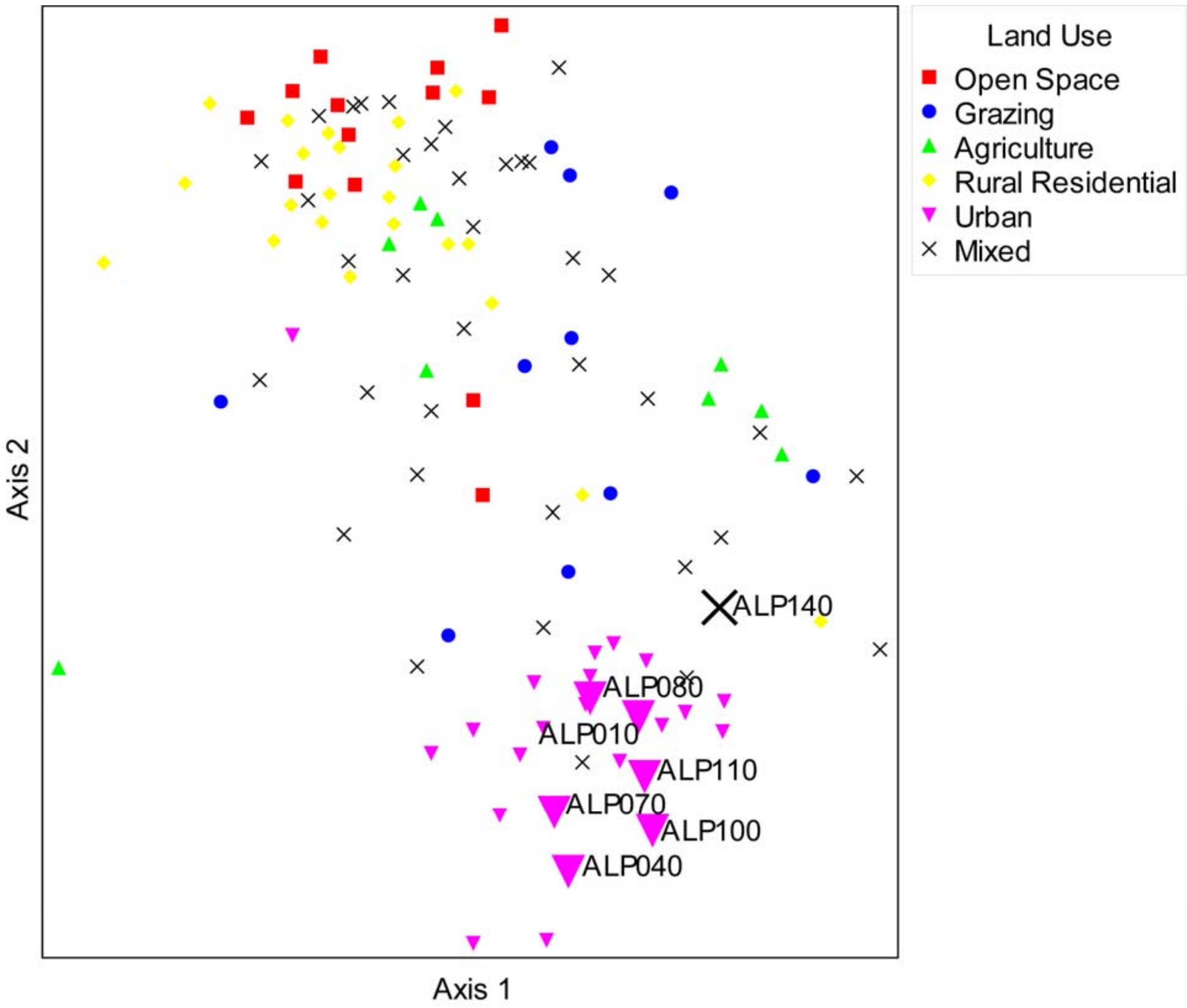

Figure 7-47. NMS ordination of sites in the Arroyo Las Positas watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Arroyo Las Positas watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-19. Biological metrics from the Arroyo Las Positas watershed

	ALP010	ALP040	ALP070	ALP080	ALP100	ALP110	ALP140
Coleoptera Taxa	1	0	0	0	0	0	0
Diptera Taxa	4	3	4	2	3	3	3
Ephemeroptera Taxa	1	0	1	1	0	0	1
Plecoptera Taxa	0	0	0	0	0	0	0
Trichoptera Taxa	1	0	0	0	1	2	3
Non-Insect Taxa	8	7	9	10	7	7	5
EPT Taxa	2	0	1	1	1	2	4
Taxa Richness	16	11	14	13	11	12	12
% EPT	1	0	1	4	0	0	82
% Sensitive EPT	0	0	0	0	0	0	1
% Chironomidae	81	79	44	73	81	57	14

% Coleoptera	0	0	0	0	0	0	0
% Oligochaeta	3	15	47	9	2	35	0
% Non-insect	15	20	54	13	11	40	1
% Intolerant	0	0	0	0	0	0	1
% Tolerant	8	3	4	2	2	4	1
Tolerance Value	6.1	5.9	5.6	5.9	5.9	5.7	5.1
% Predator	1	1	1	2	0	2	2
% Collector-filterer	3	2	4	10	8	3	11
%Collector-gatherer	89	96	94	87	90	94	86
% Scraper	6	1	1	1	0	1	1
% Shredder	0	0	0	0	0	0	0
% Other	1	0	0	0	1	0	0

Table 7-20. Percentage abundance of taxonomic groups in Arroyo Las Positas

	1	2	3	4	5
ALP010	Chironomidae (81%)	*Physa/ Physella (6%)*	Turbellaria (4%)	Oligochaeta (3%)	*Simulium* sp. *(2%)*
ALP040	Chironomidae (79%)	Oligochaeta (15%)	*Corbicula* (2%)	*Megadrili* (1%)	*Physa/ Physella* (1%)
ALP070	Oligochaeta (47%)	Chironomidae (44%)	*Corbicula* (2%)	*Simulium* sp. (2%)	Turbellaria (2%)
ALP080	Chironomidae (74%)	*Simulium* sp. (7%)	Turbellaria (7%)	Oligochaeta (2%)	Glossiphoniidae (1%)
ALP100	Chironomidae (81%)	*Simulium* sp. (7%)	Turbellaria (7%)	Oligochaeta (2%)	Glossiphoniidae (1%)
ALP110	Chironomidae (57%)	Oligochaeta (35%)	*Simulium* sp. (2%)	Sperchontidae (2%)	Ostracoda (1%)
ALP140	*Baetis* sp. (72%)	Chironomidae (14%)	*Hydropsyche* sp. (10%)	*Argia* sp. (2%)	*Simulium* sp. (1%)

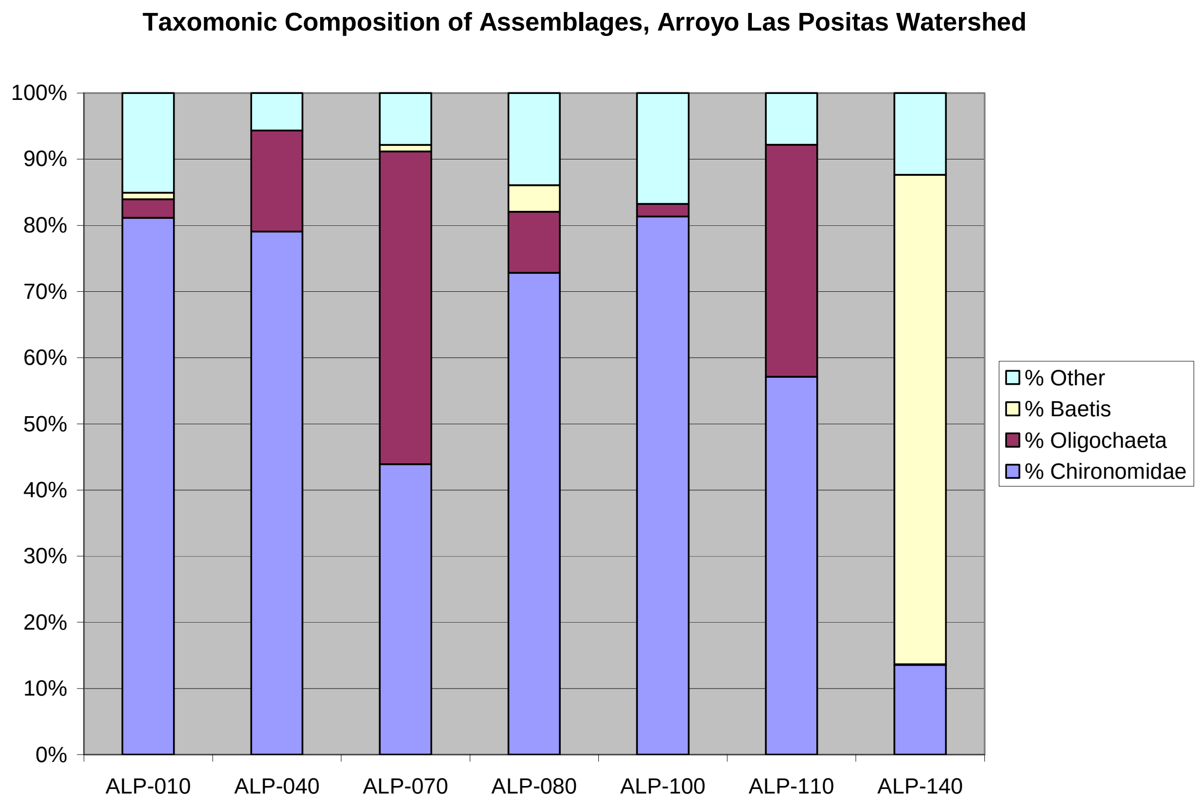

Figure 7-48. Taxonomic composition in the Arroyo Las Positas watershed

7.6.4 Basic Water Quality Field Measurements

Leidy *et al.*(2003) reports that Arroyo Las Positas was an historical migration route for steelhead but Gunther *et al.* (2000) determined that the creek had no current potential to support spawning and rearing.

Stream temperatures were high and dissolved oxygen low throughout the watershed in spring and dry season measurements (Figure 7-, Figure 7-, Figure 7-, and Appendix D).

- In spring, HWAT values exceeded the MWAT threshold for coho salmon (14.8ºC) at Arroyo Las Positas at El Charro (ALP010), Airway Blvd. Exit (ALP040), and N. Livermore Ave. (ALP080).
- The higher MWAT threshold for steelhead (17ºC) was exceeded in spring measurements from Altamont Creek at Springtown (ALP105), and Arroyo Seco (ALP150).
- The short-term maximum temperature for salmonid survival was exceeded in the spring at ALP040, ALP105, and ALP 150.
- In the summer, the MWAT threshold for steelhead (17ºC) was exceeded at all of the above sites, as was the short-term maximum temperature for salmonid survival.

Dissolved oxygen concentrations failed to meet Basin Plan objectives (7 mg/L) in both spring and summer, with the exception of ALP010, which fell below 9 mg/L. Even in winter, DO at ALP150 fell below 7 mg/L (5.6 mg/L). Most notable were the maximum DO percent saturation values, which ranged from 112.9 (ALP010, summer) to 395 percent (ALP150, spring, 36.42 mg/L). Supersaturation above 120 percent is consistent with eutrophication and nutrient enrichment suggested by the high nitrate levels. The extreme value of 395 percent is the highest encountered in all SWAMP monitoring to date.

The Basin Plan objective for maximum pH (8.5) was exceeded at all five sites in at least one season, with a high measurement of 9.24 in the wet season at ALP150 (Figure 7-).

The Arroyo Las Positas watershed was the only one of the nine watersheds in this study that had a substantial number of exceedances for dissolved salt content, measured as specific conductance. The Basin Plan maximum for municipal drinking water taste was exceeded at all five sites in all three seasons. The higher objective for agricultural use was exceeded at Altamont Creek just downstream of the Spring (ALP105) in the spring and summer.

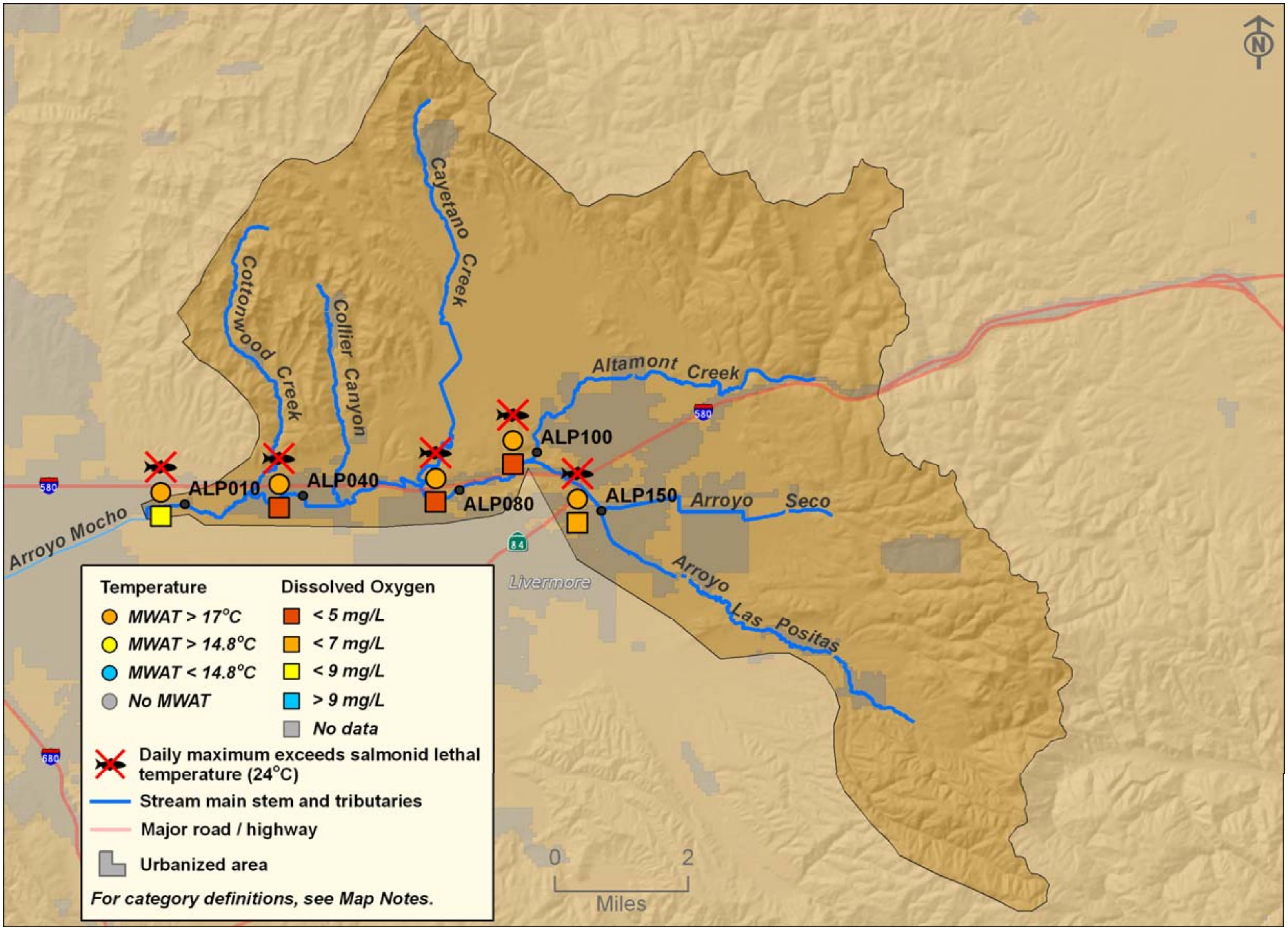

Figure 7-49. Map of temperature and DO monitoring in Arroyo Las Positas

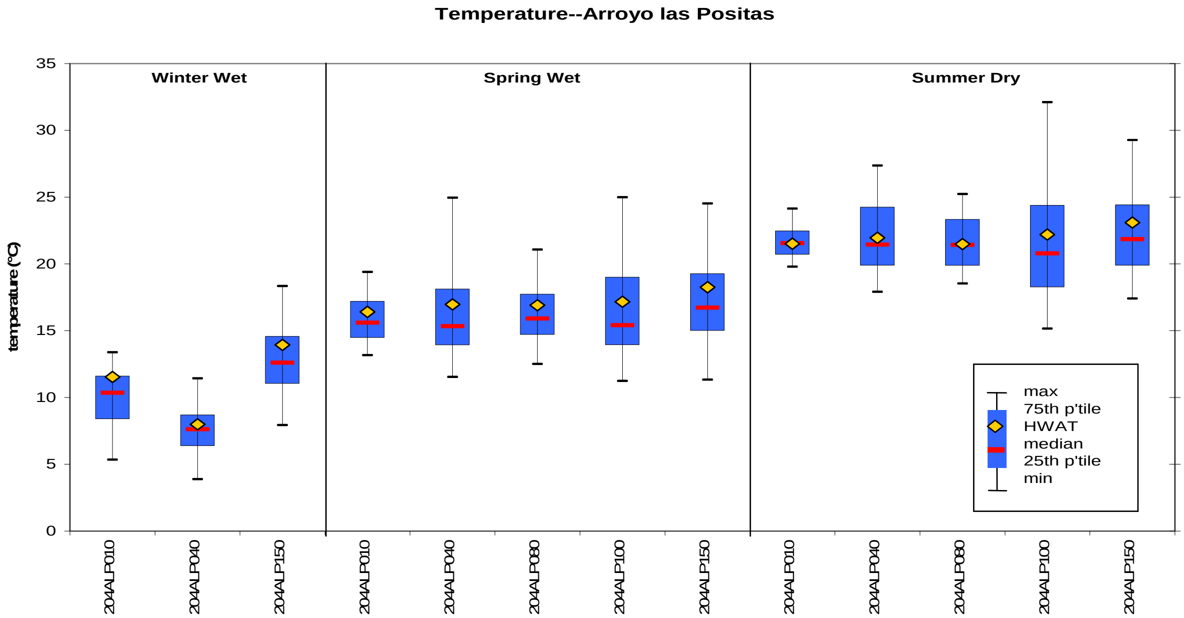

Figure 7-50. Temperature monitoring in Arroyo Las Positas

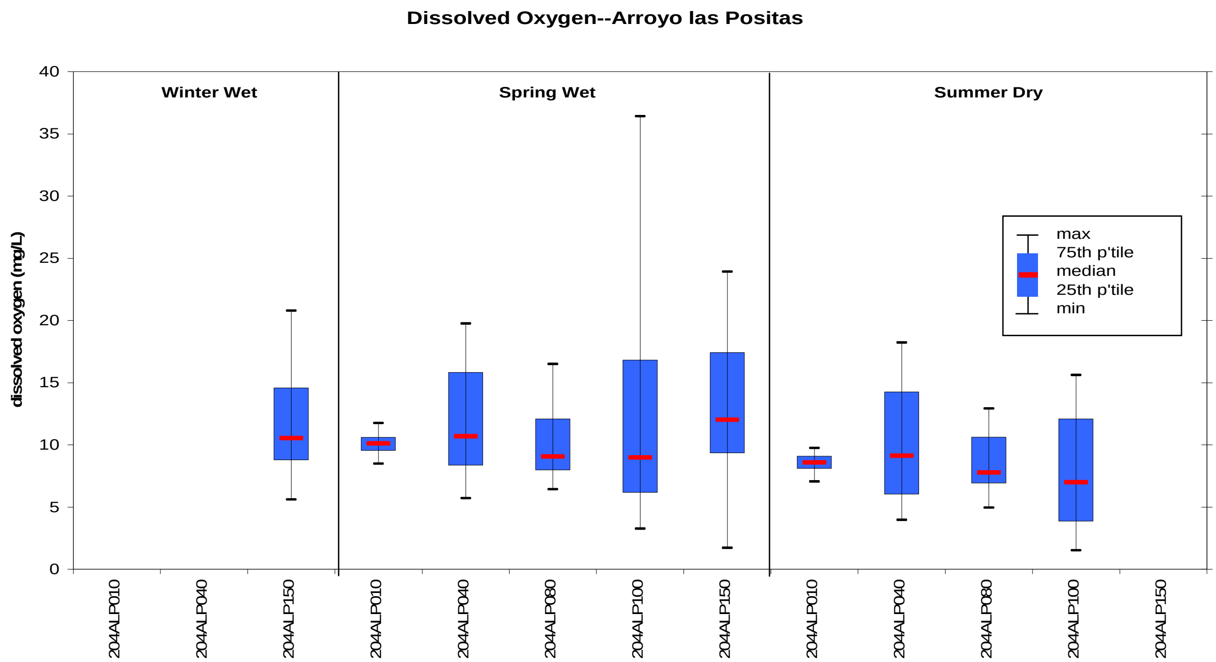

Figure 7-51. DO monitoring in Arroyo Las Positas

Data were rejected from ALP101 and ALP040 for the winter season and from ALP150 for the summer season.

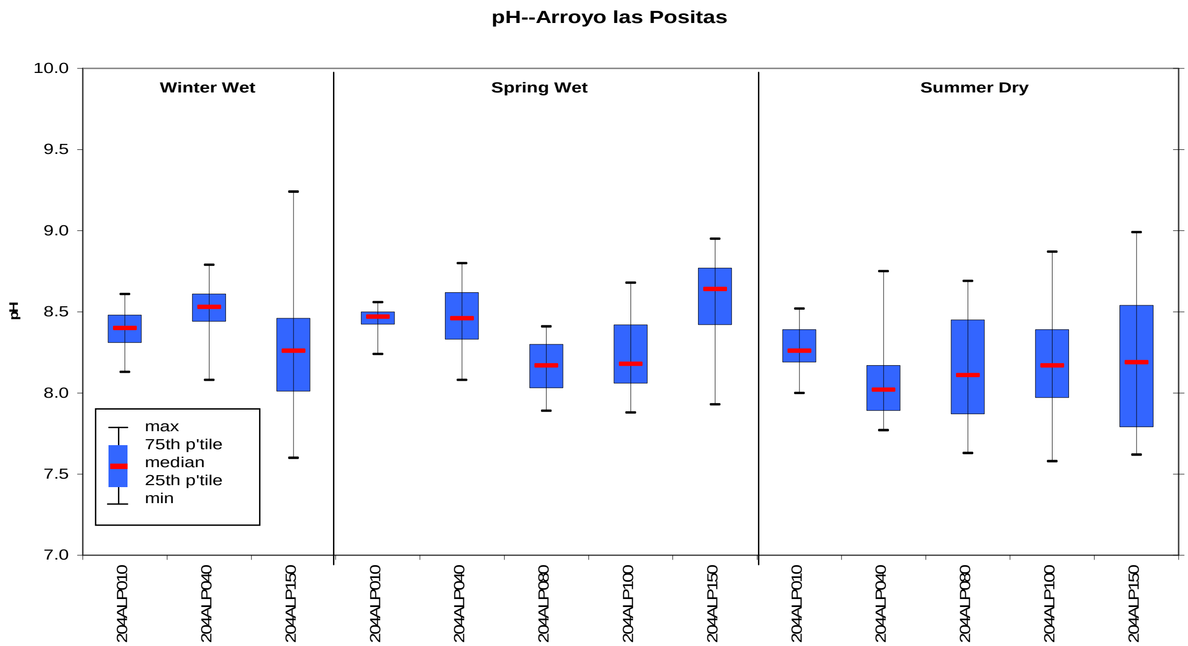

Figure 7-52. pH monitoring in Arroyo Las Positas

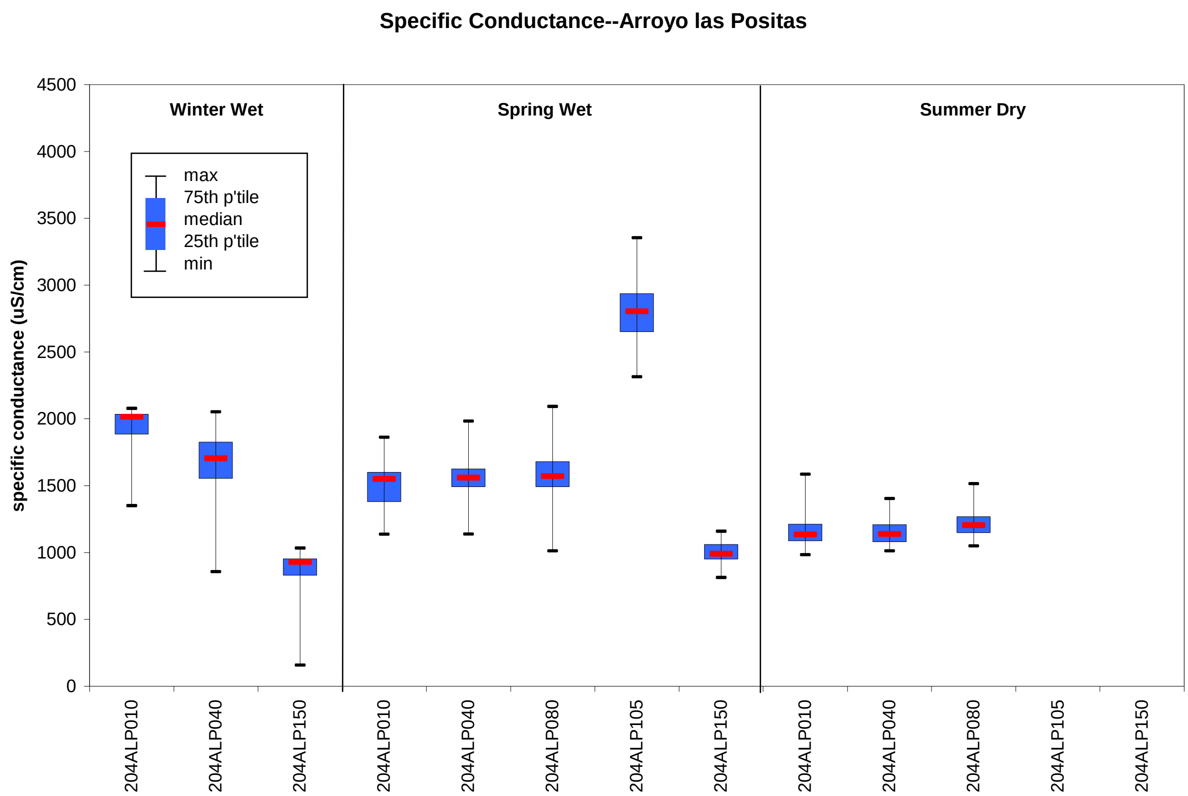

Figure 7-53. Specific conductance monitoring in Arroyo Las Positas

7.6.5 Water, Sediment, and Clam Tissue Chemistry

Water samples were analyzed for nutrients at four sites in the Arroyo Las Positas watershed: Arroyo Las Positas at El Charro (ALP010), Altamont Creek (ALP100), Arroyo Las Positas (ALP110) and Altamont Creek at Altamont Pass (ALP140). Nitrate concentrations were high at all sites, especially in the wet season. A high value of 8.04 mg/L was measured at ALP110 in spring. All measurements were significantly above the U.S. EPA reference guideline (Figures 6-15 to 6-17; Appendix G).

Total phosphorus measurements were not as conspicuously elevated as were the nitrate values, but most were significantly above 0.030, the U.S. EPA reference guideline. All but one orthophosphorus value exceeded the total phosphorus guideline.

Trace metals were measured at three sites: Arroyo Las Positas at El Charro (ALP010), Altamont Creek (ALP100), and Arroyo Las Positas (ALP110). Selenium exceeded the Basin Plan chronic aquatic life water quality objective (WQO) in the spring samples from ALP010 and ALP100. There were no other WQO exceedances in samples from this watershed.

Sediments were collected for analysis from Arroyo Las Positas at El Charro (ALP010). Probable effects concentrations were exceeded for the geologically abundant elements chromium and nickel, and the lower threshold effects concentrations were exceeded for copper and mercury. The sediment quality guideline quotient value was fairly low at 0.21 (Appendix H).

Tissues of clams deployed at Arroyo Las Positas at El Charro (ALP010) had values near the regional average for mercury, selenium, DDT, and PCBs. Copper was slightly elevated, and chlordane was not detected. Tissues from clams deployed at this site had a markedly high concentration of the herbicide oxadiazon (Figure 6-27).

7.6.6 Water and Sediment Toxicity

Three-species toxicity tests were conducted on water samples from Arroyo Las Positas at El Charro (ALP010), Altamont Creek (ALP100), and Arroyo Las Positas (ALP110). There were significant decreases in algal population growth in spring and dry season samples from ALP110, and in the spring sample from ALP010. The ALP010 site had the highly elevated clam tissue concentration of oxadiazon. No significant toxicity was observed to any other species (Figure 7-). An amphipod toxicity test was conducted on a sediment sample at ALP010; there were no significant observed effects on amphipods in this test.

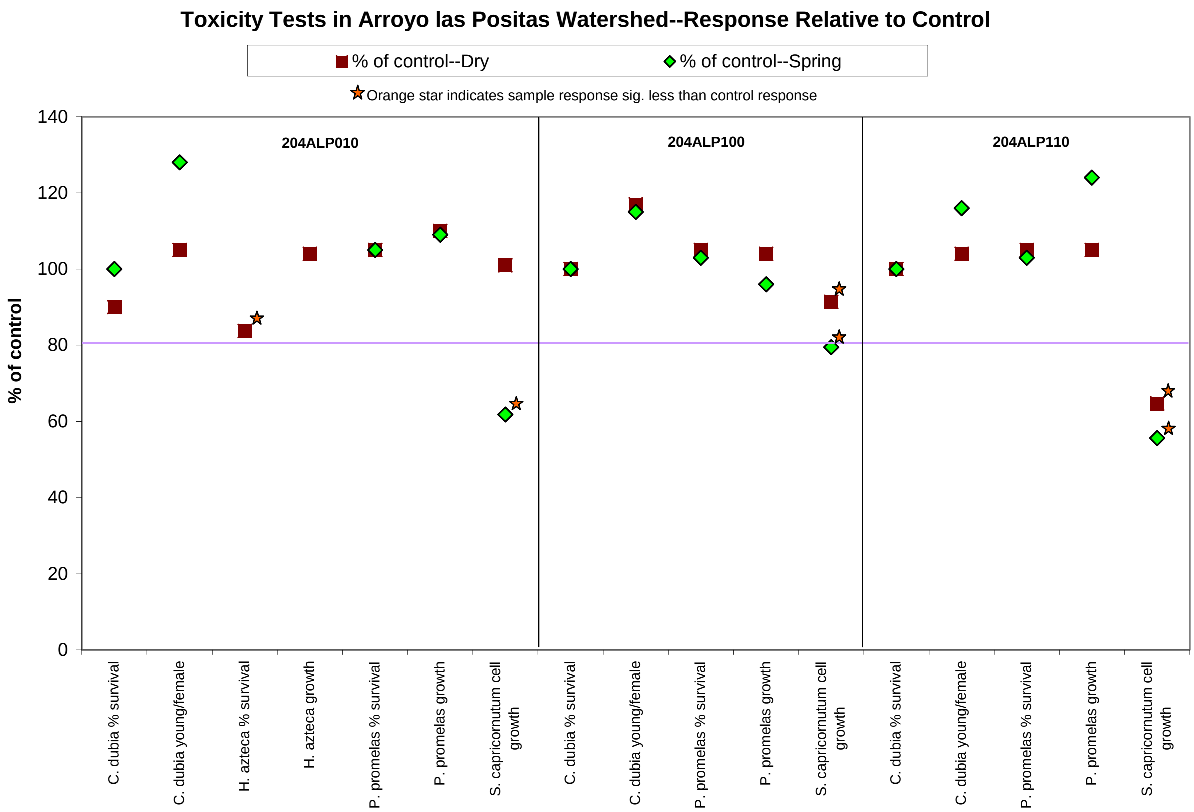

Figure 7-54. Toxicity tests in Arroyo Las Positas

Results of toxicity tests are shown, with three species in water samples and one species in sediment samples from Arroyo Las Positas. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.6.7 Coliform Bacteria

Coliform bacteria were not measured in the Arroyo Las Positas watershed.

7.7 Pescadero Creek/Butano Creek Watershed

7.7.1 Sites of Concern

Exceedances noted in the summary tables (Table 7-21 and Table 7-22) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

While data collected in this study do not indicate any specific sites of serious concern for nutrients or contaminants, high coliform exceedances at PES060 (Community Church) suggest the need for further investigation and management.

Temperature and dissolved oxygen levels were supportive of salmonids at most sites. The significant relationship between riparian vegetation and stream temperature indicates that riparian zone management is a priority for continued protection of salmonid populations.

Table 7-21. Summary of sites with exceedances in Pescadero Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 9 sites sampled*		
Temperature	MWAT, steelhead	2
	MWAT, coho	4
Oxygen, dissolved	minimum, COLD	1
	3-month median	1
CONVENTIONAL WATER QUALITY *of 4 sites sampled*		
Nitrate as N	maximum	2
Phosphorus, total as P	maximum	4
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals Chromium	TEC	1
SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	growth	1
COLIFORMS *of 6 sites sampled*		
E. coli	steady state	1
Fecal coliform	log mean	1
	90th percentile	1
Total coliform	median	6
	maximum	1

Table 7-22. Summary of sites with exceedances in Butano Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 3 sites sampled*		
Oxygen, dissolved	minimum, COLD	1
CONVENTIONAL WATER QUALITY *of 2 sites sampled*		
Nitrate as N	maximum	2
Phosphorus, total as P	maximum	2
SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	growth	1
COLIFORMS *of 2 sites sampled*		
Total coliform	median	2

7.7.2 Water Quality in Relation to Land Use

Land use in the watershed is primarily open space, agriculture, rural residential, and mixed use. Agriculture is predominant in the broad valleys of the lower mainstem of Pescadero and Butano creeks. Benthic invertebrate assemblages at sites in the lower watershed are slightly impacted, although much better than assemblages in urban watersheds.

7.7.3 Macroinvertebrate Assemblages and Physical Habitat

Three groups of sites were identified from the cluster analysis dendrogram (Figure 7-) of benthic assemblages in the Pescadero Creek and Butano Creek watersheds:

- The Headwaters group (HW) is composed of sites on tributaries and headwater streams in the upper Pescadero Creek (PES170, PES180, PES200, PES210, PES240) and Butano Creek (BUT040, BUT050) watersheds.
- The Middle Mainstem Pescadero Creek group (MMP) includes five sites on the middle section of Pescadero Creek (PES100, PES120, PES140, PES160, PES190).
- The Lower Pescadero Creek and Butano Creek group (LPB) includes four sites on the lower mainstem of Pescadero Creek (PES050, PES060, PES070, PES095) and two sites on the mainstem of Butano Creek (BUT020, BUT030).
- Four dissimilar sites (BUT010, PES050, PES080, PES150) that were not classified into any of the three groups are apparent on the cluster dendrogram (Figure 7-) and the ordination plot (Figure 7-).

The Headwaters group

These sites are located on small, steep, perennial streams draining forested catchments with minimal human land use, other than limited timber harvest. Benthic assemblages at the seven sites were very diverse, with taxa richness values ranging from 40-55, all within the range of values (38-59) observed at minimally disturbed perennial streams (Table 6-10). In addition to high taxonomic diversity, sites in the Headwaters group exhibit high functional diversity, with scrapers making up 27 to 52 percent of organisms and collector-gatherers making up 19 to 42 percent of all organisms. Despite the small stream size and dense canopy cover common to these forested streams, the scraper functional feeding group was the dominant feeding group at five of seven sites. The high taxonomic and functional diversity, low abundance of common tolerant taxa, and presence of sensitive taxa indicates that these sites possessed excellent biological integrity relative to other streams in the Bay Area.

Abundant taxa included:

Cinygmula sp. (Heptageniidae)	13%
Optiosevus sp. (Elmidae)	10%
Baetis sp. (Batidae)	7%
Chironomidae	7%
Calineuria californica (Perlidae)	5%

The percentage of common tolerant taxa was greater than 20 percent at only two sites, BUT040 (37 percent) and PES180 (29 percent). Many rare taxa with specific habitat requirements were found at these sites, including *Pteronarcella* sp. and *Pteronarcys* sp. (Plecoptera: Pteronarcyidae), Apatania sp. (Trichoptera: Apataniidae), *Despaxia augusta* (Plecoptera: Leuctridae), the grappletail dragonfly *Octogomphus specularis* (Odonata: Gomphidae), *Hesperocanopa* sp. (Diptera: Tipulidae), *Oreogeton* sp. (Diptera: Empididae), and *Philorus* sp. (Diptera: Blephariceridae).

Also notable at four sites was the aquatic pillbug *Gnorimosphaeroma* sp. (Isopoda: Sphaeromatidae), common in estuarine and intertidal habitats of the Pacific Coast. *Gnorimosphaeroma* has been found in coastal freshwater streams, including low elevation tributaries to Drake's Estero in Point Reyes (Lee, 2001), but its occurrence in headwater tributaries of the Santa Cruz Mountains is remarkable. It was also found (in very high abundances) at the most downstream site on Pescadero Creek (PES050) and in Jones Gulch (PES150).

The Middle Mainstem Pescadero (MMP) group

Most of this portion of the creek flows in a narrow canyon through heavily forested state and county parkland. Sites in this group were located on the ordination plot (Figure 6-77) between the Headwaters group (HW) and the Lower Pescadero Creek and Butano Creek group (LPB). Like sites in the Headwaters group, sites in the Middle Mainstem Pescadero group were characterized by high taxanomic richness (42-45), high abundance of EPT, low abundance of common tolerant taxa, and presence of rare and intolerant taxa.

Common tolerant taxa made up less than 25 percent of individuals at all five sites (Table 6-26). Several rare taxa were found at these sites, including the riffle beetles *Cleptelmis addenda* and *Lara* sp. (Coleoptera: Elmidae), the beetle family Staphylinidae (Coleoptera), and *Pteronarcella* sp. (Plecoptera: Pteronarcyidae).

Benthic assemblages were dominated by mayflies (Epemeroptera), including:

Ephemerella sp. (Ephemerellidae)	16%
Serratella sp. (Ephemerellidae)	9%
Cinygmula sp. (Heptageniidae)	6%
Baetis sp. (Baetidae)	6%
Epeorus sp. (Heptageniidae)	5%
Diphetor hageni (Baetidae)	4%
Drunella sp. (Ephemerellidae)	4%

Other abundant taxa included:

Optioservus sp. (Elmidae)	7%
Simulium sp. (Diptera: Simuliidae)	6%
Malenka sp. (Plecoptera: Nemouridae)	4%
Chironomidae (Diptera)	4%.

Lower Pescadero-Butano group

Land use in the lower portion of the Pescadero Creek watershed is primarily agricultural, with minor residential and commercial land use near the town of Pescadero. Sites PES050 and PES060 are located downstream of the town, while PES070 and PES095 are located upstream, adjacent to row crop agricultural fields. BUT030 is located on Butano Creek downstream of the small residential community of Butano Park, while site BUT020 is farther downstream of agricultural land use, including greenhouse operations. BUT010, the farthest downstream site on Butano Creek, was taxonomically distinct from these sites and is discussed separately.

Within the Lower Pescadero-Butano group of sites, biological data suggest that upstream sites are affected by minor water quality impacts, while lower sites exhibit moderate reductions in biological integrity. Although tolerant taxa were numerically dominant, the presence of common intolerant taxa such as *Malenka* sp. (Plecoptera: Nemouridae) and *Drunella* sp. (Ephemeroptera: Ephemerellidae) at all six sites indicates at least a moderate level of biological integrity. The number of common intolerant taxa at upstream sites (PES095, BUT030) is higher than at downstream sites (PES050, PES060, PES070, BUT020), suggesting a downstream trend in water quality impacts. Similarly, the values of percent sensitive EPT at downstream sites (11-22 percent) are less than at upstream sites (35-47 percent), which in turn are less than sites in the Middle Mainstem Pescadero group (49-70 percent).

In general, benthic assemblages at sites in the Lower Pescadero-Butano group were numerically dominated by common tolerant taxa:

Chironomidae	26%
Simulium sp. (Simulidae)	10%
Baetis sp. (Baetidae)	9%
Optioservus sp.(Elmidae)	7%

Ephemerella sp. (Ephemerellidae)	6%
Tricorythodes sp. (Leptohyphidae)	5%
Diphetor hageni (Baetidae)	4%
Cinygmula sp. (Heptageniidae)	3%.

The aquatic pillbug *Gnorimosphaeroma* sp. (Isopoda: Sphaeromatidae), a common invertebrate in coastal brackish waters, was the dominant taxa at PES050, making up over 50 percent of organisms collected. Rare taxa found at these sites included beetles such as *Postelichus* sp. (Dryopidae), found only at PES060 in the Bay Area; *Brychius* sp. (Haliplidae); and *Laccobius* sp. (Hydrophilidae). Other rare, relatively intolerant taxa collected from these sites included *Molophilus* sp. (Diptera: Tipulidae), *Cultus* sp. (Plecoptera: Perlodidae), and *Brachycentrus* sp. (Trichoptera: Brachycentridae).

Anomalous sites

Four sites were noticeably dissimilar from all other sites in the watershed.

- Both the ordination plot (Figure 7-) and cluster dendrogram (Figure 7-) showed the site on Waterman Creek (PES230) to be considerably different from other nearby sites in the Headwaters group (HW). Several common intolerant taxa found at neighboring sites were absent or present in very low abundances at PES230, such as *Narpus* sp. (Coleoptera: Elmidae), and *Rhyacophila* sp. (Trichoptera: Rhyacophilidae). Most notably, three genera of Heptageniidae found at every site in the Headwaters group were absent from PES230: *Epeorus* sp., *Ironodes* sp., and *Rithrogena* sp. Heptageniid mayflies are the dominant algal grazing herbivores in minimally disturbed Bay Area streams. These taxonomic differences mirror differences in biological metrics between PES230 and other Headwater sites, especially EPT taxa richness (17 at PES230 versus 20-31 at other sites) and the percentage of collector-filterers (55 percent versus 19-42 percent). These differences are likely the result of local habitat conditions. The Waterman Creek sampling reach received very low P-HAB scores for embeddedness (4 out of 20), sediment deposition (5 out of 20), and channel alteration (2 out of 20) parameters.
- Jones Gulch (PES150) is a small tributary that flows through forested parkland. The only human land use in the watershed is a youth camp near the source of the creek. Many ubiquitous sensitive EPT taxa were absent from PES150, including the ephemerellid mayflies *Drunella* sp. and *Serratella* sp.; the heptageniid mayflies *Cinygmula* sp., *Epeorus* sp., and *Ironodes* sp.; the chloroperlid stonefly *Suwallia* sp., and the caddisfly *Neophylax* sp. Physical habitat conditions at PES150 may be responsible for the taxonomic differences, as evidenced by the poor embeddedness (4 out of 20) and sediment deposition (5 out of 20) P-HAB scores. Additionally, water was observed to be brown-colored and foamy during the wet season, possibly suggesting an upstream source of organic pollution.
- Honsinger Creek (PES080) is another small tributary that flows across the broad alluvial valley of Pescadero Creek. Row crop agriculture is the dominant land use in the lower portion of the Honsinger Creek watershed. Relative to other sites in the Pescadero Creek watershed, many ubiquitous EPT taxa were absent from PES080, including three genera of ephemerellid mayflies, the perlodid family of stoneflies, and the caddisflies *Hydropsyche* sp. (Hydropsychidae) and *Neophylax* sp. Whereas local physical habitat

conditions were generally excellent, water quality may be negatively impacting the biological integrity of Honsinger Creek.

- The lowest site on Butano Creek, BUT010, was characterized by extremely low benthic abundances (~50/sq. meter) and low diversity (16 taxa). The benthic assemblage was dominated by chironomids (42 percent), oligochaetes (12 percent), the elmid beetle *Optioservus* sp. (12 percent), *Baetis* sp. (8 percent), and the heptageniid *Cinygmula* sp. (7 percent). The channel bed is predominantly composed of sand, with minimal gravel. A combination of natural tectonic processes, human-induced erosion in the upper Butano Creek watershed, and local channel alteration have resulted in deposition of large amounts of fine sediment in this reach of Butano Creek (Curry 1985). The balance between sediment supply and transport capacity is such that the sand-grained bed is mobile for much of the year, resulting in unstable substrate for invertebrate colonization. This is reflected in the P-HAB scores for epifaunal substrate (3 out of 20), embeddedness (1 out of 20) and sediment deposition (1 out of 20). The lack of pollution sensitive and intolerant taxa suggests that water quality issues may be important as well, but the available biological information is inconclusive.

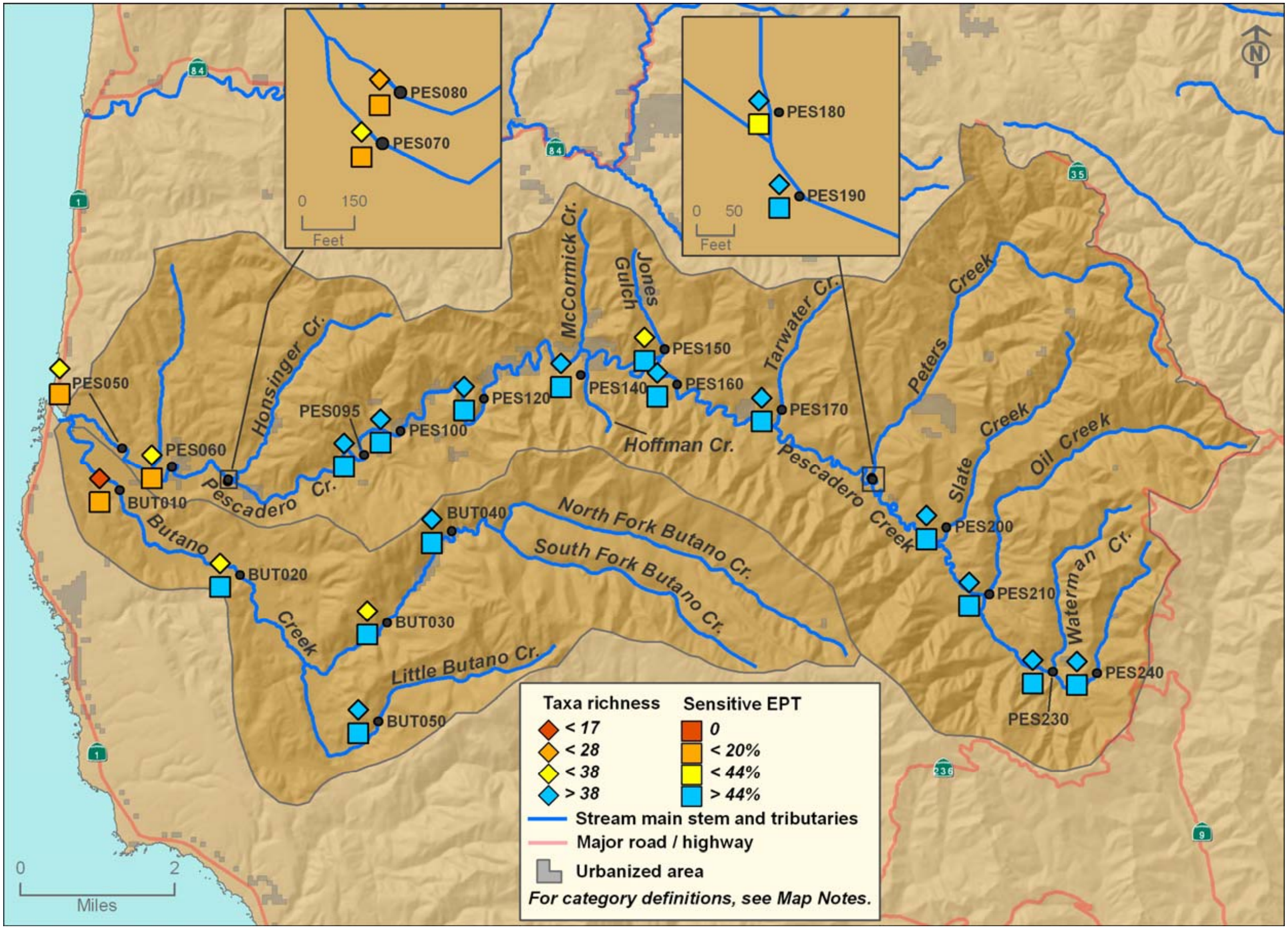

Figure 7-55. Map of Pescadero and Butano creeks benthic macroinvertebrate index scores

Table 7-23. Bioassessment sites in the Pescadero Creek/Butano Creek watershed

Site ID	Site Name	Stream
BUT010	Lower Butano	Butano Creek
BUT020	Cloverdale Coast Ranch	Butano Creek
BUT030	Girl Scout Camp	Butano Creek
BUT040	Butano Falls	Butano Creek
BUT050	Butano State Park	Little Butano Creek
PES050	Water Lane	Pescadero Creek
PES060	Community Church	Pescadero Creek
PES070	Cloverdale Road	Pescadero Creek
PES080	Honsinger	Honsinger
PES095	Pesky Ranch	Pescadero Creek
PES100	USGS Gage	Pescadero Creek
PES120	Loma Mar	Pescadero Creek
PES140	Memorial Park	Pescadero Creek
PES150	Jones Gulch	Jones Gulch
PES160	Towne Fire Rd.	Pescadero Creek
PES170	Tarwater	Tarwater Creek
PES180	Peters Creek	Peters Creek
PES190	Portola SP	Pescadero Creek
PES200	Slate	Slate Creek
PES210	Oil	Oil Creek
PES230	Waterman	Waterman Creek
PES240	Headwaters	Pescadero Creek

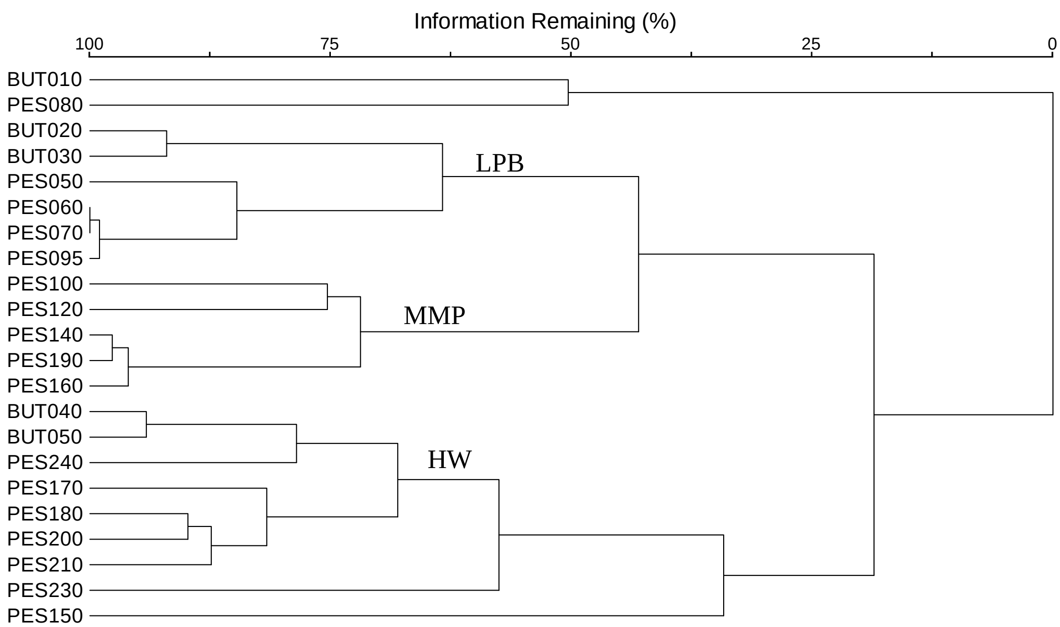

Figure 7-56. Cluster dendrogram of sites in the Pescadero Creek/Butano Creek watershed

The cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present. The Information Remaining axis at the top signifies how similar the sites are with respect to taxa presence. Abbreviations: LPB, Lower Pescadero and Butano; MMP, Middle Mainstem Pescadero; HW, Headwaters.

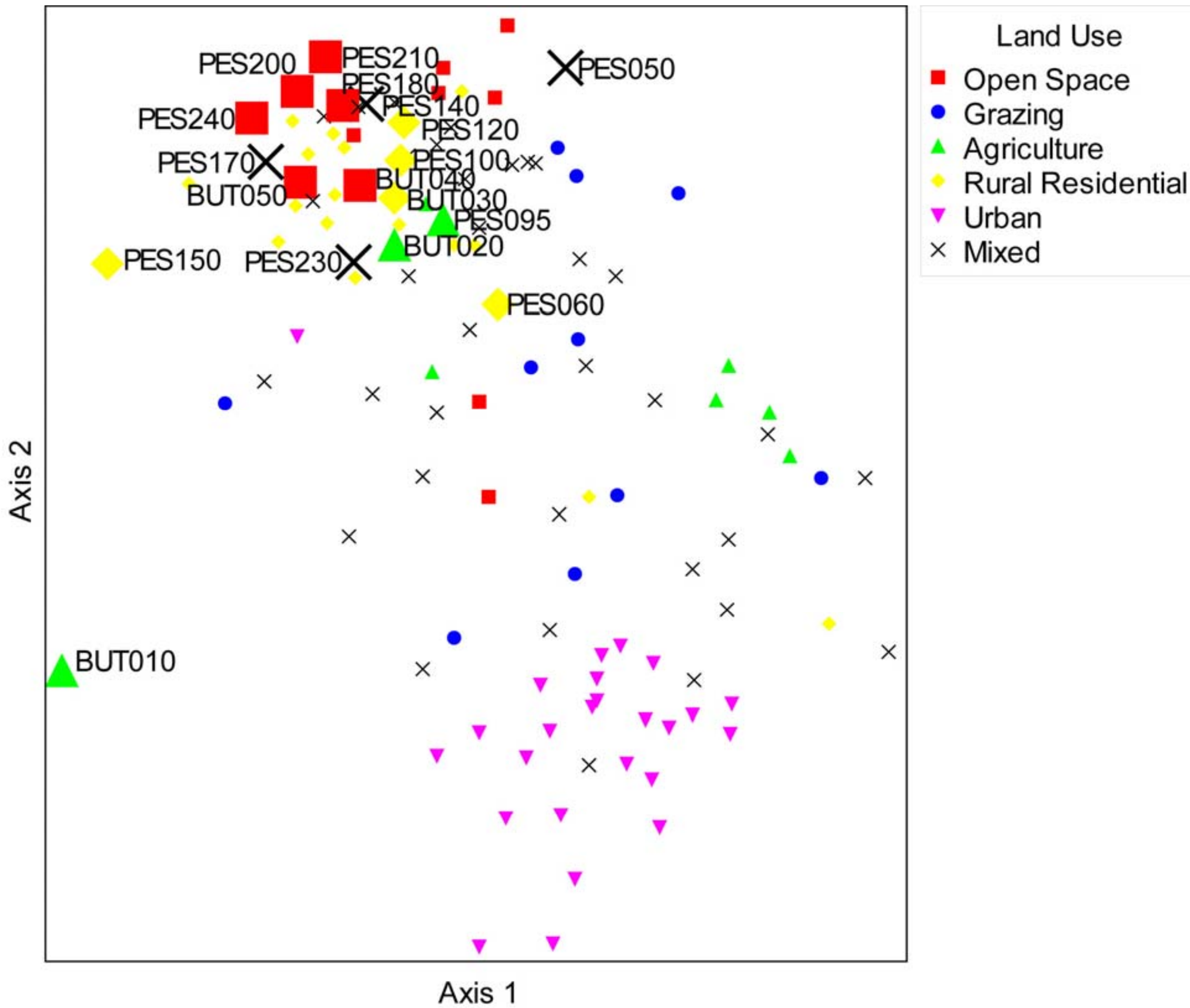

Figure 7-57. NMS ordination of sites in the Pescadero Creek/Butano Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Pescadero/Butano Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-24. Biological metrics in the Pescadero Creek/Butano Creek watershed

	BUT 010	BUT 020	BUT 030	BUT 040	BUT 050	PES 050	PES 060	PES 070	PES 080	PES 095	PES 100	PES 120	PES 140	PES 150	PES 160	PES 170	PES 180	PES 190	PES 200	PES 210	PES 230	PES 240
Coleoptera Taxa	2	2	5	8	7	3	5	3	3	5	5	7	6	6	7	6	10	7	8	9	8	8
Diptera Taxa	3	6	10	8	7	5	6	6	5	9	6	8	9	8	8	6	11	9	11	9	13	14
Ephemerop. Taxa	4	10	10	10	12	9	10	9	7	10	11	10	11	7	10	10	12	11	10	11	7	11
Plecoptera Taxa	0	3	2	3	5	3	3	3	1	5	6	5	6	4	4	4	6	7	5	8	5	8
Trichoptera Taxa	2	7	7	8	7	5	8	10	4	10	9	8	9	5	9	6	8	7	9	9	5	12
Non-Insect Taxa	5	4	2	4	7	6	5	5	6	7	5	5	1	4	4	8	5	4	6	6	4	2
EPT Taxa	6	20	19	21	24	17	21	22	12	25	26	23	26	16	23	20	26	25	24	28	17	31
Taxa Richness	16	32	36	41	45	32	37	36	26	46	42	43	42	35	42	40	52	45	49	52	42	55
% EPT	25	41	67	62	70	22	42	38	33	55	76	78	84	39	69	69	69	73	48	41	47	62
% Sensitive EPT	10	22	47	37	41	11	16	19	18	35	58	54	70	38	54	37	41	49	31	23	40	47
% Chironomidae	42	37	12	9	6	14	36	29	46	29	4	2	6	10	5	3	12	5	7	5	26	8
% Coleoptera	12	8	7	15	10	5	9	7	4	6	9	7	7	5	17	15	8	13	34	35	18	17
% Oligochaeta	12	0	0	1	1	0	1	0	3	0	0	0	0	0	0	4	0	1	1	0	1	0
% Non-insect	20	3	0	2	2	56	5	1	5	1	1	2	0	39	1	9	1	2	2	12	2	2
% Intolerant	0	15	44	36	35	7	10	11	15	30	46	47	66	24	51	35	40	46	27	20	39	41
% Tolerant	8	3	0	0	1	56	3	1	1	1	1	1	0	39	0	3	1	0	1	12	1	2
Tolerance Value	5.3	4.8	3.4	3.5	3.5	6.4	4.8	4.8	5.0	4.0	3.2	3.1	2.1	5.3	2.6	3.3	3.4	3.1	3.3	4.1	3.7	3.2
% Predator	7	5	7	5	19	11	7	5	3	6	8	8	8	25	8	22	12	11	11	9	7	27
% Coll.-filterer	1	12	13	9	10	4	10	26	11	11	13	12	1	7	5	1	10	7	2\	4	2	6
% Coll.-gatherer	67	59	52	41	26	68	65	50	59	65	57	57	64	46	41	19	42	36	26	26	55	26
% Scraper	19	21	16	29	31	16	14	12	13	11	15	11	21	10	37	48	27	38	44	52	20	33
% Shredder	6	3	11	8	14	1	4	6	13	6	7	4	5	12	8	11	5	6	17	8	15	9
% Other	1	0	1	7	0	0	0	0	0	1	0	9	1	0	1	0	5	3	0	1	1	0
Com. Tol. (%)	63	55	39	37	19	19	49	61	67	48	25	23	10	15	12	10	29	15	14	15	32	14
Com. Int. Taxa	3	9	14	21	19	4	9	10	6	15	16	16	18	12	15	17	21	21	21	20	17	21

7.7.4 Basic Water Quality Field Measurements

Stream temperatures exceeded some thresholds at about half of the continuously monitored sites, all during the dry season (Figure 7-, Figure 7-, and Appendix D). HWAT values exceeded the MWAT threshold for coho salmon (14.8ºC) in Pescadero Creek at Memorial Park (PES140) and the Canyon Mouth (PES105). The higher MWAT threshold for steelhead (17ºC) was exceeded in Pescadero Creek at the Community Church (PES060) and at the USGS Gage (PES100). In total, a temperature threshold was exceeded at four of eleven sites, but only in the dry season.

Dissolved oxygen concentrations fell below Basin Plan objectives in the dry season at eight sites: BUT010, PES060, PES100, PES140, PES150, PES170, PES190, and PES240 (see Figure 7-, Figure 7-, and Appendix D).

There were no measured exceedances of pH objectives, and specific conductance was low throughout the watershed.

Physical habitat parameters distinguished two sites in the lower watershed (PES060 and PES100) from three sites further upstream (PES140, PES150 and PES170). The lower sites had relatively low scores for channel alteration, riparian zone width, and canopy cover, while the upstream sites had very high scores for these parameters. There was a significant correlation between stream temperature and physical habitat parameters among these sites, as illustrated for canopy cover (Figure 7-). This trend may reflect a natural downstream pattern of decreased canopy cover with increasing stream width, however, and should not necessarily be considered a sign of poor habitat.

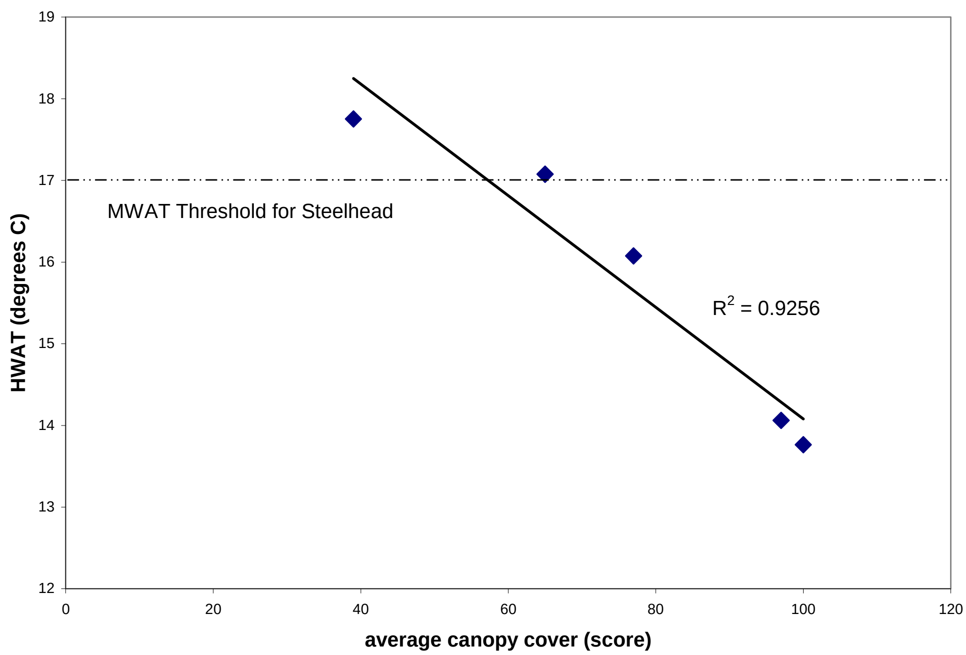

Figure 7-58. Riparian canopy cover and stream temperature in Pescadero Creek

MWAT is maximum weekly average temperature. HWAT is highest weekly average temperature for the period sampled.

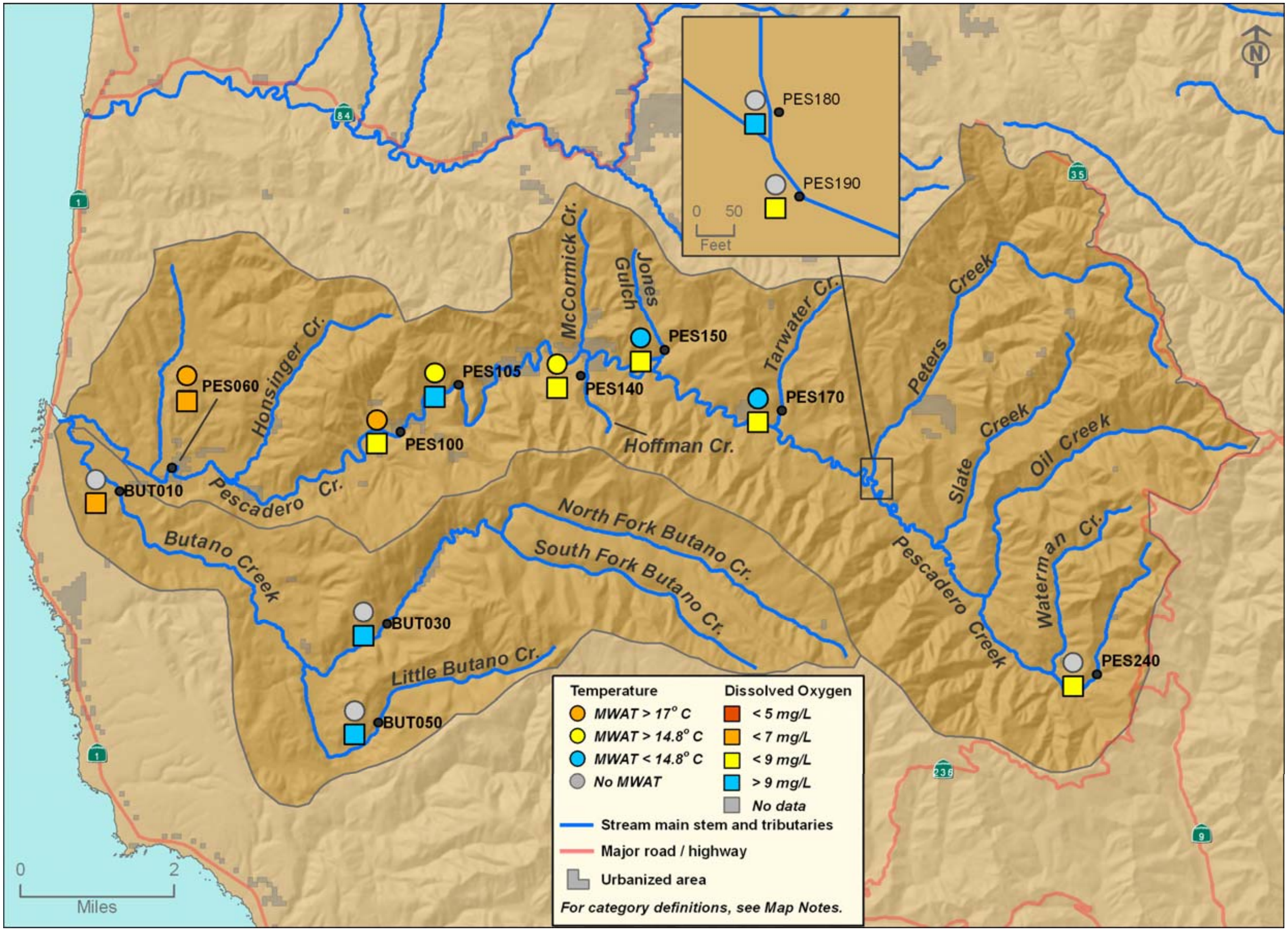

Figure 7-59. Map of temperature and DO levels in Pescadero and Butano creeks

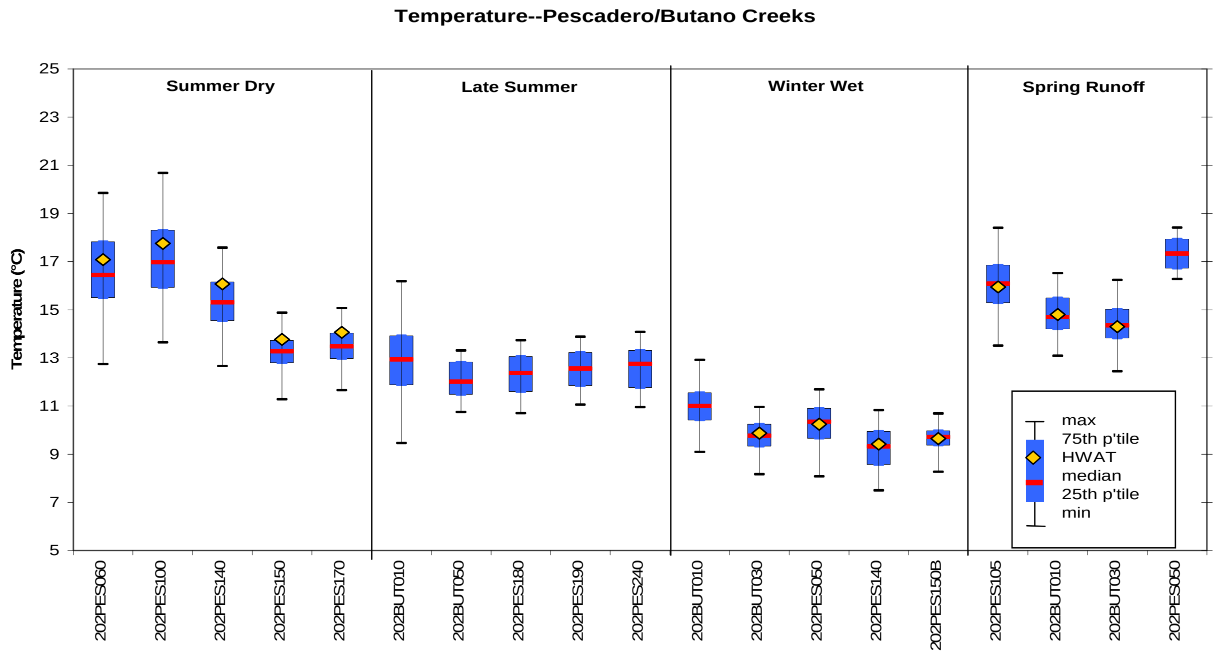

Figure 7-60. Temperature monitoring in Pescadero and Butano creeks

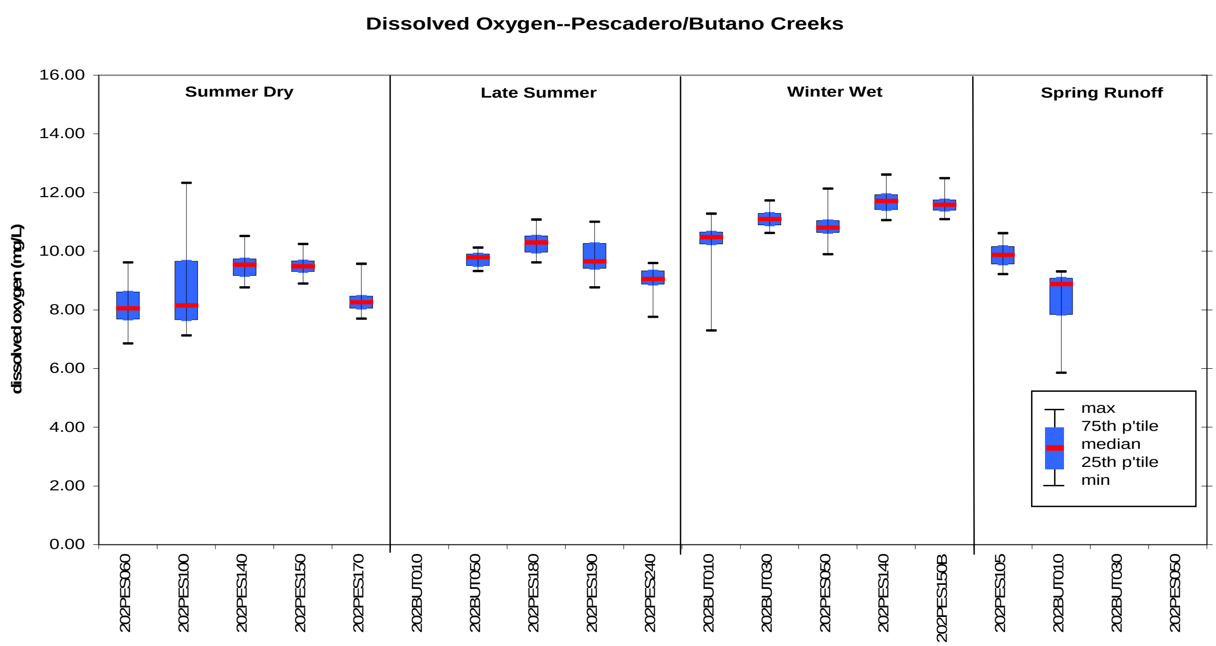

Figure 7-61. DO monitoring in Pescadero and Butano creeks

Data were rejected from BUT010 in the late summer and from BUT030 and PES050 in the spring.

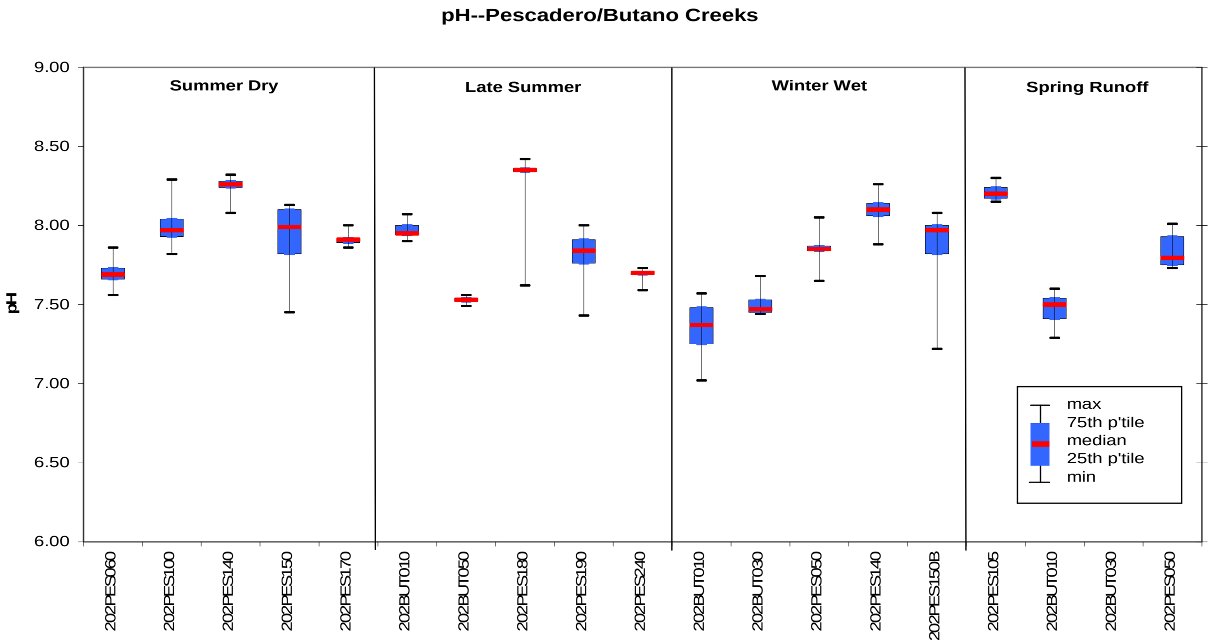

Figure 7-62. pH monitoring in Pescadero and Butano creeks

Data were rejected from BUT030 in the spring.

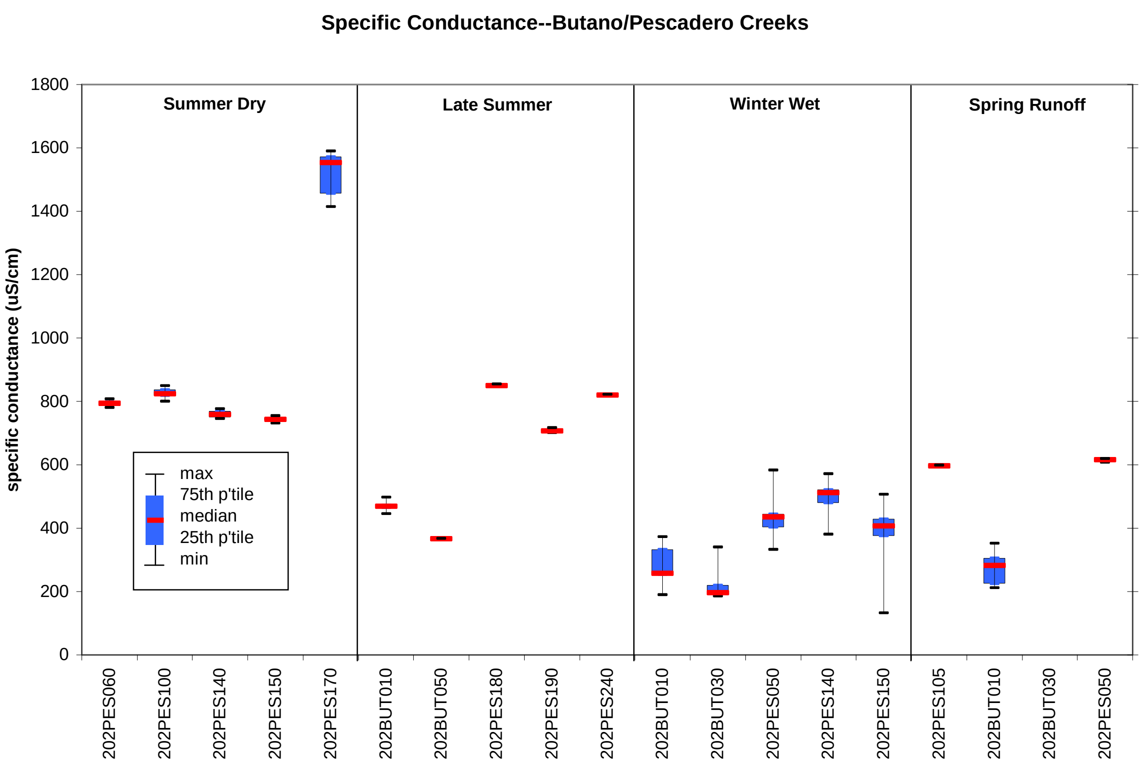

Figure 7-63. Specific conductance monitoring in Pescadero and Butano creeks

Data were rejected from BUT030 in the spring.

7.7.5 Water, Sediment, and Clam Tissue Chemistry

Nutrient and chlorophyll-a concentrations in water samples were relatively low throughout the watershed. Chlorophyll-a exceeded the 1.78 µg/L guideline value at one site (BUT010) in dry and spring seasons. About half of the nitrate values exceeded the U.S. EPA reference guideline of 0.155 mg/L.

Total phosphorus measurements were also moderate, 0.17 mg/L or less, but, most were significantly above the U.S. EPA reference guideline.

Orthophosphate concentrations were generally low to moderate, with all measurements less than 0.15. All samples in Pescadero Creek were above the 0.030 mg/L U.S. EPA total phosphorus guideline, but only one exceedance was observed in Butano Creek.

Metal and organic contaminants were measured in water samples from three sites: BUT010, PES050, and PES070. Land use at these sites was characterized as agricultural and mixed use. There were no exceedances of Basin Plan aquatic life water quality objectives in any samples from this watershed.

Sediments were collected for analysis from two sites, BUT010 and PES050. The only exceedance of a guideline value was chromium measured above the threshold effects concentration (TEC) at PES050. Nickel did not exceed any guideline values. The sediment quality guideline quotients values were the lowest measured in this study: 0.04 at BUT010 and 0.07 at PES050.

Tissues of clams deployed at these two sites had low concentrations of all measured compounds.

7.7.6 Water and Sediment Toxicity

Three-species toxicity tests were conducted on water samples from the same three sites as metal and organic chemistry: BUT010, PES050, and PES070. No significant toxicity was observed for any of the water samples (Figure 7-).

There were statistically significant effects on amphipod growth in sediments collected from BUT010 and PES050. While growth integrates a number of physiological processes, the relationship of the amphipod growth endpoint to specific stressors is not well established. These samples had the study's lowest concentrations of contaminants for which guideline values have been established, so it is not clear whether the depressed amphipod growth was related to chemical contamination.

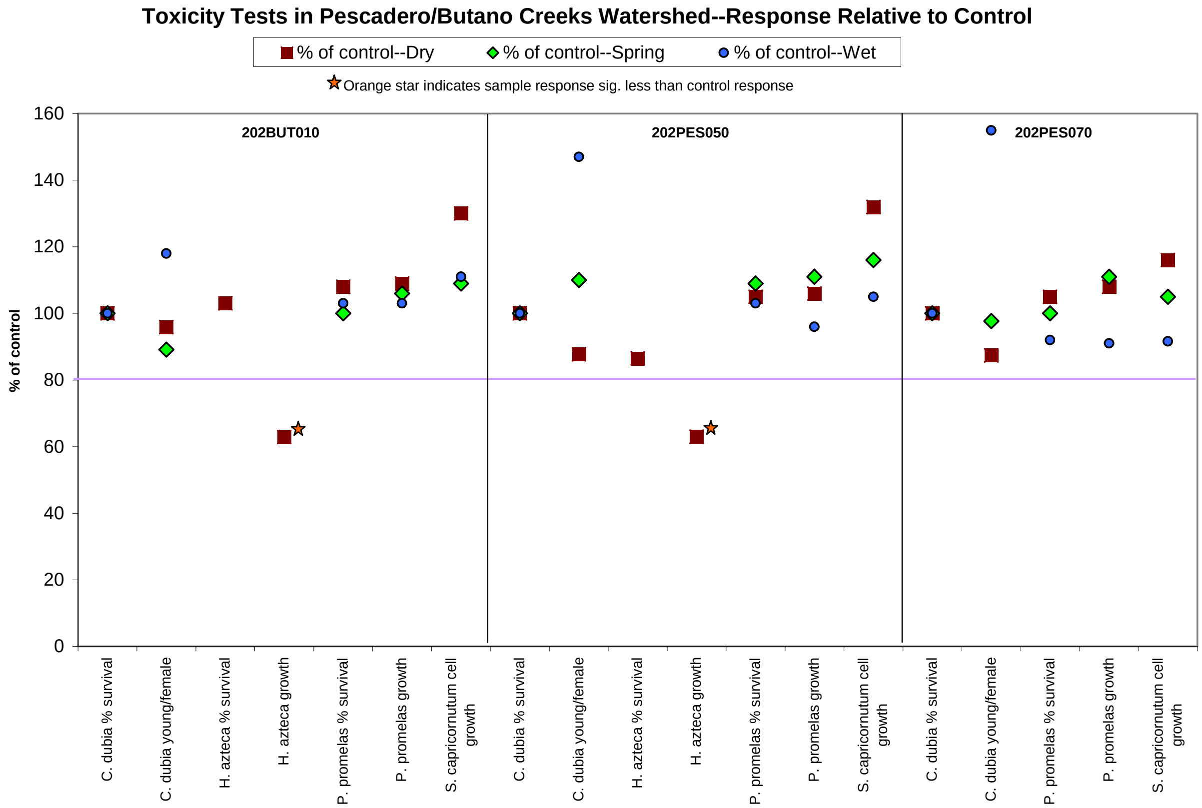

Figure 7-64. Toxicity tests from Pescadero and Butano creeks

Results of toxicity tests are shown, with three species in water samples and one species in sediment samples. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.7.7 Coliform Bacteria

Samples were analyzed for coliform bacteria at eight sites in the watershed (Figure 3-7). As noted above, Basin Plan objectives for all three indicators, *E. coli*, fecal coliforms, and total coliforms were exceeded at only one site, Pescadero Creek at Community Church (PES060). Basin Plan objectives for total coliforms were exceeded at each of the eight sites: Butano Creek at Butano Falls (BUT040), Little Butano Creek at Butano State Park (BUT050), Pescadero Creek at Community Church (PES060), Memorial Park Swim 1 (PES134), Memorial Park Swim 2 (PES135), Jones Gulch (PES150), Iverson Trail (PES193), and Sequoia Nature Trail (PES194).

7.8 San Gregorio Creek Watershed

7.8.1 Sites of Concern

Exceedances noted in the summary table (Table 7-1725) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

Results of this survey did not indicate any specific sites of concern for nutrients or contaminants; however, coliform bacteria levels at Playbowl on La Honda Creek (SGR100) and San Gregorio Confluence (SGR079) did exceed coliform objectives and bear further investigation. Temperature and dissolved oxygen levels were supportive of salmonids at all sites except the downstream site (SGR010) during the dry season and Sky Londa (SGR120) in the fall. The unusual pattern of temperature, DO, and specific conductance noted at Sky Londa in the fall (see section 6.2.2.7) warrants further investigation.

Table 7-25. Summary of sites with exceedances in San Gregorio Creek watershed

Analyte	***Standard***	***# of sites***
FIELD MEASURES *of 6 sites sampled*		
Temperature	MWAT, coho	1
Oxygen, dissolved	minimum, COLD	1
	minimum, WARM	1
	3-month median	1
CONVENTIONAL WATER QUALITY *of 4 sites sampled*		
Nitrate as N	maximum	4
Phosphorus, total as P	maximum	4
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals		
Chromium	TEC	1
Nickel	TEC	1
SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	growth	1
COLIFORMS *of 2 sites sampled*		
E. coli	steady state	2
Fecal coliform	log mean	1
Total coliform	median	2
	maximum	1

7.8.2 Water Quality in Relation to Land Use

Land use in the watershed is primarily open space and rural residential. Only two sites (SGR010 and SGR040) are categorized as mixed use; the rest are categorized as rural residential. No trends between measured parameters and land use were apparent or likely be discerned, given the low variability among measured parameters in the watershed data set.

7.8.3 Macroinvertebrate Assemblages and Physical Habitat

Two groups of benthic assemblages were identified in the San Gregorio Creek watershed from the cluster dendrogram (Figure 7-) and ordination plot (Figure 7-):

- The Mainstem (MS) group is composed of two sites on San Gregorio Creek (SGR040 and SGR075) and one site on lower La Honda Creek (SGR080).
- The Tributary (TR) group includes sites on small tributary streams including El Corte de Madera Creek (SGR030), Harrington Creek (SGR060), Alpine Creek (SGR090, SGR150), Mindego Creek (SGR130), and upper La Honda Creek (SGR110, SGR120).
- The lowest site on San Gregorio Creek, SGR010, was sufficiently different from other sites that it is considered separately.

The Mainstem group
Land use in the San Gregorio Creek watershed is primarily protected open space, with small amounts of rural residential, commercial, grazing, and agriculture land use. Very high numbers of sensitive and intolerant organisms were present at these sites, suggesting excellent water quality and habitat conditions. The tolerance value of 2.1 at SGR040 is the lowest measured value in the Bay Area, while the percent intolerant values of 45-64 percent are well above the median value from minimally disturbed perennial sites (33 percent). Functional diversity was very high, with all five primary functional feeding groups well represented (Table 7-27). Although few rare taxa were found at these sites, the dominance of common intolerant taxa indicates high biological integrity.

Benthic assemblages at these sites were numerically dominated by EPT taxa (68-81 percent), including *Ephemerella* sp. (14 percent), *Cinygmula* sp. (10 percent), *Lepidostoma* sp. (9 percent), and *Epeorus* sp. (8 percent).

The Tributary group
These sites almost exclusively drain open space, with minor amounts of rural residential land use. Biological metric values, such as taxa richness (36-51) and tolerance value (2.8-4.3) generally fall within the range of minimally disturbed conditions (Table 6-10), suggesting that tributaries in the San Gregorio Creek watershed had excellent biological integrity and water quality conditions.

The benthic assemblages are dominated by mayflies, including:

Baetis sp. (Baetidae)	20%
Cinygmula sp. (Heptageniidae)	10%
Epeorus sp. (Heptageniidae)	8%
Ephemerella sp. (Ephemerellidae)	5%
Serratella sp. (Ephemerellidae)	4%
Drunella sp. (Ephemerellidae)	2%

Other abundant taxa included:

Chironomidae	7%
Optioservus sp. (Elmidae)	5%
Calineuria californica (Perlidae)	4%
Malenka sp. (Nemouridae)	4%
Simulium sp. (Simuliidae)	4%

Several rare taxa not found elsewhere in the Bay Area were collected at these sites, including the elmid beetle *Ampumixis dispar*, *Brachycera* sp. (Diptera: Brachycera), and the water mite *Testudacarus* sp. (Acari: Torrenticolidae).

Lower San Gregorio Creek Site
The richness and sensitivity of taxa at the lowest site on San Gregorio Creek, SGR010, suggests that this site provides a rare depiction of a minimally disturbed benthic assemblage from a large perennial stream in the Bay Area. The benthic assemblage here included many rare taxa not found at other sites in the watershed, such as the beetles *Oreodytes* sp. (Dytiscidae) and *Brychius* sp. (Halipldae), the caddisfly *Oecetis disjuncta* (Leptoceridae), *Atrichopogon* sp. (Diptera: Ceratopogonidae), and the water mite *Corticacarus* sp. (Hygrobatidae). These taxa are most likely present as a result of complex habitat, such as undercut banks and overhanging riparian vegetation, associated with minimally disturbed low gradient channels. Dominant taxa included Chironomidae (18 percent), *Optioservus* sp. (18 percent), and the mayflies *Ephemerella* sp. (8 percent) and *Diphetor hageni* (7 percent).

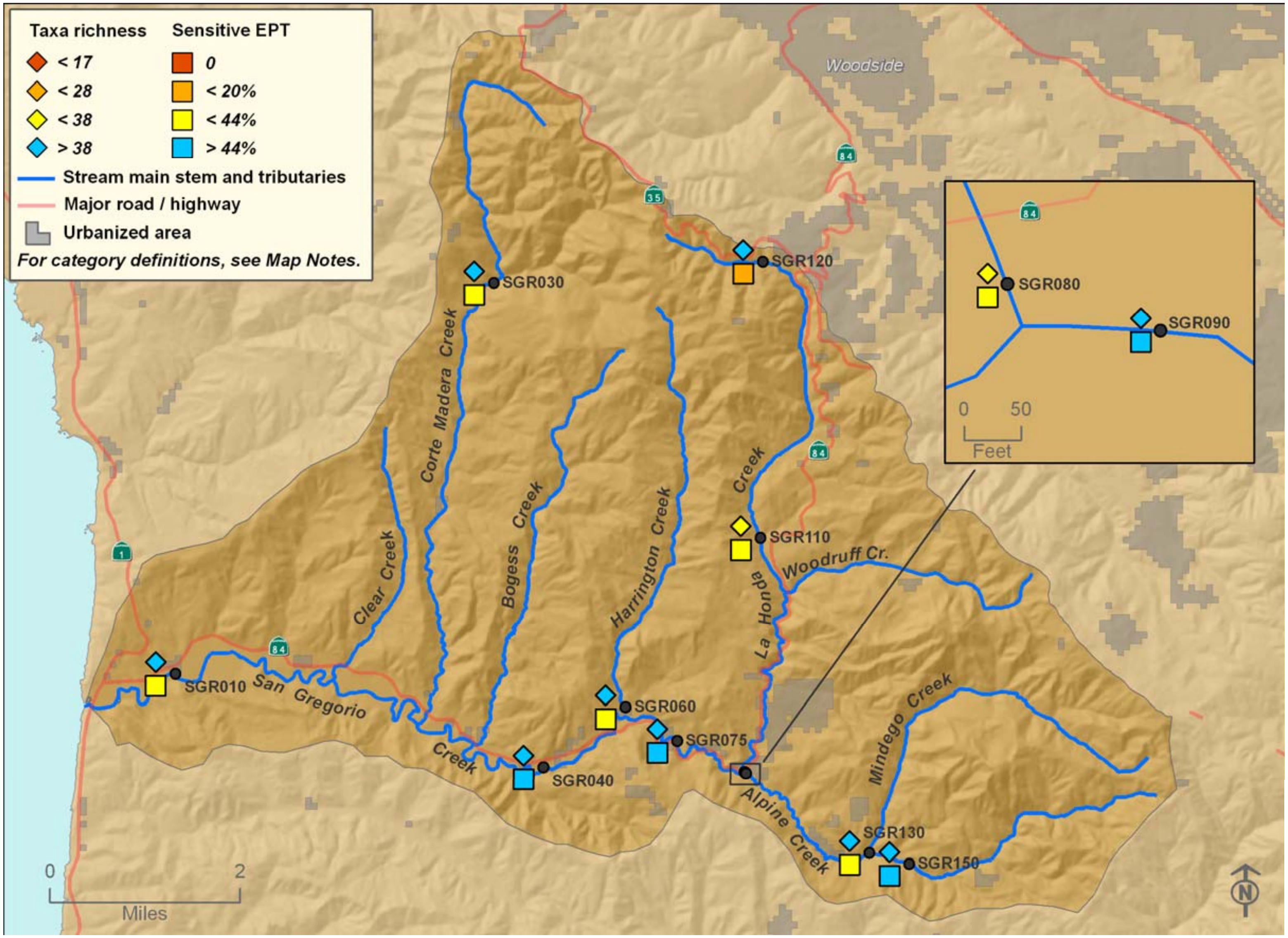

Figure 7-65. Map of San Gregorio Creek benthic macroinvertebrate index scores

Table 7-26. Bioassessment sites in the San Gregorio Creek watershed

Site ID	Site Name	Stream
SGR010	SG USGS Gage	San Gregorio Creek
SGR030	Star Hill Rd.	El Corte de Madera Creek
SGR040	Boysville	San Gregorio Creek
SGR060	Harrington	Harrington Creek
SGR075	Upper San Gregorio	San Gregorio Creek
SGR080	La Honda Low	La Honda Creek
SGR090	Alpine Low	Alpine Creek
SGR110	Spanish Ranch	La Honda Creek
SGR120	Sky Londa	La Honda Creek
SGR130	Mindego	Mindego Creek
SGR150	Heritage Grove	Alpine Creek

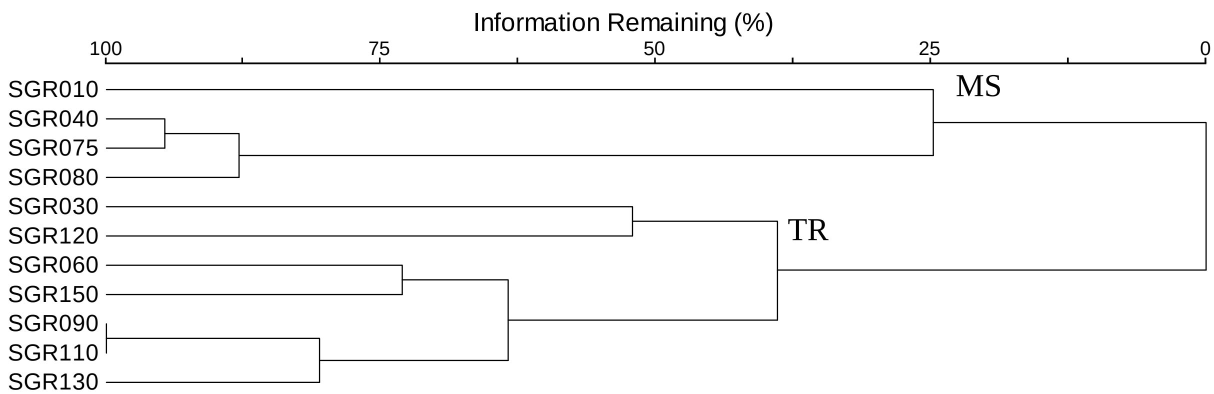

Figure 7-66. Cluster dendrogram of sites in the San Gregorio Creek watershed

This cluster dendrogram groups sites based on similarity of macroinvertebrate taxa present in the San Gregorio Creek watershed. The Information Remaining axis at the top signifies how similar the sites are with respect to taxa presence. Abbreviations: MS, Mainstem; TR, Tributary

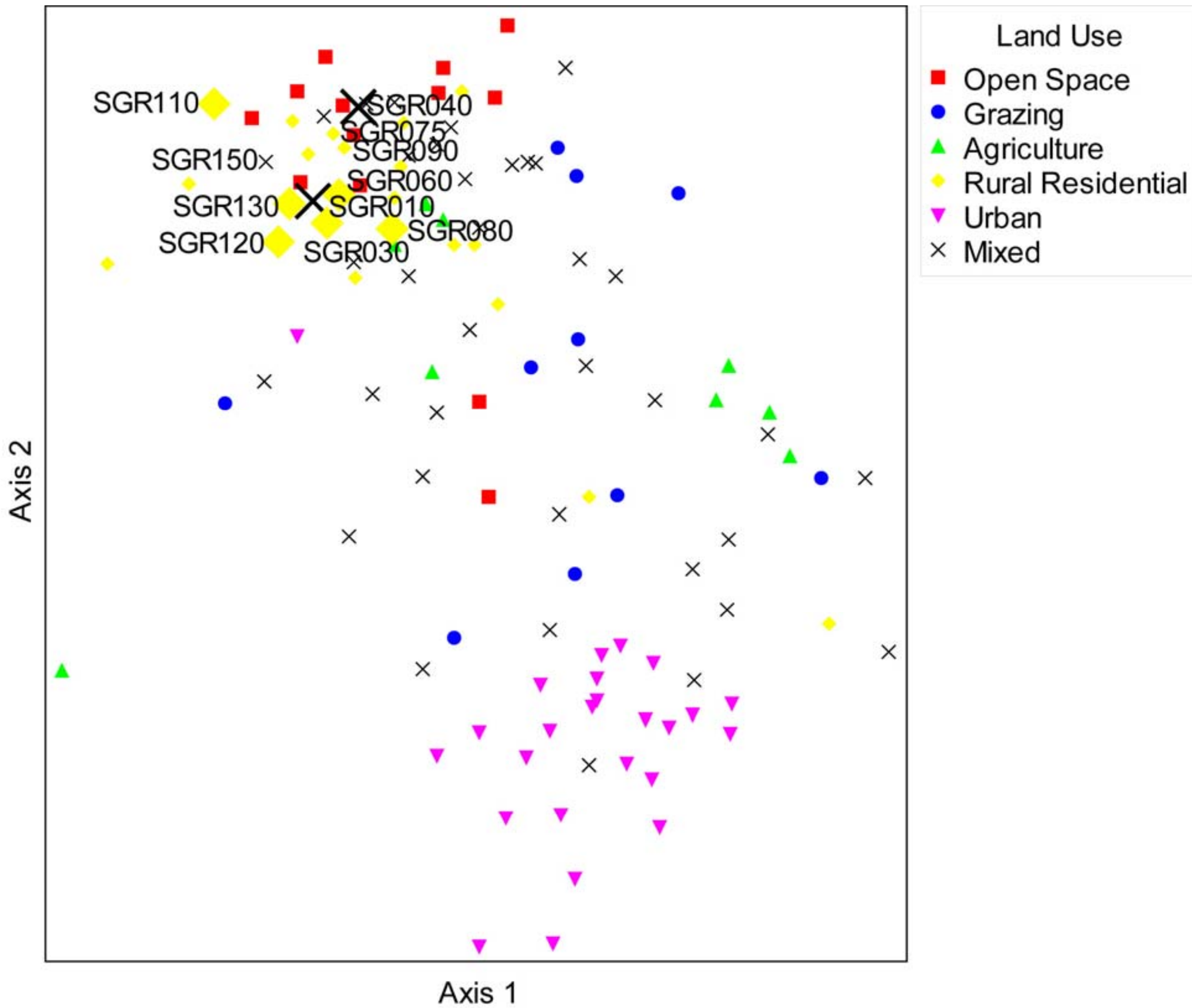

Figure 7-67. NMS ordination of sites in the San Gregorio Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the San Gregorio Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-27. Biological metrics from San Gregorio Creek watershed

	SGR010	SGR030	SGR040	SGR060	SGR075	SGR080	SGR090	SGR110	SGR120	SGR130	SGR150
Coleoptera Taxa	7	8	5	8	5	5	6	6	5	7	9
Diptera Taxa	13	8	7	8	9	9	6	6	10	11	13
Ephemeroptera Taxa	11	10	11	11	12	9	11	10	10	11	9
Plecoptera Taxa	4	3	5	5	4	5	6	5	4	4	6
Trichoptera Taxa	10	8	10	5	8	6	7	7	9	6	6
Non-Insect Taxa	9	6	4	8	5	3	2	2	6	2	8
EPT Taxa	25	21	26	21	24	20	24	22	23	21	21
Taxa Richness	54	43	42	45	43	37	38	36	44	41	51
% EPT	44	76	81	69	79	68	84	73	69	71	75
% Sensitive EPT	32	35	65	41	58	46	50	43	17	38	53
% Chironomidae	18	5	1	7	4	6	5	4	13	7	7
% Coleoptera	19	11	6	5	9	4	3	19	7	8	8
% Oligochaeta	0	3	0	1	1	3	0	0	0	1	1
% Non-insect	10	4	1	3	2	3	0	0	1	2	3
% Intolerant	22	31	64	37	56	45	47	39	16	40	49
% Tolerant	9	1	1	2	1	0	0	0	1	1	1
Tolerance Value	4.3	3.7	2.1	3.6	2.5	3.2	2.8	2.9	4.3	3.3	2.8
% Predator	18	5	8	9	11	7	18	10	7	17	22
% Collector-filterer	4	2	7	14	5	21	10	6	5	16	3
%Collector-gatherer	44	63	26	45	39	34	28	37	72	28	38
% Scraper	24	17	30	27	26	21	32	41	10	35	31
% Shredder	9	4	26	3	14	12	11	5	7	3	5
% Other	1	9	3	1	4	6	1	1	0	0	1
Common Tolerant (%)	22	47	7	34	7	31	17	21	65	27	12
Common Intolerant (Taxa)	13	17	16	19	16	15	18	18	17	20	21

7.8.4 Basic Water Quality Field Measurements

Stream temperatures were measured at six sites (Figure 7-). HWAT values exceeded the MWAT threshold for coho salmon (14.8ºC) at only one site, San Gregorio Creek at the USGS Gage (SGR010), during the dry season. Dissolved oxygen concentrations fell below 9 mg/L at sites SGR010, SGR040, SGR090, and SGR120, all during the dry season. All but SGR120 remained above cold water habitat limits of 7mg/L.

In the fall, SGR120 had an unusual pattern of midnight temperature spikes coincident with dramatic decreases of DO and increases of specific conductance, indicating periodic discharges (see Figures 6-13 and 6-14 and the discussion in section 6.2.2.7).

There were no measurements above pH guidelines.

Dissolved salt content, as measured by specific conductance, exceeded the objective for drinking water taste at three sites during the dry season, SGR010, SGR040, SGR100 (Figure 7- through Figure 7-; and Appendix D).

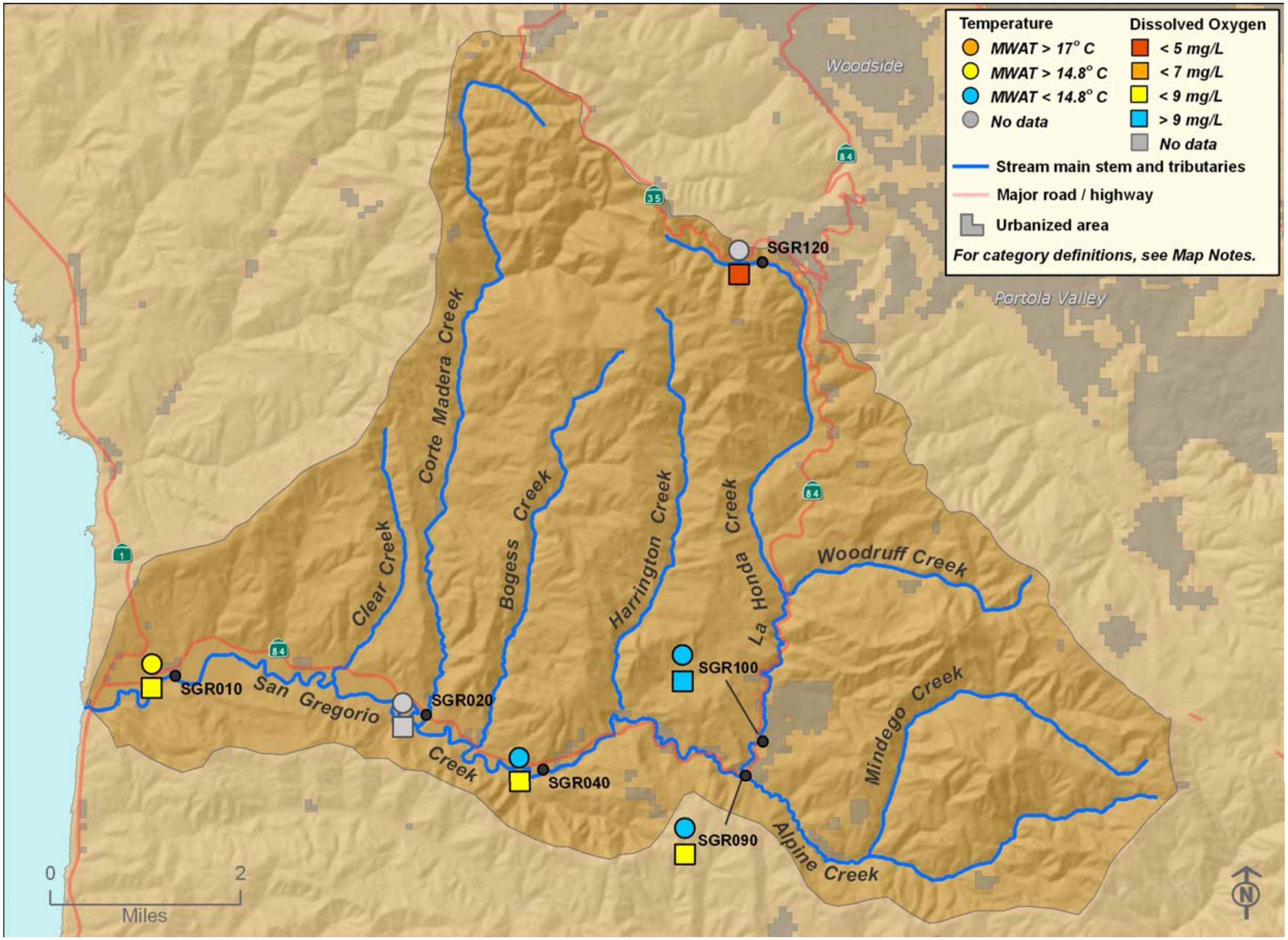

Figure 7-68. Map of temperature and DO levels in San Gregorio Creek watershed

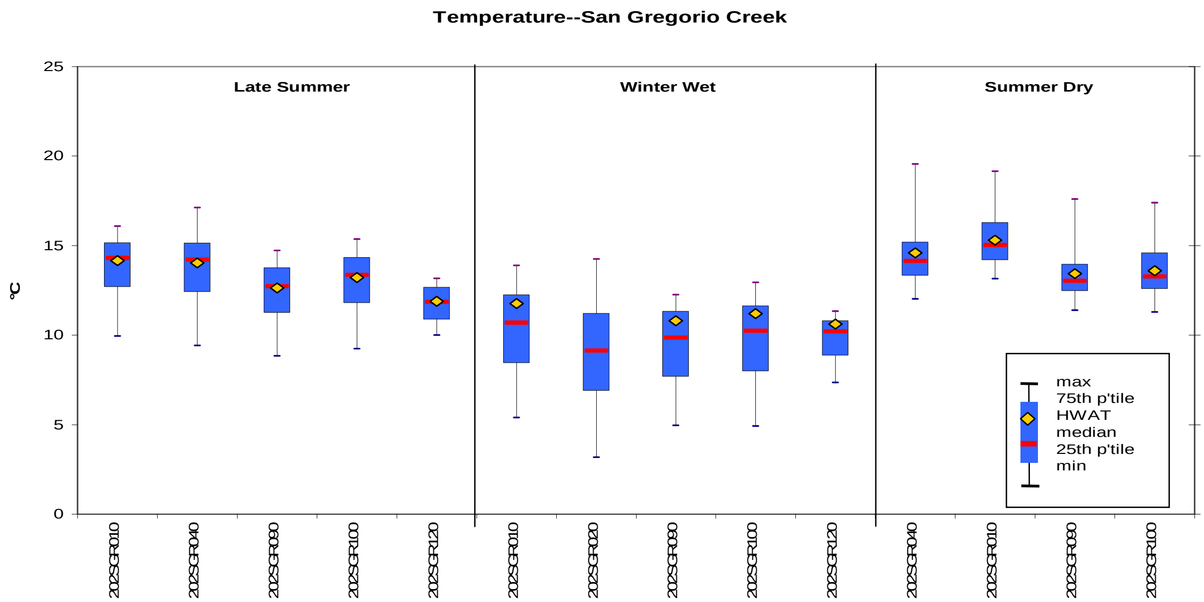

Figure 7-69. Temperature monitoring in San Gregorio Creek watershed

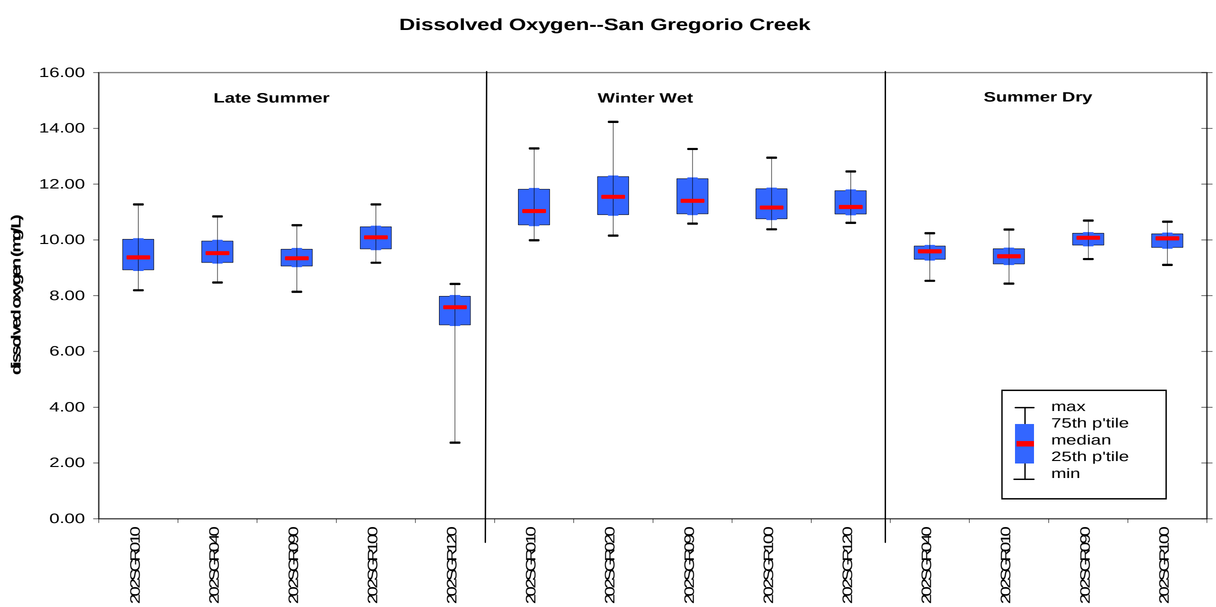

Figure 7-70. DO monitoring in San Gregorio Creek watershed

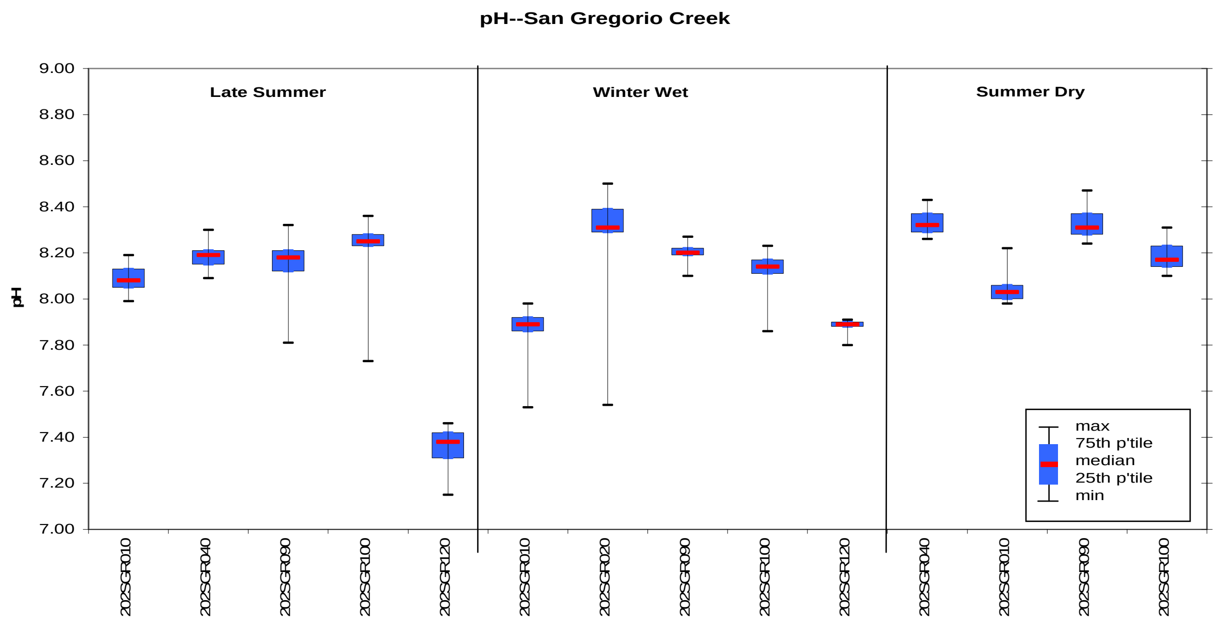

Figure 7-71. pH monitoring of sites in San Gregorio Creek watershed

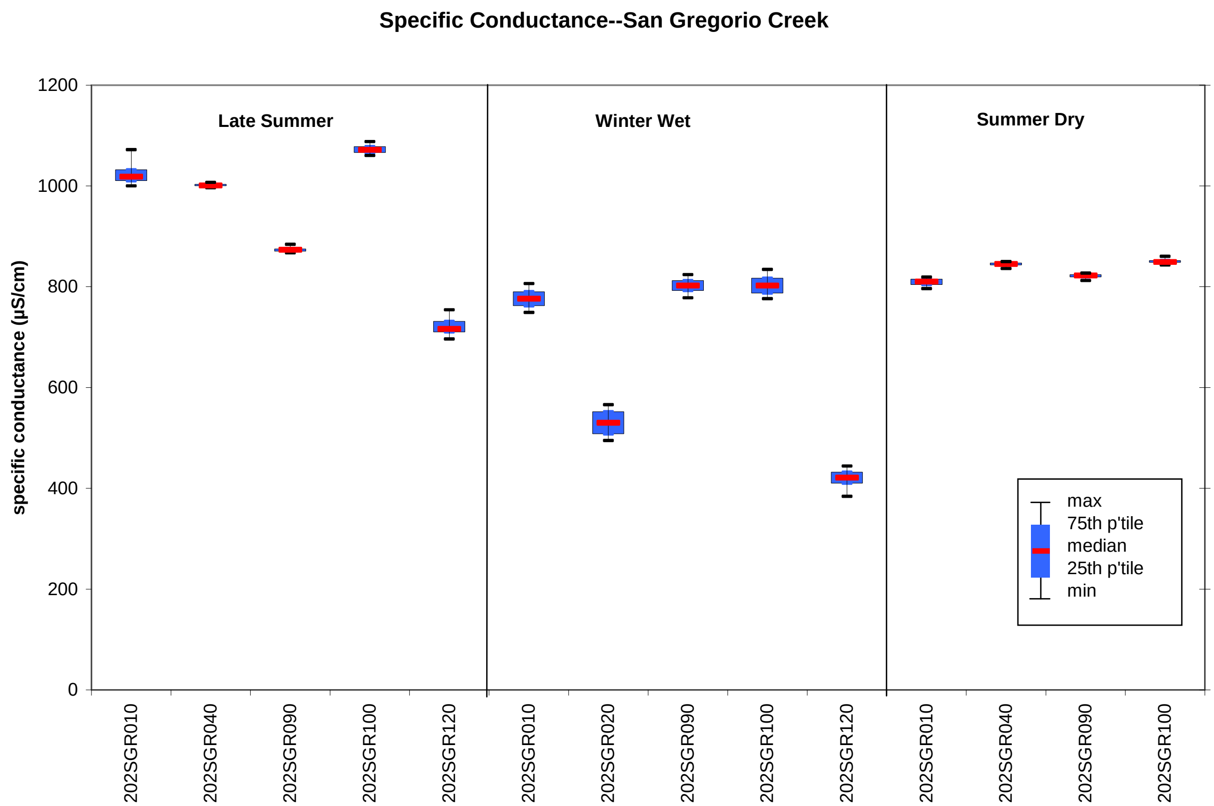

Figure 7-72. Specific conductance monitoring in San Gregorio Creek watershed

7.8.5 Water, Sediment, and Clam Tissue Chemistry

Nutrient concentrations in water samples were generally low, although about half of the samples exceeded the U.S. EPA reference guideline (Figures 6–15 to 6–17; Appendix G).

Chlorophyll-a values were also generally low, with only two measurements above the 1.78 µg/L guideline value (Appendix G).

Total phosphorus measurements were relatively high, all substantially above the 0.030 U.S. EPA reference guideline value. Orthophosphate values were also high, exceeding the total phosphorus guideline in all cases. The elevated phosphorus values are not of great concern, however, since San Gregorio Creek appears to be nitrogen-limited.

Measured contaminant concentrations in water and sediment were very low; there were no exceedances of aquatic life water quality objectives in any sample from this watershed. Metal and organic contaminants were analyzed in water from two sites: San Gregorio Creek at the USGS Gage (SGR010) and La Honda Creek at the Confluence (SGR080). The only sediment chemicals measured above guideline values were chromium and nickel, both above the threshold effects concentration (TEC). The SQGQ value for this sample was a very low 0.09.

Tissues of clams deployed at SGR010 had no apparent accumulation of any compounds over control values (Figure 6-21 to 6-27).

7.8.6 Water and Sediment Toxicity

Three-species toxicity tests were conducted on water samples from San Gregorio Creek at the USGS Gage (SGR010) and La Honda Creek at the Confluence (SGR080). None of the samples had significant toxicity.

There was a statistically significant effect on amphipod growth in sediment collected from SGR010. While growth integrates a number of physiological processes, the relationship of growth to specific stressors is not well established. These sediment samples had very low concentrations of contaminants for which guideline values have been established, so it is not clear whether the depressed amphipod growth was related to chemical contamination.

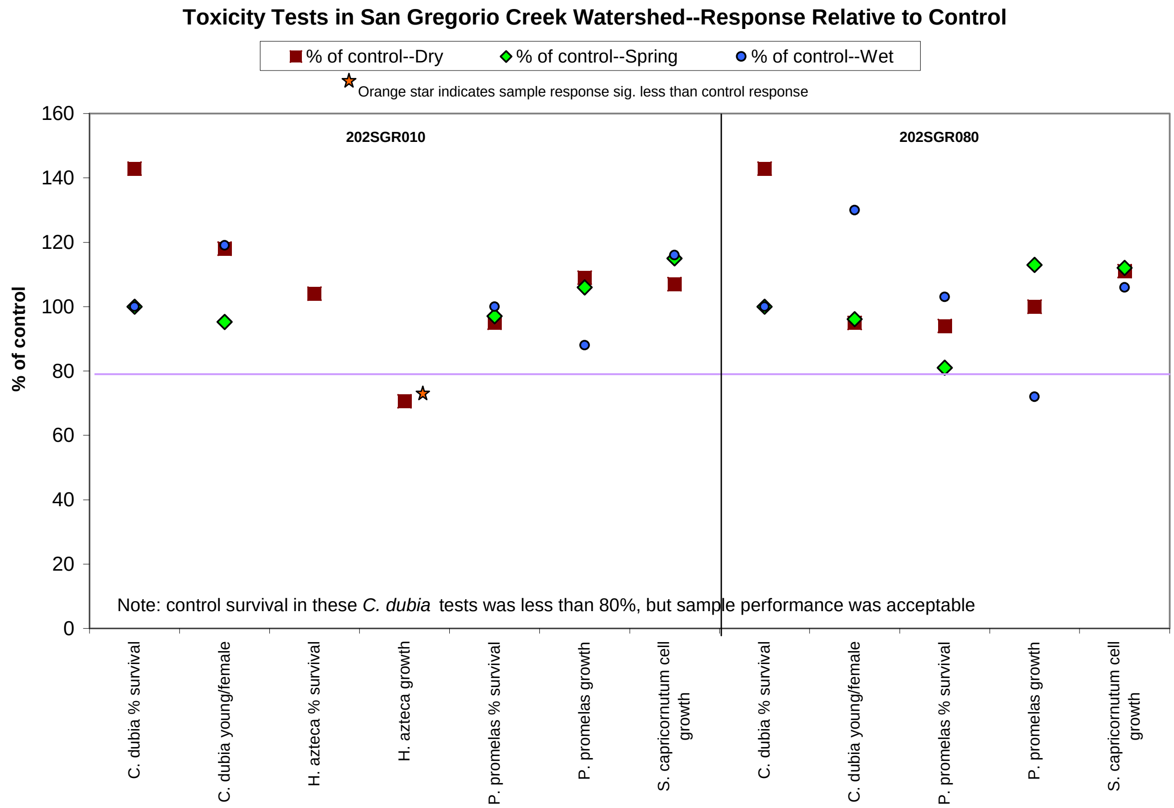

Figure 7-73. Toxicity tests in San Gregorio Creek

Results of toxicity tests are shown, with three species in water samples and one species in sediment samples from San Gregorio Creek. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.8.7 Coliform Bacteria

Bacterial counts were made in water samples from two sites in the watershed (see Figures 6-28 to 6-30). Basin Plan objectives for all three indicators, *E. coli*, fecal coliforms, and total coliforms were slightly exceeded at San Gregorio Creek, San Gregorio confluence (SGR079). Basin Plan objectives for *E. coli* were also slightly exceeded , and total coliforms were exceeded at Playbowl on La Honda Creek (SGR100). While there is public access to these two sites, they are no longer used as community swimming holes.

In particular, there has been concern about leaking septic systems upstream of the confluence of La Honda Creek and Alpine Creek. The moderate to low counts for Jones Gulch should alleviate concern about potential contamination upstream of the site at the time of sampling.

7.9 Stevens Creek/Permanente Creek Watershed

7.9.1 Sites of Concern

Exceedances noted in the summary table (Table 7-28 and Table 7-29) are discussed in the relevant sub-section for this watershed. A weight-of-evidence approach was used to evaluate sites of concern. Individual exceedances of parameters, particularly those without regulatory objectives, are considered in context. In general, nickel and chromium levels are geologically elevated in the Bay Area, particularly where there are serpentine deposits. Nutrient levels (nitrate and phosphorus) are above U.S. EPA guidelines at most sites, but may still be relatively low.

Temperature and dissolved oxygen conditions throughout this watershed would make it difficult for these streams to support salmonid populations without further improvements. Nutrient and contaminant data indicate considerable inputs of metals, pesticides, and PAHs in the lower watershed. Toxicity results indicate the presence of constituents at toxic levels both at the upstream and downstream ends of the most urbanized areas. Contaminant concentrations near the creek mouths indicate that the urban areas are of concern for stream degradation and for transport of metals, PAHs, and legacy pesticides to the Bay. STE190 at the Cooley Picnic Area, with its elevated coliform counts, is a site of concern particularly because of its continued recreational use.

Table 7-28. Summary of sites with exceedances in Stevens Creek watershed

Analyte	***Standard***	***# of sites***
FIELD MEASURES *of 3 sites sampled*		
Temperature	maximum, salmonid	1
	MWAT, steelhead	3
Oxygen, dissolved	minimum, COLD	2
	minimum, WARM	1
	3-month median	2
pH	range	1
CONVENTIONAL WATER QUALITY *of 3 sites sampled*		
Nitrate as N	maximum	3
Phosphorus, total as P	maximum	3
WATER TOXICITY *of 2 sites sampled*		
Ceriodaphnia	survival	1
Pimephales	survival	1
Selenastrum	growth	1
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals Chromium	TEC	1
Nickel	TEC	1
Organics DDE (sum op + pp)	TEC	1
PCB (total)	TEC	1
SEDIMENT TOXICITY *of 1 sites sampled*		
Hyalella	growth	1
TISSUE CHEMISTRY *of 1 sites sampled*		
Copper	EDL 85	1

COLIFORMS *of 4 sites sampled*		
E. coli	steady state	2
Fecal coliform	log mean	1
	90th percentile	3
Total coliform	median	4
	maximum	4

Table 7-29. Summary of sites with exceedances in Permanente Creek watershed

Analyte	*Standard*	*# of sites*
FIELD MEASURES *of 2 sites sampled*		
Temperature	maximum, salmonid	1
	MWAT, steelhead	1
	MWAT, coho	1
Oxygen, dissolved	minimum, COLD	1
	minimum, WARM	1
	3-month median	1
pH	range	1
CONVENTIONAL WATER QUALITY *of 2 sites sampled*		
Nitrate as N	maximum	2
Phosphorus, total as P	maximum	2
WATER METALS *of 2 sites sampled*		
Selenium, total	chronic	1
WATER TOXICITY *of 2 sites sampled*		
Ceriodaphnia	survival	1
Selenastrum	growth	2
SEDIMENT CHEMISTRY *of 1 site sampled*		
Metals Zinc	TEC	1
Organics Benz(a)anthracene	TEC	1
Benzo(a)pyrene	TEC	1
Chlordane	PEC	1
Chrysene	TEC	1
DDD (sum op + pp)	TEC	1
DDE (sum op + pp)	TEC	1
DDT (sum op + pp)	TEC	1
DDT (total)	TEC	1
Dibenz(a,h)anthracene	TEC	1
Dieldrin	TEC	1
Fluoranthene	TEC	1
PAH (total)	TEC	1
PCB (total)	TEC	1
Phenanthrene	TEC	1
Pyrene	TEC	1

SEDIMENT TOXICITY *of 1 site sampled*		
Hyalella	growth	1

TISSUE CHEMISTRY *of 1 site sampled*		
Copper	EDL 85	1
COLIFORMS *of 1 site sampled*		
E. coli	steady state	1
Total coliform	median	1
	maximum	1

7.9.2 Water Quality in Relation to Land Use

Comparisons of contaminant profiles at the upstream and downstream edges of the urban areas indicate that urban land use is contributing lead, pesticides, and particularly PAHs into these two creeks. Chemical and toxicity data indicate that contaminants are present at elevated or toxic concentrations even at the upstream edge of the urbanized areas. Figure 3-9 and Figure 7- depict the urbanized areas and locates quarries in the watershed.

7.9.3 Macroinvertebrate Assemblages and Physical Habitat

Three distinct groups of sites are apparent on the cluster dendrogram (Figure 7-) and ordination plot (Figure 7-).

- The Lower Stevens Creek and Permanente Creek (LSP) group consists of seven sites: three on lower Permanente Creek (PER010, PER020, PER040), three on lower Stevens Creek (STE020, STE030, STE040), and one on Hale Creek (PER030), a tributary to Permanente Creek.
- The Middle Stevens Creek and Permanente Creek group (MSP) consists of sites on Stevens Creek (STE060, STE070) and Permanente Creek (PER050, PER070, PER080) at the base of the foothills on the southern edge of the urban boundary.
- The Upper Stevens Creek (US) group included three sites in the Stevens Creek canyon (STE100, STE110, STE120) draining protected parkland of the Santa Cruz Mountains.

Lower Stevens Creek and Permanente Creek group
All of the sites in this group drain the heavily urbanized Santa Clara Valley and were among the least diverse in the Bay Area, especially STE030 (7 taxa), PER020 (6 taxa), and PER040 (7 taxa). Taxa richness values, which ranged from 6 to 14, were all well below values from minimally disturbed sites (28-59). Other biological metrics were similarly very different from minimally disturbed conditions (Table 6–11). Benthic assemblages at sites in this group are severely altered, and show little resemblance to natural systems. Significant portions of these streams have been channelized, either with natural substrate banks or concrete. The structural and functional diversity of these streams has been significantly reduced, resulting in very low biological integrity.

Benthic assemblages at sites in the Lower Stevens Creek and Permanente Creek (LSP) group were completely dominated by two common tolerant taxa, Chironomidae (69 percent) and

Oligochaeta (23 percent). No other taxa were common to every site. The percentage of organisms belonging to common tolerant taxa ranged from 97 to 100 percent (Table 7-31).

Simulium sp. (Diptera: Simulidae) was very abundant (21 percent) at Hale Creek (PER030), but was less abundant at sites in Stevens Creek and absent from sites in Permanente Creek, except for one individual from PER040. *Baetis* sp., the most pollution-tolerant EPT taxon, was found in low abundances at most sites and was absent from PER010 and PER020. No beetles were present at any of the sites, including the moderately intolerant family of riffle beetles (Elmidae). Stoneflies were completely absent, except for one individual *Calineuria californica* (Perlidae) from Hale Creek (PER030). Only two caddisflies were found, a single *Rhyacophila* sp. (Rhyacophilidae) at Hale Cr. (PER030) and one *Hydroptila* sp. (Hydroptilidae sp.) at STE020.

Middle Stevens Creek and Permanente Creek group

Other than PER080, which resembles minimally disturbed conditions, sites in the Middle Stevens Creek and Permanente Creek group (MSP) represent an intermediate level of biological integrity between sites in the Lower Stevens Creek and Permanente Creek (LSP) group and the Upper Stevens Creek (US) group.

These sites were numerically dominated by four common tolerant taxa:

Chironomidae	48%
Baetis sp.	14%
Oligochaeta	8%
Simulium sp.	6%

Benthic assemblages at all sites were dominated by common tolerant taxa (>87 percent), except at PER080, where only 32 percent of organisms were common tolerant taxa (see Table 7-31). Few common intolerant taxa were found at STE060 (none), STE070 (only 1), or PER050 (only 1), but PER070 and PER080 contained four and eight common intolerant taxa, respectively.

Sites on middle Stevens Creek (STE060, STE070) were vastly different from sites in the Upper Stevens Creek (US) group (STE100, STE110, STE120). Downstream differences suggest that Stevens Creek Reservoir has a dramatic effect on benthic assemblages. Site STE100 is located above the reservoir in Stevens Creek County Park, while STE070 is located directly downstream of the reservoir, but upstream of the urban boundary. At the upstream site, 44 taxa were found, of which 14 were common intolerant taxa; below the dam, taxa richness was only 17, and just one member of a common intolerant taxa was found. Other biological metrics follow this trend, with much lower values at downstream sites than upstream (Table 7-31). Within this group, at STE060 in the urban area, the benthic assemblage was very similar to STE070. High turbidity has been observed downstream of the reservoir throughout the year,

The West Fork of Permanente Creek (PER080), which primarily drains county open space, is the least disturbed site in the Permanente Creek watershed. Intolerant taxa found at PER080 include the mayfly *Paraleptophlebia* sp., the caddisflies *Lepidostoma* sp. and *Rhyacophila* sp., and the stonefly *Malenka* sp. Other intolerant taxa expected at intermittent minimally disturbed streams, such as *Drunella* sp. (Ephemerellidae) and *Sweltsa* sp. (Chloroperlidae), were absent. Metric values at PER080, however, were within the range of values from intermittent minimally disturbed streams.

The East Fork of Permanente Creek (PER070) also primarily drains open space, except for a large quarry immediately adjacent to the stream. Taxa richness is higher at PER070 than at sites in urban areas, and several rare or intolerant taxa were collected here, including Aeshnidae (Odonata), *Lepidostoma* sp., and *Rhyacophila* sp. The benthic assemblage was primarily composed of common tolerant taxa (94 percent), however, and metric values were outside of the range of values from minimally disturbed streams.

Upper Stevens Creek group

Benthic assemblages at sites in the Upper Stevens Creek (US) group were taxonomically very diverse and contained many intolerant taxa. The taxonomic richness value of 58 at STE110 is the highest value from any site of the nine watersheds discussed in this report.

Less than half of the organisms at any of the three sites are common tolerant taxa. Abundant taxa included:

Chironomidae	20%
Ephemerella sp. (Ephemeroptera: Ephemerellidae)	12%
Baetis sp. (Ephemeroptera: Batidae)	10%
Calineuria californica (Plecoptera: Perlidae)	4%
Malenka sp. (Plecoptera: Nemouridae)	3%

Rare taxa found at one or more sites include sensitive taxa such as *Agathon* sp. and *Blepharicera* sp. (Diptera: Blephariceridae), *Ormosia* sp. (Diptera: Tipulidae), *Haploperla* sp. (Plecoptera: Chloroperlidae), *Pteronarcella* sp. and *Pteronarcys* sp. (Plecoptera: Pteronarcyidae), *Ecclisomyia* sp. (Trichoptera: Limnephilidae).

Although metric values from all three sites are within the range of conditions at minimally disturbed sites, there is some evidence that biological integrity at STE100 is slightly reduced relative to STE110 and STE120. Many common tolerant organisms, such as Chironomidae, *Simulium* sp., and Oligochaeta, were more abundant at STE100. Additionally, Plecoptera and Coleoptera taxa richness was reduced at STE100 relative to upstream sites. While STE110 and STE120 are located in protected parkland, STE100 is located downstream of some residences and adjacent to a paved road. STE100 received a lower sediment deposition P-HAB score (8 out of 20) and has a sandier bed than upstream sites, suggesting that increased levels of fine sediment at STE100 may be responsible for slight differences in benthic assemblages.

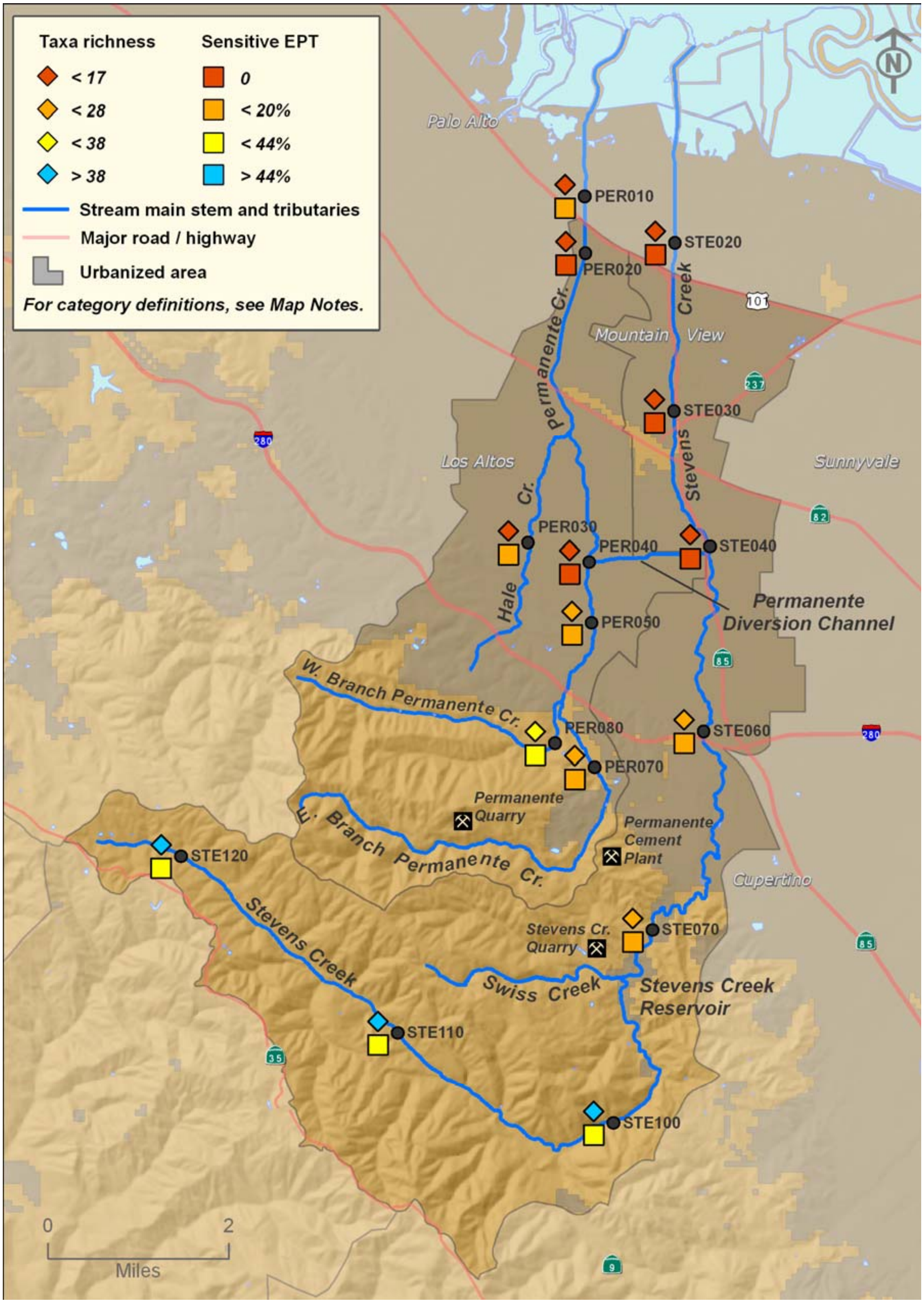

Figure 7-74. Map of Stevens/Permanente creeks benthic macroinvertebrate index scores

Table 7-30. Bioassessment sites in the Stevens Creek/Permanente Creek watershed

Site ID	Site Name	Stream
PER010	Lower Permanente	Permanente Creek
PER020	Crittenden Middle School	Permanente Creek
PER030	Hale Creek at Covington	Hale Creek
PER040	Permanente at Diversion Channel	Permanente Creek
PER050	Loyola Corners	Permanente Creek
PER070	Rancho San Antonio	East Fork Permanente Creek
PER080	West Fork Permanente	West Fork Permanente Creek
STE020	La Avenida	Stevens Creek
STE030	Landels School	Stevens Creek
STE040	Below Diversion Channel	Stevens Creek
STE060	Belleville/ Barranca	Stevens Creek
STE070	Chestnut Picnic Area/ USGS Gage	Stevens Creek
STE100	Moss Rock	Stevens Creek
STE110	Upper Park 1	Stevens Creek
STE120	Upper Park 2	Stevens Creek

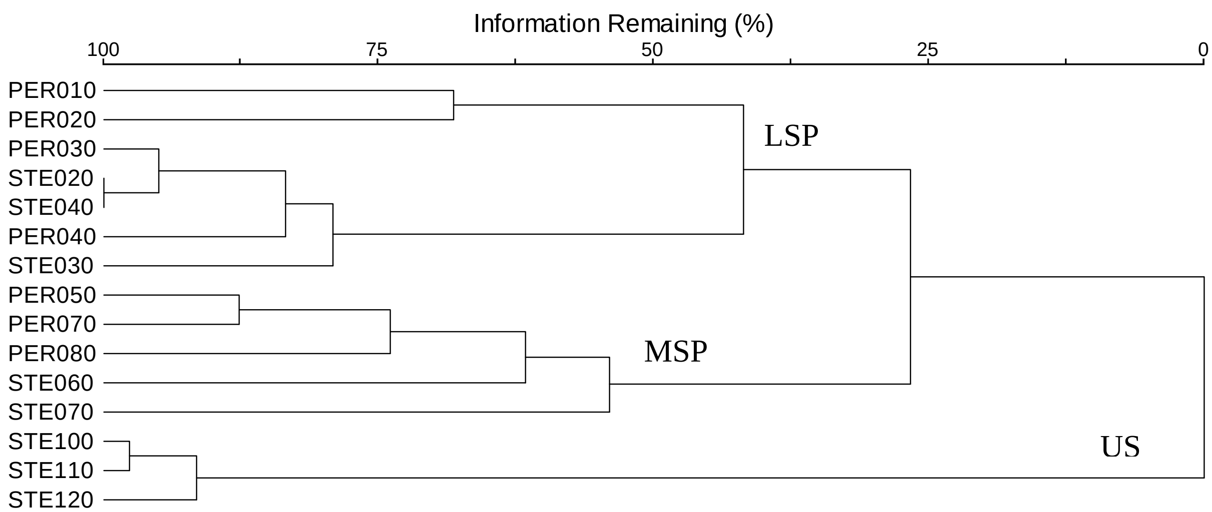

Figure 7-75. Cluster dendrogram for the Stevens Creek/Permanente Creek watershed

The cluster dendrogram is based on similarity of macroinvertebrate taxa present in the Stevens Creek/Permanente Creek watershed. The Information Remaining axis at the top signifies how similar the sites are with respect to taxa presence. Abbreviations: LSP, Lower Stevens/Permanente; MSP, Middle Stevens/Permanente; US, Upper Stevens.

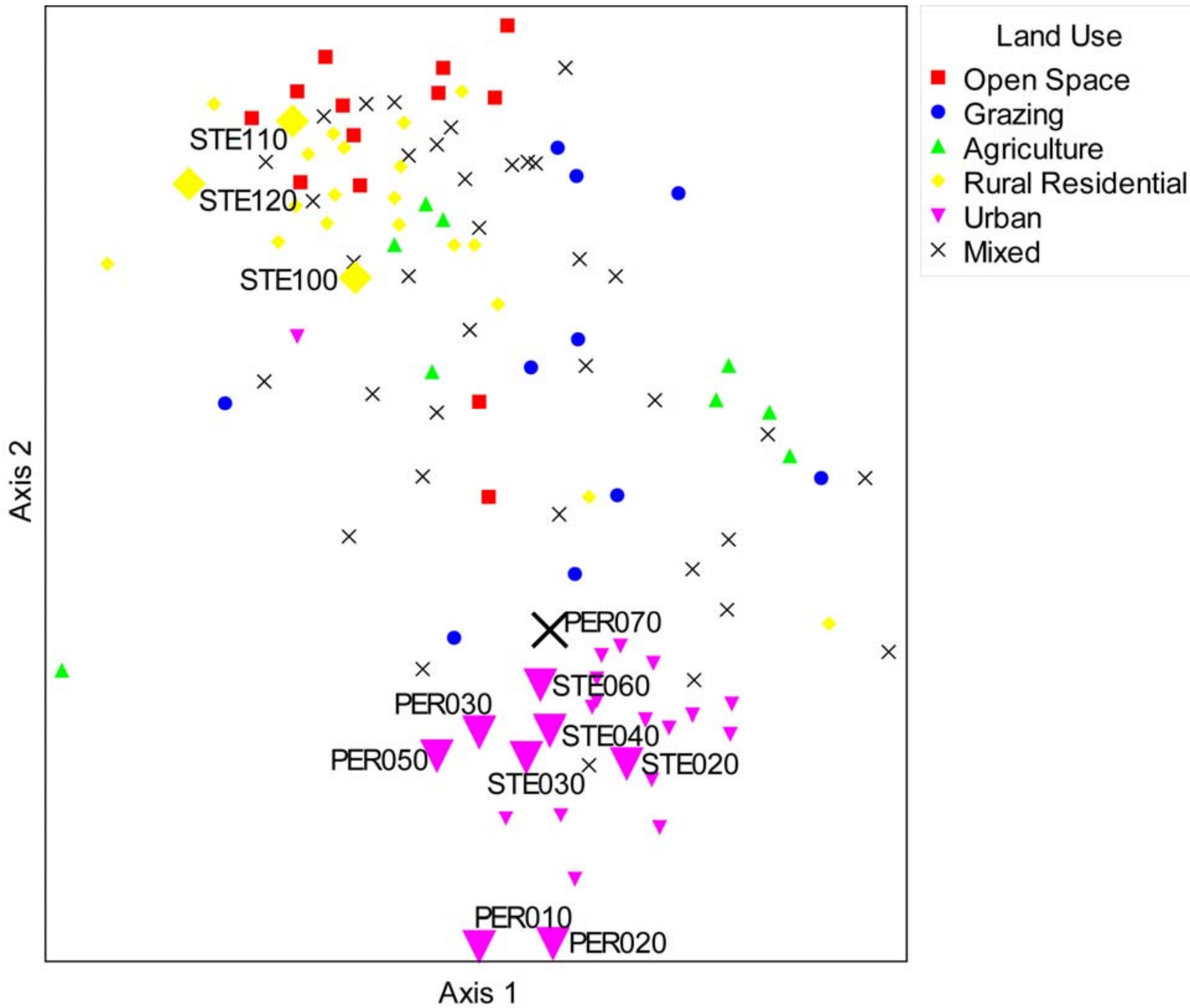

Figure 7-76. NMS ordination of sites in the Stevens Creek/Permanente Creek watershed

The NMS ordination of sites by macroinvertebrate taxa abundance. Sites in the Stevens Creek/Permanente Creek watershed are labeled and symbols are enlarged. For an explanation of ordination graphs, refer to Section 6.1.

Table 7-31. Biological metrics from the Stevens Creek/Permanente Creek watershed

	STE 020	STE 030	STE 040	STE 060	STE 070	STE 100	STE 110	STE 120	PER 010	PER 020	PER 030	PER 040	PER 050	PER 070	PER 080
Coleoptera Taxa	0	0	0	1	0	5	9	9	0	0	0	0	2	1	1
Diptera Taxa	3	4	4	5	5	14	15	11	4	2	5	2	6	6	6
Ephemeroptera Taxa	1	1	1	1	1	10	11	10	2	0	1	1	1	3	4
Plecoptera Taxa	0	0	0	0	1	4	8	6	0	0	1	0	0	0	2
Trichoptera Taxa	1	0	0	2	2	6	8	5	0	0	1	0	1	6	6
Non-Insect Taxa	7	2	5	9	8	5	7	4	4	4	6	4	7	5	10
EPT Taxa	2	1	1	3	4	20	27	21	2	0	3	1	2	9	12
Taxa Richness	12	7	10	18	17	44	58	46	11	6	14	7	17	21	30
% EPT	0	3	3	1	33	53	54	65	0	0	1	1	16	21	70
% Sensitive EPT	0	0	0	0	4	44	43	32	0	0	0	0	0	1	21
% Chironomidae	80	71	61	67	53	30	14	13	16	89	72	91	50	61	10
% Coleoptera	0	0	0	2	0	2	17	10	0	0	0	0	1	1	0
% Oligochaeta	11	25	32	14	2	5	1	1	75	11	3	7	21	5	3
% Non-insect	13	25	34	18	10	7	4	2	83	11	5	8	25	11	14
% Intolerant	0	0	0	0	4	40	42	32	0	0	0	0	0	1	18
% Tolerant	2	0	2	3	4	1	1	0	8	0	1	1	3	6	4
Tolerance Value	5.9	5.7	5.7	5.9	5.5	3.7	3.1	3.5	5.4	5.9	6.0	5.9	5.7	5.8	4.1
% Predator	1	0	0	3	6	9	23	17	0	0	1	0	3	3	11
% Collector-filterer	6	1	2	11	3	3	4	8	0	0	21	0	7	5	4
%Collector-gatherer	93	99	97	82	84	73	38	56	99	100	77	99	87	86	70
% Scraper	0	0	1	3	0	7	26	14	1	0	0	1	2	4	1
% Shredder	0	0	0	0	4	8	6	4	0	0	0	0	0	1	13
% Other	0	0	0	0	2	1	3	1	0	0	0	0	0	1	0
Common Tolerant (%)	100	100	99	95	87	44	21	37	99	100	97	99	97	94	32
Common Intolerant (Taxa)	0	0	0	0	1	14	22	16	1	0	2	0	1	4	8

7.9.4 Basic Water Quality Field Measurements

Continuous field measurements were made at six sites on Stevens and Permanente Creeks: Permanente Creek at Charleston Rd. (PER010), and at Loyola Corners (PER050); and Stevens Creek at La Avenida (STE020), Belleville/ Barranca (STE060), Chestnut Picnic Area/ USGS Gage, STE070, and at Moss Rock (STE100).

The two downstream sites, PER010 and STE020, are within the baylands wetland habitat. Continuous monitoring during winter 2002 overlapped with a high tide, confirming that PER010 is tidally influenced at least part of the year and thus not subject to the freshwater objectives.

Although coho salmon are not historically resident in these streams, the MWAT threshold for coho(14.8ºC) was exceeded at STE020, STE060, STE070, and PER010 in the dry season, and at three of these sites (not STE060) in the wet season. Steelhead are currently resident in both Stevens and Permanente Creeks (Leidy *et al.* 2005). The higher MWAT threshold for steelhead (17ºC) was exceeded at all four of these sites in the dry season, and at STE020 in the wet season. The maximum temperature for salmonid survival (24ºC) was exceeded in the dry season at PER010 and STE020.

Dissolved oxygen concentrations failed to meet Basin Plan objectives (7 mg/L) at STE070 and PER010 in the both the dry season and the wet season. DO levels at STE070 are strongly dependent on the water released from Stevens Creek Reservoir directly upstream. Although PER010 is tidally influenced, it had DO values too low to support healthy aquatic life. STE060 and STE100 had DO values below 9mg/L during dry season measurements (Figure 7-, Figure 7-, and Appendix D).

The pH values at STE060 (8.65) and PER010 (8.70) were above the Basin Plan maximum.

Dissolved salt content, as measured by specific conductance, was above the objective for drinking water taste in both the wet and dry seasons at STE020 and PER010, consistent with their location in the baylands wetland habitat. A high tide sequence at PER010 accounts for the specific conductance above the higher value for the maximum for agricultural use in the wet season, with a very high reading of 14,541 µS/cm.

Dry season physical habitat scores were available for four sites on Stevens and Permanente Creeks: Permanente Creek at Charleston Rd. (PER010), and Stevens Creek at La Avenida (STE020), Belleville/Barranca (STE060), and the Chestnut Picnic Area/ USGS Gage, STE070. Site STE070 had excellent riparian habitat scores, but the scores for the other three sites ranged from fair to poor.

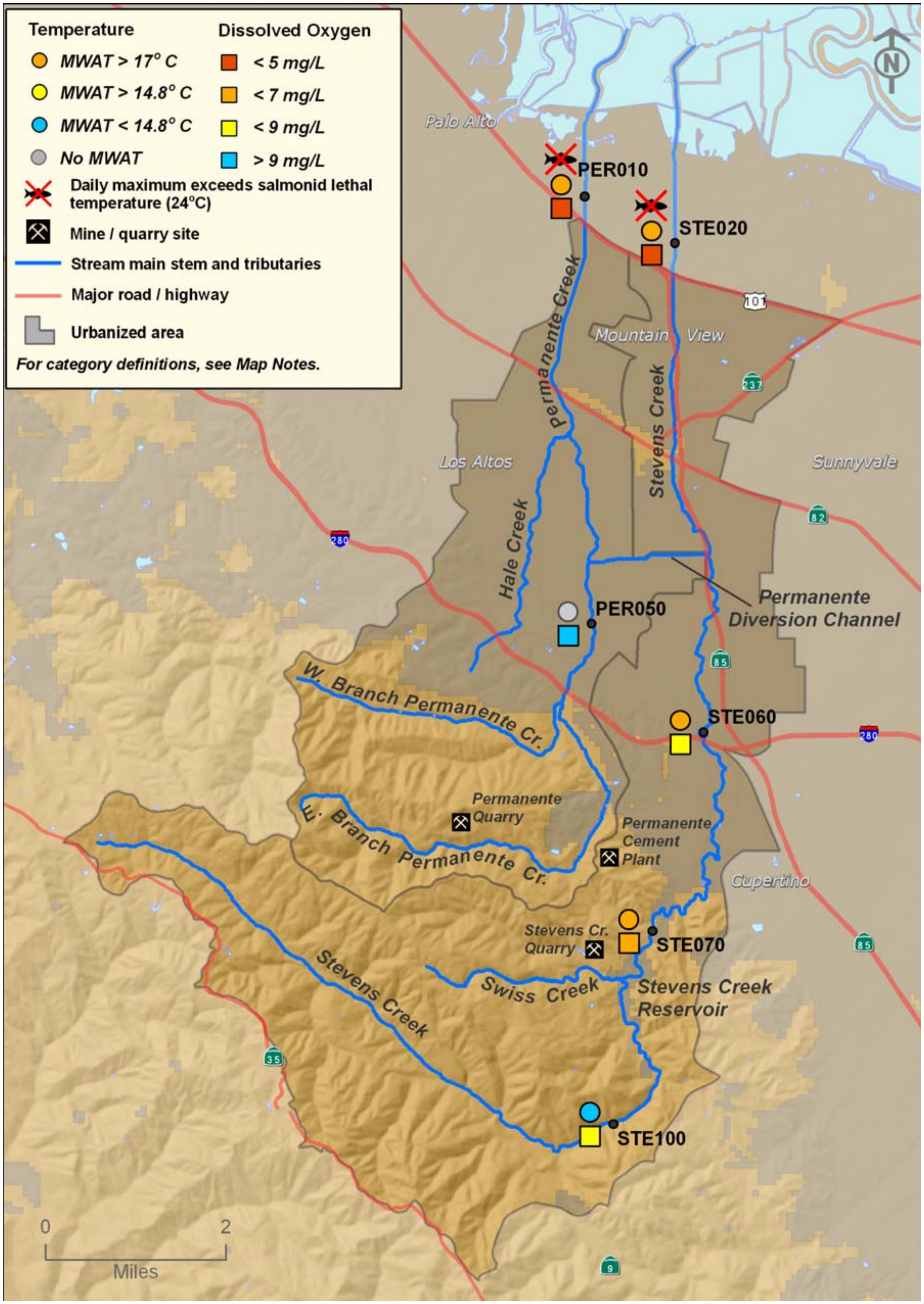

Figure 7-77. Map of temperature and DO levels in Stevens and Permanente creeks

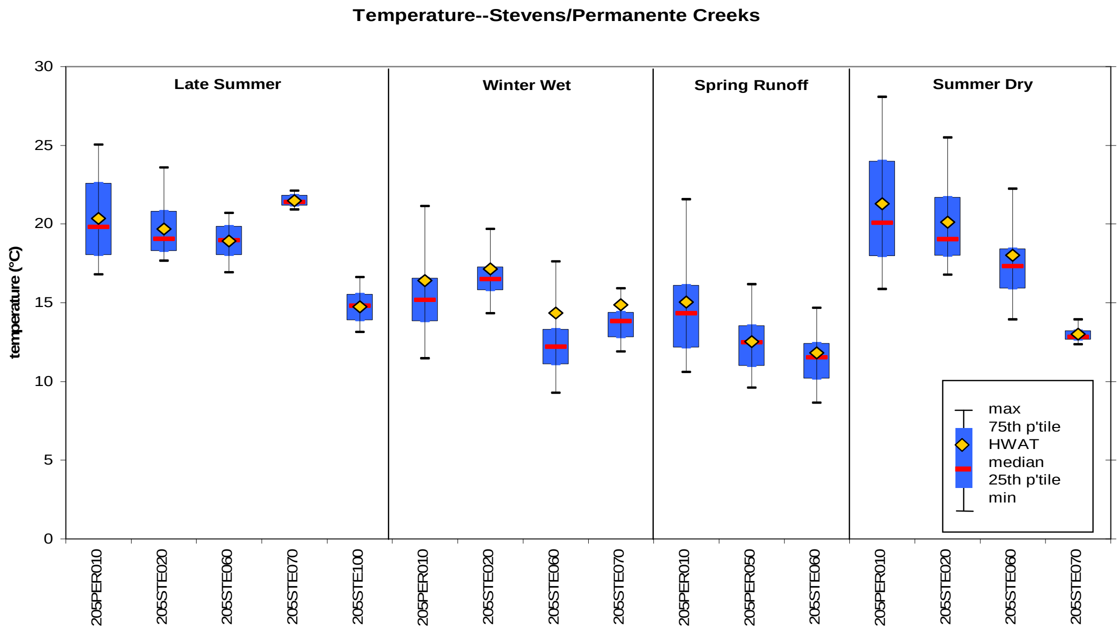

Figure 7-78. Temperature monitoring in Stevens and Permanente creeks

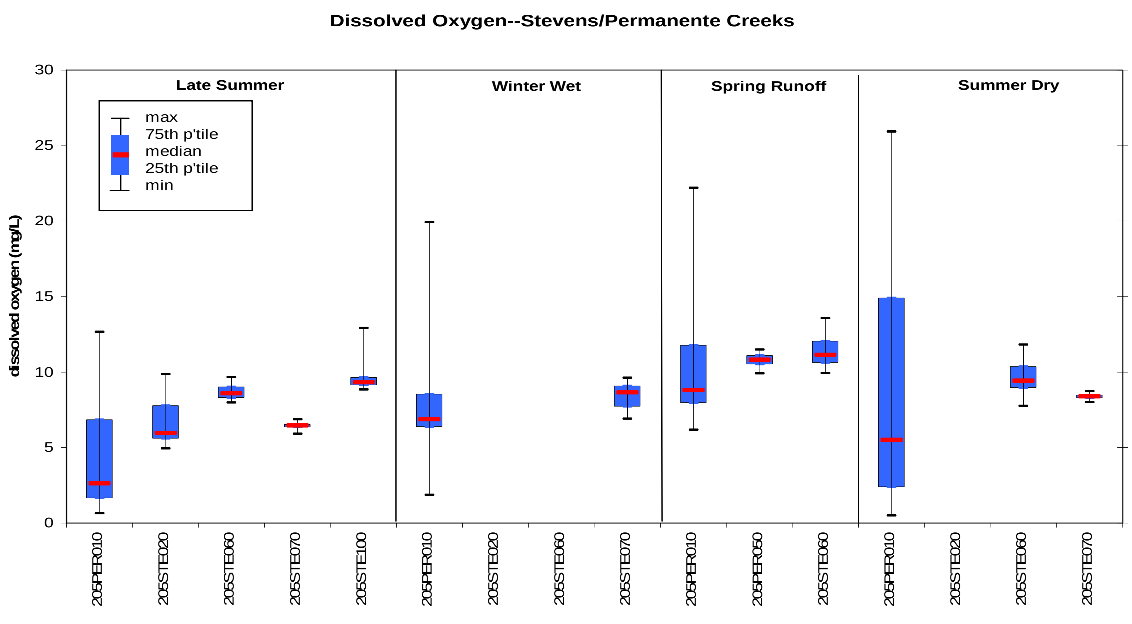

Figure 7-79. DO monitoring in Stevens and Permanente creeks

Data were rejected from STE020 and STE060 for the winter season and from STE020 for the early summer dry season.

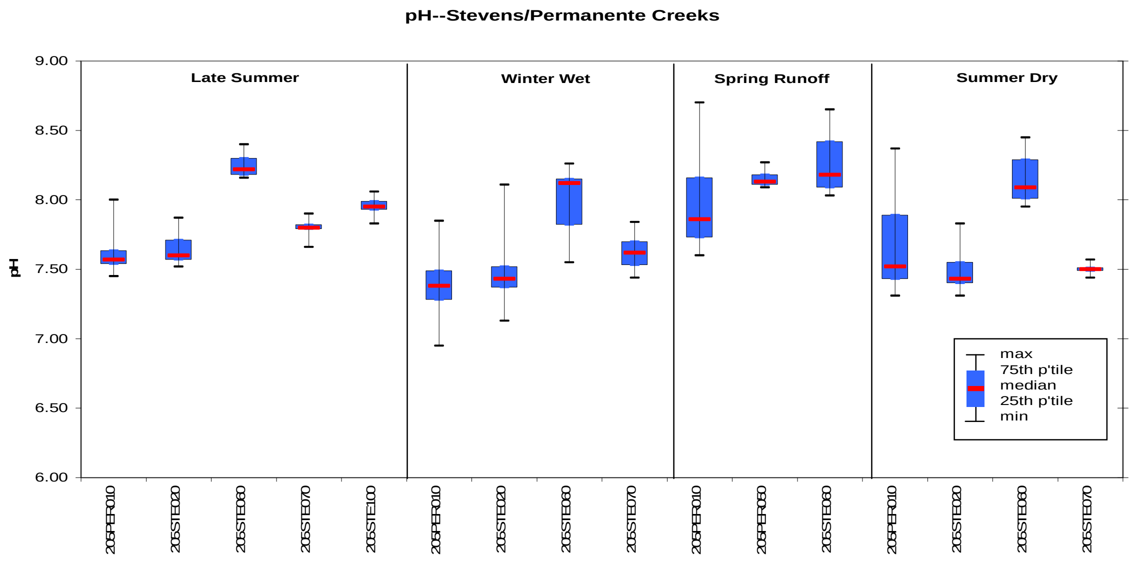

Figure 7-80. pH monitoring in Stevens and Permanente creeks

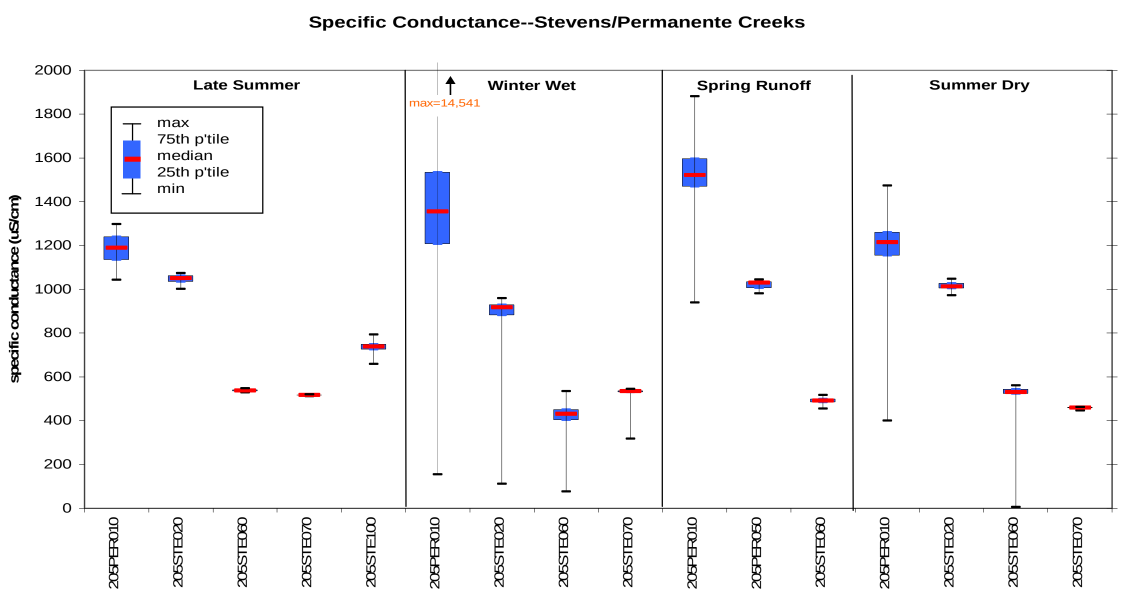

Figure 7-81. Specific conductance monitoring in Stevens and Permanente creeks

7.9.5 Water, Sediment, and Clam Tissue Chemistry

Nutrients were measured in water samples from PER010, PER070, STE020, STE060, and STE100. Nitrate exceeded 1 mg/L at PER010 in the wet season, PER070 in the spring and wet seasons, and STE020 in all three seasons. All but two nitrate samples exceeded the U.S. EPA reference guideline of 0.155 mg-N/L.

All total phosphorus and most orthophosphate values exceeded the U.S. EPA total phosphorus reference guideline of 0.030 mg/L, usually by a significant amount, with total phosphorus concentrations approaching, and in one case exceeding 0.5 mg/L.

Chlorophyll-a values were somewhat elevated relative to most of the other watersheds sampled, exceeding the 1.78 µg/L guideline value in the wet and spring seasons at PER010, and in all three seasons at STE020 and STE060. The high value was 22 µg/L at PER010 (Figures 6-15 to 6-17; Appendix G).

Trace metal and organic contaminants were measured in water samples at four sites. At the upstream Permanente Creek site (PER070), selenium was above the Basin Plan chronic water quality objective for aquatic life protection (WQO) during all three seasons (dry, wet, spring). There were no exceedances of WQOs for other chemicals in any water samples from this watershed.

Sediments were collected for analysis from the most downstream sites on Stevens and Permanente Creeks. The STE020 sediment had chromium, nickel, sum PCBs, and sum DDE above threshold effects concentrations (TECs). These concentrations were generally well below probable effects concentrations (PECs), and the PEC-based sediment quality guideline quotient was 0.12. The Permanente Creek sediment site (PER010) did not exceed the thresholds for chromium or nickel, but exceeded TEC for zinc and a list of organic compounds, including: sum PCBs, sum DDD, sum DDE, sum DDT, dieldrin, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, phenanthrene, pyrene, and sum PAHs (Appendix H). This Permanente site had a sediment quality guideline quotient of 0.14 without DDE, and 0.35 with DDE (MacDonald *et al*., 2000).

Tissues from clams deployed at STE020 and PER 010 had similar profiles, with PCB concentrations about twice the control value and elevated chlordanes, but average concentrations of the other analytes (Figures 6-21 to 6-27)

7.9.6 Water and Sediment Toxicity

Water samples from the Stevens and Permanente Creek sites (PER010, PER070, STE020, and STE060) had by far the most incidences of observed toxicity of any watershed in this study. The magnitude of toxicity was greatest for the alga *Selenastrum* *capricornatum*, primarily in the downstream sites (PER010 and STE020), but also at PER070. Significant toxicity to fish at one upstream site (STE060) and invertebrates at two upstream sites (STE060 and PER070) was not reproduced in the downstream samples (Figure 7-). There were minor reductions in amphipod growth in sediments from the two downstream sites. The lack of mortality indicates that the long list of chemicals exceeding threshold effects concentrations (especially at PER010) did not produce bioavailable mixtures.

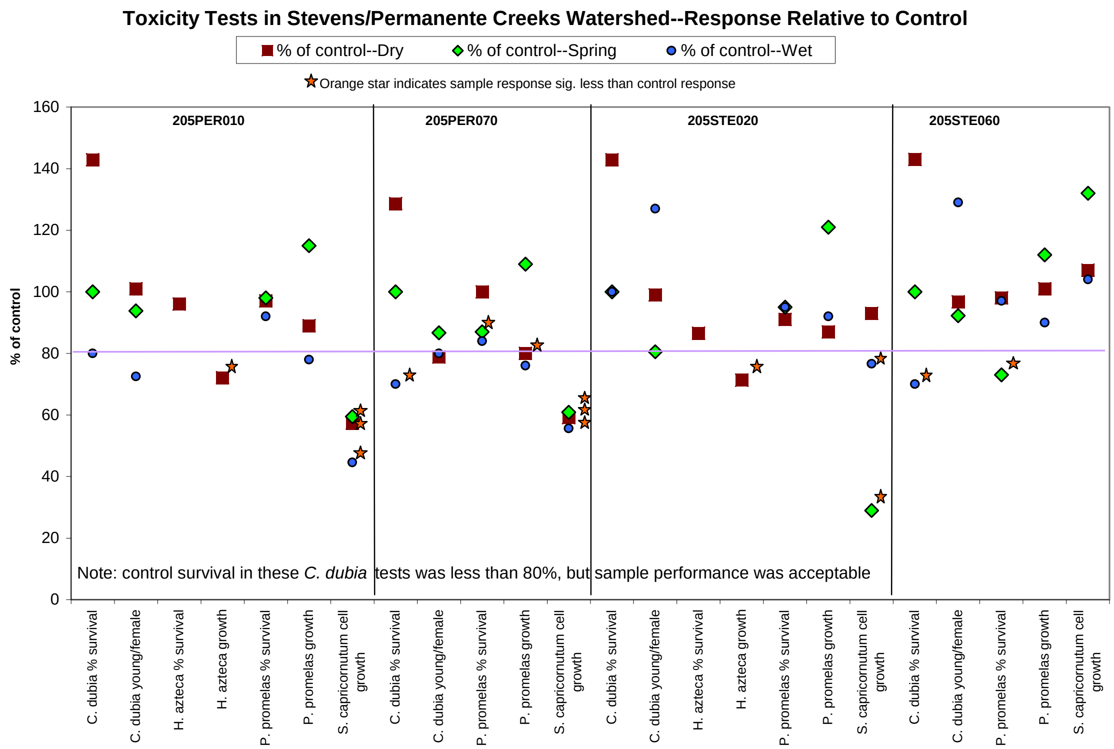

Figure 7-82. Toxicity tests in Stevens and Permanente creeks

Results from toxicity tests are shown, with three species in water samples and one species in sediment samples from Stevens and Permanente creeks. See text for description of species and endpoints. Stars indicate statistically significant differences from test controls. Samples with stars that were also below 80 percent of the control were considered toxic for this assessment.

7.9.7 Coliform Bacteria

Coliform bacteria were measured at five sites: Stevens Creek at La Avenida (STE020), at Chestnut Picnic Area/USGS Gage (STE070), above the reservoir (STE080), and at Camp Cooley (STE090); and Permanente Creek at Lower Meadow/West Branch (PER080). Basin Plan objectives for all three indicators, *E. coli*, fecal coliforms, and total coliforms were exceeded at two sites: STE020, and STE090. Camp Cooley (STE090) is an active swimming area despite posted swimming restrictions. Basin Plan objectives for *E. coli* and total coliforms were exceeded at PER080; and Basin Plan objectives for total coliforms only were exceeded at STE070 and STE080 (Figures 6-28 to 6-30).

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8 Conclusions and Recommendations

Conclusions and recommendations in this section relate to the objectives of this study: new data are described and put in context; seasonal trends are evaluated; the relationships between water quality indicators, stressors, and land use are evaluated; reference conditions are discussed; monitoring tools are evaluated; and recommendations are made in regard to water quality management and future monitoring and assessment.

8.1 Conclusions

Land use
Land use is one of the most important factors affecting the composition and structure of benthic assemblages in streams in the San Francisco Bay Area. In general, benthic assemblages in urban areas are in poor condition. These communities exhibit low diversity and are numerically dominated by four pollutant-tolerant taxa of invertebrates: Oligochaeta, Chironomidae, *Simulium*, and *Baetis* sp. Although stressor identification is difficult, these degraded benthic assemblages are most likely due to a combination of factors including poor physical habitat, hydromodification, low dissolved oxygen, and elevated nutrients and chemical contaminants. Streams in open space areas or those with rural residential land uses generally contain benthic assemblages with more taxonomic and functional diversity indicating more healthy benthic communities. Streams with intact riparian habitat and less channel alteration had healthier benthic communities.

Flow Intermittency
One of the most important natural factors affecting benthic communities is flow intermittency. Benthic assemblages in streams that go dry in the summer are less diverse than in streams with perennial flow. The decreased diversity is a result of the strict aquatic habitat requirements of organisms such as aquatic beetles. While some streams are historically intermittent, water diversions can also effectively eliminate dry weather flows affecting aquatic communities.

Physical habitat
In this study, most of the watersheds had an overlapping pattern of habitat disturbances and water quality stressors with potential to affect aquatic life. Temperature and DO values often exceeded thresholds for fish and other aquatic life, even in areas with less intensive human land use activities. As with benthic communities, physical habitat parameters correlated significantly with temperature and DO. Sites where channels were less modified, riparian and stream bank vegetation was more extensive, and canopy cover was greatest had significantly lower stream temperatures and higher dissolved oxygen concentrations.

Nutrients and chemical contaminants
In addition to the effects of physical stressors on water quality, nutrients and chemical contaminants from areas of more intensive human activity, primarily urban areas, have significant impacts on stream ecosystems. Nutrients, herbicides, metals, PCBs, and PAHs tended to be higher as streams flowed through residential and urban areas. Most samples exceeded U.S. EPA criteria for nitrate, total phosphorus, and orthophosphate. Nitrate concentrations over all

seasons were highest and most variable in streams draining urban areas, followed by mixed land use, agricultural, rural residential, and open space. The mean nitrate level for urban streams was more than twice that for steams draining agricultural areas.

In general, land use and physical habitat alterations seemed to play a greater role in their impact on aquatic communities than chemical contaminants. Although nutrients were above U.S. EPA criteria in many cases, these criteria were based on the 25^{th} percentile values of monitoring data from Southern and Central California reference streams, thus they may not be indicative of concentrations that cause eutrophication. A subsequent study conducted by Tetra Tech to identify more meaningful reference conditions in the same area seemed to indicate that these concentrations may be low (U.S. EPA 2003). U.S. EPA has encouraged states and tribes to establish more informed reference conditions and criteria.

Seasonal differences
In general, the number of exceedances of water quality thresholds for contaminants was low. In this study, the greatest number of exceedances was observed during the dry season. It is likely that the highest chemical concentrations are associated with discrete rain-related runoff events which were not sampled in this ambient monitoring program. Base flows during the winter and early spring are fed predominantly by seepage from soggy soils, while the base flows during summer are composed of more concentrated seepage heavily supplemented by urban runoff. Therefore, it is not unexpected that spring base flows had lower concentrations of contaminants than summer flows.

Toxicity
Stevens Creek had the highest number of toxic samples, but in general the level of toxicity in water samples was moderate. Grab samples taken three times a year during ambient flow conditions may not be reflective of chronic conditions. Sediment samples act as a better integrator of temporal variability. In this study, except for one sample at San Leandro Creek where mortality was 100 percent, sediment toxicity was also moderate. Sediment chemistry showed few exceedances of the sediment guidelines, and there was no clear relationship between sediment chemistry and sediment toxicity.

8.2 Reference Conditions

It is important to identify reference sites and reference conditions in order to develop meaningful tools for management. Understanding the physical and biological characteristics of minimally impacted creeks in the region is essential in interpreting monitoring data. For instance, in the San Francisco Bay Area, chromium and nickel are geologically high. This knowledge is important in differentiating between natural background concentrations of metals and those that may be elevated due to anthropogenic causes.

Minimally disturbed conditions in the Bay Area generally exist in steep, mountainous streams. Biological conditions at minimally disturbed streams can serve as standards that can be applied to most stream types in the Bay Area, except for low-gradient sandy streams. A subset of biological metrics for benthic invertebrates, such as taxa richness, Diptera taxa richness, percent

EPT, and tolerance value may serve as useful non-redundant indicators of human disturbance for intermittent and perennial streams. In order to establish appropriate biological criteria, further work is needed to compile all existing bioassessment data in the Bay Area and analyze it with the techniques used in this analysis. Given the great extent of urban land use in the Bay Area, investigations should aim to identify the least disturbed urban "reference" sites to develop feasible restoration targets for streams in urban areas.

Identification of reference conditions for nutrient monitoring is important to view SWAMP data in a broader context. In this study, only two sites designated as open space were monitored for nutrients. Although these sites exceeded U.S. EPA criteria, they were well below the maximum values for minimally impacted streams in the Tetra Tech study (U.S. EPA 2003). Currently, the State is developing nutrient criteria. Collection of nutrient data from reference sites in this region is important to develop meaningful criteria that apply to the Bay Area.

8.3 Evaluation of Monitoring Tools

Monitoring tools were evaluated based on the following criteria:

- ability to produce interpretable data
- cost compared to the value of data
- availability of water quality thresholds (guidelines or objectives) to evaluate results
- ability to integrate the effect of different stressors
- ability to reflect a relevant indication of beneficial use impact

Stream bioassessments
Of all of the tools used in this study, macroinvertebrate bioassessments provided the most integrative and relevant indicator of ecosystem health. Although an Index of Biological Integrity (IBI) has not been developed for the Bay Area, a comparison of metrics made it possible to distinguish between degraded and non-degraded sites. This indicator was shown to be a valuable tool for evaluating ecosystem effects based on various land uses and alterations in physical habitat. Currently, Bay Area macroinvertebrate data from local agencies and volunteer groups that used the same protocol are being entered into the California Environmental Data Analysis System (CalEDAS) database. This will allow for evaluation of whether Northern or Southern California IBIs, a combination of the two, or a separate IBI is appropriate for the Bay Area.

At this time, tools for macroinvertebrate bioassessments are the most developed type of stream bioassessment. The development of periphyton bioassessment tools for this area is recommended to evaluate the potential effects of nutrient input or other factors that may cause an increase in the biomass or change in the taxonomic makeup of periphyton. In addition, this tool could be used to indicate toxic effects of herbicides, copper, or other chemicals. Periphyton bioassessments would be a better indicator than chlorophyll analysis or the *Selenastrum* toxicity test, which were used in this study, because they can integrate impacts over time and are more ecologically relevant. SWAMP is starting to conduct studies to develop this tool; however, it will take some time before this is a useful assessment tool in California. Although fish bioassessments have been conducted by local agencies and U.S.EPA in this area, their usefulness in evaluating aquatic life impacts is questionable. Low diversity in fish species found in this region makes it difficult to differentiate between impacted and un-impacted fish communities.

However, aside from an indicator of impact, the identification of fish species that inhabit Bay Area streams has value in itself.

Physical habitat assessment

Evaluation of physical habitat is a part of the bioassessment procedure. This assessment procedure was valuable in determining the potential cause of high temperatures and low dissolved oxygen and contributed to interpretation of macroinvertebrate bioassessment metrics. An updated more quantitative protocol is currently being drafted.

Continuous monitoring

Continuous monitoring of basic water quality parameters using data-logging sondes was shown in this study to be a very valuable monitoring tool. Continuous monitoring revealed diurnal patterns that cannot be detected with grab samples. These patterns not only indicated the potential level of impact on salmonid populations but also the mediating factors (photosynthesis or temperature) for low dissolved oxygen concentrations. Sondes, however, are expensive and difficult to deploy for long periods, due to the need for periodic maintenance. Seven days is the minimum deployment period needed to calculate Maximum Weekly Average Temperatures (MWATs). In this study, sensors were not deployed year-round, so the maximum yearly temperature could not be determined; thus, an annual MWAT could not be calculated. When temperature is a cause for concern, small temperature data loggers are the most valuable and economical tools to use. Small digital temperature loggers are inexpensive and can be deployed over the period of a year, annual maximum temperatures and the duration of those temperatures can be measured, and the potential for effects on salmonid populations can be better evaluated.

Nutrients

Measurement of nutrients was valuable in order to determine concentrations in areas with various land uses. Several TMDL nutrient targets for the region will be available in coming years. Currently, the state is developing nutrient criteria. Determining background concentrations for the San Francisco Bay Region is important when considering the development of water quality objectives. In this study, the fact that nitrates were significantly higher in urban areas than in agricultural areas was a surprising and useful finding for management. The concentrations of chlorophyll-a in water samples did not have a relationship to nutrients or other measurements of eutrophication. Since primary productivity in shallow streams is dominated by benthic algae, periphyton bioassessments would be a better indicator of the effect of nutrients in these systems.

Water contaminants

Water column chemistry (metals and organics) was measured to compare concentrations to Basin Plan objectives and other water quality guidelines. In general, concentrations of contaminants were low. It is likely that the highest chemical concentrations are associated with discrete rain-related runoff events; however, these were not sampled in this ambient monitoring program. Although it is useful to evaluate whether water quality objectives for contaminants are exceeded, collecting grab samples during ambient conditions are not representative of worst case or chronic conditions, which have the most impact on aquatic life, and thus may not produce information worth the cost. This is especially true for organics which are expensive to analyze and may not have associated water quality thresholds. Evaluating storm events for concentrations and loads of contaminants of concern may be a better use of resources.

Toxicity tests

U.S. EPA three-species toxicity tests (*Ceriodaphnia* survival and reproduction, fathead minnow survival and growth, and *Selenastrum* growth) were conducted on water collected at the same time as water collected for chemical analysis. Results showed that diazinon-associated *Ceriodaphnia* toxicity had declined in urban creeks since management measures were taken to control diazinon use. This information was valuable in the development of the pesticide TMDL for the region. The other two toxicity tests were used because different species are sensitive to different chemicals. Using these three tests was also part of the weight-of-evidence approach. Toxicity was only found once for fathead minnow. *Selenastrum* showed the most toxicity of all three species, yet *Selenastrum* data can be difficult to interpret due to variability in the test. This is predominantly due to the difficulty in keeping laboratory cultures and the variability in cell growth rates. Nevertheless, until additional bioassessment tools are developed, these tools should be considered for inclusion in ambient monitoring programs.

Sediment

Measurement of sediment chemistry along with sediment toxicity tests and macroinvertebrate bioassessments could provide a triad weight-of-evidence approach to determining environmental impact and potential stressors. From a temporal perspective, sediment evaluations provide a more integrative measurement than aquatic grab samples. Sediment assessments are becoming more valuable with the replacement of pyrethroids for orthophosphate pesticides. Whereas water column toxicity tests were useful in detecting the effects of orthophosphate pesticides, which are water soluble, pyrethroids are predominantly found adhered to the sediment and are hard to detect in water column tests. Pyrethroids can have severe benthic impacts, which can be predicted by the results of bulk sediment toxicity tests. In this study pyrethroids were not measured, but have been included in subsequent years' studies.

Although regulatory objectives for sediment chemistry have not been developed, published guidelines are useful in sediment evaluations. In collecting sediment for analysis, care must be taken to find depositional areas with fine grain sediment. Although a sediment-triad approach using bioassessment, sediment chemistry, and toxicity is theoretically ideal, depositional areas with fine grain sediment are not the appropriate habitat for current benthic macroinvertebrate assessments.

Clam Tissue

In this study SWAMP deployed clams at sites located at the bottom of watersheds for approximately three months to provide an integrative measurement of chemicals that would be entering the receiving water. Clam tissue concentrations were useful for identifying oxadiazon as a potential stressor. This tool identified oxadiazon as ten times higher than the control at Arroyo Las Positas. Oxadiazon was also found at lower levels in sediment and water. The clam deployment results did not resolve major differences between sites or between sites and controls. In addition, collecting, deploying, retrieving, and analyzing the clams before and after deployment was very expensive. This tool is not recommended for ambient studies due to the high cost and limited benefit.

Trash
SWAMP in the San Francisco Region has developed a quantitative trash assessment procedure and has used that procedure to evaluate trash in various watersheds in the region (see http://www.waterboards.ca.gov/sanfranciscobay/basinplan.htm#monitoring). Trash is increasingly being recognized as a water quality problem and regulated as such. This assessment procedure is useful to set priorities for management actions, identify sources, and show trends.

Study design
The study design used in this monitoring program was two-tiered, using bioassessments at all sites as the primary tool for evaluating aquatic life impacts and physical habitat assessments as the primary evaluation of stress. Biological measurements (toxicity tests) and measurements of other stressors including temperature, DO, nutrients and contaminants were performed at a subset of stations. Integrator sites were placed at the bottom of watersheds to evaluate the cumulative effect of the watershed on the receiving waterbody. A deterministic design was used to locate sites near confluences and in areas with different land use impacts. In general, this approach was useful in meeting our objectives within the resources that were available. As stated above, bioassessments and physical habitat assessment were some of the most valuable tools used in assessing impacts on aquatic life and identifying stressors. Although a probabilistic approach may be used, the deterministic approach used in this study was helpful in identifying water quality characteristics associated with specific land uses. Although integrator sites were located at the bottom of watersheds to integrate upstream water quality characteristics, the spatial extent they represented was unclear. Integrator sites have been useful in the Central Coast Region in showing temporal trends of nutrients being discharged to the Pacific.

In general, a weight-of-evidence approach is most useful in evaluating potential water quality impacts. Evaluation of the costs and benefits of the available tools is necessary. It is important to measure indicators such as bioassessment to determine beneficial use impact, as well as stressors such as physical habitat, temperature, and dissolved oxygen to identify the potential cause of impacts. The combination of these tools is necessary for effective water quality management.

8.4 Management Recommendations

This study found that benthic invertebrate assemblages were strongly affected by land use. Urban areas, in particular, had uniformly degraded conditions. Low biological integrity in urban areas is most likely due to a variety of factors, including poor physical habitat (particularly riparian habitat and channel alteration), low dissolved oxygen, and chemical contaminants. There were significant correlations between riparian habitat, temperature, and DO. Temperature and DO values often exceeded thresholds for fish and other aquatic life, even in areas with less intensive human land use activities. Improvement and maintenance of riparian habitat as a primary management focus is likely to lower temperatures, elevate DO, and improve the health of benthic communities. The role of water management also needs to be assessed to determine how alternative strategies might improve conditions for aquatic life.

Nutrients, herbicides, metals, PCBs and PAHs tended to be higher as streams flowed through residential and urban areas. Many of the contaminants found in streams in this study are released from a multitude of small sources, such as cars, lawn-care activities, and transport of urban soils contaminated with legacy pesticides from decades ago. Management activities here should also include riparian habitat improvement to allow for the absorption and degradation of pollutants through retention in vegetated areas. Designing riparian corridors to limit transport of these materials is likely to be among the easiest and more successful strategies to reduce contaminants, improve temperature and dissolved oxygen conditions, and maintain the essential ecological values of riparian areas. Management measures should also concentrate on preventing pollution from entering creeks by: 1) educating urban citizens on the use of pesticides and fertilizers, pet care and car washing, 2) regulating pollution sources and source materials, and 3) using pervious surface and vegetation in the design of green buildings, parking lots, green swales and decentralized landscape for the treatment of stormwater.

8.5 Recommendations for Future Monitoring and Assessment

This study has provided a survey of nine watersheds at a screening level. Most water quality parameters were measured in only four or five locations in watersheds covering 50 to over 100 square miles. This study has been useful in providing indications of impacts, potential stressors, and associated land uses. Managing these stressors will require monitoring that focuses on specific parameters and their spatial patterns relative to land use, so that water quality can be more effectively managed.

Stream temperature is one of the key stressors highlighted by the results of these surveys, and there appears to be a significant relationship between temperature and certain features of riparian habitats. We recommend that inexpensive temperature data loggers be deployed for extended periods at sites with salmonid populations and at sites with elevated temperatures due to alterations in physical habitat. This will assist in identifying areas where riparian improvements could make streams more supportive of fish and other aquatic organisms. Flow measurements are also needed to evaluate natural flow conditions and to determine the role water management may have on water quality.

Toxicity in San Leandro and Stevens Creek should be further investigated to determine if the toxicity is persistent and to identify causes. Follow-up monitoring should also be conducted at bathing areas that exceeded coliform objectives. Additional monitoring should be conducted at Arroyo Las Positas to determine whether oxadiazon is still elevated and to identify the source.

All macroinvertebrate bioassessment data collected in the region using the California Stream Bioassessment Procedure (CSBP) type sampling is being entered into a common database. Data analysis should be conducted to determine whether the Northern or Southern California IBI may be used for interpretation, or whether a Bay Area specific IBI is needed. In addition, specific emphasis should be put on identifying urban areas that are least impacted by land use and characterizing benthic communities at these sites. This assessment is necessary to develop management actions for urban areas and to identify the highest achievable metrics for tiered aquatic life use assessments.

Long-term monitoring sites should be located at impacted sites to determine trends and at reference sites to determine variability in natural conditions and the role of climate change. Sites should also be located in areas representative of different land uses to determine the level of impact associated with that land use. It is especially important to locate sites where there is a plan to change land use to determine baseline conditions and to track water quality impacts that may be caused by these changes.

A watershed monitoring coalition should be formed in this region in order to develop the most meaningful information in the most efficient manner. SWAMP may best be used to provide a regional context for local monitoring programs.

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Appendix A: Land uses by watershed and site

Station Code	Station Name	Land Use Category
Walker Creek Watershed		
WLK030	Keys at Tomales	Rural Residential
WLK050	Keys @ Irvin Road	Mixed
WLK090	Walker Creek	Mixed
WLK100	Chileno Canyon	Grazing
WLK120	Chileno Valley	Mixed
WLK130	Laguna Lake	Mixed
WLK140	Walker Canyon	Grazing
WLK160	Walker Creek Ranch	Mixed
WLK162	Turtle Pond	Mixed
WLK170	Verde Canyon	Grazing
WLK180	Gambonini Mine	Mixed
WLK190	Salmon Creek	Grazing
WLK200	Soulajule	Mixed
WLK230	Arroyo Sausal	Grazing
WLK240	Cheese Factory	Grazing
Lagunitas Creek Watershed		
LAG040	Olema Low	Mixed
LAG050	Bear Valley Road Bridge	Mixed
LAG060	Vedanta	Agriculture
LAG075	Truttman	Agriculture
LAG085	Five Brooks	Agriculture
LAG090	Giacomini Gulch	Agriculture
LAG100	Blue Line	Agriculture
LAG115	Hagmaier Pond	Agriculture
LAG120	Green Bridge (Hwy 1)	Mixed
LAG130	Gallagher's Ranch	Mixed
LAG150	Halleck	Mixed
LAG160	Nicasio	Rural Residential
LAG165	Below Tocaloma	Mixed
LAG170	Tocaloma	Open Space
LAG180	Cheda	Mixed
LAG185	Swimming Hole @ SPTaylor	Mixed
LAG190	Devil's Gulch	Mixed
LAG210	Taylor Park	Mixed
LAG220	Irving Bridge	Mixed
LAG230	Inkwells	Mixed
LAG240	White Horse Bridge	Rural Residential
LAG250	Papermill Cr. Saloon	Rural Residential
LAG270	Creamery Gulch	Rural Residential
LAG290	Water Treatment Plant	Rural Residential
LAG300	Woodacre Creek	Rural Residential
LAG320	Shafter Bridge	Mixed
LAG330	Big Carson 1	Open Space
LAG335	Big Carson 2	Open Space
LAG380	Little Carson	Open Space
LAG390	Cataract	Open Space

Appendix A: Land uses by watershed and site

Station Code	Station Name	Land Use Category
San Leandro Creek Watershed		
SLE030	Empire Road	Urban
SLE050	San Leandro BART	Urban
SLE070	Root Park	Urban
SLE090	Chabot City Park	Mixed
SLE170	Redwood Park (West Fork)	Mixed
SLE180	East Fork Redwood Creek	Open Space
SLE190	Canyon School	Rural Residential
SLE200	Huckleberry Preserve	Rural Residential
SLE210	Moraga	Urban
SLE220	Indian	Grazing
SLE230	Kaiser Creek at Callahan	Open Space
Wildcat Creek Watershed		
WIL020	Richmond Parkway	Urban
WIL030	3rd St.	Urban
WIL050	Davis Park	Urban
WIL060	Vale Road	Urban
WIL070	Alvarado Park	Mixed
WIL100	Jewel Lake Outlet	Mixed
WIL130	Lone Oak	Mixed
WIL170	Botanic Garden	Mixed
WIL180	Big Springs Picnic Area	Open Space
WIL190	Possum Picnic Area	Mixed
San Pablo Creek Watershed		
SPA020	3rd St. Bridge	Urban
SPA050	20th St. at Road 20	Urban
SPA060	San Pablo City Park	Urban
SPA070	Cemetery Bridge	Urban
SPA100	Appian Way	Urban
SPA110	De Anza School	Urban
SPA130	Castro Ranch	Mixed
SPA140	Xmas Tree Farm	Mixed
SPA150	Briones 1	Grazing
SPA160	Briones 2	Open Space
SPA170	Bear Creek Road	Mixed
SPA200	Lauterwasser	Urban
SPA220	Orinda Village	Urban
SPA235	Camino Encinas Low	Urban
SPA240	Camino Encinas	Urban
Suisun Creek Watershed		
207SUI010	Cordelia	Mixed
207SUI020	Rockville	Agriculture
207SUI050	Putah South Canal - Downstream	Agriculture
207SUI060	Putah South Canal - Upstream	Agriculture
207SUI090	Capp Confluence	Agriculture
207SUI110	Wooden Valley	Mixed
207SUI125	Wolf	Mixed
207SUI130	Lake Curry Road	Agriculture
207SUI180	White Creek	Mixed
207SUI185	East Wooden Valley above White Cr.	Agriculture
207SUI210	E Wooden Valley	Agriculture
207SUI250	Gordon Valley	Grazing
207SUI260	Upper Suisun	Grazing

Appendix A: Land uses by watershed and site

Station Code	Station Name	Land Use Category
Arroyo Las Positas Creek Watershed		
ALP010	El Charro	Urban
ALP040	Airway Blvd. Exit	Urban
ALP070	Airway 2	Urban
ALP080	N. Livermore Ave.	Urban
ALP100	Altamont Creek	Mixed
ALP105	Altamont-Springtown	Urban
ALP110	Arroyo Seco	Mixed
ALP140	Altamont Pass	Agriculture
ALP150	Above Arroyo Seco	Mixed
Pescadero Creek Watershed		
PES050	Water Lane	Mixed
PES060	Community Church	Mixed
PES070	Cloverdale Rd	Agriculture
PES080	Honsinger	Agriculture
PES095	Pesky Ranch	Agriculture
PES100	PES USGS Gage	Rural Residential
PES105	Canyon Mouth	Rural Residential
PES120	Loma Mar	Mixed
PES134	Memorial Park Swim 1	Mixed
PES135	Memorial Park Swim 2	Mixed
PES140	Water Treatment Plant	Mixed
PES150	Jones Gulch	Rural Residential
PES160	Towne Fire Rd. (Steve Young)	Mixed
PES170	Tarwater Creek	Mixed
PES180	Peters Creek	Open Space
PES190	Portola State Park	Open Space
PES193	Iverson Trail	Open Space
PES194	Sequoia Nature Trail	Open Space
PES200	Slate Creek	Open Space
PES210	Oil Creek	Open Space
PES230	Waterman Creek	Mixed
PES240	Headwaters	Open Space
Butano Creek Watershed		
BUT010	Bean Hollow	Agriculture
BUT020	Cloverdale Coast Ranch	Agriculture
BUT030	Girl Scout Camp	Rural Residential
BUT040	Butano Falls	Open Space
BUT050	Butano State Park	Open Space
San Gregorio Creek Watershed		
SGR010	San Gregorio USGS Gage	Mixed
SGR020	El Corte de Madera Low	Mixed
SGR030	Star Hill Rd.	Rural Residential
SGR040	Boysville	Mixed
SGR060	Harrington Creek	Rural Residential
SGR075	Upper San Gregorio	Rural Residential
SGR079	San Gregorio confluence	Rural Residential
SGR080	La Honda at Confluence	Rural Residential
SGR090	Alpine at Confluence	Rural Residential
SGR100	Playbowl	Rural Residential
SGR110	Spanish Ranch	Rural Residential
SGR120	Sky Londa	Rural Residential
SGR130	Mindego Creek	Rural Residential
SGR150	Heritage Grove	Rural Residential

Appendix A: Land uses by watershed and site

Station Code	Station Name	Land Use Category
Stevens Creek Watershed		
STE020	La Avenida	Urban
STE030	Landels School	Urban
STE040	Below Diversion Channel	Urban
STE060	"Belleville"/Barranca	Urban
STE070	Chestnut Picnic Area	Mixed
STE080	Above the Reservoir	Mixed
STE090	Camp Cooley	Mixed
STE100	Moss Rock	Rural Residential
STE110	Upper Stevens 1	Rural Residential
STE120	Upper Stevens 2	Rural Residential
Permanente Creek Watershed		
PER010	Charleston Rd	Urban
PER020	Crittendon Middle School	Urban
PER030	Hale Creek @ Covington	Urban
PER040	Permanente @ Diversion Channel	Urban
PER050	Loyola Corners	Urban
PER070	Rancho San Antonio	Mixed
PER080	Lower Meadow/West Branch	Mixed

Appendix B: Station locations by watershed and station ID

Station Code	Station Name	Waterbody	Latitude	Longitude
Walker Creek Watershed				
201WLK030	Keys at Tomales	Keys Creek	38.24111	-122.90431
201WLK050	Keys @ Irvin Road	Keys Creek	38.24353	-122.89806
201WLK090	Walker Creek	Walker Creek	38.22778	-122.90806
201WLK100	Chileno Canyon	Chileno Creek	38.21450	-122.85794
201WLK120	Chileno Valley	Chileno Creek	38.20764	-122.79456
201WLK130	Laguna Lake	Lake	38.20639	-122.76975
201WLK140	Walker Canyon	Walker Creek	38.21192	-122.86006
201WLK160	Walker Creek Ranch	Walker Creek	38.17544	-122.82044
201WLK162	Turtle Pond	Pond	38.16782	-122.81734
201WLK170	Verde Canyon	Verde Canyon	38.16444	-122.81136
201WLK180	Gambonini Mine	Salmon Creek	38.16175	-122.78033
201WLK190	Salmon Creek	Salmon Creek	38.16458	-122.77194
201WLK200	Soulajoule	Sausal, Arroyo	38.15758	-122.78408
201WLK230	Arroyo Sausal	Sausal, Arroyo	38.14342	-122.72472
201WLK240	Cheese Factory	Sausal, Arroyo	38.13589	-122.70914
Lagunitas Creek Watershed				
201LAG040	Olema Low	Olema Creek	38.05731	-122.80311
201LAG050	Bear Valley Road Bridge	Olema Creek	38.04181	-122.78969
201LAG060	Vedanta	Olema Creek	38.03808	-122.78531
201LAG075	Truttman	Olema Creek	38.02306	-122.77917
201LAG085	Five Brooks	Olema Creek	37.99905	-122.75533
201LAG100	Blue Line	Olema Creek	37.99614	-122.75578
201LAG115	Hagmeier Pond	Hagmeier Pond	37.97382	-122.72711
201LAG120	Green Bridge (Hwy 1)	Olema Creek	38.06470	-122.80860
201LAG130	Gallagher's Ranch	Lagunitas Creek	38.08064	-122.78450
201LAG150	Halleck	Halleck Creek	38.06669	-122.70264
201LAG160	Nicasio	Nicasio Creek	38.06156	-122.69958
201LAG165	Below Tocaloma	Lagunitas Creek	38.05839	-122.76522
201LAG170	Tocaloma	Lagunitas Creek	38.04970	-122.75945
201LAG180	Cheda	Lagunitas Creek	38.03722	-122.74611
201LAG185	Swimming Hole @ SPTaylor	Lagunitas Creek	38.02872	-122.74326
201LAG190	Devils Gulch	Devils Gulch	38.02964	-122.73636
201LAG210	Taylor Park	Lagunitas Creek	38.01861	-122.73306
201LAG220	Irving Bridge	Lagunitas Creek	38.01611	-122.72297
201LAG230	Inkwells	San Geronimo Creek	38.00500	-122.70833
201LAG240	White Horse Bridge	San Geronimo Creek	38.00703	-122.70569
201LAG250	Papermill Cr. Saloon	San Geronimo Creek	38.01472	-122.68917
201LAG270	Creamery Gulch	San Geronimo Creek	38.01356	-122.66664
201LAG290	Lag Water Treatment Plant	San Geronimo Creek	38.01305	-122.65055
201LAG300	Woodacre Creek	San Geronimo Creek	38.01275	-122.64689
201LAG320	Shafter Bridge	Lagunitas Creek	38.00453	-122.70878
201LAG330	Big Carson 1	Big Carson Creek	37.99194	-122.66972
201LAG335	Big Carson 2	Big Carson Creek	37.99222	-122.66000
201LAG380	Little Carson	Big Carson Creek	37.96722	-122.64944
201LAG390	Cataract	Cataract Creek	37.93250	-122.63556

Appendix B: Station locations by watershed and station ID

Station Code	Station Name	Waterbody	Latitude	Longitude
San Leandro Creek Watershed				
204SLE030	Empire Road	San Leandro Creek	37.72556	-122.18361
204SLE050	San Leandro BART	San Leandro Creek	37.72611	-122.16389
204SLE070	Root Park	San Leandro Creek	37.72706	-122.15733
204SLE090	Chabot City Park	San Leandro Creek	37.73139	-122.13206
204SLE170	Redwood Park (West Fork)	San Leandro Creek	37.80028	-122.14472
204SLE180	East Fork Redwood Creek	Redwood Creek	37.80111	-122.14472
204SLE190	Canyon School	San Leandro Creek	37.82778	-122.16397
204SLE200	Huckleberry Preserve	San Leandro Creek	37.84150	-122.18725
204SLE210	Moraga Creek	Moraga Creek	37.84333	-122.14972
204SLE220	Indian Creek	Indian Creek	37.81833	-122.14583
204SLE230	Kaiser Creek at Callahan	Kaiser Creek	37.79778	-122.07528
Wilcat Creek Watershed				
206WIL020	Richmond Parkway	Wildcat Creek	37.95778	-122.37389
206WIL030	3rd St.	Wildcat Creek	37.96028	-122.36750
206WIL050	Davis Park	Wildcat Creek	37.96136	-122.35250
206WIL060	Vale Road	Wildcat Creek	37.95319	-122.33836
206WIL070	Alvarado Park	Wildcat Creek	37.95233	-122.32039
206WIL100	Jewel Lake Outlet	Wildcat Creek	37.91306	-122.27000
206WIL130	Lone Oak (130)	Wildcat Creek	37.90361	-122.25889
206WIL170	Botanic Garden	Wildcat Creek	37.89333	-122.24333
206WIL180	Big Springs Picnic Area	Wildcat Creek	37.88944	-122.23361
206WIL190	Possum Picnic Area	Wildcat Creek	37.88444	-122.22944
San Pablo Creek Watershed				
206SPA020	3rd St. Bridge	San Pablo Creek	37.96750	-122.36583
206SPA050	20th St. at Road 20	San Pablo Creek	37.96333	-122.34833
206SPA060	San Pablo City Park	San Pablo Creek	37.96250	-122.34639
206SPA070	Cemetery Bridge	San Pablo Creek	37.96278	-122.33278
206SPA100	Appian Way	San Pablo Creek	37.97031	-122.30642
206SPA110	De Anza School	San Pablo Creek	37.96889	-122.29042
206SPA130	Castro Ranch	San Pablo Creek	37.95592	-122.26992
206SPA140	Xmas Tree Farm	Bear Creek	37.92194	-122.16333
206SPA150	Briones 1	Bear Creek	37.92611	-122.15889
206SPA160	Briones 2	Bear Creek	37.92722	-122.15250
206SPA170	Bear Creek Road	San Pablo Creek	37.90111	-122.20722
206SPA200	Lauterwasser Creek	Lauterwasser Creek	37.89139	-122.19389
206SPA220	Orinda Village	San Pablo Creek	37.88611	-122.19278
206SPA235	Camino Encinas Low	San Pablo Creek	37.87623	-122.18028
206SPA240	Camino Encinas	San Pablo Creek	37.87250	-122.17861
Suisun Creek Watershed				
207SUI010	Cordelia	Suisun Creek	38.21833	-122.10444
207SUI020	Rockville	Suisun Creek	38.24472	-122.11194
207SUI050	Putah South Canal - Downstream	Suisun Creek	38.27483	-122.12186
207SUI060	Putah South Canal (upstream)	Suisun Creek	38.27458	-122.12275
207SUI090	Capp Confluence	Suisun Creek	38.32831	-122.13708
207SUI110	Wooden Valley	Wooden Valley Creek	38.33086	-122.13858
207SUI125	Middle Suisun	Suisun Creek	38.33361	-122.12800
207SUI130	Lake Curry Road	Suisun Creek	38.34956	-122.13061
207SUI180	White Creek	White Creek	38.35689	-122.17086
207SUI185	East Wooden Valley above White C	Wooden Valley Creek	38.35742	-122.17120
207SUI210	E Wooden Valley	Suisun Creek	38.36333	-122.17444
207SUI250	Gordon Valley	Suisun Creek	38.37361	-122.14500
207SUI260	Upper Suisun	Suisun Creek	38.37528	-122.14222

Appendix B: Station locations by watershed and station ID

Station Code	Station Name	Waterbody	Latitude	Longitude
Arroyo Las Positas Creek Watershed				
204ALP010	El Charro	Arroyo Las Positas	37.69708	-121.84964
204ALP040	Airway Blvd. Exit	Arroyo Las Positas	37.69856	-121.81728
204ALP070	Airway 2	Arroyo Las Positas	37.69961	-121.79886
204ALP080	N. Livermore Ave.	Arroyo Las Positas	37.69942	-121.77442
204ALP100	Altamont Creek	Altamont Creek	37.70739	-121.75325
204ALP105	Altamont-Springtown	Altamont Creek	37.71533	-121.74780
204ALP110	Arroyo las Positas	Arroyo Seco	37.70528	-121.75417
204ALP140	Altamont Pass	Arroyo Las Positas	37.72175	-121.69658
204ALP150	Above Arroyo Seco	Arroyo Seco	37.69441	-121.73578
Pescadero Creek Watershed				
202PES050	Water Lane	Pescadero Creek	37.25800	-122.39492
202PES060	Community Church	Pescadero Creek	37.25449	-122.38314
202PES070	Cloverdale Rd	Pescadero Creek	37.25164	-122.36999
202PES080	Honsinger	Honsinger Creek	37.25200	-122.36980
202PES095	Pesky Ranch	Pescadero Creek	37.25649	-122.33777
202PES100	PES USGS Gage	Pescadero Creek	37.26098	-122.32909
202PES105	Canyon Mouth	Pescadero Creek	37.26966	-122.31538
202PES120	Loma Mar	Pescadero Creek	37.26695	-122.30935
202PES134	Memorial Park Swim 1	Pescadero Creek	37.27345	-122.29180
202PES135	Memorial Park Swim 2	Pescadero Creek	37.27334	-122.29003
202PES140	Water Treatment Plant	Hoffman Creek	37.27119	-122.28647
202PES150	Jones Gulch	Jones Gulch	37.27605	-122.26669
202PES160	Towne Fire Rd. (Steve Young)	Pescadero Creek	37.26927	-122.26368
202PES170	Tarwater Creek	Tarwater Creek	37.26443	-122.23911
202PES180	Peters Creek	Peters Creek	37.25137	-122.21792
202PES190	Portola State Park	Pescadero Creek	37.25106	-122.21783
202PES193	Iverson Trail	Pescadero Creek	37.25731	-122.23508
202PES194	Sequoia Nature Trail	Pescadero Creek	37.25030	-122.21972
202PES200	Slate Creek	Slate Creek	37.24190	-122.20041
202PES210	Oil Creek	Oil Creek	37.22935	-122.19052
202PES230	Waterman Creek	Waterman Creek	37.21446	-122.17565
202PES240	Headwaters	Pescadero Creek	37.21410	-122.16521
Butano Creek Watershed				
202BUT010	Bean Hollow	Butano Creek	37.25003	-122.39553
202BUT020	Cloverdale Coast Ranch	Butano Creek	37.23395	-122.36719
202BUT030	Girl Scout Camp	Little Butano Cree	37.22474	-122.33254
202BUT040	Butano Falls	Little Butano Cree	37.24195	-122.31719
202BUT050	Butano State Park	Butano Creek	37.20607	-122.33483
San Gregorio Creek Watershed				
202SGR010	San Gregorio USGS Gage	San Gregorio Creek	37.32583	-122.38583
202SGR020	El Corte de Madera Low	Corte Madera Creek	37.31962	-122.33811
202SGR030	Star Hill Rd.	Corte Madera Creek	37.38509	-122.32473
202SGR040	Boysville	San Gregorio Creek	37.31120	-122.31595
202SGR060	Harrington Creek	Harrington Creek	37.32027	-122.30026
202SGR075	Upper San Gregorio	San Gregorio Creek	37.31512	-122.29048
202SGR079	San Gregorio confluence	San Gregorio Creek	37.31003	-122.27776
202SGR080	La Honda at Confluence	Honda Creek, La	37.31024	-122.27774
202SGR090	Alpine at Confluence	Alpine Creek	37.31005	-122.27740
202SGR100	Playbowl	Honda Creek, La	37.31524	-122.27408
202SGR110	Spanish Ranch	Honda Creek, La	37.34591	-122.27425
202SGR120	Sky Londa	Honda Creek, La	37.38799	-122.27345
202SGR130	Mindego Creek	Mindego Creek	37.29775	-122.25393
202SGR150	Heritage Grove	Alpine Creek	37.29606	-122.24639

Appendix B: Station locations by watershed and station ID

Station Code	Station Name	Waterbody	Latitude	Longitude
Steven's Creek Watershed				
205STE020	La Avenida	Stevens Creek	37.41357	-122.06865
205STE030	Landels School	Stevens Creek	37.38658	-122.06917
205STE040	Below Diversion Channel	Stevens Creek	37.36475	-122.06224
205STE060	"Belleville"/Barranca	Stevens Creek	37.33503	-122.06384
205STE070	Chestnut Picnic Area	Stevens Creek	37.30320	-122.07456
205STE080	Above the Reservoir	Stevens Creek	37.28367	-122.07694
205STE090	Camp Cooley	Stevens Creek	37.28038	-122.07334
205STE100	Moss Rock	Stevens Creek	37.27226	-122.08278
205STE110	Upper Stevens 1	Stevens Creek	37.28705	-122.12601
205STE120	Upper Stevens 2	Stevens Creek	37.31578	-122.16917
Permanente Creek Watershed				
205PER010	Charleston Rd	Permanente Creek	37.42118	-122.08673
205PER020	Crittendon Middle School	Permanente Creek	37.41206	-122.08663
205PER030	Hale Creek @ Covington	Hale Creek	37.36565	-122.09877
205PER040	Permanente @ Diversion Channel	Permanente Creek	37.36245	-122.08656
205PER050	Loyola Corners	Permanente Creek	37.35264	-122.08617
205PER070	Rancho San Antonio	Permanente Creek	37.32941	-122.08586
205PER080	Lower Meadow/West Branch	Permanente Creek	37.33335	-122.09381

Appendix C-1: Data batches missing blank(s)

Batch ID	BatchQualCode	BatchValCode	Notes	Lab
012703-TDS	A,VMD	VAC,VI	QAO: no blank or CRM	
012903-TDS	A,VMD	VAC,VI	QAO: no blank or CRM	
AMS10401-1	A,VMD	VAC,VI	QAO: no blk, DUP, CRM	AMS
AMSDOC21102-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC21302-1	A,VMD	VAC,VI	LAB:all samples were lab filtered within 3 days of collectionQA: no blk, DUP	AMS
AMSDOC2902-1	A,VMD	VAC,VI	QAO: no blk	AMS
AMSDOC2902-2	A,VMD	VAC,VI	QAO: no blk	AMS
AMSDOC51102-1	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC5302-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5302-2	A,VMD	VAC,VI	QAO: no blk	AMS
AMSDOC5402-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-1	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC5402-2	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-2	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC5402-3	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC62302-1	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC62402-1	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC62402-1	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSDOC62402-2	A,VMD	VAC,VI	QAO: no blk, DUP	
AMSTOC51102-1	A,VMD	VAC,VI	QAO: no blk, DUP	
L-012503-OCH	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; MS/MSD RPD for p'p'-DDD was above QC limit	
L-012503-OCH	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; MS/MSD RPD for p'p'-DDD was above QC limit	
L-012503-OP	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; Both MS/MSD RPDs above 25% for coumaphos, demeton-s, tetrachlorvinphos	
L-012503-OP	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; Both MS/MSD RPDs above 25% for coumaphos, demeton-s, tetrachlorvinphos	
L-012503-PAH	A,MD	VAC,VI	LAB:holding times exceeded; low surrogate %Rs<50% for many samples, MS/D, LCS %R & RPD outside criteria for several cmpds; See QA CodesQAO:no LCS or MS/MSD for 1/25/03, no QC for 1/31/03, no blank for 1/29/03	
L-012503-PAH	A,MD	VAC,VI	LAB:holding times exceeded; low surrogate %Rs<50% for many samples, MS/D, LCS %R & RPD outside criteria for several cmpds; See QA CodesQAO:no LCS or MS/MSD for 1/25/03, no QC for 1/31/03, no blank for 1/29/03	
L-012503-PCB	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03	
L-012503-PCB	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03	
L-012503-TRIAZ	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03, per laboratory surrogates are reported with the OP pest batch L-012503-OP, MS/MSD RPD out for Ametryn	
L-012503-TRIAZ	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03, per laboratory surrogates are reported with the OP pest batch L-012503-OP, MS/MSD RPD out for Ametryn	
L-041802-OPP	A,VMD	VAC,VI	QAO: no blk for 4/15/2002 and no LCS for 4/12/2002	DFG-WPCL
L-041802-OPP	A,VMD	VAC,VI	QAO: no blk for 4/15/2002 and no LCS for 4/12/2002	
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	DFG-WPCL
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	
L-042702-OCH	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-042702-OCH	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	
L-042702-PCB	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-042702-PCB	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	
L-050302-PAH	A,VMD	VAC,VI	QAO: no blank, MS/MSD, LCS for 4/22/02, no blank for 4/23/02	
L-050602-TR	A,VMD	VAC,VI	QAO: no blank was performed, no QC since screening data only	

Appendix C-1: Data batches missing blank(s)

Batch ID	BatchQualCode	BatchValCode	Notes	Lab
L-050602-TR	A,VMD	VAC,VI	QAO: no blank was performed, no QC since screening data only	
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	
L-101001-OCH	A,MD	VAC,VI	QAO: no blank for 10/7/2001, MS/MSD RPD for endosulfan I above QC limit of 25%	DFG-WPCL
L-101001-OPP	A,VMD	VAC,VI	QAO: no MSD; no blank for 10/7/2001	DFG-WPCL
L-101001-PAH	A,VMD	VAC,VI	QAO: no blank for 10/7/2001	DFG-WPCL
L-101001-PCB	A,VMD	VAC,VI	QAO: no MSD; no blank for 10/7/2001	DFG-WPCL
L39801_BS179_KR_CONG	A,VMD	VAC,VI	QAO:no QC for 11/20/01, samples added to batch after extraction process began; LCS %R outside QC limit for PCB-29, PCB-56, PCB-60; MS/MSD %R PCB-029 and PCB-056	
L39801BS179_KRPEST	A,VMD	VAC,VI	QAO:no QC for 11/20/01, samples added to batch after extraction process began; LCS %R outside QC limit for several compounds:CRM %R outside QC limit for trans chlordane, alpha HCH, cis Nonachlor, MS/MSD %R and RPD outside QC limit for several compounds	
L-418-01-ALK	A,VMD	VAC,VI	QAO: no blank	DFG-WPCL
L-418-01-NO2	A,VMD	VAC,VI	QAO: no blank	DFG-WPCL
L-424-01-ALK	A,VMD	VAC,VI	QAO: no blank	DFG-WPCL
L-424-01-NO2	A,VMD	VAC,VI	QAO: no blank or MS	DFG-WPCL
L-430-01-ALK	A,VMD	VAC,VI	QAO: no blank	DFG-WPCL
L-430-01-NH3	A,VMD	VAC,VI	QAO: no blank	DFG-WPCL
L-430-01-NO2	A,VMD	VAC,VI	QAO: no blank or MS	DFG-WPCL
L-442-01-ALK	A,VMD	VAC,VI	QAO: no blank	
L-442-01-NO2	A,VMD	VAC,VI	QAO: no blank or MS	
L-442-01-TDS	A,VMD	VAC,VI	QAO: no blank, MS, DUP	
L-445-01-ALK	A,VMD	VAC,VI	QAO: no blank	
L-445-01-NO2	A,VMD	VAC,VI	QAO: no blank or MS	
L-445-01-TDS	A,VMD	VAC,VI	QAO: no blank	
R2-013002-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blank or DUP	
R2-013002-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blk or DUP	
R2-071002-ICP	A,VMD	VAC,VI	LAB:all samples were acidified within 2 days of collectionQAO: no blank or CRM; MS/MSD %Rs outside QC limit of 75-125	
R2-100101-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collection QAO: no blank or DUP	
R2-100101-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blak or DUP	
R2-101001-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collection QAO: no blk or DUP	
R2-101001-ICP	A,VMD	VAC,VI	LAB:sample was acidified within 2 days of collection;QAO: no blank, MS %R for Cu and Cr outside QC limit of 75-125	
R2-101001-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blk or DUP	
R29-101102-ICP	A,VMD	VAC,VI	LAB:All samples were acidified within 2 days of collectionQAO: no blank	
R29-101102-ICP	A,VMD	VAC,VI	LAB:All samples were acidified within 2 days of collectionQAO: no blank	

Appendix C-2: Laboratory blanks detected

Analyte	Result	Unit	MDL	RL	Detected	AnalysisDate	MethodName	Laboratory	Batch ID
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	6/24/2002	QC 10303311A	DFG-WPCL	L-295-02-ALK
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	4/29/2002	QC 10303311A	DFG-WPCL	L-181-02-ALK
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	6/24/2002	QC 10303311A	DFG-WPCL	L-288-02-ALK
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	4/16/2002	QC 10303311A	DFG-WPCL	L17902-ALK
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	4/16/2002	QC 10303311A	DFG-WPCL	L-177-01-ALK
Alkalinity as CaCO3	-88	mg/L	3	10	DNQ	4/16/2002	QC 10303311A	DFG-WPCL	L-173-01-ALK
Alkalinity as CaCO3	1	mg/L	0.5	1		2/1/2002	DFG-WPCL	DFG-WPCL	L-058-01-ALK
Alkalinity as CaCO3	2	mg/L	0.5	1		1/28/2002	DFG-WPCL	DFG-WPCL	L-052-01-ALK
Alkalinity as CaCO3	3	mg/L	0.5	1		1/28/2002	DFG-WPCL	DFG-WPCL	L-048-01-ALK
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	6/21/2002	EPA 350.3	DFG-WPCL	L-288-02-NH3
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	4/13/2002	EPA 350.3	DFG-WPCL	L17902-NH3
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	4/12/2002	EPA 350.3	DFG-WPCL	L-173-01-NH3
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	6/25/2002	EPA 350.3	DFG-WPCL	L-295-02-NH3
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	4/19/2002	EPA 350.3	DFG-WPCL	L-181-02-NH3
Ammonia as N	0.08	mg/L	0.05	0.1	DNQ	1/28/2002	EPA 350.3	DFG-WPCL	L-048-01-NH3
Ammonia as N	0.08	mg/L	0.05	0.1	DNQ	2/4/2002	EPA 350.3	DFG-WPCL	L-058-01-NH3
Ammonia as N	-88	mg/L	0.05	0.1	DNQ	4/13/2002	EPA 350.3	DFG-WPCL	L-177-01-NH3
Ammonia as N	0.08	mg/L	0.05	0.1	DNQ	1/30/2002	EPA 350.3	DFG-WPCL	L-052-01-NH3
Chloride	-88	mg/L	0.15	0.25	DNQ	6/20/2002	EPA 300.0	DFG-WPCL	L-288-02-CL
Chloride	-88	mg/L	0.15	0.25	DNQ	4/10/2002	EPA 300.0	DFG-WPCL	L-173-01-CL
Chloride	-88	mg/L	0.15	0.25	DNQ	4/15/2002	EPA 300.0	DFG-WPCL	L-177-01-CL
Chloride	-88	mg/L	0.15	0.25	DNQ	6/21/2002	EPA 300.0	DFG-WPCL	L-295-02-CL
Chloride	-88	mg/L	0.15	0.25	DNQ	4/18/2002	EPA 300.0	DFG-WPCL	L-181-02-CL
Chloride	-88	mg/L	0.15	0.25	DNQ	4/16/2002	EPA 300.0	DFG-WPCL	L17902-CL
Chlorophyll a	0.75	µg/L	0.5	1	DNQ	4/16/2002	SM 10200 H-2b	SFL	R12-041602-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	4/23/2002	SM 10200 H-2b	SFL	R12-042302-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2b	SFL	R12-071702-Chl
Chlorophyll a	0.75	µg/L	0.5	1	DNQ	7/10/2002	SM 10200 H-2b	SFL	R12-071002-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	4/23/2002	SM 10200 H-2b	SFL	R12-042302-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2b	SFL	R12-071702-Chl
Chlorophyll a	0.9	µg/L	0.5	1.3	DNQ	4/17/2002	SM 10200 H-2b	SFL	R2-041702-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	2/7/2002	SM 10200 H-2b	SFL	R12-020702-Chl
Chlorophyll a	0.75	µg/L	0.5	1	DNQ	4/16/2002	SM 10200 H-2b	SFL	R12-041602-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	4/19/2002	SM 10200 H-2b	SFL	R12-041902-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2b	SFL	R12-071702-Chl
Chlorophyll a	0.75	µg/L	0.5	1	DNQ	7/10/2002	SM 10200 H-2b	SFL	R12-071002-Chl
Chlorophyll a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2b	SFL	R12-071702-Chl
Copper	0.004	mg/Kg	0.003	0.01	DNQ	3/1/2002	EPA 200.8	MPSL-DFG	2002Dig7
Copper	0.005	mg/Kg	0.003	0.01	DNQ	2/20/2003	EPA 200.8	MPSL-DFG	2003Dig06
Copper	0.006	mg/Kg	0.003	0.01	DNQ	3/1/2002	EPA 200.8	MPSL-DFG	2002Dig7
Copper	0.006	mg/Kg	0.003	0.01	DNQ	2/20/2003	EPA 200.8	MPSL-DFG	2003Dig06
C1 -Dibenzothiophenes	5.42	ng/g	1.95	1.95		4/15/2002	DFG-WPCL	DFG-WPCL	L-021902-PAH
C2 -Dibenzothiophenes	4.02	ng/g	1.95	1.95		4/15/2002	DFG-WPCL	DFG-WPCL	L-021902-PAH
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	4/11/2002	SM 2340 C	DFG-WPCL	L-173-01-H
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	6/20/2002	SM 2340 C	DFG-WPCL	L-288-02-H
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	4/15/2002	SM 2340 C	DFG-WPCL	L17902-H
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	4/17/2002	SM 2340 C	DFG-WPCL	L-181-02-H
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	7/1/2002	SM 2340 C	DFG-WPCL	L-295-02-H
Hardness as CaCO3	-88	mg/L	0.5	1	DNQ	4/15/2002	SM 2340 C	DFG-WPCL	L-177-01-H
HCH, gamma	0.0015	µg/L	0.001	0.002	DNQ	5/3/2002	EPA 8081AM	DFG-WPCL	L-050302-OCH
Manganese	0.005	mg/Kg	0.003	0.01	DNQ	2/20/2003	EPA 200.8	MPSL-DFG	2003Dig06
Manganese	0.009	mg/Kg	0.003	0.01	DNQ	3/1/2002	EPA 200.8	MPSL-DFG	2002Dig7
Manganese	0.009	mg/Kg	0.003	0.01	DNQ	3/1/2002	EPA 200.8	MPSL-DFG	2002Dig7
Manganese	0.006	mg/Kg	0.003	0.01	DNQ	2/20/2003	EPA 200.8	MPSL-DFG	2003Dig06
Naphthalene	2.47	ng/g	1.52	1.52		4/15/2002	DFG-WPCL	DFG-WPCL	L-010902-PAH
C1 - Naphthalenes	2.9	ng/g	1.52	1.52		4/15/2002	DFG-WPCL	DFG-WPCL	L-010902-PAH
C1 - Naphthalenes	7.3	ng/g	1.95	1.95		4/15/2002	DFG-WPCL	DFG-WPCL	L-021902-PAH
C2 - Naphthalenes	1.81	ng/g	1.52	1.52		4/15/2002	DFG-WPCL	DFG-WPCL	L-010902-PAH
C3 - Naphthalenes	3.18	ng/g	1.95	1.95		4/15/2002	DFG-WPCL	DFG-WPCL	L-021902-PAH
Nickel	0.007	mg/Kg	0.006	0.01	DNQ	3/1/2002	EPA 200.8	MPSL-DFG	2002Dig7
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	6/21/2002	QC 10107041B	DFG-WPCL	L-295-02-NO3

Appendix C-2: Laboratory blanks detected

Analyte	Result	Unit	MDL	RL	Detected	AnalysisDate	MethodName	Laboratory	Batch ID
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	6/20/2002	QC 10107041B	DFG-WPCL	L-288-02-NO3
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	4/10/2002	QC 10107041B	DFG-WPCL	L-173-01-NO3
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	4/18/2002	QC 10107041B	DFG-WPCL	L-181-02-NO3
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10107041B	DFG-WPCL	L17902-NO3
Nitrate as N	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10107041B	DFG-WPCL	L-177-01-NO3
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10107041B	DFG-WPCL	L17902-NO2
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	4/17/2002	QC 10107041B	DFG-WPCL	L-181-02-NO2
Nitrite as N	0.02	mg/L	0.01	0.03	DNQ	2/1/2002	FR 8507	DFG-WPCL	L-058-01-NO2
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10107041B	DFG-WPCL	L-177-01-NO2
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	6/21/2002	QC 10107041B	DFG-WPCL	L-295-02-NO2
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	4/10/2002	QC 10107041B	DFG-WPCL	L-173-01-NO2
Nitrite as N	-88	mg/L	0.005	0.01	DNQ	6/19/2002	QC 10107041B	DFG-WPCL	L-288-02-NO2
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	5/2/2002	EPA 351.3	DFG-WPCL	L17902-TKN
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	6/27/2002	EPA 351.3	DFG-WPCL	L-295-02-TKN
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	5/2/2002	EPA 351.3	DFG-WPCL	L-181-02-TKN
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	6/26/2002	EPA 351.3	DFG-WPCL	L-288-02-TKN
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	4/19/2002	EPA 351.3	DFG-WPCL	L-173-01-TKN
Nitrogen, Total Kjeldahl	-88	mg/L	0.25	0.5	DNQ	4/24/2002	EPA 351.3	DFG-WPCL	L-177-01-TKN
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	6/21/2002	QC 10115011M	DFG-WPCL	L-295-02-OPO4
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10115011M	DFG-WPCL	L17902-OPO4
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	4/17/2002	QC 10115011M	DFG-WPCL	L-181-02-OPO4
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	4/12/2002	QC 10115011M	DFG-WPCL	L-177-01-OPO4
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	4/10/2002	QC 10115011M	DFG-WPCL	L-173-01-OPO4
OrthoPhosphate as P	-88	mg/L	0.005	0.01	DNQ	6/19/2002	QC 10115011M	DFG-WPCL	L-288-02-OPO4
PCB 028	0.165	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 031	0.192	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 044	0.182	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 052	0.292	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 066	0.158	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 095	0.236	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 101	0.265	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 110	0.348	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
PCB 110	0.261	ng/g	0.25	0.25		12/11/2001	DFG-WPCL	DFG-WPCL	L39801_BS179_KR_CONG
PCB 118	0.269	ng/g	0.15	0.6	DNQ	8/22/2003	EPA 8082M	DFG-WPCL	L_121_03_BS 241_KR_CONGENERS
Pheophytin a	0.9	µg/L	0.5	1.3	DNQ	4/17/2002	SM 10200 H-2a	SFL	R2-041702-Ph
Pheophytin a	0.75	µg/L	0.5	1	DNQ	7/10/2002	SM 10200 H-2a	SFL	R12-071002-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	4/23/2002	SM 10200 H-2a	SFL	R12-042302-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	4/23/2002	SM 10200 H-2a	SFL	R12-042302-Ph
Pheophytin a	0.75	µg/L	0.5	1	DNQ	7/10/2002	SM 10200 H-2a	SFL	R12-071002-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	4/19/2002	SM 10200 H-2a	SFL	R12-041902-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2a	SFL	R12-071702-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2a	SFL	R12-071702-Ph
Pheophytin a	1.25	µg/L	0.5	2	DNQ	7/17/2002	SM 10200 H-2a	SFL	R12-071702-Ph
Pheophytin a	0.75	µg/L	0.5	1	DNQ	4/16/2002	SM 10200 H-2a	SFL	R12-041602-Ph
Pheophytin a	1.65	µg/L	0.5	2.8	DNQ	2/7/2002	SM 10200 H-2a	SFL	R12-020702-Ph
Pheophytin a	0.75	µg/L	0.5	1	DNQ	4/16/2002	SM 10200 H-2a	SFL	R12-041602-Ph
Sulfate	-88	mg/L	0.37	1	DNQ	4/18/2002	EPA 300.0	DFG-WPCL	L-181-02-SO4
Sulfate	-88	mg/L	0.37	1	DNQ	4/15/2002	EPA 300.0	DFG-WPCL	L-177-01-SO4
Sulfate	-88	mg/L	0.37	1	DNQ	6/20/2002	EPA 300.0	DFG-WPCL	L-288-02-SO4
Sulfate	-88	mg/L	0.37	1	DNQ	4/10/2002	EPA 300.0	DFG-WPCL	L-173-01-SO4
Sulfate	-88	mg/L	0.37	1	DNQ	6/21/2002	EPA 300.0	DFG-WPCL	L-295-02-SO4
Sulfate	-88	mg/L	0.37	1	DNQ	4/16/2002	EPA 300.0	DFG-WPCL	L17902-SO4
Total Aluminum	0.98	mg/Kg	0.05	0.1	DNQ	2/20/2003	EPA 200.8	MPSL-DFG	2003Dig06
Total Aluminum	0.105	µg/L	0.1	0.3	DNQ	4/8/2003	EPA 1638M	MPSL-DFG	ICP040803
Total Aluminum	1.28	mg/Kg	0.05	0.1		3/1/2002	MPSL-DFG	MPSL-DFG	2002Dig7
Total Aluminum	1.0093	mg/Kg	0.05	0.1		2/20/2003	MPSL-DFG	MPSL-DFG	2003Dig06
Total Aluminum	0.929	mg/Kg	0.05	0.1		3/1/2002	MPSL-DFG	MPSL-DFG	2002Dig7
Total Boron	-88	mg/L	0.02	0.1	NR	7/1/2002	EPA 200.7	Babcock	R2-070102-B
Total Cadmium	0.002	µg/L	0.002	0.05	DNQ	4/8/2003	EPA 1638M	MPSL-DFG	ICP040803
Total Copper	0.023	µg/L	0.01	0.01		5/30/2002	MPSL-DFG	MPSL-DFG	R2-053002-ICP
Total Copper	0.063	µg/L	0.003	0.01		4/8/2003	MPSL-DFG	MPSL-DFG	ICP040803

Appendix C-2: Laboratory blanks detected

Analyte	Result	Unit	MDL	RL	Detected	AnalysisDate	MethodName	Laboratory	Batch ID
Total Dissolved Solids	-88	mg/L	10	10	DNQ	6/21/2002	SM 2540 C	DFG-WPCL	L-295-02-TDS
Total Dissolved Solids	-88	mg/L	10	10	DNQ	4/15/2002	SM 2540 C	DFG-WPCL	L-177-01-TDS
Total Dissolved Solids	-88	mg/L	10	10	DNQ	4/11/2002	SM 2540 C	DFG-WPCL	L-173-01-TDS
Total Dissolved Solids	-88	mg/L	10	10	DNQ	6/21/2002	SM 2540 C	DFG-WPCL	L-288-02-TDS
Total Dissolved Solids	-88	mg/L	10	10	DNQ	4/15/2002	SM 2540 C	DFG-WPCL	L17902-TDS
Total Dissolved Solids	-88	mg/L	10	10	DNQ	4/18/2002	SM 2540 C	DFG-WPCL	L-181-02-TDS
Total Lead	0.006	µg/L	0.002	0.05	DNQ	4/8/2003	EPA 1638M	MPSL-DFG	ICP040803
Total Organic Carbon	47.8	mg/L	1	1		6/24/2002	AMS	AMS	AMSTOC62402-2
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	6/21/2002	EPA 365.3	DFG-WPCL	L-295-02-TPHOS
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	6/19/2002	EPA 365.3	DFG-WPCL	L-288-02-TPHOS
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	4/12/2002	EPA 365.3	DFG-WPCL	L-177-01-TPHOS
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	4/10/2002	EPA 365.3	DFG-WPCL	L-173-01-TPHOS
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	4/12/2002	EPA 365.3	DFG-WPCL	L17902-TPHOS
Total Phosphorus as P	-88	mg/L	0.03	0.05	DNQ	4/17/2002	EPA 365.3	DFG-WPCL	L-181-02-TPHOS
Total Silver	0.018	µg/L	0.008	0.1	DNQ	4/8/2003	EPA 1638M	MPSL-DFG	ICP040803
Total Zinc	0.034	µg/L	0.02	0.06	DNQ	4/8/2003	EPA 1638M	MPSL-DFG	ICP040803

Appendix C-3: Batches containing surrogate recoveries outside control limits

Surrogate	Site	Batch ID	%R	Laboratory
Benz(a)anthracene-d12(Surrogate)	202BUT010	L-012503-PAH	45.1	DFG-WPCL
Benz(a)anthracene-d12(Surrogate)	202SGR010	L-012503-PAH	43.5	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	LCS	L-012503-PAH	47	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	202SGR080	L-012503-PAH	37.9	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	202PES070	L-012503-PAH	22	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	205STE060	L-012503-PAH	37.7	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	LabBlank	L-060203-PAH	40.4	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	205PER070	L-012503-PAH	41.2	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	202BUT010	L-012503-PAH	22.1	DFG-WPCL
Benz(e)pyrene-d12(Surrogate)	202SGR010	L-012503-PAH	19.8	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LabBlank	L-060203-PAH	10.8	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	202SGR080	L-012503-PAH	10.5	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	206PET310	L-012503-PAH	46.1	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	202BUT010	L-012503-PAH	4.89	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LCS	L-060203-PAH	18	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	205STE020	L-012503-PAH	39.2	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	202PES070	L-012503-PAH	2.88	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	205STE060	L-012503-PAH	9.56	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	202SGR010	L-012503-PAH	6.37	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	205PER070	L-012503-PAH	13.8	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	206PET010	L-012503-PAH	41	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LabBlank	L-012503-PAH	27.4	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LCS	L-012503-PAH	8.12	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	CRM	L-010902-PAH	22.1	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	201LAG120	L-060203-PAH	35.9	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LabBlank	L-021902-PAH	45.2	DFG-WPCL
Benzo(g,h,I)perylene-d12(Surrogate)	LCS	L-010902-PAH	22.2	DFG-WPCL
Naphthalene-d8(Surrogate)	LabBlank	L-021902-PAH	46	DFG-WPCL
Perylene-d12(Surrogate)	205PER070	L-012503-PAH	31.3	DFG-WPCL
Perylene-d12(Surrogate)	202BUT010	L-012503-PAH	13.9	DFG-WPCL
Perylene-d12(Surrogate)	LCS	L-012503-PAH	33.2	DFG-WPCL
Perylene-d12(Surrogate)	LabBlank	L-060203-PAH	33.8	DFG-WPCL
Perylene-d12(Surrogate)	202PES070	L-012503-PAH	17	DFG-WPCL
Perylene-d12(Surrogate)	LabBlank	L-012503-PAH	46.2	DFG-WPCL
Perylene-d12(Surrogate)	202PES070	L-070602-PAH	49.6	DFG-WPCL
Perylene-d12(Surrogate)	202SGR080	L-012503-PAH	25.9	DFG-WPCL
Perylene-d12(Surrogate)	202SGR010	L-012503-PAH	15.3	DFG-WPCL
Perylene-d12(Surrogate)	205STE060	L-012503-PAH	29.8	DFG-WPCL

Appendix C-4: Data batches missing MS/MSDs

Batch ID	BatchQualCode	BatchValCode	Notes	Lab
23ELGC	A,VMD	VAC,VI	QAO: No MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
3ELGC	A,VMD	VAC,VI	QAO: no MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	DFG-WPCL
L-058-01-aNO3	A,VMD	VAC,VI	QAO: no CRM or MS/MSD	DFG-WPCL
L-093001-OCH	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L-093001-OPP	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L-093001-PAH	A,VMD	VAC,VI	QAO: no LCS or MS/MSD, a DUP was performed	DFG-WPCL
L-093001-PCB	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L-101001-OCH	A,MD	VAC,VI	QAO: no blank for 10/7/2001, MS/MSD RPD for endosulfan I above QC limit of 25%	DFG-WPCL
L39801_BS179_KR_CONG	A,VMD	VAC,VI	QAO:no QC for 11/20/01; LCS %R outside QC limit for PCB-29, PCB-56, PCB-60; MS/MSD %R PCB-029 and PCB-056	DFG-WPCL
L39801BS179_KRPEST	A,VMD	VAC,VI	QAO:no QC for 11/20/01; LCS %R outside QC limit for several compounds; MS/MSD %R and RPD outside QC limit for several compounds	DFG-WPCL
R2-071002-ICP	A,VMD	VAC,VI	QAO: no blank or CRM; MS/MSD %Rs outside QC limit of 75-125	MPSL-DFG
39ELGC	A,VMD	VAC,VI	QAO: no MS/MSD or LCM	UCD-GC
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	DFG-WPCL
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	DFG-WPCL
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	DFG-WPCL
012403-TKN-1	A,VMD	VAC,VI	QAO: no MS/MSD	DFG-WPCL
021103-TPHOS-1	A,VMD	VAC,VI	QAO: no MS/MSD	DFG-WPCL
23ELGC	A,VMD	VAC,VI	QAO: No MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
39ELGC	A,VMD	VAC,VI	QAO: no MS/MSD or LCM	UCD-GC
L-012503-OCH	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; MS/MSD RPD for p'p'-DDD was above QC limit	DFG-WPCL
L-012503-OP	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; Both MS/MSD RPDs above 25% for coumaphos, demeton-s, tetrachlorvinphos	DFG-WPCL
L-012503-PAH	A,MD	VAC,VI	QAO:no LCS or MS/MSD for 1/25/03, no QC for 1/31/03, no blank for 1/29/03	DFG-WPCL
L-012503-PCB	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03	DFG-WPCL
L-012503-TRIAZ	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03, MS/MSD RPD out for Ametryn	DFG-WPCL
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	DFG-WPCL
L-050302-PAH	A,VMD	VAC,VI	QAO: no blank, MS/MSD, LCS for 4/22/02, no blank for 4/23/02	DFG-WPCL
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	DFG-WPCL
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	DFG-WPCL
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	DFG-WPCL
R2-070102-B	A,VMD	VAC,VI	QAO: no CRM, MS/MSD on non-SWAMP sample, lab would not provide confirmation of prep and digest methods and dates	Babcock

Appendix C-5: Data batches containing MS/MSD % Recovery and RDP values outside of acceptance criteria

Analyte	StationCode	Sample Date	MatrixName	LabBatch	MS %R	MSD %R	RPD	Laboratory
(o,p') DDT	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	50.7256	65.63707	25.629	DFG-WPCL
(p,p') DCBP	206WIL020	6/17/2002	sediment	L_121_03_BS 241_KR_PESTICIDES	0	0	0	DFG-WPCL
(p,p') DDD	202SGR080	1/22/2003	samplewater	L-012503-OCH	75	108.5	36.512	DFG-WPCL
2-Methylnaphthalene	201LAG270	10/1/2001	sediment	L-010902-PAH	65.1163	45.73643	34.965	DFG-WPCL
alpha Chlordene	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	58.7071	86.61519	38.409	DFG-WPCL
Ametryn	204SMA020	1/23/2003	samplewater	L-012503-Triaz	73.00	102.00	33.14	DFG-WPCL
Anthracene	206WIL020	6/17/2002	sediment	L-060203-PAH	164.82	123.0986	28.981	DFG-WPCL
Benz(a)anthracene	206WIL020	6/17/2002	sediment	L-060203-PAH	0	0	0	DFG-WPCL
Benzo(a)pyrene	206WIL020	6/17/2002	sediment	L-060203-PAH	164.74	93.78531	54.892	DFG-WPCL
Benzo(b)fluoranthene	206WIL020	6/17/2002	sediment	L-060203-PAH	0	0	0	DFG-WPCL
Benzo(k)fluoranthene	204ALP010	9/18/2001	sediment	L-021902-PAH	50	35.19553	34.754	DFG-WPCL
Benzo(k)fluoranthene	206WIL020	6/17/2002	sediment	L-060203-PAH	122.599	88.20225	32.634	DFG-WPCL
Biphenyl	201LAG270	10/1/2001	sediment	L-010902-PAH	68.9922	44.18605	43.836	DFG-WPCL
C1- Naphthalenes	204ALP010	9/18/2001	sediment	L-021902-PAH	206.881	197.1429	4.8204	DFG-WPCL
C1- Naphthalenes	206WIL020	6/17/2002	sediment	L-060203-PAH	193.296	205.6497	6.1931	DFG-WPCL
C1- Phenanthrene/Anthracene	201LAG270	10/1/2001	sediment	L-010902-PAH	51.5385	30.23256	52.111	DFG-WPCL
C2-Naphthalenes	201LAG270	10/1/2001	sediment	L-010902-PAH	83.7209	50.3876	49.711	DFG-WPCL
Chlorpyrifos	204ALP010	9/18/2001	samplewater	1ELGC	148	NA	NA	UCD-GC
Chlorpyrifos	204SLE230	9/19/2001	samplewater	2ELGC	140	NA	NA	UCD-GC
Chlorpyrifos	201LAG270	10/1/2001	sediment	L39801BS179_KRPEST	49.4832	21.28744	79.682	DFG-WPCL
Chlorpyrifos	201LAG270	10/1/2001	sediment	L39801BS179_KRPEST	49.4832	21.28744	79.682	DFG-WPCL
Chrysene	206WIL020	6/17/2002	sediment	L-060203-PAH	116.571	48.31461	82.793	DFG-WPCL
Coumaphos	202PES070	1/22/2003	samplewater	L-012503-OP	75.5	103	30.812	DFG-WPCL
delta HCH	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	0	0	0	DFG-WPCL
delta HCH	201LAG270	10/1/2001	sediment	L39801BS179_KRPEST	0	0	0	DFG-WPCL
Demeton-s	202PES070	1/22/2003	samplewater	L-012503-OP	69	98	34.731	DFG-WPCL
Diazinon	205STE060	1/23/2003	samplewater	63ELGC	153	NA	NA	UCD-GC
Dichlorvos	207SUI010	4/18/2002	samplewater	L-041802-OPP	101	72	34	DFG-WPCL
Dichlorvos	202BUT010	4/16/2002	samplewater	L-050302-OPP	74.5	114	41.91	DFG-WPCL
Dioxathion	202SGR080	6/18/2002	samplewater	L-070602-OPP	110	67	48	DFG-WPCL
Dissolved Cadmium	207KIR115	1/21/2003	samplewater	ICP040803	88.00	72.00	6.27	MPSL-DFG
Endosulfan I	207SUI010	10/2/2001	samplewater	L-101001-OCH	79.3	111	33.316	DFG-WPCL
Endosulfan sulfate	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	43.9974	45.17375	2.6385	DFG-WPCL
Endosulfan sulfate	201LAG270	10/1/2001	sediment	L39801BS179_KRPEST	35.3609	33.33401	5.9011	DFG-WPCL
Fenchlorphos	202SGR080	6/18/2002	samplewater	L-070602-OPP	119	70.5	51.187	DFG-WPCL
Fensulfothion	202PES070	1/22/2003	samplewater	L-012503-OP	75	99.5	28.08	DFG-WPCL
Fensulfothion	202SGR080	6/18/2002	samplewater	L-070602-OPP	107	82.7	25.619	DFG-WPCL
Fluoranthene	206WIL020	6/17/2002	sediment	L-060203-PAH	115.06	70.62147	47.866	DFG-WPCL
gamma Chlordene	202PES050	4/16/2002	samplewater	L-050302-OCH	120	72.2	49.74	DFG-WPCL
gamma HCH	202PES050	4/16/2002	samplewater	L-050302-OCH	90	56	46	DFG-WPCL
Heptachlor	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	0	12.99871	200	DFG-WPCL
Heptachlor	201LAG270	10/1/2001	sediment	L39801BS179_KRPEST	17.3256	0	200	DFG-WPCL
Heptachlor epoxide	204ALP010	9/18/2001	sediment	L39801BS178_KRPEST	131.32	151.3889	14.198	DFG-WPCL
Methyl Chlorpyrifos	202SGR080	6/18/2002	samplewater	L-070602-OPP	112	69	48	DFG-WPCL
Mevinphos	202PES070	1/22/2003	samplewater	L-012503-OP	84.5	61.5	31.507	DFG-WPCL
Naled(Dibrom)	202SGR080	6/18/2002	samplewater	L-070602-OPP	90	120	28	DFG-WPCL
Naphthalene	201LAG040	4/18/2002	samplewater	L-041802-PAH	87.3	114	26.528	DFG-WPCL
Nitrite as N	204SMA020	1/23/2003	samplewater	012403-NO2	103	76	30	DFG-WPCL
OrthoPhosphate as P	204SMA020	1/23/2003	samplewater	012403-OPO4	124	152	21	DFG-WPCL
Oxadiazon	206WIL020	6/17/2002	sediment	L_121_03_BS 241_KR_PESTICIDES	271.63	169.6713	46.208	DFG-WPCL
Oxadiazon	202PES050	4/16/2002	samplewater	L-050302-OCH	119	82.7	35.994	DFG-WPCL
PCB 029	204ALP010	9/18/2001	sediment	L39801_BS178_KR_CONG	36.1	48.3	28.91	DFG-WPCL
PCB 029	201LAG270	10/1/2001	sediment	L39801_BS179_KR_CONG	61.2	38.1	46.526	DFG-WPCL
PCB 056	204ALP010	9/18/2001	sediment	L39801_BS178_KR_CONG	42.7	55.5	26.069	DFG-WPCL
PCB 056	201LAG270	10/1/2001	sediment	L39801_BS179_KR_CONG	57.8	43.1	29.138	DFG-WPCL
PCB 095	202SGR010	4/16/2002	samplewater	L-050302-PCB	83.5	109	26.494	DFG-WPCL
PCB 101	202SGR010	4/16/2002	samplewater	L-050302-PCB	83.3	109	26.729	DFG-WPCL
PCB 110	206WIL020	6/17/2002	sediment	L_121_03_BS 241_KR_CONGENERS	75.3	104.5	32.481	DFG-WPCL
PCB 118	205PER070	4/11/2002	samplewater	L-042702-PCB	88	118	29.126	DFG-WPCL
PCB 158	202SGR010	4/16/2002	samplewater	L-050302-PCB	71.4	93.3	26.594	DFG-WPCL
Perylene	206WIL020	6/17/2002	sediment	L-060203-PAH	31.4607	44.63277	34.621	DFG-WPCL
Phenanthrene	201LAG270	10/1/2001	sediment	L-010902-PAH	48.4615	22.48062	73.245	DFG-WPCL
Phenanthrene	206WIL020	6/17/2002	sediment	L-060203-PAH	170.76	205.0847	18.265	DFG-WPCL
Phorate	202SGR080	6/18/2002	samplewater	L-070602-OPP	65.3	106	47.519	DFG-WPCL
Phosmet	202PES070	1/22/2003	samplewater	L-012503-OP	66	87	27.451	DFG-WPCL
Pyrene	206WIL020	6/17/2002	sediment	L-060203-PAH	97.619	57.38636	51.911	DFG-WPCL
Terbufos	202SGR080	6/18/2002	samplewater	L-070602-OPP	57.1	100	54.615	DFG-WPCL
Tetrachlorvinphos	202PES070	1/22/2003	samplewater	L-012503-OP	79.5	113	34.805	DFG-WPCL
Analyte	**StationCode**	**Sample Date**	**MatrixName**	**LabBatch**	**MS %R**	**MSD %R**	**RPD**	**Laboratory**

Appendix C-5: Data batches containing MS/MSD % Recovery and RDP values outside of acceptance criteria

Total Alumnium	201LAG130	4/8/2002	samplewater	R2-071002-ICP	21.00	23.00	9.09	MPSL-DFG
Total Arsenic	201LAG130	4/8/2002	samplewater	R2-071002-ICP	137.00	144.00	4.98	MPSL-DFG
Total Boron	207SUI020	6/17/2002	samplewater	R2-071002-B	73.00	NA	NA	SFL
Total Cadmium	201LAG130	4/8/2002	samplewater	R2-071002-ICP	100.00	150.00	40.00	MPSL-DFG
Total Chromium	201LAG130	4/8/2002	samplewater	R2-071002-ICP	1.00	0.00	200.00	MPSL-DFG
Total Chromium	204ALP010	9/18/2001	samplewater	R2-101001-ICP	37.79	NA	NA	MPSL-DFG
Total Copper	204ALP010	9/18/2001	samplewater	R2-101001-ICP	51.11	NA	NA	MPSL-DFG
Total Manganese	201LAG130	4/8/2002	samplewater	R2-071002-ICP	1.60	0.40	120.00	MPSL-DFG
Total Nickel	201LAG130	4/8/2002	samplewater	R2-071002-ICP	10.40	12.00	14.29	MPSL-DFG
Total Selenium	201LAG130	4/8/2002	samplewater	R2-071002-ICP	132.00	132.00	0.00	MPSL-DFG
Total Silver	201LAG130	4/8/2002	samplewater	R2-071002-ICP	150.00	150.00	0.00	MPSL-DFG

Appendix C-6: Data batches missing CRM, SRM, LCS or LCM

Batch ID	BatchQualCode	BatchValCode	Notes	Lab
AMS102901-1	A,VMD	VAC,VI	QAO: no DUP or SRM	AMS
AMS10401-1	A,VMD	VAC,VI	QAO: no blk, DUP, CRM	AMS
AMS92901-1	A,VMD	VAC,VI	QAO: no SRM	AMS
AMS62702-1	A,VMD	VAC,VI	QAO: no SRM	AMS
012703-TDS	A,VMD	VAC,VI	QAO: no blank or CRM	DFG-WPCL
012903-TDS	A,VMD	VAC,VI	QAO: no blank or CRM	DFG-WPCL
AMS62702-1	A,VMD	VAC,VI	QAO: no SRM	AMS
23ELGC	A,VMD	VAC,VI	QAO: No MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
3ELGC	A,VMD	VAC,VI	QAO: no MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
L-041802-OPP	A,VMD	VAC,VI	QAO: no blk for 4/15/2002 and no LCS for 4/12/2002	DFG-WPCL
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	DFG-WPCL
L-042702-OCH	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-042702-PCB	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-093001-OCH	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L-093001-OPP	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L-093001-PAH	A,VMD	VAC,VI	QAO: no LCS or MS/MSD, a DUP was performed	DFG-WPCL
L-093001-PCB	A,VMD	VAC,VI	QAO: no LCS or MS/MSD	DFG-WPCL
L39801_BS179_KR_CONG	A,VMD	VAC,VI	QAO:no QC for 11/20/01; LCS %R outside QC limit for PCB-29, PCB-56, PCB-60; MS/MSD %R PCB-029 and PCB-056	DFG-WPCL
L39801BS179_KRPEST	A,VMD	VAC,VI	QAO:no QC for 11/20/01; LCS %R outside QC limit for several compounds:CRM %R outside QC limit for trans chlordane, alpha HCH, cis Nonachlor	DFG-WPCL
39ELGC	A,VMD	VAC,VI	QAO: no MS/MSD or LCM	UCD-GC
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	DFG-WPCL
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	DFG-WPCL
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	DFG-WPCL
23ELGC	A,VMD	VAC,VI	QAO: No MS/MSD; LCM %R for chlorpyrifos above QAPP QC limit of 80-120	UCD-GC
25ELGC	A,VMD	VAC,VI	QAO: no MS, LCM %R for diazinon above QC limit of 80-120	UCD-GC
39ELGC	A,VMD	VAC,VI	QAO: no MS/MSD or LCM	UCD-GC
66ELGC	A,VMD	VAC,VI	QAO: no MS, LCM %R outside QC limit of 80-120, 0%R for diazinon, 123% for chlorpyrifos	UCD-GC
L-012503-OCH	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; MS/MSD RPD for p'p'-DDD was above QC limit	DFG-WPCL
L-012503-OP	A,VMD	VAC,VI	QAO: no QC (blank, MS/MSD, LCS) for extraction date 1/31/03; Both MS/MSD RPDs above 25% for coumaphos, demeton-s, tetrachlorvinphos	DFG-WPCL
L-012503-PAH	A,MD	VAC,VI	QAO:no LCS or MS/MSD for 1/25/03, no QC for 1/31/03, no blank for 1/29/03	DFG-WPCL
L-012503-PCB	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03	DFG-WPCL
L-012503-TRIAZ	A,VMD	VAC,VI	QAO: no QC(blank, MS/MSD, LCS) for extraction date 1/31/03, MS/MSD RPD out for Ametryn	DFG-WPCL
L-041802-OPP	A,VMD	VAC,VI	QAO: no blk for 4/15/2002 and no LCS for 4/12/2002	DFG-WPCL
L-041802-PAH	A,VMD	VAC,VI	QAO: no blank,MS/MSD,LCS for extraction date 4/15/2002;MS/MSD RPD for napthalene above QC limit	DFG-WPCL
L-042702-OCH	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-042702-PCB	A,VMD	VAC,VI	QAO: no CRM, no Blk for 4/15/02, no LCS for 4/12/02	DFG-WPCL
L-050302-PAH	A,VMD	VAC,VI	QAO: no blank, MS/MSD, LCS for 4/22/02, no blank for 4/23/02	DFG-WPCL
L-070602-OPP	A,VMD	VAC,VI	QAO: no LCS for 6/22/02, no blk, LCS, MS/MSD for 6/26/02, no blk, MS/MSD for 6/30/02, MS/MSD RPDs above QC limit of 25%	DFG-WPCL
L-071902-OCH	A,VMD	VAC,VI	QAO: associated blk, MS/MSD and LCS reported in batch L-072002-OCH	DFG-WPCL
L-071902-PCB	A,VMD	VAC,VI	QAO: no blank or LCS for 6/26 or 6/30, n0o MS/MSD for 6/22 or 6/30	DFG-WPCL

Appendix C-7: Data batches containing LCS, LCM and CRM % Recovery outliers

Analyte	Sample Type	Batch ID	%R	Laboratory
Benzo(g,h,i)perylene	LCS	L-012503-PAH	47	DFG-WPCL
Benzo(g,h,i)perylene	CRM	L-021902-PAH	176	DFG-WPCL
Benzo(k)fluoranthene	LCS	L-021902-PAH	28	DFG-WPCL
Benzo(k)fluoranthene	LCS	L-012503-PAH	48	DFG-WPCL
trans-Chlordane	CRM	L_121_03_BS 241_KR_PESTICIDES	168	DFG-WPCL
trans-Chlordane	CRM	L39801BS179_KRPEST	306	DFG-WPCL
trans-Chlordane	CRM	L39801BS178_KRPEST	401	DFG-WPCL
Chlorpyrifos	LCM	3ELGC	136	UCD-GC
Chlorpyrifos	LCS	L39801BS179_KRPEST	26	DFG-WPCL
Chlorpyrifos	LCM	66ELGC	123	UCD-GC
Chlorpyrifos	LCM	23ELGC	125	UCD-GC
Chlorpyrifos	LCM	1ELGC	134	UCD-GC
Chlorpyrifos	LCM	2ELGC	137	UCD-GC
DDT(p,p')	CRM	L39801BS178_KRPEST	194	DFG-WPCL
Diazinon	LCM	1ELGC	130	UCD-GC
Diazinon	LCM	2ELGC	128	UCD-GC
Diazinon	LCM	25ELGC	131	UCD-GC
Diazinon	LCM	66ELGC	-12	UCD-GC
Endosulfan sulfate	LCS	L39801BS178_KRPEST	38	DFG-WPCL
Endosulfan sulfate	LCS	L39801BS179_KRPEST	33	DFG-WPCL
HCH, alpha	CRM	L39801BS179_KRPEST	-48	DFG-WPCL
HCH, alpha	CRM	L_121_03_BS 241_KR_PESTICIDES	-47	DFG-WPCL
HCH, alpha	CRM	L39801BS178_KRPEST	-47	DFG-WPCL
HCH, delta	LCS	L39801BS178_KRPEST	-4	DFG-WPCL
HCH, delta	LCS	L39801BS179_KRPEST	-4	DFG-WPCL
Heptachlor	LCS	L39801BS179_KRPEST	-5	DFG-WPCL
Heptachlor	LCS	L39801BS178_KRPEST	18	DFG-WPCL
Indeno(1,2,3-c,d)pyrene	LCS	L-012503-PAH	158	DFG-WPCL
Indeno(1,2,3-c,d)pyrene	CRM	L-010902-PAH	151	DFG-WPCL
Indeno(1,2,3-c,d)pyrene	CRM	L-021902-PAH	294	DFG-WPCL
Manganese	CRM	2002Dig7	65	MPSL-DFG
C1 - Naphthalenes	LCS	L-010902-PAH	209	DFG-WPCL
C1 - Naphthalenes	LCS	L-021902-PAH	249	DFG-WPCL
C1 - Naphthalenes	LCS	L-012503-PAH	220	DFG-WPCL
C1 - Naphthalenes	LCS	L-060203-PAH	187	DFG-WPCL
cis-Nonachlor	CRM	L39801BS179_KRPEST	-53	DFG-WPCL
PCB 029	LCS	L39801_BS179_KR_CONG	33	DFG-WPCL
PCB 056	LCS	L39801_BS179_KR_CONG	36	DFG-WPCL
PCB 060	LCS	L39801_BS179_KR_CONG	48	DFG-WPCL
Perylene	CRM	L-021902-PAH	45	DFG-WPCL
Perylene	CRM	L-060203-PAH	47	DFG-WPCL
Silver	CRM	2002Dig7	128	MPSL-DFG

Appendix C-8: Batches containing field duplicated RPD outliers

Analyte	Site	Field Sample	Field Duplicate	Unit	RPD	Laboratory
Aluminum	206PET310	18.7	6.03	µg/L	102	MPSL-DFG
Benzo(b)fluoranthene	204ALP010	9.24	6.91	ng/g	29	DFG-WPCL
Benzo(b)fluoranthene	205PER010	0.035	-0.02	µg/L	200	DFG-WPCL
Benzo(b)fluoranthene	206WIL020	-0.02	0.035	µg/L	200	DFG-WPCL
Benzo(g,h,i)perylene	205PER010	0.057	-0.02	µg/L	200	DFG-WPCL
Benzo(g,h,i)perylene	206WIL020	-0.02	0.035	µg/L	200	DFG-WPCL
Benzo(k)fluoranthene	204ALP010	-0.02	0.035	µg/L	200	DFG-WPCL
Benzo(k)fluoranthene	204ALP010	-1.83	5.45	ng/g	200	DFG-WPCL
Benzo(k)fluoranthene	205PER010	0.035	-0.02	µg/L	200	DFG-WPCL
Benzo(k)fluoranthene	205PER010	131	99.8	ng/g	27	DFG-WPCL
Benzo(k)fluoranthene	206WIL020	-0.02	0.035	µg/L	200	DFG-WPCL
Chrysene	204ALP010	-0.02	0.035	µg/L	200	DFG-WPCL
C2-Chrysenes	204ALP010	5.83	4.12	ng/g	34	DFG-WPCL
C3-Chrysenes	204ALP010	6.7	-1.61	ng/g	200	DFG-WPCL
Dibenz(a,h)anthracene	204ALP010	4.07	2.96	ng/g	32	DFG-WPCL
Dibenzothiophene	204ALP010	4.49	-1.61	ng/g	200	DFG-WPCL
2,6, - Dimethylnaphthalene	205PER010	9.17	15.3	ng/g	50	DFG-WPCL
Fluoranthene	205PER010	468	-2	ng/g	200	DFG-WPCL
C3-Naphthalenes	205PER010	17.1	25.8	ng/g	40	DFG-WPCL
C4-Naphthalenes	205PER010	5.77	8.37	ng/g	37	DFG-WPCL
PCB 027	204ALP010	0.212	0.564	ng/g	91	DFG-WPCL
PCB 028	204ALP010	-0.191	0.167	ng/g	200	DFG-WPCL
PCB 031	204ALP010	0.233	-0.166	ng/g	200	DFG-WPCL
PCB 033	204ALP010	1.05	0.322	ng/g	106	DFG-WPCL
PCB 066	204ALP010	-0.191	0.181	ng/g	200	DFG-WPCL
PCB 070	204ALP010	-0.191	0.19	ng/g	200	DFG-WPCL
PCB 087	204ALP010	0.198	-0.166	ng/g	200	DFG-WPCL
Perylene	206WIL020	0.08	-0.02	µg/L	200	DFG-WPCL
Phenanthrene	206WIL020	0.035	-0.02	µg/L	200	DFG-WPCL
Pyrene	205PER010	0.035	-0.02	µg/L	200	DFG-WPCL
Suspended Sediment Concentration	205PER010	2.9	-0.1	mg/L	200	AMS
2,3,5-Trimethylnaphthalene	204ALP010	0.035	-0.02	µg/L	200	DFG-WPCL
2,3,5-Trimethylnaphthalene	205PER010	3.76	5.41	ng/g	36	DFG-WPCL

Appendix C-9: Batches missing laboratory duplicates

Batch ID	BatchQualCode	BatchValCode	Notes	Lab
AMS102901-1	A,VMD	VAC,VI	QAO: no DUP or SRM	AMS
AMS10401-1	A,VMD	VAC,VI	QAO: no blk, DUP, CRM	AMS
AMS10901-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS12902-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS12902-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS12902-3	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS2102-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41102-4	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41102-5	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41201-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41202-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS91901-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSDOC21102-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC21302-1	A,VMD	VAC,VI	LAB:all samples were lab filtered within 3 days of collectionQA: no blk, DUP	AMS
AMSDOC5302-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-2	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSTOC2902-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSTOC2902-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSTOC5302-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSTOC5402-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSTOC5402-2	A,VMD	VAC,VI	QAO: no DUP	AMS
L-093001-PAH	A,VMD	VAC,VI	QAO: no LCS or MS/MSD, a DUP was performed	DFG-WPCL
L-424-01-TDS	A,VMD	VAC,VI	QAO: no DUP	DFG-WPCL
L-430-01-TKN	A,VMD	VAC,VI	QAO: no MS or DUP	DFG-WPCL
L-442-01-TDS	A,VMD	VAC,VI	QAO: no blank, MS, DUP	DFG-WPCL
L-442-01-TSS	A,VMD	VAC,VI	QAO: no MS or DUP	DFG-WPCL
R2-013002-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blank or DUP	MPSL-DFG
R2-013002-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blk or DUP	MPSL-DFG
R2-100101-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collection QAO: no blank or DUP	MPSL-DFG
R2-100101-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blak or DUP	MPSL-DFG
R2-101001-Chl	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collection QAO: no blk or DUP	MPSL-DFG
R2-101001-Ph	A,VMD	VAC,VI	LAB:all samples were field filtered on the date of collectionQAO: no blk or DUP	MPSL-DFG
AMS62102-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS62102-3	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSDOC62402-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC62402-2	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
021403-4	A,VMD	VAC,VI	LAB:all samples were acidified within 48 hours of collectionQAO: no DUP	AMS
021403-6	A,VMD	VAC,VI	LAB:all samples were lab filtered within 48 hours of collectionQAO: no DUP	AMS
63ELGC	A,VMD	VAC,VI	QAO: no DUP, MS %R for diazinon outside QC limit of 80-120	UCD-GC
AMS41201-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41202-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS41802-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS62102-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMS62102-2	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSDOC51102-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-2	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC5402-3	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC62302-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSDOC62402-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSTOC51102-1	A,VMD	VAC,VI	QAO: no blk, DUP	AMS
AMSTOC5402-1	A,VMD	VAC,VI	QAO: no DUP	AMS
AMSTOC5402-2	A,VMD	VAC,VI	QAO: no DUP	AMS
SSC03-0002	A,VMD	VAC,VI	LAB:all samples were lab filtered on the analysis dateQAO: no DUP	MPSL-DFG

Appendix C-10: Data batches with laboratory duplicates containing RPD outliers

Analyte	Site	Parent Value	Duplicate Value	Unit	RPD	Laboratory	Batch ID
Acenaphthene	201LAG120	3.76	-1.45	ng/g	200	DFG-WPCL	L-060203-PAH
Aluminum	403STCNRB	23234	40000	mg/Kg	57	MPSL-DFG	2002Dig7
Benz(a)anthracene	201LAG120	2.87	-1.45	ng/g	200	DFG-WPCL	L-060203-PAH
Benzo(a)pyrene	201LAG120	1.64	-1.45	ng/g	200	DFG-WPCL	L-060203-PAH
Benzo(b)fluoranthene	201LAG120	6.11	2.6	ng/g	80	DFG-WPCL	L-060203-PAH
Benzo(e)pyrene	206SPA020	27.9	21.5	ng/g	26	DFG-WPCL	L-010902-PAH
Benzo(g,h,i)perylene	206SPA020	25.6	3.41	ng/g	153	DFG-WPCL	L-010902-PAH
Benzo(g,h,i)perylene	206SPA020	33.3	6.56	ng/g	134	DFG-WPCL	L-010902-PAH
Benzo(k)fluoranthene	204ALP010	-1.58	5.45	ng/g	200	DFG-WPCL	L-021902-PAH
Biphenyl	206SPA020	3.82	31.6	ng/g	157	DFG-WPCL	L-010902-PAH
Biphenyl	201LAG120	4.65	-2.38	ng/g	200	DFG-WPCL	L-060203-PAH
Chromium	403STCNRB	15.5	22.9	mg/Kg	42	MPSL-DFG	2002Dig7
Chrysene	201LAG120	3.83	11.5	ng/g	100	DFG-WPCL	L-060203-PAH
C1-Chrysenes	201LAG120	2.62	13	ng/g	133	DFG-WPCL	L-060203-PAH
C2-Chrysenes	201LAG120	1.65	9.35	ng/g	140	DFG-WPCL	L-060203-PAH
C3-Chrysenes	204ALP010	5.77	-1.61	ng/g	200	DFG-WPCL	L-021902-PAH
C3-Chrysenes	201LAG120	-1.45	5.92	ng/g	200	DFG-WPCL	L-060203-PAH
Dibenz(a,h)anthracene	201LAG120	14.1	2.6	ng/g	138	DFG-WPCL	L-060203-PAH
Dibenzothiophene	204ALP010	3.58	-1.61	ng/g	200	DFG-WPCL	L-021902-PAH
C1-Dibenzothiophenes	201LAG120	2.05	70.6	ng/g	189	DFG-WPCL	L-060203-PAH
C1-Dibenzothiophenes	206SPA020	44.8	-1.45	ng/g	200	DFG-WPCL	L-010902-PAH
C2-Dibenzothiophenes	206SPA020	52.6	-1.45	ng/g	200	DFG-WPCL	L-010902-PAH
C2-Dibenzothiophenes	206SPA020	73.8	1.95	ng/g	190	DFG-WPCL	L-010902-PAH
C3-Dibenzothiophenes	206SPA020	65.8	50	ng/g	27	DFG-WPCL	L-010902-PAH
2,6-Dimethylnaphthalene	204ALP010	-1.61	3.45	ng/g	200	DFG-WPCL	L-021902-PAH
2,6-Dimethylnaphthalene	201LAG120	35.7	4.64	ng/g	154	DFG-WPCL	L-060203-PAH
Fluoranthene	201LAG120	1.86	5.21	ng/g	95	DFG-WPCL	L-060203-PAH
C1-Fluoranthene/Pyrenes	201LAG120	3.02	12.9	ng/g	124	DFG-WPCL	L-060203-PAH
C1-Fluoranthene/Pyrenes	204ALP010	1.97	2.79	ng/g	34	DFG-WPCL	L-021902-PAH
Fluorene	206SPA020	2.52	-1.45	ng/g	200	DFG-WPCL	L-010902-PAH
Fluorene	206SPA020	-2.38	2.37	ng/g	200	DFG-WPCL	L-010902-PAH
C2-Fluorenes	204ALP010	3.62	6.06	ng/g	50	DFG-WPCL	L-021902-PAH
C2-Fluorenes	206SPA020	4.82	7.44	ng/g	43	DFG-WPCL	L-010902-PAH
C3-Fluorenes	206SPA020	7.28	22.1	ng/g	100	DFG-WPCL	L-010902-PAH
Heptachlor epoxide	204ALP010	2.21	1.58	ng/g	33	DFG-WPCL	L39801BS178_KRPEST
Indeno(1,2,3-c,d)pyrene	204ALP010	6.91	3.09	ng/g	76	DFG-WPCL	L-021902-PAH
Indeno(1,2,3-c,d)pyrene	201LAG120	9.56	4.19	ng/g	78	DFG-WPCL	L-060203-PAH
Mercury	403STCNRB	0.169	0.104	mg/Kg	48	MPSL-DFG	2002Dig7Hg
1-Methylnaphthalene	201LAG120	46.4	4.03	ng/g	168	DFG-WPCL	L-060203-PAH
1-Methylnaphthalene	206SPA020	-2.34	4.61	ng/g	200	DFG-WPCL	L-010902-PAH
2-Methylnaphthalene	201LAG120	6.11	10.6	ng/g	54	DFG-WPCL	L-060203-PAH
2-Methylnaphthalene	206SPA020	6.11	47.9	ng/g	155	DFG-WPCL	L-010902-PAH
1-Methylphenanthrene	201LAG120	2.01	15.5	ng/g	154	DFG-WPCL	L-060203-PAH
Naphthalene	201LAG120	4.98	61.2	ng/g	170	DFG-WPCL	L-060203-PAH
Naphthalene	206SPA020	15.1	8.95	ng/g	51	DFG-WPCL	L-010902-PAH
C1-Naphthalenes	206SPA020	19.4	-1.61	ng/g	200	DFG-WPCL	L-010902-PAH
C1-Naphthalenes	204ALP010	2.28	77.6	ng/g	188	DFG-WPCL	L-021902-PAH
C2-Naphthalenes	206SPA020	17.6	12	ng/g	38	DFG-WPCL	L-010902-PAH
C2-Naphthalenes	204ALP010	6.4	2.22	ng/g	97	DFG-WPCL	L-021902-PAH
C2-Naphthalenes	201LAG120	14	66.7	ng/g	131	DFG-WPCL	L-060203-PAH
C3-Naphthalenes	206SPA020	11.6	41.8	ng/g	113	DFG-WPCL	L-010902-PAH
C3-Naphthalenes	204ALP010	2.22	8.05	ng/g	113	DFG-WPCL	L-021902-PAH
C3-Naphthalenes	201LAG120	10.6	2.08	ng/g	134	DFG-WPCL	L-060203-PAH
C4-Naphthalenes	206SPA020	-2.38	2.23	ng/g	200	DFG-WPCL	L-010902-PAH
C4-Naphthalenes	206SPA020	2.83	12.3	ng/g	125	DFG-WPCL	L-010902-PAH
PCB 027	204ALP010	0.564	0.316	ng/g	56	DFG-WPCL	L39801_BS178_KR_CONG
PCB 028	204ALP010	0.167	-0.169	ng/g	200	DFG-WPCL	L39801_BS178_KR_CONG
PCB 031	204ALP010	0.249	-0.166	ng/g	200	DFG-WPCL	L39801_BS178_KR_CONG
PCB 033	204ALP010	-0.169	0.322	ng/g	200	DFG-WPCL	L39801_BS178_KR_CONG
PCB 066	204ALP010	0.181	-0.169	ng/g	200	DFG-WPCL	L39801_BS178_KR_CONG
Analyte	**Site**	**Parent Value**	**Duplicate Value**	**Unit**	**RPD**	**Laboratory**	**Batch ID**
Phenanthrene	201LAG120	49	14.8	ng/g	107	DFG-WPCL	L-060203-PAH
Phenanthrene	206SPA020	21.2	27.7	ng/g	26	DFG-WPCL	L-010902-PAH
C1-Phenanthrene/Anthracene	201LAG120	70.1	22.5	ng/g	103	DFG-WPCL	L-060203-PAH
C1-Phenanthrene/Anthracene	204ALP010	7.65	4.81	ng/g	46	DFG-WPCL	L-021902-PAH
C2-Phenanthrene/Anthracene	206SPA020	17.9	10.4	ng/g	53	DFG-WPCL	L-010902-PAH

Appendix C-10: Data batches with laboratory duplicates containing RPD outliers

C2-Phenanthrene/Anthracene	206SPA020	24.1	62.4	ng/g	88	DFG-WPCL	L-010902-PAH
C3-Phenanthrene/Anthracene	201LAG120	3.67	18.6	ng/g	134	DFG-WPCL	L-060203-PAH
C4-Phenanthrene/Anthracene	206SPA020	23.9	5.27	ng/g	128	DFG-WPCL	L-010902-PAH
C4-Phenanthrene/Anthracene	206SPA020	17.6	-1.45	ng/g	200	DFG-WPCL	L-010902-PAH
Pyrene	201LAG120	8.52	50.3	ng/g	142	DFG-WPCL	L-060203-PAH
Pyrene	206SPA020	37.7	2.58	ng/g	174	DFG-WPCL	L-010902-PAH
2,3,5-Trimethylnaphthalene	201LAG120	1.86	7.93	ng/g	124	DFG-WPCL	L-060203-PAH

Appendix D-1: Summary of continuous field measures in Walker Creek Watershed

		Winter		Spring			Late Spring		Late Summer			
	Station	WLK160	WLK180	WLK100	WLK140	WLK200	WLK160	WLK180	WLK140	WLK160	WLK180	WLK200
	Start Date	1/21/2002	2/15/2002	3/5/2002	3/5/2002	3/5/2002	5/23/2002	5/23/2002	8/16/2002	8/16/2002	8/16/2002	8/16/2002
	End Date	2/5/2002	2/23/2002	3/19/2002	3/19/2002	3/19/2002	5/30/2002	5/30/2002	8/21/2002	8/21/2002	8/21/2002	8/21/2002
	Data points	1445	790	1343	1346	1344	672	671	490	476	469	464
Temperature (°C)	Min.	5.66	7.82	7.54	6.99	9.90	12.05	11.50	13.99	13.57	13.91	13.40
	0.25	7.17	9.94	10.35	9.58	10.59	14.40	13.99	14.68	14.39	14.84	13.71
	Median	8.04	11.22	11.15	10.84	11.27	15.54	15.11	15.47	15.12	15.20	13.81
	0.75	8.88	11.91	12.48	11.50	11.88	17.13	16.52	16.07	16.42	16.01	14.15
	Max.	10.72	14.33	14.20	13.02	13.19	20.92	18.42	17.72	18.64	17.12	15.42
	HWAT	8.1	11.1	11.8	11.1	11.6	15.9	15.2				
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid,5	Valid,5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.32	7.36	7.63	6.63	7.08	7.42	7.30	7.55	7.64	7.08	7.05
	0.25	7.66	7.42	7.70	7.42	7.21	7.47	7.63	7.60	7.71	7.16	7.07
	Median	7.70	7.57	7.76	7.47	7.32	7.74	7.65	7.65	7.76	7.20	7.10
	0.75	7.76	7.67	7.86	7.55	7.54	8.71	7.75	7.74	7.91	7.27	7.12
	Max.	8.31	8.02	8.09	7.81	8.13	9.07	7.99	7.84	8.18	7.37	7.31
	Data Quality Objective: +/- 0.50 pH units	0.10	0.02	0.02	0.02	0.10	0.13	0.16	0.10	0.11	0.06	0.03
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 3	Valid	Valid	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3
Dissolved Oxygen (%)	Min.	96.60	95.40	96.60	97.50	89.90	82.90	63.20	90.00	90.00	43.60	80.10
	0.25	105.30	97.70	101.30	99.70	99.08	86.90	86.80	91.20	91.80	64.60	80.80
	Median	108.00	100.20	103.10	100.90	100.60	95.10	88.20	92.80	93.60	68.30	82.20
	0.75	110.40	101.10	109.45	106.70	108.83	114.10	94.80	96.70	99.53	70.80	85.90
	Max.	121.30	107.90	123.90	126.90	134.90	127.30	104.90	101.00	107.10	79.40	94.00
	Data Quality Objective: +/- 5.0%	11.00	2.40	3.00	3.90	5.00	5.60	2.90	0.70	0.40	1.80	0.60
	QA Qualifier	rejected	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	rejected	Valid	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3
Dissolved Oxygen (mg/L)	Min.	11.22	10.35	10.29	10.54	9.86	7.98	5.93	8.77	8.81	4.20	8.31
	0.25	12.40	10.82	11.03	11.03	10.94	8.79	8.77	9.14	9.18	6.43	8.38
	Median	12.83	11.00	11.46	11.39	11.13	9.48	9.05	9.40	9.52	6.84	8.51
	0.75	13.26	11.12	12.13	11.91	11.84	11.03	9.47	9.61	9.88	7.13	8.83
	Max.	14.22	12.22	13.58	13.94	14.43	12.57	10.58	9.94	10.37	8.10	9.42
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	rejected	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	rejected	Valid	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3
Specific Conductance (µS/cm)	Min.	155	rejected	211	146	152	NA	261	162	161	283	161
	0.25	159	rejected	261	155	155	NA	267	163	162	284	161
	Median	163	rejected	266	158	155	NA	268	164	163	285	162
	0.75	165	rejected	270	161	156	NA	269	164	163	286	162
	Max.	171	rejected	285	172	158	NA	273	167	165	289	162
	Data Quality Objective: +/- 50 uS/cm	3	0.11	4	29	2	NA	30	2	6	0	8
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	NA	Valid	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3

Appendix D-2: Summary of continuous field measures in Lagunitas Creek Watershed

		Winter Wet			Spring Wet				
	Station	**LAG050**	**LAG160**	**LAG270**	**LAG050**	**LAG085**	**LAG160**	**LAG165**	**LAG270**
	Start Date	2/15/2002	1/21/2002	1/6/2002	5/23/2002	5/9/2002	5/23/2002	5/23/2002	5/8/2002
	End date	3/1/2002	2/5/2002	1/21/2002	5/30/2002	5/21/2002	5/30/2002	5/30/2002	5/21/2002
	Data points	1336	1457	1415	669	1159	654	669	1153
Temperature (°C)	Min.	9.05	4.07	5.93	11.35	9.26	12.26	11.60	10.08
	0.25	9.81	5.82	7.28	13.62	10.85	13.40	13.65	11.59
	Median	10.51	6.40	9.69	14.76	11.50	14.01	14.36	12.02
	0.75	11.06	7.26	10.97	15.93	12.67	14.57	15.04	12.66
	Max.	12.35	8.81	12.35	19.40	14.22	15.98	17.07	13.84
	HWAT		6.9	11.0	14.8	11.9		14.3	12.4
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.03	7.29	7.70	6.60	7.62	7.05	NA	7.74
	0.25	7.10	7.65	7.91	7.51	7.69	7.13	NA	7.82
	Median	7.20	7.67	7.95	7.53	7.72	7.18	NA	7.83
	0.75	7.27	7.75	7.97	7.63	7.79	7.32	NA	7.86
	Max.	7.41	8.15	8.00	7.71	7.88	7.52	NA	7.91
	Data Quality Objective: +/- 0.50 pH units	0.08	0.09	0.09	0.15	0.05	0.18	NA	0.03
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Rejected, 6	Valid
Dissolved Oxygen (%)	Min.	91.90	95.90	58.90	72.00	90.60	0.90	89.30	79.20
	0.25	98.30	99.40	66.10	86.30	91.60	23.85	90.90	83.50
	Median	99.30	102.60	76.00	88.40	92.80	51.40	92.90	85.40
	0.75	100.80	105.60	86.05	95.60	97.20	66.90	97.00	89.90
	Max.	103.30	123.00	104.10	103.40	103.10	81.80	100.90	95.10
	Data Quality Objective: +/- 5.0%	3.50	5.00	34.60	3.00	0.10	3.40	3.90	2.50
	QA Qualifier	Valid	Valid	Rejected	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	10.14	11.29	7.03	7.01	9.57	0.10	8.87	8.63
	0.25	10.93	12.24	7.93	8.87	10.00	2.41	9.35	8.99
	Median	11.15	12.69	8.56	9.12	10.16	5.26	9.55	9.23
	0.75	11.26	13.15	9.54	9.60	10.44	6.88	9.86	9.57
	Max.	11.56	14.76	11.18	10.27	10.96	8.76	10.61	10.16
	Data Quality Objective: +/- 0.5 mg/l	NA	NA	NA	NA	NA	NA	NA	NA
	QA Qualifier	Valid, 1	Valid, 1	Rejected	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	99.00	206.00	213.00	277.00	238.00	299.00	216.00	398.00
	0.25	119.00	220.00	259.00	289.00	243.00	306.00	217.00	450.00
	Median	147.00	224.00	291.00	290.00	248.00	317.00	218.00	454.00
	0.75	161.00	229.00	316.00	296.00	253.00	338.00	220.00	459.00
	Max.	195.00	236.00	332.00	528.00	292.00	410.00	221.00	463.00
	Data Quality Objective: +/- 50 uS/cm	20.00	17.00	17.00	13.00	2.00	14.00	3.00	7.00
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

Appendix D-2: Summary of continuous field measures in Lagunitas Creek Watershed

		Summer Dry				
	Station	**LAG050**	**LAG085**	**LAG165**	**LAG190**	**LAG270**
	Start Date	8/1/2002	8/1/2002	8/1/2002	8/1/2002	8/1/2002
	End date	8/13/2002	8/13/2002	8/13/2002	8/13/2002	8/13/2002
	Data points	1147	1148	1137	1148	1131
Temperature (°C)	Min.	13.05	13.14	13.18	11.65	13.23
	0.25	15.29	15.16	14.80	13.97	14.97
	Median	16.09	15.87	15.49	14.91	15.74
	0.75	17.46	16.69	16.26	15.78	16.36
	Max.	19.98	18.40	17.17	17.59	18.09
	HWAT	16.5	16.1	15.4	14.9	15.4
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.42	7.56	7.57	8.00	7.49
	0.25	7.47	7.67	7.61	8.04	7.70
	Median	7.52	7.70	7.63	8.05	7.78
	0.75	7.66	7.78	7.66	8.08	7.83
	Max.	7.92	7.93	7.72	8.13	7.97
	Data Quality Objective: +/- 0.50 pH units	0.10	0.12	0.03	0.06	0.11
	QA Qualifier	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (%)	Min.	72.10	70.10	86.40	89.10	56.00
	0.25	77.00	75.50	88.30	94.40	63.80
	Median	79.50	78.20	90.30	95.60	68.70
	0.75	92.95	86.40	93.40	96.90	74.30
	Max.	109.60	97.20	97.30	99.50	88.90
	Data Quality Objective: +/- 5.0%	3.60	0.30	0.80	0.80	2.00
	QA Qualifier	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	7.07	6.83	8.51	8.83	5.44
	0.25	7.61	7.48	8.81	9.41	6.36
	Median	8.00	7.89	9.06	9.67	6.86
	0.75	9.04	8.47	9.30	9.90	7.43
	Max.	10.29	9.37	9.83	10.55	8.76
	Data Quality Objective: +/- 0.5 mg/l	NA	NA	NA	NA	NA
	QA Qualifier	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	319.00	300.00	184.00	360.00	488.00
	0.25	321.00	303.00	185.00	361.00	491.00
	Median	322.00	304.00	186.00	362.00	497.00
	0.75	324.00	308.00	186.00	364.00	506.00
	Max.	340.00	310.00	187.00	366.00	514.00
	Data Quality Objective: +/- 50 uS/cm	2.00	6.00	8.00	0.00	6.00
	QA Qualifier	Valid	Valid	Valid	Valid	Valid

Appendix D-3: Summary of continuous field measures in San Leandro Creek Watershed

		Winter Wet			Spring Wet				
	Station	SLE050	SLE190	SLE210	SLE050	SLE170	SLE180	SLE190	SLE210
	Start Date	02/15/02	01/18/02	01/04/02	04/11/02	04/11/02	04/11/02	04/11/02	04/11/02
	End Date	03/01/02	02/05/02	01/18/02	04/23/02	04/23/02	04/23/02	04/23/02	04/23/02
	Data points	1339	1707	1355	1153	1151	1151	1162	1160
Temperature (°C)	Min.	9.37	3.51	4.51	10.09	6.97	7.31	7.66	8.47
	0.25	10.74	5.03	7.41	12.12	9.36	9.56	9.36	10.28
	Median	11.79	5.69	9.48	13.14	10.63	10.92	10.35	11.32
	0.75	12.53	6.36	10.78	14.98	12.18	12.38	11.73	12.92
	Max.	14.54	8.75	12.15	17.96	15.40	15.80	14.66	16.61
	HWAT	12.1	6.3	10.7	14.0	11.2	11.5	11.0	11.8
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.52	8.11	8.06	7.19	7.80	7.56	7.65	7.84
	0.25	7.88	8.25	8.16	7.34	7.95	7.64	8.00	8.02
	Median	8.01	8.27	8.20	7.46	7.97	7.66	8.01	8.04
	0.75	8.16	8.30	8.23	7.77	8.02	7.73	8.02	8.07
	Max.	8.41	8.31	8.28	8.22	8.11	7.84	8.06	8.66
	Data Quality Objective: +/- 0.50 pH units	0.07	0.09	0.09	0.02	0.04	0.06	0.03	0.05
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (%)	Min.	63.80	72.40	100.90	12.30	95.30	90.00	92.00	86.10
	0.25	79.10	80.20	104.80	38.30	97.80	92.00	94.20	88.90
	Median	88.60	88.70	108.00	50.80	99.60	93.20	95.30	90.75
	0.75	99.20	96.80	109.50	60.20	101.20	97.00	96.20	94.60
	Max.	125.30	109.10	111.30	96.00	105.40	105.50	98.60	101.90
	Data Quality Objective: +/- 5.0%	1.70	17.50	17.50	0.40	4.20	0.10	2.70	0.30
	QA Qualifier	Valid	Rejected	Rejected	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	7.17	9.22	11.58	1.24	9.66	9.26	9.41	8.85
	0.25	8.60	10.34	12.15	4.11	10.55	10.00	10.22	9.64
	Median	9.60	10.86	12.33	5.30	11.11	10.41	10.67	9.99
	0.75	10.78	12.08	12.57	6.28	11.55	10.83	10.99	10.26
	Max.	13.14	13.29	13.09	9.75	12.34	11.58	11.58	11.59
	Data Quality Objective: +/- 0.5 mg/l	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	QA Qualifier	Valid, 1	Rejected	Rejected	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	65	396	388	137	345	538	670	18
	0.25	416	636	484	551	458	568	775	629
	Median	567	655	529	609	462	568	782	656
	0.75	604	688	558	624	464	569	790	667
	Max.	620	701	573	654	468	573	800	678
	Data Quality Objective: +/- 50 uS/cm	45	10	10	3	3	9	7	10
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

Appendix D-3: Summary of continuous field measures in San Leandro Creek Watershed

		Summer Dry				Fall Dry			
	Station	**SLE070**	**SLE170**	**SLE190**	**SLE210**	**SLE090**	**SLE170**	**SLE190**	**SLE210**
	Start Date	05/31/02	05/31/02	05/31/02	05/31/02	10/15/2002	10/15/2002	10/15/2002	10/15/2002
	End Date	06/05/02	06/18/02	06/18/02	06/18/02	10/18/02	10/18/02	10/18/02	10/18/02
	Data points	373	1723	1722	1724	263	262	260	265
Temperature (°C)	Min.	13.20	10.85	10.95	12.67	14.63	11.99	11.53	11.57
	0.25	14.33	12.42	12.70	14.19	14.90	12.14	11.68	11.88
	Median	15.31	13.32	13.56	15.19	15.02	12.28	11.77	11.96
	0.75	16.19	14.19	14.36	16.42	15.10	12.53	11.97	12.21
	Max.	18.36	17.14	16.76	19.62	15.25	13.13	12.32	12.76
	HWAT		13.9	14.4	16.2				
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.39	7.47	7.85	7.83	7.14	7.00	7.79	7.27
	0.25	7.56	7.71	7.94	7.91	7.20	7.18	7.85	7.32
	Median	7.65	7.74	7.97	7.98	7.22	7.20	7.86	7.34
	0.75	7.78	7.77	8.00	8.07	7.26	7.21	7.86	7.36
	Max.	8.49	7.85	8.06	8.20	7.53	7.24	7.87	7.40
	Data Quality Objective: +/- 0.50 pH units	0.13	0.03	0.01	0.07	0.05	0.06	0.10	0.06
	QA Qualifier	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	11.50	85.50	83.10	67.60	33.10	40.40	80.60	9.80
	0.25	42.20	90.10	87.20	80.08	51.45	51.90	81.60	13.80
	Median	51.10	91.70	89.00	85.20	62.40	54.10	82.00	15.50
	0.75	58.70	93.70	90.70	97.00	78.90	55.70	82.50	21.80
	Max.	118.40	98.60	95.50	118.50	83.50	58.80	84.40	29.80
	Data Quality Objective: +/- 5.0%	2.60	2.60	2.90	0.20	4.30	4.50	2.10	0.30
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	1.14	8.43	8.14	6.88	3.33	4.30	8.71	1.05
	0.25	4.17	9.31	8.95	8.01	5.17	5.54	8.82	1.48
	Median	5.14	9.62	9.26	8.65	6.28	5.74	8.85	1.67
	0.75	5.99	9.90	9.54	9.57	7.97	5.97	8.89	2.35
	Max.	11.13	10.52	10.28	11.57	8.40	6.28	9.06	3.18
	Data Quality Objective: +/- 0.5 mg/l	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	QA Qualifier	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	521	454	869	650	559	460	974	669
	0.25	557	457	879	677	539	459	970	667
	Median	612	458	893	681	566	461	976	670
	0.75	624	460	906	684	575	461	978	673
	Max.	629	467	913	702	591	465	979	680
	Data Quality Objective: +/- 50 uS/cm	15	15	29	17	3	4	10	1
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

Appendix D-4: Summary of continuous field measures in San Pablo and Wildcat Creek Watersheds

		Winter Wet Season				Spring Runoff Season						
	Station	**WIL020**	**SPA050**	**SPA220**	**SPA240**	**WIL020**	**WIL100**	**SPA050**	**SPA070**	**SPA200**	**SPA220**	**SPA235**
	Start Date	2/19/2002	11/21/2001	1/18/2002	1/4/2002	5/9/2002	4/11/2002	5/9/2002	3/5/2002	3/5/2002	3/5/2002	5/9/2002
	End Date	03/01/02	12/4/2001	2/5/2002	1/18/2002	5/21/2002	4/23/2002	5/21/2002	3/19/2002	3/19/2002	3/19/2002	5/21/2002
	Data points	972	1273	1727	1338	1155	1161	1155	1322	1316	1312	1128
Temperature (°C)	Min.	10.42	9.86	5.04	4.29	13.38	10.98	12.67	8.62	6.64	7.06	10.51
	0.25	11.67	11.04	6.52	7.61	14.73	12.53	13.95	9.92	8.57	8.89	12.27
	Median	12.41	11.57	7.12	9.18	15.17	13.29	14.51	10.68	9.63	9.85	13.12
	0.75	12.97	13.16	7.69	10.64	15.63	14.48	15.34	11.65	10.76	11.01	14.25
	Max.	14.63	16.29	10.17	12.27	17.11	17.17	16.37	13.03	12.19	12.68	15.89
	HWAT	12.6	12.8	7.6	10.6	15.3	14.0	14.9	11.2	10.3	10.5	13.8
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.73	7.57	7.97	8.05	7.22	7.64	7.57	7.54	7.50	7.79	7.70
	0.25	8.10	7.65	8.10	8.27	7.55	7.81	7.63	7.75	7.73	8.14	7.87
	Median	8.21	7.75	8.35	8.29	7.60	7.84	7.75	7.81	7.76	8.23	7.92
	0.75	8.29	7.86	8.39	8.31	7.64	7.88	7.79	7.87	7.81	8.27	8.00
	Max.	8.56	8.07	8.56	8.44	7.89	7.96	7.90	8.04	8.11	8.45	8.20
	Data Quality Objective: +/- 0.50 pH units	0.04	0.29	0.09	0.09	2.65	0.02	0.05	0.13	0.04	0.05	0.02
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Rejected, 6	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Valid
Dissolved Oxygen (%)	Min.	70.50	78.50	101.10	99.30	3.70	68.70	60.50	84.10	91.90	95.90	68.50
	0.25	81.88	85.10	105.30	100.50	32.90	77.80	75.80	92.80	97.60	101.00	75.40
	Median	98.10	87.70	107.50	101.40	42.00	81.90	78.80	95.60	98.80	101.90	81.30
	0.75	120.05	89.90	109.30	103.10	51.30	85.60	86.50	98.50	100.40	103.40	89.43
	Max.	145.20	106.80	119.20	109.60	78.50	91.00	104.00	131.20	106.80	111.80	101.60
	Data Quality Objective: +/- 5.0%	0.50	49.50	7.20	7.20	5.00	5.00	2.00	0.50	4.20	2.50	0.70
	QA Qualifier	Estimated, 2	Rejected	Rejected	Rejected	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Valid
Dissolved Oxygen (mg/L)	Min.	7.46	8.61	11.73	10.69	0.37	7.14	6.25	9.02	10.14	10.35	7.02
	0.25	8.84	9.02	12.60	11.16	3.32	8.03	7.73	10.35	10.94	11.17	7.93
	Median	10.52	9.41	13.00	11.68	4.24	8.48	8.05	10.52	11.25	11.58	8.44
	0.75	12.70	9.75	13.41	12.31	5.15	8.89	8.69	10.97	11.58	11.94	9.40
	Max.	15.04	11.27	14.36	13.85	7.67	9.76	10.22	14.11	12.40	12.78	10.41
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Estimated, 2	Rejected	Rejected	Rejected	Valid, 1	Valid, 1	Valid, 1	Estimated, 1	Estimated, 1	Estimated, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	434	245	242	425	250	683	415	154	206	119	274
	0.25	541	517	555	514	720	719	1250	779	682	402	496
	Median	599	736	596	549	810	731	1297	1022	879	480	691
	0.75	627	902	615	572	820	745	1308	1233	990	509	701
	Max.	649	1189	650	588	830	759	1332	1521	1514	649	767
	Data Quality Objective: +/- 50 uS/cm	3	19	11	10	10	22	24	14	3	24	10
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Valid

Appendix D-4: Summary of continuous field measures in San Pablo and Wildcat Creek Watersheds

		Summer Dry Season					Late Summer Dry					
	Station	**WIL100**	**SPA050**	**SPA070**	**SPA200**	**SPA220**	**SPA070**	**SPA220**	**SPA235**	**SPA240**	**WIL070**	**WIL100**
	Start Date	5/31/2002	7/18/2002	7/18/2002	7/3/2002	7/3/2002	10/18/02	10/17/02	10/18/02	10/18/02	10/18/02	10/18/02
	End Date	6/18/2002	07/30/02	07/30/02	7/16/2002	7/16/2002	10/24/02	10/24/02	10/24/02	10/24/02	10/19/02	10/24/02
	Data points	1725	1145	1147	1242	1243	560	560	7/16/01	567	88	543
Temperature (°C)	Min.	12.70	15.27	14.92	14.95	14.55	12.96	12.04	11.21	11.50	12.84	10.23
	0.25	14.44	16.07	15.68	16.39	15.80	13.33	12.83	12.20	12.17	13.11	11.59
	Median	15.36	16.62	16.19	17.51	16.87	13.84	13.10	12.66	12.63	13.13	11.96
	0.75	16.29	17.56	16.73	18.60	17.78	14.21	13.84	13.64	13.49	13.44	12.89
	Max.	19.21	24.52	17.61	21.27	19.68	14.89	15.22	15.62	15.61	14.03	14.39
	HWAT	16.4	16.9	16.4	18.3	17.6						
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	4.66	7.10	7.86	7.86	7.71	7.89	8.12	7.52	7.76	7.91	7.44
	0.25	4.73	7.62	7.93	7.94	8.27	7.91	8.14	7.84	7.79	7.93	7.47
	Median	4.75	7.64	7.96	7.97	8.29	7.92	8.16	7.90	7.83	7.95	7.54
	0.75	4.77	7.67	8.00	8.02	8.31	7.93	8.17	7.96	7.86	7.95	7.63
	Max.	4.86	8.22	8.08	8.10	8.37	7.96	8.22	8.08	7.92	7.95	7.70
	Data Quality Objective: +/- 0.50 pH units	1.05	0.05	0.03	0.00	0.06	0.06	0.10	0.06	0.00	0.96	0.00
	QA Qualifier	Rejected	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Rejected	Estimated, 2
Dissolved Oxygen (%)	Min.	44.20	1.40	67.70	81.60	74.80	76.10	88.00	53.50	77.50	68.70	14.70
	0.25	56.70	70.70	77.60	85.00	81.80	79.68	90.50	70.90	81.10	70.68	18.15
	Median	62.70	74.90	82.50	88.15	84.80	81.50	91.75	78.00	85.90	74.00	26.00
	0.75	69.40	88.20	93.20	93.90	87.80	84.10	94.03	84.55	90.40	75.53	36.50
	Max.	81.30	102.10	104.90	100.40	96.70	88.20	100.80	97.90	103.00	78.30	49.30
	Data Quality Objective: +/- 5.0%	2.20	1.50	0.80	1.10	2.10	2.30	2.80	5.80	5.70	0.90	0.00
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	rejected	rejected	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	4.64	0.13	6.53	7.51	7.00	7.80	8.85	5.67	8.21	7.06	1.61
	0.25	5.74	6.92	7.69	8.13	7.88	8.18	9.46	7.45	8.65	7.45	1.97
	Median	6.25	7.34	8.09	8.42	8.26	8.45	9.67	8.17	9.11	7.76	2.86
	0.75	6.76	8.34	9.06	8.87	8.58	8.65	9.84	8.83	9.40	7.91	3.78
	Max.	8.02	9.74	10.11	9.77	9.47	9.05	10.58	10.34	10.77	8.13	5.13
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	rejected	rejected	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	489	0	1239	1404	510	1290	686	424	578	771	631
	0.25	502	230	1352	1581	737	1356	718	527	589	783	644
	Median	510	260	1361	1621	751	1372	733	592	591	793	675
	0.75	520	340	1367	1645	759	1394	744	600	595	803	685
	Max.	548	400	1401	1668	794	1416	760	669	601	817	696
	Data Quality Objective: +/- 50 uS/cm	23	7	7	2	1	1	10	4	3	2	2
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 3

Appendix D-5: Summary of continuous field measures in Suisun Creek Watershed

		Winter Wet Season			Spring Runoff						
	Station	**SUI020**	**SUI110**	**SUI125**	**SUI020**	**SUI050**	**SUI090**	**SUI110**	**SUI125**	**SUI180**	**SUI185**
	Start Date	1/21/2002	1/4/2002	2/15/2002	4/25/2002	4/25/2002	4/25/2002	3/26/2002	3/26/2002	3/26/2002	3/26/2002
	End Date	2/5/2002	1/21/2002	3/1/2002	5/7/2002	5/7/2002	5/7/2002	4/9/2002	4/9/2002	4/9/2002	3/29/2002
	Data points	1425	1631	1335	1141	1135	1141	1325	1325	1325	314
Temperature (°C)	Min.	6.76	5.73	8.22	12.51	11.89	11.71	9.65	11.40	8.42	9.26
	0.25	8.28	7.87	10.48	14.17	13.70	13.86	12.90	13.63	12.63	11.45
	Median	8.79	10.19	11.09	15.12	14.87	15.07	14.68	14.56	13.90	13.18
	0.75	9.37	11.26	12.11	16.15	16.04	16.52	17.72	16.42	15.76	14.58
	Max.	10.81	13.31	14.71	18.78	19.85	20.07	22.48	18.66	18.33	17.40
	HWAT	9.1	11.5	12.0	15.7	15.2	16.0	16.2	15.5	14.8	
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.62	7.80	7.84	7.40	7.85	7.58	8.00	7.70	7.72	8.15
	0.25	7.66	7.98	7.93	7.44	7.95	7.70	8.04	7.78	7.98	8.21
	Median	7.68	8.05	8.00	7.47	8.07	7.79	8.11	7.90	8.03	8.23
	0.75	7.72	8.10	8.19	7.51	8.34	8.03	8.29	8.16	8.26	8.35
	Max.	7.92	8.63	8.51	7.59	8.64	8.28	8.49	8.62	8.49	8.46
	Data Quality Objective: +/- 0.50 pH units	0.03	0.14	0.08	0.08	0.01	0.03	0.04	0.03	0.05	0.04
	QA Qualifier	Valid	Valid, 4	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (%)	Min.	93.70	Reject	90.90	78.90	79.70	79.90	92.10	83.70	93.30	94.20
	0.25	95.30	Reject	94.00	83.40	86.20	85.10	95.30	88.40	98.20	95.30
	Median	96.40	Reject	96.50	86.70	92.50	90.00	97.60	91.50	101.30	96.30
	0.75	100.80	Reject	104.90	97.30	114.65	109.20	106.60	107.20	107.20	101.78
	Max.	124.50	Reject	122.90	107.30	135.30	128.80	119.20	124.30	114.50	110.10
	Data Quality Objective: +/- 5.0%	1.00	Reject	1.50	1.10	1.40	2.50	3.20	1.30	5.00	2.20
	QA Qualifier	Valid	Reject	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	10.58	Reject	9.54	7.70	7.76	7.58	8.50	8.17	8.86	9.33
	0.25	11.07	Reject	10.39	8.40	8.81	8.60	9.58	8.96	9.93	9.92
	Median	11.29	Reject	10.62	8.83	9.44	9.26	10.08	9.45	10.58	10.35
	0.75	11.71	Reject	11.44	9.64	11.45	10.86	10.58	10.81	11.19	10.78
	Max.	14.08	Reject	13.22	10.86	12.95	12.45	11.67	12.22	12.34	11.69
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid, 1	Reject	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	393	162	386	456	475	459	396	422	208	569
	0.25	412	285	398	477	482	478	427	437	222	573
	Median	419	340	412	481	486	482	444	445	230	575
	0.75	423	373	420	485	488	484	448	452	234	577
	Max.	435	390	434	493	493	490	464	458	251	580
	Data Quality Objective: +/- 50 uS/cm	24	14	16	2	6	6	1	2	5	2
	QA Qualifier	Valid	Valid, 4	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

Appendix D-5: Summary of continuous field measures in Suisun Creek Watershed

		Summer Dry Season						Late Summer				
	Station	**SUI020**	**SUI050**	**SUI090**	**SUI110**	**SUI125**	**SUI185**	**SUI020**	**SUI050**	**SUI090**	**SUI125**	**SUI185**
	Start Date	7/3/2002	7/3/2002	7/3/2002	6/20/2002	6/20/2002	6/20/2002	10/24/2002	10/24/2002	10/23/2002	10/24/2002	10/24/2002
	End Date	7/16/2002	7/16/2002	7/16/2002	7/1/2002	7/1/2002	7/1/2002	10/30/2002	10/30/2002	10/29/2002	10/30/2002	10/30/2002
	Data points	1248	1246	1245	1050	1048	1050	567	570	564	562	561
Temperature (°C)	Min.	17.44	17.68	17.84	17.02	15.29	15.30	12.67	11.11	11.81	12.29	9.64
	0.25	18.92	20.14	20.19	19.77	17.72	17.39	13.55	12.20	12.98	13.50	10.62
	Median	20.11	21.74	21.16	22.03	19.07	19.11	13.85	12.76	13.48	14.25	11.42
	0.75	21.03	23.09	21.99	24.80	20.23	20.47	14.20	13.35	13.92	14.76	12.01
	Max.	24.21	26.50	23.89	29.32	22.40	24.03	14.74	14.35	14.67	15.56	12.82
	HWAT	20.9	22.7	21.7	22.9	19.5	19.8					
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.06	7.59	6.68	7.45	7.75	7.99	6.80	7.43	7.35	7.64	7.99
	0.25	7.48	7.76	7.46	7.54	7.79	8.07	7.00	7.85	7.46	7.71	8.02
	Median	7.61	7.85	7.54	7.67	7.86	8.16	7.37	7.88	7.48	7.74	8.03
	0.75	7.68	7.98	7.59	7.95	8.08	8.40	7.43	7.92	7.53	7.80	8.06
	Max.	7.93	8.15	7.72	8.41	8.23	8.62	7.50	8.06	7.62	7.93	8.10
	Data Quality Objective: +/- 0.50 pH units	0.03	0.03	0.07	0.00	0.06	0.07	0.05	0.06	0.10	0.06	0.04
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Valid	Valid
Dissolved Oxygen (%)	Min.	65.20	55.80	50.30	43.80	82.00	73.00	47.80	85.10	85.20	78.30	86.00
	0.25	78.50	68.30	76.80	58.93	85.20	82.70	70.20	88.40	86.90	86.70	88.00
	Median	83.65	79.55	80.30	83.45	90.75	87.85	78.60	92.00	89.15	88.20	89.20
	0.75	101.80	96.15	91.70	148.78	109.00	100.60	86.40	96.40	94.33	94.93	92.40
	Max.	117.40	112.10	100.70	205.10	121.40	112.60	104.40	106.10	101.40	103.30	96.00
	Data Quality Objective: +/- 5.0%	1.00	2.30	1.00	1.30	1.80	3.30	4.30	4.50	2.10	0.30	0.20
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	6.06	4.95	4.42	3.90	7.36	6.62	5.06	9.13	8.83	8.25	9.37
	0.25	7.17	6.15	6.86	5.39	7.93	7.77	7.26	9.49	9.12	8.87	9.67
	Median	7.76	7.06	7.22	7.27	8.60	8.29	8.11	9.75	9.35	9.15	9.83
	0.75	9.03	8.18	8.12	12.47	10.14	9.17	8.87	10.06	9.78	9.79	10.05
	Max.	10.30	9.43	8.88	16.26	11.14	10.43	10.61	10.93	10.43	10.35	10.41
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	363	482	442	558	421	486	364	471	430	414	522
	0.25	379	485	445	580	423	492	378	472	432	416	526
	Median	393	487	447	588	424	496	385	473	433	417	527
	0.75	412	487	451	593	425	500	393	475	433	417	529
	Max.	449	492	711	607	426	507	417	476	435	427	533
	Data Quality Objective: +/- 50 uS/cm	5	4	1	1	0	0	0	0	0	0	0
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

Appendix D-6: Summary of continuous field measures in Arroyo Las Positas Creek Watershed

		Winter Wet			Spring Wet				
	Station	**ALP010**	**ALP040**	**ALP150**	**ALP010**	**ALP040**	**ALP080**	**ALP105**	**ALP150**
	Start Date	1/4/2002	1/18/2002	2/15/2002	4/25/2002	4/25/2002	4/25/2002	3/26/2002	3/26/2002
	End date	1/18/2002	2/5/2002	3/1/2002	5/7/02	5/7/2002	5/7/2002	4/9/2002	4/9/2002
	Data points	1340	1720	1337	1146	1146	1140	1343	1345
Temperature (°C)	Min.	5.35	3.89	7.93	13.16	11.54	12.50	11.23	11.34
	0.25	8.39	6.37	11.04	14.48	13.92	14.71	13.93	15.00
	Median	10.35	7.62	12.60	15.59	15.34	15.91	15.41	16.72
	0.75	11.61	8.69	14.58	17.19	18.13	17.74	19.01	19.27
	Max.	13.38	11.44	18.34	19.39	24.96	21.06	24.98	24.53
	HWAT	11.5	8.0	13.9	16.4	17.0	16.9	17.2	18.2
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	8.13	8.08	7.60	8.24	8.08	7.89	7.88	7.93
	0.25	8.31	8.44	8.01	8.42	8.33	8.03	8.06	8.42
	Median	8.40	8.53	8.26	8.47	8.46	8.17	8.18	8.64
	0.75	8.48	8.61	8.46	8.50	8.62	8.30	8.42	8.77
	Max.	8.61	8.79	9.24	8.56	8.80	8.41	8.68	8.95
	Data Quality Objective: +/- 0.50 pH units	0.14	0.14	0.24	0.03	0.03	0.04	0.02	0.06
	QA Qualifier	Estimated, 2, 3	Estimated, 2, 3	Estimated, 2, 3	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3	Estimated, 3
Dissolved Oxygen (%)	Min.	96.60	84.60	49.20	88.50	57.50	70.40	32.30	20.20
	0.25	98.50	97.00	81.10	96.80	80.40	80.00	60.25	93.50
	Median	101.60	106.10	96.80	102.90	106.25	89.90	90.90	124.80
	0.75	105.30	146.03	140.40	107.68	166.05	124.30	182.65	185.25
	Max.	115.20	212.10	218.10	119.20	234.90	174.20	395.10	266.50
	Data Quality Objective: +/- 5.0%	5.90	5.90	2.00	0.30	0.70	2.30	0.60	47.50
	QA Qualifier	Rejected	Rejected	Estimated, 2	Valid	Valid	Valid	Valid	Rejected
Dissolved Oxygen (mg/L)	Min.	10.21	10.06	5.62	8.49	5.71	6.44	3.27	1.73
	0.25	10.69	11.89	8.78	9.54	8.35	7.97	6.18	9.34
	Median	11.38	12.77	10.55	10.11	10.69	9.06	8.98	12.02
	0.75	12.11	17.11	14.58	10.61	15.83	12.08	16.82	17.43
	Max.	14.06	23.20	20.78	11.75	19.75	16.51	36.42	23.92
	Data Quality Objective: +/- 0.5 mg/l	NA	NA	NA	NA	NA	NA	NA	NA
	QA Qualifier	Rejected, 1	Rejected, 1	Estimated, 1, 2	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Rejected, 1
Specific Conductance (µS/cm)	Min.	1351	857	157	1137	1138	1013	2315	813
	0.25	1884	1554	829	1379	1490	1491	2652	949
	Median	2015	1705	928	1550	1560	1571	2803	990
	0.75	2035	1826	953	1599	1626	1681	2937	1060
	Max.	2078	2052	1033	1862	1983	2092	3354	1158
	Data Quality Objective: +/- 50 uS/cm	22	22	13	7	11	3	0	24
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Valid	Valid	Valid	Valid	Valid

Appendix D-6: Summary of continuous field measures in Arroyo Las Positas Creek Watershed

		Summer Dry				
	Station	**ALP010**	**ALP040**	**ALP080**	**ALP105**	**ALP150**
	Start Date	7/18/2002	7/18/2002	7/18/2002	6/20/2002	6/20/2002
	End date	7/30/2002	7/30/2002	7/30/2002	7/1/2002	7/1/2002
	Data points	1149	1149	1150	1048	1049
Temperature (°C)	Min.	19.79	17.91	18.53	15.15	17.41
	0.25	20.71	19.89	19.88	18.27	19.89
	Median	21.55	21.44	21.43	20.78	21.85
	0.75	22.47	24.25	23.33	24.39	24.43
	Max.	24.14	27.35	25.22	32.10	29.27
	HWAT	21.5	21.9	21.5	22.2	23.1
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	8.00	7.77	7.63	7.58	7.62
	0.25	8.19	7.89	7.87	7.97	7.79
	Median	8.26	8.02	8.11	8.17	8.19
	0.75	8.39	8.17	8.45	8.39	8.54
	Max.	8.52	8.75	8.69	8.87	8.99
	Data Quality Objective: +/- 0.50 pH units	0.01	0.03	0.06	0.09	0.04
	QA Qualifier	Valid	Valid	Estimated, 2	Valid	Valid
Dissolved Oxygen (%)	Min.	81.60	42.60	56.80	6.00	6.30
	0.25	90.70	66.00	77.40	30.60	29.75
	Median	97.60	102.20	88.40	74.80	77.90
	0.75	104.80	169.60	122.30	148.50	158.78
	Max.	112.90	221.70	151.10	256.70	190.10
	Data Quality Objective: +/- 5.0%	1.60	3.90	0.80	0.40	5.40
	QA Qualifier	Valid	Valid	Estimated, 2	Valid	Rejected
Dissolved Oxygen (mg/L)	Min.	7.06	3.98	4.96	0.56	0.59
	0.25	8.09	6.02	6.91	2.85	2.81
	Median	8.59	9.13	7.78	6.79	7.13
	0.75	9.09	14.25	10.63	12.35	13.47
	Max.	9.75	18.23	12.92	20.59	16.22
	Data Quality Objective: +/- 0.5 mg/l	NA	NA	NA	NA	NA
	QA Qualifier	Valid, 1	Valid, 1	Estimated, 1, 2	Valid, 1	Rejected, 1
Specific Conductance (µS/cm)	Min.	984	1013	1050	835	824
	0.25	1087	1078	1147	2222	873
	Median	1134	1138	1204	2469	902
	0.75	1212	1209	1268	2559	929
	Max.	1586	1403	1515	3873	1048
	Data Quality Objective: +/- 50 uS/cm	7	5	5	UNK	UNK
	QA Qualifier	Valid	Valid	Estimated, 2	Rejected, 8	Rejected, 8

Appendix D-7: Summary of continuous field measures in Pescadero and Butano Creek Watersheds

		Summer Dry Season					Late Summer				
	Station	**PES060**	**PES100**	**PES140**	**PES150**	**PES170**	**BUT010**	**BUT050**	**PES180**	**PES190**	**PES240**
	Start Date	8/26/2002	8/26/2002	8/26/2002	8/26/2002	8/26/2002	10/9/2002	10/9/2002	10/9/2002	10/8/2002	10/9/2002
	End date	09/12/02	9/12/2002	9/12/2002	9/12/2002	9/12/2002	10/15/2002	10/15/2002	10/15/2002	10/14/2002	10/15/2002
	Data points	1630	1616	1627	1627	1627	572	571	574	571	573
Temperature (°C)	Min.	12.74	13.64	12.66	11.28	11.66	9.46	10.75	10.70	11.06	10.95
	0.25	15.50	15.92	14.54	12.79	12.97	11.88	11.48	11.60	11.84	11.77
	Median	16.45	16.97	15.31	13.27	13.48	12.94	12.01	12.37	12.56	12.75
	0.75	17.82	18.30	16.16	13.73	14.03	13.92	12.83	13.05	13.22	13.31
	Max.	19.85	20.68	17.58	14.88	15.07	16.18	13.31	13.73	13.88	14.08
	HWAT	17.1	17.8	16.1	13.8	14.1					
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.56	7.82	8.08	7.45	7.86	7.90	7.49	7.62	7.43	7.59
	0.25	7.66	7.93	8.24	7.82	7.89	7.94	7.52	8.34	7.76	7.69
	Median	7.69	7.97	8.26	7.99	7.91	7.95	7.53	8.35	7.84	7.70
	0.75	7.73	8.04	8.28	8.10	7.92	8.00	7.54	8.36	7.91	7.70
	Max.	7.86	8.29	8.32	8.13	8.00	8.07	7.56	8.42	8.00	7.73
	Data Quality Objective: +/- 0.50 pH units	0.03	0.04	0.02	0.06	0.03	0.00	0.06	0.06	0.10	0.05
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	71.90	73.10	88.50	86.60	73.90	8.70	88.70	91.90	83.50	75.50
	0.25	78.70	77.60	92.40	89.85	77.50	88.20	89.70	94.10	87.40	84.70
	Median	81.70	84.30	94.70	90.60	79.30	92.30	90.60	95.50	90.80	85.60
	0.75	88.38	101.60	97.50	91.70	81.90	94.30	91.10	98.20	97.30	86.60
	Max.	101.80	135.00	104.90	94.10	94.00	138.00	93.80	103.40	106.10	87.60
	Data Quality Objective: +/- 5.0%	0.70	0.80	0.60	0.40	1.80	93.00	1.90	0.60	0.90	1.50
	QA Qualifier	Valid, 4	Valid, 4	Valid, 4	Valid, 4	Valid, 4	Rejected	Valid	Valid	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	6.85	7.13	8.76	8.90	7.70	0.91	9.32	9.62	8.76	7.76
	0.25	7.68	7.66	9.17	9.30	8.05	9.16	9.50	9.96	9.41	8.87
	Median	8.05	8.15	9.54	9.48	8.26	9.63	9.79	10.30	9.65	9.05
	0.75	8.61	9.66	9.74	9.67	8.47	10.05	9.91	10.52	10.26	9.33
	Max.	9.62	12.33	10.52	10.24	9.57	15.26	10.12	11.08	11.00	9.60
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid, 4	Valid, 4	Valid, 4	Valid, 4	Valid, 4	Rejected	Valid, 1	Valid, 1	Valid, 1	Valid, 1
Specific Conductance (µS/cm)	Min.	780	800	745	731	1414	446	365	847	701	817
	0.25	790	818	749	740	1456	465	366	849	705	819
	Median	794	824	758	743	1553	469	366	850	707	820
	0.75	799	836	769	748	1572	473	367	852	709	821
	Max.	808	849	777	755	1589	498	368	854	717	822
	Data Quality Objective: +/- 50 uS/cm	0	2	0	2	0	2	1	4	10	3
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2

Appendix D-7: Summary of continuous field measures in Pescadero and Butano Creek Watersheds

		Winter Wet Season					Spring Runoff Season			
	Station	**BUT010**	**BUT030**	**PES050**	**PES140**	**PES150**	**PES105**	**BUT010**	**BUT030**	**PES050**
	Start Date	2/13/2003	2/13/2003	2/13/2003	2/13/2003	2/13/2003	6/5/2003	6/4/2003	6/5/2003	06/05/03
	End date	02/27/03	2/27/2003	2/27/2003	2/27/2003	2/27/2003	6/12/2003	6/11/2003	6/12/2003	06/07/03
	Data points	721	1345	1350	1328	1327	661	661	663	210.00
Temperature (°C)	Min.	9.09	8.17	8.08	7.50	8.27	13.51	13.09	12.44	16.27
	0.25	10.41	9.33	9.66	8.57	9.37	15.28	14.20	13.82	16.72
	Median	11.00	9.77	10.35	9.32	9.72	16.08	14.69	14.35	17.33
	0.75	11.56	10.25	10.90	9.95	9.98	16.85	15.49	15.02	17.94
	Max.	12.92	10.96	11.69	10.83	10.69	18.40	16.52	16.24	18.41
	HWAT		9.9	10.2	9.4	9.7	15.9	14.8	14.3	
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.02	7.44	7.65	7.88	7.22	8.15	7.29	0.09	7.73
	0.25	7.25	7.45	7.84	8.06	7.82	8.17	7.41	0.11	7.75
	Median	7.37	7.47	7.85	8.10	7.97	8.20	7.50	0.14	7.80
	0.75	7.48	7.53	7.87	8.14	8.00	8.24	7.54	0.14	7.93
	Max.	7.57	7.68	8.05	8.26	8.08	8.30	7.60	0.15	8.01
	Data Quality Objective: +/- 0.50 pH units	0.07	0.04	0.12	0.03	0.18	0.08	0.12	NA	0.08
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Rejected, 9	Estimated, 2
Dissolved Oxygen (%)	Min.	65.30	95.40	88.70	99.10	97.50	96.90	57.00	7.66	83.70
	0.25	93.70	96.50	95.00	100.50	100.40	97.70	75.10	7.69	84.53
	Median	95.30	97.70	96.05	101.40	101.90	98.90	89.10	7.71	89.55
	0.75	96.60	98.90	97.90	103.30	103.10	101.80	90.00	7.74	104.90
	Max.	100.50	101.00	110.40	108.60	106.50	108.70	94.70	7.80	113.70
	Data Quality Objective: +/- 5.0%	1.20	0.00	0.80	1.10	0.40	2.00	3.60	NA	NA
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Rejected, 9	Rejected, 9
Dissolved Oxygen (mg/L)	Min.	7.30	10.62	9.89	11.06	11.09	9.22	5.86	9.31	7.94
	0.25	10.24	10.89	10.63	11.41	11.39	9.56	7.84	9.48	8.14
	Median	10.48	11.10	10.80	11.71	11.58	9.87	8.88	9.71	8.65
	0.75	10.65	11.29	11.04	11.93	11.75	10.16	9.08	9.97	10.01
	Max.	11.28	11.73	12.13	12.61	12.49	10.61	9.31	10.31	10.77
	Data Quality Objective: +/- 0.5 mg/l	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Valid, 1	Rejected, 9	Rejected, 9
Specific Conductance (µS/cm)	Min.	190	186	333	381	132	593	212	338	608
	0.25	253	192	403	479	375	595	225	343	614
	Median	257	196	435	512	407	596	282	344	616
	0.75	332	219	444	521	429	597	305	345	618
	Max.	373	340	583	572	506	599	352	346	620
	Data Quality Objective: +/- 50 uS/cm	1	4	18	7	3	15	0	NA	4
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Rejected, 9	Estimated, 2

Appendix D-8: Summary of continuous field measures in San Gregorio Creek Watershed

		Late Summer					Winter Wet Season				
	Station	**SGR010**	**SGR040**	**SGR090**	**SGR100**	**SGR120**	**SGR010**	**SGR020**	**SGR090**	**SGR100**	**SGR120**
	Start Date	9/26/2002	9/26/2002	9/26/2002	9/26/2002	9/26/2002	1/24/2003	1/24/2003	1/24/2003	1/24/2003	1/24/2003
	End date	10/4/2002	10/4/2002	10/4/2002	10/4/2002	10/4/2002	2/7/2003	2/7/2003	2/7/2003	2/7/2003	2/7/2003
	Data points	753	758	761	768	775	1351	1916	1331	1334	1326
Temperature (°C)	Min.	9.95	9.43	8.85	9.24	10.01	5.40	3.18	4.95	4.92	7.36
	0.25	12.69	12.41	11.26	11.81	10.87	8.44	6.90	7.68	7.99	8.85
	Median	14.31	14.21	12.72	13.36	11.85	10.69	9.13	9.86	10.24	10.21
	0.75	15.16	15.14	13.77	14.34	12.68	12.26	11.22	11.32	11.63	10.81
	Max.	16.09	17.12	14.72	15.36	13.17	13.89	14.26	12.26	12.94	11.33
	HWAT	14.2	14.0	12.6	13.2	11.9	11.8	11.3	10.8	11.2	10.6
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.99	8.09	7.81	7.73	7.15	7.53	7.54	8.10	7.86	7.80
	0.25	8.05	8.15	8.12	8.23	7.31	7.86	8.29	8.19	8.11	7.88
	Median	8.08	8.19	8.18	8.25	7.38	7.89	8.31	8.20	8.14	7.89
	0.75	8.13	8.21	8.21	8.28	7.42	7.92	8.39	8.22	8.17	7.90
	Max.	8.19	8.30	8.32	8.36	7.46	7.98	8.50	8.27	8.23	7.91
	Data Quality Objective: +/- 0.50 pH units	0.10	0.06	0.08	0.02	0.10	0.06	0.18	0.02	0.05	0.05
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	82.70	86.00	78.60	91.10	25.50	96.30	93.70	98.60	98.10	96.20
	0.25	86.70	90.10	86.20	94.68	64.35	97.70	98.50	100.00	98.80	98.00
	Median	89.20	91.60	87.30	96.00	70.10	99.20	100.00	101.00	99.50	99.80
	0.75	97.30	95.18	89.10	97.60	72.70	101.10	102.30	102.30	100.20	101.60
	Max.	110.40	103.50	95.70	101.50	76.90	110.10	116.80	105.10	102.80	103.70
	Data Quality Objective: +/- 5.0%	0.70	0.00	1.10	2.40	1.20	0.50	4.80	2.70	0.00	1.20
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Valid	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (mg/L)	Min.	8.19	8.47	8.14	9.18	2.73	9.99	10.15	10.58	10.38	10.61
	0.25	8.92	9.18	9.06	9.67	6.95	10.53	10.90	10.93	10.75	10.92
	Median	9.37	9.52	9.34	10.09	7.58	11.03	11.54	11.40	11.16	11.18
	0.75	10.02	9.96	9.67	10.47	7.98	11.82	12.27	12.20	11.84	11.77
	Max.	11.27	10.84	10.52	11.27	8.42	13.28	14.23	13.26	12.95	12.45
	Data Quality Objective: +/- 0.5 mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Valid, 1	Estimated, 2	Estimated, 2	Estimated, 2
Specific Conductance (µS/cm)	Min.	1000	996	867	1060	696	749	495	778	776	384
	0.25	1010	1000	870	1066	710	762	508	792	787	410
	Median	1018	1001	873	1072	716	776	530	802	802	421
	0.75	1032	1003	875	1078	731	790	552	812	817	432
	Max.	1072	1007	884	1088	754	806	566	824	834	444
	Data Quality Objective: +/- 0.05 mS/cm	5	1	2	4	1	14	3	11	7	20
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2

Appendix D-8: Summary of continuous field measures in San Gregorio Creek Watershed

		Summer Dry Season				
	Station	**SGR010**	**SGR020**	**SGR040**	**SGR090**	**SGR100**
	Start Date	6/11/2003	6/12/2003	6/12/2003	6/12/2003	6/12/2003
	End date	6/18/2003	6/20/2003	06/20/03	6/20/2003	6/19/2003
	Data points	688	761	760	761	663
Temperature (°C)	Min.	13.14	11.08	12.01	11.39	11.30
	0.25	14.20	12.81	13.32	12.47	12.58
	Median	15.04	13.45	14.15	13.03	13.28
	0.75	16.29	14.11	15.19	13.97	14.60
	Max.	19.16	16.99	19.55	17.59	17.39
	HWAT	15.3	13.7	14.6	13.4	13.6
	QA Qualifier	Valid, 5	Rejected, 6, 9	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.98	8.11	8.26	8.24	8.10
	0.25	8.00	8.15	8.29	8.28	8.14
	Median	8.03	8.17	8.32	8.31	8.17
	0.75	8.06	8.21	8.37	8.37	8.23
	Max.	8.22	8.25	8.43	8.47	8.31
	Data Quality Objective: +/- 0.50 pH units	0.12	no record	0.09	0.08	0.08
	QA Qualifier	Estimated, 2	Rejected, 6, 9	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	89.10	94.00	89.70	93.40	93.60
	0.25	91.30	96.50	91.40	94.50	95.00
	Median	92.40	97.30	92.35	95.10	95.60
	0.75	96.30	98.40	95.90	98.10	97.40
	Max.	103.70	101.20	100.10	102.00	100.50
	Data Quality Objective: +/- 5.0%	0.09	no record	1.40	0.60	1.10
	QA Qualifier	Estimated, 2	Rejected, 6, 9	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (mg/L)	Min.	8.43	9.08	8.53	9.31	9.10
	0.25	9.13	9.98	9.30	9.81	9.73
	Median	9.41	10.14	9.59	10.07	10.05
	0.75	9.68	10.36	9.78	10.24	10.22
	Max.	10.37	10.83	10.24	10.69	10.65
	Data Quality Objective: +/- 0.5 mg/l	see DO%	no record	see DO%	see DO%	see DO%
	QA Qualifier	Estimated, 1,2	Rejected, 6, 9	Estimated, 1, 2	Estimated, 1,2	Estimated, 1,2
Specific Conductance (µS/cm)	Min.	796	568	836	812	843
	0.25	804	571	843	819	848
	Median	810	576	845	822	849
	0.75	815	582	847	824	852
	Max.	819	587	850	827	860
	Data Quality Objective: +/- 0.05 mS/cm	0	no record	5	15	4
	QA Qualifier	Estimated, 2	Rejected, 6, 9	Estimated, 2	Estimated, 2	Estimated, 2

Appendix D-9: Summary of continuous field measures in Steven's and Permanente Creek Watersheds

		Late Summer					Winter Wet Season			
	Station	**PER010**	**STE020**	**STE060**	**STE070**	**STE100**	**PER010**	**STE020**	**STE060**	**STE070**
	Start Date	9/17/2002	9/17/2002	9/17/2002	9/17/2002	9/17/2002	11/7/2002	11/7/2002	11/6/2002	11/7/2002
	End Date	9/24/2002	9/24/2002	9/24/2002	9/24/2002	09/24/02	12/6/2002	12/6/2002	12/5/2002	12/6/2002
	Data points	667	668	670	677	690	2803	2801	2791	2788
Temperature (°C)	Min.	16.80	17.66	16.94	20.91	13.14	11.47	14.33	9.28	11.91
	0.25	18.05	18.30	18.03	21.17	13.90	13.83	15.80	11.10	12.80
	Median	19.81	19.06	18.97	21.39	14.80	15.17	16.50	12.21	13.83
	0.75	22.58	20.81	19.85	21.82	15.54	16.56	17.28	13.31	14.40
	Max.	25.04	23.58	20.71	22.12	16.62	21.14	19.68	17.63	15.92
	HWAT	20.4	19.7	18.9	21.5	14.7	16.4	17.2	14.3	14.9
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.45	7.52	8.16	7.66	7.83	6.95	7.13	7.55	7.44
	0.25	7.54	7.57	8.18	7.79	7.93	7.28	7.37	7.82	7.53
	Median	7.57	7.60	8.22	7.80	7.95	7.38	7.43	8.12	7.62
	0.75	7.64	7.71	8.30	7.82	7.99	7.49	7.52	8.15	7.70
	Max.	8.00	7.87	8.40	7.90	8.06	7.85	8.11	8.26	7.84
	Data Quality Objective: +/- 0.50 pH units	0.10	0.07	0.06	0.02	0.08	0.12	0.09	0.12	0.02
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	7.00	53.80	88.50	66.60	88.90	19.20	0.60	70.50	67.70
	0.25	17.40	59.90	90.20	72.00	90.30	62.70	2.60	91.20	75.50
	Median	28.60	64.10	91.50	73.10	91.30	67.70	2.90	92.80	84.10
	0.75	79.85	86.25	96.48	74.20	95.20	87.25	3.30	98.10	86.30
	Max.	153.40	114.60	103.90	78.10	132.30	206.70	100.40	104.10	90.40
	Data Quality Objective: +/- 5.0%	0.60	0.70	0.80	0.40	1.80	4.10	9.00	9.00	4.90
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid	Rejected	Rejected	Valid
Dissolved Oxygen (mg/L)	Min.	0.65	4.94	7.97	5.92	8.85	1.86	0.05	7.21	6.92
	0.25	1.65	5.59	8.30	6.35	9.13	6.37	0.26	9.79	7.71
	Median	2.62	5.96	8.58	6.45	9.32	6.88	0.28	10.17	8.65
	0.75	6.86	7.78	9.02	6.53	9.65	8.54	0.32	10.50	9.09
	Max.	12.66	9.87	9.67	6.88	12.91	19.91	9.89	11.51	9.62
	Data Quality Objective: +/- 0.5 mg/l	n/a	n/a	n/a	n/a	n/a	see DO%	see DO%	see DO%	see DO%
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Valid, 1	Rejected	Rejected	Valid, 1
Specific Conductance (µS/cm)	Min.	1043	1001	529	512	659	155	111	76	318
	0.25	1135	1034	534	516	726	1206	882	403	530
	Median	1189	1051	537	517	739	1355	917	430	534
	0.75	1240	1062	540	518	748	1535	929	451	536
	Max.	1297	1073	548	520	794	14541	960	534	545
	Data Quality Objective: +/- 50 uS/cm	5	0	0	4	0	7	9	5	2
	QA Qualifier	Valid	Valid	Valid	Valid	Valid	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2

Appendix D-9: Summary of continuous field measures in Steven's and Permanente Creek Watersheds

		Spring Runoff Season			Summer Dry Season			
	Station	**PER010**	**PER050**	**STE060**	**PER010**	**STE020**	**STE060**	**STE070**
	Start Date	3/3/2003	3/3/2003	3/3/2003	6/26/2003	6/25/2003	6/26/2003	6/26/2003
	End Date	3/13/2003	3/13/2003	3/13/2003	7/8/2003	07/07/03	7/8/2003	7/8/2003
	Data points	964	941	960	1165	1149	1160	1149
Temperature (°C)	Min.	10.59	9.60	8.65	15.86	16.78	13.94	12.36
	0.25	12.17	10.98	10.20	17.97	17.99	15.92	12.66
	Median	14.33	12.49	11.53	20.07	19.04	17.33	12.83
	0.75	16.11	13.55	12.42	23.99	21.69	18.43	13.22
	Max.	21.57	16.17	14.67	28.06	25.49	22.24	13.93
	HWAT	15.1	12.5	11.8	21.3	20.1	18.0	13.0
	QA Qualifier	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5	Valid, 5
pH	Min.	7.60	8.09	8.03	7.31	7.31	7.95	7.44
	0.25	7.73	8.11	8.09	7.43	7.40	8.01	7.49
	Median	7.86	8.13	8.18	7.52	7.43	8.09	7.50
	0.75	8.16	8.18	8.42	7.89	7.55	8.29	7.51
	Max.	8.70	8.27	8.65	8.37	7.83	8.45	7.57
	Data Quality Objective: +/- 0.50 pH units	0.10	0.07	0.04	0.07	0.05	0.04	0.08
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2
Dissolved Oxygen (%)	Min.	61.80	97.70	96.20	5.40	64.40	86.20	75.60
	0.25	74.40	99.60	97.90	25.60	74.20	93.40	78.40
	Median	83.10	100.20	99.50	59.20	86.30	96.50	79.40
	0.75	119.05	102.70	110.10	176.90	131.10	108.03	80.50
	Max.	239.70	108.90	127.90	321.00	164.30	121.30	84.20
	Data Quality Objective: +/- 5.0%	0.10	0.00	2.20	4.30	6.70	1.60	3.60
	QA Qualifier	Valid	Valid	Valid	Valid	Rejected	Valid	Valid
Dissolved Oxygen (mg/L)	Min.	6.17	9.90	9.92	0.49	5.91	7.76	7.99
	0.25	7.96	10.51	10.63	2.39	7.01	8.95	8.28
	Median	8.80	10.82	11.14	5.50	8.06	9.44	8.38
	0.75	11.77	11.10	12.05	14.92	11.54	10.36	8.47
	Max.	22.19	11.48	13.56	25.92	14.02	11.81	8.73
	Data Quality Objective: +/- 0.5 mg/l	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	QA Qualifier	Valid	Valid	Valid	Valid	Rejected	Valid	Valid
Specific Conductance (µS/cm)	Min.	940	981	455	401	972	6	446
	0.25	1469	1006	484	1154	1004	524	459
	Median	1522	1030	491	1216	1013	530	460
	0.75	1597	1035	498	1260	1028	543	460
	Max.	1882	1045	517	1474	1048	561	463
	Data Quality Objective: +/- 50 uS/cm	1	7	3	4	12	10	6
	QA Qualifier	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2	Estimated, 2

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
Site Code:				WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	Adults	5	sh	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus		5	p																
Agabus sp.	--	8	p	5	6	4	2	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	--	5	p	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																
Agabus sp.	Adults	5	p																
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																
Stictotarsus sp.	Adults	5	p	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	--	4	sc	0	0	0	2	0	92	31	1	16	44	0	0	0	0	0	1
Ordobrevia nubrifera	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	--	4	sc	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	Adults	4	sc	0	0	0	0	0	41	9	0	2	1	0	0	0	0	0	0
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	Adults	4	sc	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																		
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	--	5	mh	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Helophoridae			sh																
Helophorus sp.	Larvae		sh																
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helochares sp.	Larvae																		
Hydrochus sp.	Larvae	5	p																
Laccobius sp.	Larvae	5	mh	0	5	0	0	0	0	0	0	0	0	0	4	1	0	0	0
Tropisternus sp.	--	5	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eubrianax edwardsi	--	4	sc	0	0	0	0	0	5	4	0	7	13	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Phylum Arthropoda / Insecta / Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	0	1	0	0	1	2	0	0	0	0	0	4	0	0	0	0	1
Agabinus		5	p																	
Agabus sp.	--	8	p	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																	
Agabus sp.	Adults	5	p																	
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																	
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ordobrevia nubrifera	--	4	sc	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																			
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																	
Helophorus sp.	Larvae		sh																	
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helochares sp.	Larvae																			
Hydrochus sp.	Larvae	5	p																	
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eubrianax edwardsi	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
Site Code: / *Year:*				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	Adults	5	sh	0	0	0	0	0	0	1	2	6	0	0	0	0	0	0	0
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Agabinus		5	p																
Agabus sp.	--	8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																
Agabus sp.	Adults	5	p																
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	0	0	0	0	2	20	4	1	1	2	0
Optioservus sp.	--	4	sc	0	0	110	254	2	0	44	100	20	59	104	49	59	76	95	55
Ordobrevia nubrifera	--	4	sc	0	0	0	2	0	0	4	73	6	0	4	29	9	1	0	0
Zaitzevia sp.	--	4	sc	0	0	11	13	0	0	36	4	5	2	1	14	1	2	1	5
Elmidae	Adults	4	cg	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9
Optioservus sp.	Adults	4	sc	0	0	77	15	1	0	54	25	38	22	25	11	7	1	1	12
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	1	12	0	0	0	0	0	0	0	0
Zaitzevia sp.	Adults	4	sc	0	0	4	3	0	0	8	6	4	2	0	0	1	5	1	1
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																		
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																
Helophorus sp.	Larvae		sh																
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helochares sp.	Larvae																		
Hydrochus sp.	Larvae	5	p																
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eubrianax edwardsi	--	4	sc	0	0	0	0	0	0	0	36	15	0	5	12	3	1	9	0

Appendix E-1: Bioassessment master taxa list

Site Code:	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	Adults	5	sh	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus		5	p																	
Agabus sp.	--	8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																	
Agabus sp.	Adults	5	p																	
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																	
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	--	4	sc	0	2	17	11	1	0	0	0	0	0	0	0	54	33	6	8	43
Ordobrevia nubrifera	--	4	sc	29	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	--	4	sc	10	31	94	7	0	0	0	0	0	0	0	0	0	0	0	0	10
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	Adults	4	sc	2	0	6	4	0	0	0	0	0	0	0	0	2	1	0	0	4
Ordobrevia nubrifera	Adults	4	sc	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	Adults	4	sc	6	14	10	8	0	0	0	0	0	0	0	0	0	0	1	0	3
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																			
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																	
Helophorus sp.	Larvae		sh																	
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helochares sp.	Larvae																			
Hydrochus sp.	Larvae	5	p																	
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Eubrianax edwardsi	--	4	sc	7	66	27	8	0	0	0	0	0	0	0	0	0	0	0	0	1

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	Adults	5	sh	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dytiscidae	--	5	p	2	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Agabinus		5	p																	
Agabus sp.	--	8	p	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																	
Agabus sp.	Adults	5	p																	
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																	
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	--	4	sc	3	10	0	11	30	37	91	57	0	0	0	0	2	0	2	21	47
Ordobrevia nubrifera	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	--	4	sc	0	0	0	0	0	1	4	4	0	0	0	0	0	0	0	0	0
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	Adults	4	sc	0	0	1	8	41	16	22	12	0	0	0	0	0	0	0	20	38
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zaitzevia sp.	Adults	4	sc	0	0	0	0	0	1	3	15	0	0	0	0	0	0	0	0	0
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																			
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																	
Helophorus sp.	Larvae		sh																	
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helochares sp.	Larvae																			
Hydrochus sp.	Larvae	5	p																	
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eubrianax edwardsi	--	4	sc	0	3	0	0	0	2	7	0	0	0	0	0	0	0	0	0	0

Phylum Arthropoda / Insecta / Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	0	0	0	0	0	0	0	0	3	0	8	0	0	19	1	0
Helichus sp.	Adults	5	sh	0	0	1	1	0	0	0	0	0	0	0	5	5	1	1	0	0
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Agabinus		5	p																	
Agabus sp.	--	8	p	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																	
Agabus sp.	Adults	5	p																	
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Sanfilippodytes sp.	Adults	5	p																	
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Cleptelmis addenda sp.		4	cg	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Narpus sp.	--	4	cg	0	0	0	0	0	2	0	10	2	11	4	5	4	0	5	0	2
Optioservus sp.	--	4	sc	27	26	14	19	23	12	15	51	34	18	27	56	61	109	66	105	69
Ordobrevia nubrifera	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	95	0	0	0	0
Zaitzevia sp.	--	4	sc	0	0	1	2	3	1	1	21	41	20	25	20	40	1	1	1	2
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Optioservus sp.	Adults	4	sc	37	8	33	54	25	50	18	30	22	1	6	80	43	21	42	52	23
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Zaitzevia sp.	Adults	4	sc	0	0	2	3	4	1	1	2	17	12	16	28	19	5	3	0	1
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																			
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																	
Helophorus sp.	Larvae		sh																	
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.		5	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor sp.		5	p	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Helochares sp.	Larvae																			
Hydrochus sp.	Larvae	5	p																	
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Eubrianax edwardsi	--	4	sc	2	0	0	0	8	1	0	35	23	5	33	94	43	4	4	1	1

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Dryopidae		5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	--	5		0	2	0	0	0	0	0	1	6	0	0	0	0	0	0	3	0
Helichus sp.	Adults	5	sh	4	4	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1
Postelichus sp.	Adults	5	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus		5	p																	
Agabus sp.	--	8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictotarsus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agabinus sp.	Adults	5	p																	
Agabus sp.	Adults	5	p																	
Oreodytes sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanfilippodytes sp.	Adults	5	p																	
Stictotarsus sp.	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampumixis dispar		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleptelmis addenda sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lara sp.	--	4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	--	4	cg	1	5	1	1	2	9	2	10	18	0	0	0	0	0	0	7	0
Optioservus sp.	--	4	sc	21	14	44	19	10	46	39	20	31	0	0	0	22	0	14	46	27
Ordobrevia nubrifera	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0
Zaitzevia sp.	--	4	sc	0	4	1	1	2	0	5	7	3	0	0	0	0	0	0	27	2
Elmidae	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	Adults	4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	Adults	4	sc	30	11	31	16	7	13	19	9	6	0	0	0	0	0	4	21	14
Ordobrevia nubrifera	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Zaitzevia sp.	Adults	4	sc	0	2	0	0	2	1	0	4	2	0	0	0	0	0	0	14	5
Gyrinidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliplidae		5	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apteraliplus parvulus	Adults																			
Brychius sp.		5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	--	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltodytes sp.	Adults	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helophoridae			sh																	
Helophorus sp.	Larvae		sh																	
Hydraenidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraena sp.	Adults	5	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Hydraena sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ametor sp.		5	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Helochares sp.	Larvae																			
Hydrochus sp.	Larvae	5	p																	
Laccobius sp.	Larvae	5	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropisternus sp.	--	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbiodyta sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracymus sp.	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ametor scabrosus	Adults	5	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acneus sp.	--	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Eubrianax edwardsi	--	4	sc	1	7	3	1	2	22	0	12	1	0	0	0	0	0	2	21	15

Appendix E-1: Bioassessment master taxa list

Taxa	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																
Scirtidae		5	sc																
Elodes sp.	--		sc																
Staphylinidae	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agathon sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharicera sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																	
Ceratopogonidae		6	p	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	0	0	5	5	0	5	0	9	0	28	1	20	5	0	1	0
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.		6	p																
Culicoides sp.		6	p	0	0	0	0	0	0	0	6	0	0	0	0	1	0	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyiinae		6	cg																
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																
Chaoboridae		7	p																
Chaoborus		7	p																
Chironomidae		6		411	291	208	135	514	83	436	278	85	164	286	579	565	491	374	334
Culicidae		8	cg																
Aedes sp.																			
Culiseta sp.																			
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixella sp.		2	cg	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Empididae		6	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Chelifera/ Metachela		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocera sp.		6	p	13	3	8	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.		6	p	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Neoplasta sp.		6	p	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae	Pupae	6																	
Muscidae		6	p	1	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Phoridae		5	cg																
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Phylum Arthropoda / Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Site Code: / *Year:*	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Coleoptera																				
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																	
Scirtidae		5	sc																	
Elodes sp.	--		sc																	
Staphylinidae	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agathon sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceraa sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																		
Ceratopogonidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	0	0	0	0	3	10	0	0	0	0	0	10	0	1	0	6	0
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Ceratopogon sp.		6	p																	
Culicoides sp.		6	p	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	1	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyiinae		6	cg																	
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																	
Chaoboridae		7	p																	
Chaoborus		7	p																	
Chironomidae		6		328	162	207	213	307	445	289	234	418	442	523	585	237	114	103	321	183
Culicidae		8	cg																	
Aedes sp.																				
Culiseta sp.																				
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Dixella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Empididae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Chelifera/ Metachela		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocera sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.		6	p	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	9	1
Neoplasta sp.		6	p	0	0	0	0	0	0	0	0	1	1	2	1	1	1	0	0	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																	
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																	
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ephydridae	Pupae	6																		
Muscidae		6	p	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0
Phoridae		5	cg																	
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Taxon	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																
Scirtidae		5	sc																
Elodes sp.	--		sc																
Staphylinidae	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agathon sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceraa sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																	
Ceratopogonidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	0	1	3	0	6	5	4	18	6	2	8	33	23	7	8	2
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.		6	p																
Culicoides sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyiinae		6	cg																
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																
Chaoboridae		7	p																
Chaoborus		7	p																
Chironomidae		6		192	271	183	147	341	719	180	173	267	191	218	145	350	461	527	203
Culicidae		8	cg																
Aedes sp.																			
Culiseta sp.																			
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Empididae		6	p	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chelifera/ Metachela		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Clinocera sp.		6	p	0	0	5	0	0	0	2	0	1	0	0	0	0	0	0	0
Hemerodromia sp.		6	p	0	1	4	1	0	0	6	0	0	1	0	0	0	0	0	1
Neoplasta sp.		6	p	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae	Pupae	6																	
Muscidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoridae		5	cg																
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Coleoptera																				
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																	
Scirtidae		5	sc																	
Elodes sp.	--		sc																	
Staphylinidae	Adults	5	p	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Agathon sp.		0	sc	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharicera sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																		
Ceratopogonidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	12	8	8	2	0	0	0	0	0	0	0	0	9	30	1	22	0
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.		6	p																	
Culicoides sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyiinae		6	cg																	
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																	
Chaoboridae		7	p																	
Chaoborus		7	p																	
Chironomidae		6		171	209	196	98	688	657	348	670	685	512	119	428	594	261	544	252	189
Culicidae		8	cg																	
Aedes sp.																				
Culiseta sp.																				
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixella sp.		2	cg	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Empididae		6	p	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Chelifera/ Metachela		6	p	0	2	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocera sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neoplasta sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																	
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																	
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae	Pupae	6																		
Muscidae		6	p	0	0	0	0	3	1	1	0	0	1	0	0	0	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Phoridae		5	cg																	
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Coleoptera																				
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																	
Scirtidae		5	sc																	
Elodes sp.	--		sc																	
Staphylinidae	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agathon sp.		0	sc	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Blephharicera sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																		
Ceratopogonidae		6	p	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0
Bezzia/ Palpomyia		6	p	1	0	4	0	0	8	12	3	0	0	5	0	0	0	4	0	1
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.		6	p																	
Culicoides sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Forcipomyiinae		6	cg																	
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																	
Chaoboridae		7	p																	
Chaoborus		7	p																	
Chironomidae		6		261	344	86	64	336	101	77	51	136	808	640	839	317	551	86	128	338
Culicidae		8	cg																	
Aedes sp.																				
Culiseta sp.																				
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Dixella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Dolichopodidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Empididae		6	p	0	0	1	0	0	0	0	0	0	0	0	0	2	2	0	0	0
Chelifera/ Metachela		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocera sp.		6	p	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	1	0
Hemerodromia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4
Neoplasta sp.		6	p	0	0	0	0	0	2	4	0	0	0	0	0	1	4	4	0	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																	
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																	
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ephydridae	Pupae	6																		
Muscidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Phoridae		5	cg																	
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																	
Scirtidae		5	sc																	
Elodes sp.	--		sc																	
Staphylinidae	Adults	5	p	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Agathon sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharicera sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cecidomyiidae		5																		
Ceratopogonidae		6	p	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	0	2	2	6	0	1	4	6	13	4	5	9	4	16	16	8	5
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
Ceratopogon sp.		6	p																	
Culicoides sp.		6	p	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Forcipomyiinae		6	cg																	
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ceratopogonidae	Pupae	6	p																	
Chaoboridae		7	p																	
Chaoborus		7	p																	
Chironomidae		6		262	416	261	40	16	54	68	47	31	104	41	64	45	200	68	157	43
Culicidae		8	cg																	
Aedes sp.																				
Culiseta sp.																				
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Dixella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Empididae		6	p	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Chelifera/ Metachela		6	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Clinocera sp.		6	p	2	0	3	0	0	2	0	0	0	0	0	0	0	1	0	10	0
Hemerodromia sp.		6	p	5	0	2	0	1	0	0	2	0	0	0	0	0	1	0	31	0
Neoplasta sp.		6	p	1	1	1	0	0	1	0	0	0	5	4	0	0	2	0	5	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Trichoclinocera sp.		6	p																	
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																	
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae	Pupae	6																		
Muscidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Phoridae		5	cg																	
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Coleoptera																				
Eubrianax edwardsi	Adults	4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenus	Larave	4	sc																	
Scirtidae		5	sc																	
Elodes sp.	--		sc																	
Staphylinidae	Adults	5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blephariceridae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1
Agathon sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0
Blephariceras sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Philorus sp.		0	sc	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Brachycera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycera sp.		5		0	0	0	0	0	0	17	0	17	0	0	0	0	0	0	0	0
Cecidomyiidae		5																		
Ceratopogonidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia		6	p	2	9	13	5	7	2	13	7	19	0	0	0	0	0	13	28	4
Atrichopogon sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.		6	p																	
Culicoides sp.		6	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Dasyhelea sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyiinae		6	cg																	
Probezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stilobezzia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	Pupae	6	p																	
Chaoboridae		7	p																	
Chaoborus		7	p																	
Chironomidae		6		13	65	34	59	45	18	115	57	61	742	625	561	610	471	269	123	91
Culicidae		8	cg																	
Aedes sp.																				
Culiseta sp.																				
Dixidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa sp.		2	cg	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1
Dixella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meringodixa sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolichopodidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Empididae		6	p	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chelifera/ Metachela		6	p	0	5	2	0	0	0	1	0	1	0	0	0	0	0	0	1	0
Clinocera sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
Hemerodromia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Neoplasta sp.		6	p	0	0	3	1	0	0	1	1	0	0	0	0	0	1	1	3	0
Oreogeton sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoclinocera sp.		6	p																	
Wiedemannia sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia sp.				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrellia sp.		6	sh																	
Scatella sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephydridae	Pupae	6																		
Muscidae		6	p	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0
Pelecorynchidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutops sp.		3	p	0	0	0	0	0	1	1	1	3	0	0	0	0	0	0	1	0
Phoridae		5	cg																	
Psychodidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Maruina lanceolata sp.		2	sc	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																
Scathophagidae		5																	
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																	
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Prosimulium sp.		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.		6	cf	226	73	4	335	59	19	181	13	60	3	18	169	203	39	35	199
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hedriodiscus/Odontomyia		8	cg																
Nemotelus		8	cg																
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Antocha sp.		3	cg	0	0	0	0	0	2	0	0	6	1	0	0	0	0	0	0
Cryptolabis		3	sh																
Dicranota sp.		3	p	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	0	0	0	0	0	1	0	0	0	6	0	0	0	0	0	0
Limnophila sp.		3	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lipsothrix sp.		5																	
Molophilus sp.		4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula sp.		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ulomorpha sp.		5																	
Tipulidae sp A.		5																	
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	3	17	2	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	45	205	75	261	3	191	55	205	132	32	98	23	45	151	210	216
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	0	0	0	1	0	73	0	5	49	3	52	0	2	0	0	0
Fallceon quilleri		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	1
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	1	1	28	12
Drunella sp.		0	cg	0	0	0	0	0	1	1	0	2	6	0	0	0	0	0	0

Taxon	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Maruina lanceolata sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																	
Scathophagidae		5																		
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																		
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.		6	cf	139	191	145	6	322	37	1	58	285	30	7	260	283	14	1	1	225
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	0	1	1	0	0	11	0	0	1	0	0	0	1	6	2	3	0
Hedriodiscus/Odontomyia		8	cg																	
Nemotelus		8	cg																	
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																	
Chrysops sp.		8	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha sp.		3	cg	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptolabis		3	sh																	
Dicranota sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	2	8	9	0	0
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																	
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Limnophila sp.		3	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Lipsothrix sp.		5																		
Molophilus sp.		4	sh	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula sp.		4	om	0	0	0	0	0	0	0	0	0	1	6	7	0	0	0	0	0
Ulomorpha sp.		5																		
Tipulidae sp A.		5																		
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetidae		4	cg	3	0	2	0	0	0	0	9	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	273	381	328	144	39	2	158	286	111	6	7	1	23	6	10	495	431
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	0	0	0	2	0	1	0	0	0	0	0	0	34	96	130	0	0
Fallceon quilleri		4	cg	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	10	31	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	0	14	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Maruina lanceolata sp.		2	sc	0	0	0	0	0	0	0	5	3	0	1	0	0	0	0	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																
Scathophagidae		5																	
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																	
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	0	0	0	0	0	0	0	0	0	0	0	1	9	40	10	13
Simulium sp.		6	cf	81	54	176	16	4	13	57	15	6	156	11	2	22	33	28	1
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Hedriodiscus/Odontomyia		8	cg																
Nemotelus		8	cg																
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha sp.		3	cg	0	0	1	0	0	0	0	1	0	2	5	0	0	0	1	3
Cryptolabis		3	sh																
Dicranota sp.		3	p	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	0	0	0	0	0	0	0	11	11	1	2	6	0	0	4	1
Limnophila sp.		3	s	0	0	4	0	0	0	0	0	0	0	1	124	44	0	11	2
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lipsothrix sp.		5																	
Molophilus sp.		4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Tipula sp.		4	om	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Ulomorpha sp.		5																	
Tipulidae sp A.		5																	
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	0	0	0	1	1	4	1	1	0	0	7	5	0	3	0
Baetidae		4	cg	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	405	434	61	122	129	67	55	64	39	75	17	81	104	100	65	44
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	0	0	16	24	1	0	76	44	73	35	41	8	8	12	40	3
Fallceon quilleri		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	12	1	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	0	0	9	2	45	0	6	13	68	24	21	14	16	4	1	49

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Maruina lanceolata sp.		2	sc	2	8	19	2	0	0	0	0	0	0	0	0	0	0	0	0	4
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																	
Scathophagidae		5																		
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																		
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	8	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.		6	cf	1	2	0	19	14	5	14	92	62	22	10	178	102	6	122	110	5
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	0	2	0	0	0	0	0	0	0	0	0	0	0	6	0	8	3
Hedriodiscus/Odontomyia		8	cg																	
Nemotelus		8	cg																	
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																	
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptolabis		3	sh																	
Dicranota sp.		3	p	0	1	5	1	0	0	0	0	0	0	0	0	0	1	0	6	0
Erioptera sp.		3	cg	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																	
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	1	5	2	19	1	0	0	0	0	0	0	0	0	2	0	0	2
Limnophila sp.		3	s	39	69	25	94	0	0	0	0	0	0	0	0	0	0	0	0	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lipsothrix sp.		5																		
Molophilus sp.		4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilaria sp.		7	p	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	0
Tipula sp.		4	om	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	4	0
Ulomorpha sp.		5																		
Tipulidae sp A.		5																		
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	2	1	2	2	0	0	0	0	0	0	0	0	5	10	0	46	0
Baetidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	158	110	28	38	5	0	4	37	0	0	631	4	83	104	127	123	67
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	20	10	77	20	0	0	0	0	0	0	0	0	0	0	0	5	107
Fallceon quilleri		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	3	3	3	3	0	0	0	0	0	0	0	0	0	4	0	0	11

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
Year:				Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Maruina lanceolata sp.		2	sc	0	5	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																	
Scathophagidae		5																		
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																		
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.		6	cf	379	170	27	1	91	104	68	80	0	0	184	1	47	40	28	9	50
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	0	7	2	1	0	1	0	0	0	0	0	0	0	0	2	0	1
Hedriodiscus/Odontomyia		8	cg																	
Nemotelus		8	cg																	
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																	
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Antocha sp.		3	cg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cryptolabis		3	sh																	
Dicranota sp.		3	p	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																	
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	0	0	1	0	2	2	2	6	0	0	0	0	0	0	0	14	12
Limnophila sp.		3	s	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Lipsothrix sp.		5																		
Molophilus sp.		4	sh	0	0	0	0	2	1	0	0	0	0	0	0	1	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Tipula sp.		4	om	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ulomorpha sp.		5																		
Tipulidae sp A.		5																		
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	0	1	0	0	0	0	14	0	0	0	0	0	0	0	5	0
Baetidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	178	44	191	12	63	128	169	25	0	0	8	10	102	168	71	30	53
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Diphetor hageni		5	cg	0	69	133	5	60	24	19	49	0	0	0	0	0	0	23	41	42
Fallceon quilleri		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	0	2	0	0	9	35	19	1	0	0	0	0	0	0	0	3	4

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Site Code:				PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Maruina lanceolata sp.		2	sc	0	0	0	0	0	0	0	0	0	6	1	5	0	0	0	0	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae	Pupae	4	cg																	
Scathophagidae		5																		
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																		
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.		6	cf	201	98	66	75	89	2	29	37	8	52	49	2	26	11	26	23	14
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	0	0	2	2	0	1	0	1	2	5	1	7	1	3	0	2	4
Hedriodiscus/Odontomyia		8	cg																	
Nemotelus		8	cg																	
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																	
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tipulidae		3		0	0	0	0	0	0	0	1	0	0	1	2	0	1	0	1	0
Antocha sp.		3	cg	0	0	0	2	2	1	0	2	0	2	0	0	0	0	0	1	2
Cryptolabis		3	sh																	
Dicranota sp.		3	p	0	2	0	0	0	0	1	0	0	0	1	0	0	0	3	0	0
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																	
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Hexatoma sp.		2	p	3	0	3	0	4	4	0	6	4	3	2	6	1	3	5	1	2
Limnophila sp.		3	s	0	0	2	2	3	3	3	21	0	2	6	27	33	1	7	1	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lipsothrix sp.		5																		
Molophilus sp.		4	sh	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	0	0	1	0	0	1	0	0	0	0	3	0	0
Tipula sp.		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Ulomorpha sp.		5																		
Tipulidae sp A.		5																		
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	0	0	3	0	16	22	0	33	1	0	8	2	0	5	1	2
Baetidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	81	56	109	107	98	33	3	25	10	108	28	48	63	25	22	5	331
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	18	23	16	96	35	25	94	11	17	9	22	17	18	1	20	58	11
Fallceon quilleri		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	13	0	20	11	43	60	0	45	5	4	13	17	1	5	4	5	23

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Maruina lanceolata sp.		2	sc	0	5	1	0	1	3	0	14	6	0	0	0	0	0	1	2	0
Pericoma/ Telmatoscopus		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoda sp.		10	cg	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0
Psychodidae	Pupae	4	cg																	
Scathophagidae		5																		
Sciomyzidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antichaeta sp.		6																		
Sepedon sp.		6		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Simuliidae		6	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium sp.		3	cf	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	7	56
Simulium sp.		6	cf	36	118	6	149	39	9	7	61	5	60	10	18	102	21	19	5	1
Stratiomyidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caloparyphus/ Euparyphus		7	cg	5	9	4	1	0	0	3	2	3	0	0	5	0	0	1	4	1
Hedriodiscus/Odontomyia		8	cg																	
Nemotelus		8	cg																	
Syrphidae		10	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tabanus - Atylotus sp.		5	p																	
Chrysops sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvius sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha sp.		3	cg	1	0	0	1	0	0	0	0	3	0	0	0	3	0	0	1	0
Cryptolabis		3	sh																	
Dicranota sp.		3	p	0	0	0	1	0	0	0	0	0	0	0	0	0	6	0	2	1
Erioptera sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gonomyia sp.		3	cg																	
Hesperocanopa sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.		2	p	0	0	2	1	4	2	3	1	4	0	0	0	0	0	0	2	4
Limnophila sp.		3	s	45	1	26	12	18	0	0	1	2	0	0	0	0	0	17	24	0
Limonia sp.		6	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lipsothrix sp.		5																		
Molophilus sp.		4	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ormosia sp.		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1
Pilaria sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix sp.		3	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tipula sp.		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ulomorpha sp.		5																		
Tipulidae sp A.		5																		
Ephemeroptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus sp.		0	cg	0	3	1	0	3	4	12	1	0	0	0	0	0	0	3	4	15
Baetidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centroptilum/ Procloeon		2	cg	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp.		5	cg	10	120	14	56	69	76	456	81	30	1	26	24	8	235	55	33	160
Callibaetis sp.		9	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diphetor hageni		5	cg	6	35	6	10	25	19	1	4	9	0	0	0	0	0	35	14	8
Fallceon quilleri		4	cg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenis sp.		7	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella sp.		0	cg	24	10	44	32	14	32	18	19	11	0	0	0	0	0	20	27	20

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Ephemerella sp.		1	cg	0	0	105	5	0	0	0	3	0	0	0	0	0	0	0	1
Serratella sp.		2	cg	0	0	0	37	0	12	1	5	0	4	0	1	1	3	6	9
Heptageniidae		4	sc	0	0	0	2	0	0	1	7	0	9	0	0	0	0	9	5
Cinygma sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ironodes sp.		3	sc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	0	0	0	0	0	37	2	0	7	0	0	0	0	0	0	0
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	0	0	0	0	0	3	6	0	2	0	0	0	0	2	1	6
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	0	1	1	18	0	0	0	2	5	6	5	0	0	0	0	0
Siphlonuridae		7	cg																
Siphlonurus sp.		7	cg																
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																			
Microvelia sp.	Adults	5																	
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																			
Archanara sp.																			
Pyralidae		5																	
Petrophila		5	sc																
Tortricidae																			
Archips sp.		5																	
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	0	0	0	0	0	1	19	0	0	0	0	0	0	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gomphidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesocapnia sp.		1	sh																
Chloroperlidae		1	p	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Ephemerella sp.		1	cg	0	16	0	238	0	0	0	0	0	0	0	0	0	0	0	0	0
Serratella sp.		2	cg	9	33	5	40	0	62	0	0	0	0	0	0	0	0	0	0	0
Heptageniidae		4	sc	2	15	0	11	15	0	0	0	0	0	0	0	59	29	50	0	0
Cinygma sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	0	0	0	0	0	0	0	0	0	0	0	0	94	157	184	0	0
Epeorus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ironodes sp.		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	0	0	8	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	1	9	0	51	137	0	0	0	0	0	0	0	12	35	15	0	0
Siphlonuridae		7	cg																	
Siphlonurus sp.		7	cg																	
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																				
Microvelia sp.	Adults	5																		
Lepidoptera		5		0	0	0	0	2	0	0	0	0	1	0	3	0	3	0	0	1
Noctuidae																				
Archanara sp.																				
Pyralidae		5																		
Petrophila		5	sc																	
Tortricidae																				
Archips sp.		5																		
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																	
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	0	1	1	2	0	1	0	1	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	0	9	0	5	0	0	0	2	9	2	6	2	7	4	2	5
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
Gomphidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	7	5	5	0	0
Mesocapnia sp.		1	sh																	
Chloroperlidae		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			Site Code:	**SPA-220**	**SPA-240**	**LAG-170**	**LAG-130**	**LAG-150**	**LAG-160**	**LAG-165**	**LAG-180**	**LAG-190**	**LAG-210**	**LAG-220**	**LAG-240**	**LAG-270**	**LAG-290**	**LAG-300**	**LAG-320**
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Coleoptera																			
Ephemerella sp.		1	cg	0	0	14	2	27	15	10	0	9	7	17	83	75	24	4	0
Serratella sp.		2	cg	0	0	0	0	1	0	0	2	1	0	0	0	0	0	2	74
Heptageniidae		4	sc	0	0	3	5	3	0	0	0	0	17	34	36	9	7	4	25
Cinygma sp.		2	sc	0	0	0	0	0	0	69	28	46	53	0	0	0	0	0	37
Cinygmula sp.		4	sc	0	0	36	32	0	0	0	0	0	47	78	0	0	2	4	76
Epeorus sp.		0	sc	0	0	5	2	0	1	2	0	4	18	5	0	0	0	0	9
Ironodes sp.		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	0	0	4	1	0	0	3	1	2	3	2	0	0	0	0	0
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	0	0	2	0	1	0	0	1	0	0	1	0	0	0	0	0
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	0	0	0	1	0	0	0	1	10	0	0	28	7	0	1	0
Siphlonuridae		7	cg																
Siphlonurus sp.		7	cg																
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																			
Microvelia sp.	Adults	5																	
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																			
Archanara sp.																			
Pyralidae		5																	
Petrophila		5	sc																
Tortricidae																			
Archips sp.		5																	
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gomphidae		4	p	0	0	1	0	0	0	0	0	0	1	3	1	0	0	1	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesocapnia sp.		1	sh																
Chloroperlidae		1	p	0	0	6	0	4	0	1	0	0	0	4	12	7	0	2	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
Site Code:				LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Ephemerella sp.		1	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serratella sp.		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptageniidae		4	sc	28	19	57	79	0	0	0	0	0	0	0	0	0	81	0	19	24
Cinygma sp.		2	sc	7	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	18
Epeorus sp.		0	sc	0	0	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0
Ironodes sp.		3	sc	7	8	18	44	0	0	0	0	0	0	0	0	0	0	0	0	18
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	5	3	0	7	0	0	0	0	0	0	0	0	0	46	0	37	10
Siphlonuridae		7	cg																	
Siphlonurus sp.		7	cg																	
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																				
Microvelia sp.	Adults	5																		
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																				
Archanara sp.																				
Pyralidae		5																		
Petrophila		5	sc																	
Tortricidae																				
Archips sp.		5																		
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																	
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	36	0	0	1	0	0	4	1	1	15	0	0	0	1	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	1	7	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Gomphidae		4	p	0	2	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
Mesocapnia sp.		1	sh																	
Chloroperlidae		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Taxa	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Ephemerella sp.		1	cg	0	0	0	0	37	92	22	6	0	0	0	0	0	0	0	24	30
Serratella sp.		2	cg	0	0	0	0	13	62	39	7	0	0	0	0	0	0	0	0	3
Heptageniidae		4	sc	0	21	1	0	0	0	1	0	0	0	0	0	0	0	0	1	5
Cinygma sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	0	18	0	10	89	27	28	153	0	0	0	0	0	0	0	16	21
Epeorus sp.		0	sc	0	0	0	0	14	39	70	9	1	0	0	0	0	0	0	3	15
Ironodes sp.		3	sc	0	3	0	0	0	7	14	10	0	0	0	0	0	0	0	0	0
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	0	0	0	0	5	4	2	7	0	0	0	0	0	0	0	3	2
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	52	121
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	4	73	1	1	6	3	5	70	1	0	0	0	0	2	338	0	1
Siphlonuridae		7	cg																	
Siphlonurus sp.		7	cg																	
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Veliidae																				
Microvelia sp.	Adults	5																		
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																				
Archanara sp.																				
Pyralidae		5																		
Petrophila		5	sc																	
Tortricidae																				
Archips sp.		5																		
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																	
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	1	0	0	0	0	0	0	0	0	1	0	1	3	8	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	0	0
Gomphidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesocapnia sp.		1	sh																	
Chloroperlidae		1	p	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
			Site Code:	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Ephemerella sp.		1	cg	22	0	121	220	31	305	2	144	25	25	6	13	25	118	42	74	5
Serratella sp.		2	cg	4	0	19	10	153	42	0	36	1	86	174	0	32	39	16	2	85
Heptageniidae		4	sc	3	1	0	4	2	12	2	22	0	0	9	1	0	0	0	2	0
Cinygma sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	21	73	12	12	5	62	0	61	275	95	140	72	72	18	94	19	20
Epeorus sp.		0	sc	15	1	26	28	23	36	0	82	2	68	66	7	9	0	22	22	23
Ironodes sp.		3	sc	0	3	0	0	0	0	0	2	2	5	7	10	21	0	4	0	6
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	3	3	5	4	4	16	5	14	1	2	3	4	8	0	18	2	7
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	38	0	34	4	85	19	0	13	0	3	3	0	0	0	0	71	0
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	0	5	1	3	13	1	8	0	0	7	5	5	1	6	7	3	0
Siphlonuridae		7	cg																	
Siphlonurus sp.		7	cg																	
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																				
Microvelia sp.	Adults	5																		
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																				
Archanara sp.																				
Pyralidae		5																		
Petrophila		5	sc																	
Tortricidae																				
Archips sp.		5																		
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																	
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	0	0	0	0	0	6	0	2	4	0	9	0	2	8	0	2
Gomphidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	0	0	0	0	0	0	0	1	2	5	2	1	6	0	2
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesocapnia sp.		1	sh																	
Chloroperlidae		1	p	0	0	0	1	0	8	0	13	17	0	2	2	0	1	6	1	0
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Ephemerella sp.		1	cg	125	48	187	59	66	11	0	26	141	0	0	0	0	0	182	78	25
Serratella sp.		2	cg	30	99	23	57	5	0	4	3	8	0	0	0	0	0	22	18	0
Heptageniidae		4	sc	1	3	0	9	4	0	0	0	4	0	0	0	0	0	0	0	5
Cinygma sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula sp.		4	sc	84	117	116	83	165	38	1	97	137	0	0	0	0	0	17	36	1
Epeorus sp.		0	sc	120	85	35	63	93	68	10	89	69	0	0	0	0	0	10	27	1
Ironodes sp.		3	sc	1	0	1	0	3	7	8	5	2	0	0	0	0	0	0	2	4
Leucrocuta/Nixe/Heptagenia		3	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.		0	sc	5	2	1	0	3	4	5	6	0	0	0	0	0	0	1	3	20
Leptohyphidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes sp.		4	cg	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptophlebiidae		2	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia sp.		4	cg	9	3	13	10	15	5	2	2	4	0	0	0	0	0	1	3	57
Siphlonuridae		7	cg																	
Siphlonurus sp.		7	cg																	
Hemiptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corixidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigara sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veliidae																				
Microvelia sp.	Adults	5																		
Lepidoptera		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noctuidae																				
Archanara sp.																				
Pyralidae		5																		
Petrophila		5	sc																	
Tortricidae																				
Archips sp.		5																		
Megaloptera				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corydalidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysmicohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orohermes crepuscularis		0	p																	
Neohermes sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sialidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odonata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aeshnidae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anax sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calopterygidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hetaerina sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae			p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argia sp.		7	p	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0
Cordulegastridae		3	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordulegaster dorsalis		3	p	0	1	0	0	0	0	2	2	1	0	0	0	0	0	0	2	0
Gomphidae		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erpetogomphus sp.		4	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octogomphus specularis		4	p	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	2	0
Plecoptera		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capniidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesocapnia sp.		1	sh																	
Chloroperlidae		1	p	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	12
Bisancora sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla sp.		1	p	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	0	0	0	1	0	96	24	5	5	54	0	0	0	0	0	1
Sweltsa sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	0	0	0	40	0	18	0	83	173	48	108	0	2	0	0	2
Soyedina		2	sh																
Zapada		2	sh																
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesperoperla sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calineuria californica		2	p	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Perlodidae		2	p	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Baumannella alameda		2																	
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla sp.		2	p	0	0	139	2	0	2	1	45	4	19	7	5	4	1	1	0
Kogotus sp.		2	p	0	0	0	3	0	2	0	4	1	3	0	1	2	0	0	0
Osobenus yakimae		2	p																
Rickera sorpta		2	p																
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amiocentrus aspilus		3	cg	0	0	0	0	0	4	1	1	0	0	2	0	0	0	0	0
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0
Glossosomatidae		0	sc	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1	0
Agapetus sp.		0	sc	0	0	0	0	0	2	7	4	77	28	23	0	6	1	26	17
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	0	0	0	0	0	0	3	0	1	0	2	0	0	0	0	0
Protoptila sp.		1	sc	0	0	0	0	0	40	4	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																
Hydropsychidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	20	3	16
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	0	0	0	0	0	4	3	0	0	0	0	0	0	4	1	0
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	0	0	0	0	0	10	1	1	41	3	30	0	0	7	3	2
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																		
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Sweltsa sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	1	4	8	2	0
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																	
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	1	0	1	1	13	0	0	0	0	0	0	0	108	141	191	0	0
Soyedina		2	sh																	
Zapada		2	sh																	
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesperoperla sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calineuria californica		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlodidae		2	p	0	0	1	19	2	0	0	0	0	0	0	0	0	0	0	0	0
Baumannella alameda		2																		
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla sp.		2	p	0	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Kogotus sp.		2	p	0	0	0	11	0	0	0	0	0	0	0	0	2	1	1	0	0
Osobenus yakimae		2	p																	
Rickera sorpta		2	p																	
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amiocentrus aspilus		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosomatidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agapetus sp.		0	sc	40	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Protoptila sp.		1	sc	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																	
Hydropsychidae		4	cf	8	3	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	3	1	13	0	0	0	0	0	0	0	0	0	3	16	33	0	0
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Hydropsychidae	Pupae																			
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	8	2	0	0	0
Suwallia sp.		1	p	0	0	18	5	118	44	51	14	1	13	5	60	41	5	10	2
Sweltsa sp.		1	p	0	0	32	1	2	0	38	0	2	7	3	5	3	2	2	12
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	0	0	22	87	5	0	82	126	43	45	41	17	46	12	8	136
Soyedina		2	sh																
Zapada		2	sh																
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae		1	p	0	0	0	0	0	0	0	0	0	9	38	10	0	0	0	1
Hesperoperla sp.		2	p	0	0	1	0	0	0	1	0	10	4	0	0	0	0	0	5
Calineuria californica		2	p	0	0	1	1	0	0	1	8	32	6	10	2	3	0	0	2
Perlodidae		2	p	0	0	0	1	2	0	0	0	0	0	0	0	2	0	0	0
Baumannella alameda		2																	
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla sp.		2	p	0	0	10	4	111	22	9	4	0	1	0	1	5	10	3	2
Kogotus sp.		2	p	1	0	0	0	1	5	0	0	0	0	0	0	0	0	2	0
Osobenus yakimae		2	p																
Rickera sorpta		2	p																
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	6
Amiocentrus aspilus		3	cg	0	0	3	1	1	0	1	0	2	2	0	0	0	0	0	4
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosomatidae		0	sc	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0
Agapetus sp.		0	sc	0	0	19	46	84	1	6	3	0	5	25	0	2	0	0	0
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	0	0	0	1	0	0	5	1	1	16	15	0	0	0	0	19
Protoptila sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																
Hydropsychidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	0	0	15	34	0	0	2	5	40	12	8	1	2	3	1	17
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																		
Hydroptilidae		4	ph	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group) / *Site Code:*	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	0	0	6	14	0	0	0	0	0	0	0	0	1	13	0	0	0
Sweltsa sp.		1	p	18	4	4	22	0	0	0	0	0	0	0	0	0	1	0	0	6
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																	
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	59	24	61	106	0	0	0	0	0	0	0	0	0	24	1	51	9
Soyedina		2	sh																	
Zapada		2	sh																	
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	3	36	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae		1	p	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	1
Hesperoperla sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calineuria californica		2	p	3	0	6	7	0	0	0	0	0	0	0	0	0	2	0	0	0
Perlodidae		2	p	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	2	0
Baumannella alameda		2																		
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	57	0	1	0
Kogotus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	2	2
Osobenus yakimae		2	p																	
Rickera sorpta		2	p																	
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	18
Amiocentrus aspilus		3	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Glossosomatidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protoptila sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																	
Hydropsychidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	5	1	6	16	0	0	0	0	0	1	86	0	0	0	0	0	20
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																			
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	0	0	0	0	1	0	0	49	0	0	0	0	0	0	0	0	0
Sweltsa sp.		1	p	0	0	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																	
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	22	35	79	0	19	89	65	74	0	0	0	0	0	0	29	3	6
Soyedina		2	sh																	
Zapada		2	sh																	
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae		1	p	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Hesperoperla sp.		2	p	0	0	0	0	0	0	8	6	0	0	0	0	0	0	0	0	0
Calineuria californica		2	p	0	0	0	0	0	0	3	70	0	0	1	0	0	0	0	0	0
Perlodidae		2	p	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	1	0
Baumannella alameda		2																		
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Isoperla sp.		2	p	0	0	0	0	11	14	0	0	0	0	0	0	0	0	0	5	13
Kogotus sp.		2	p	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osobenus yakimae		2	p																	
Rickera sorpta		2	p																	
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	0	0	0	0	0	10	58	0	0	0	0	0	0	0	0	0	0
Amiocentrus aspilus		3	cg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	6
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosomatidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agapetus sp.		0	sc	0	0	0	0	12	1	0	0	0	0	0	0	0	0	5	3	1
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Protoptila sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																	
Hydropsychidae		4	cf	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Arctopsyche sp.		1	p	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	16
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	0	3	13	0	15	9	10	5	0	0	0	0	0	1	0	2	24
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																			
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group) *Site Code:*	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	0	0	1	0	0	2	0	2	0	3	3	3	4	9	8	0	0
Sweltsa sp.		1	p	0	0	0	1	2	1	10	0	57	0	1	14	8	1	20	0	1
Leuctridae		0	sh	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	0	0	3	1	0	0	0	0	1	0	0
Paraleuctra sp.		0	sh	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0
Perlomyia sp.		0	sh																	
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	1	117	7	33	34	41	17	49	43	27	43	16	3	111	39	17	29
Soyedina		2	sh																	
Zapada		2	sh																	
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Perlidae		1	p	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
Hesperoperla sp.		2	p	0	0	0	1	0	0	0	0	0	13	11	3	6	0	5	0	6
Calineuria californica		2	p	0	0	1	3	2	17	74	26	56	33	25	18	24	10	100	2	0
Perlodidae		2	p	2	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Baumannella alameda		2																		
Cultus sp.		2	p	2	0	1	2	1	1	0	0	0	1	0	0	0	0	0	0	0
Isoperla sp.		2	p	16	0	23	48	18	3	0	2	0	0	1	0	0	0	1	13	0
Kogotus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osobenus yakimae		2	p																	
Rickera sorpta		2	p																	
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	4	0	8	2	77	11	0	12	0	45	23	3	7	0	1	1	77
Amiocentrus aspilus		3	cg	4	1	7	3	27	2	0	6	0	2	7	0	1	0	0	4	5
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosomatidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agapetus sp.		0	sc	1	3	9	8	0	0	0	5	0	0	0	0	1	0	0	11	0
Anagapetus sp.		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	1	0	1	0	0	0	0	3	0	0	0	0	0	0	1	0	0
Protoptila sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																	
Hydropsychidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	8	0	4	3	0	0	0	0	0	0	0	0	0	0	0	1	0
Homoplectra		4	cf	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	25	0	24	35	17	4	0	8	1	40	16	11	4	1	1	9	3
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																			
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Paraperla sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia sp.		1	p	11	1	17	11	52	1	0	0	17	0	0	0	0	0	5	6	3
Sweltsa sp.		1	p	0	0	0	0	0	4	3	4	1	0	0	0	0	0	1	15	13
Leuctridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Despaxia augusta		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra sp.		0	sh	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0
Perlomyia sp.		0	sh																	
Nemouridae		2	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka sp.		2	sh	44	11	60	42	78	14	50	20	35	0	0	0	0	38	52	8	22
Soyedina		2	sh																	
Zapada		2	sh																	
Peltoperlidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Soliperla sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Perlidae		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesperoperla sp.		2	p	0	3	0	1	3	7	0	9	1	0	0	0	0	0	0	0	0
Calineuria californica		2	p	7	14	16	9	39	15	11	93	85	0	0	0	0	0	7	47	49
Perlodidae		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baumannella alameda		2																		
Cultus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla sp.		2	p	3	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Kogotus sp.		2	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osobenus yakimae		2	p																	
Rickera sorpta		2	p																	
Pteronarcyidae		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Pteronarcys sp.		0	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Taeniopterygidae		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taenionema sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Trichoptera		3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apataniidae		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentridae		1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.		1	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.		1	mh	25	10	38	52	6	5	1	2	12	0	0	0	0	0	7	17	0
Amiocentrus aspilus		3	cg	1	0	1	1	2	1	0	0	0	0	0	0	1	0	4	0	0
Calamoceratidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteroplectron		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosomatidae		0	sc	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	0	0
Agapetus sp.		0	sc	2	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Anagapetus sp.		0	sc	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Culoptila sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma sp.		1	sc	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protoptila sp.		1	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsyche borealis		3	sc																	
Hydropsychidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctopsyche sp.		1	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.		5	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoplectra		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.		4	cf	27	6	41	40	52	21	1	63	23	0	0	0	0	6	5	18	0
Parapsyche sp.		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae	Pupae																			
Hydroptilidae		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Hydroptila sp.		6	ph	0	0	0	1	0	0	0	0	0	0	0	0	0	2	2	5
Ochrotrichia sp.		4	ph	0	0	0	0	0	1	22	8	1	0	0	0	0	13	4	11
Oxyethira sp.		3	ph	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	0	0	1	0	0	6	13	21	1	2	3	0	0	0	0	0
Lepidostoma sp.	Pupae	1	sh																
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																
Dicosmoecus gilvipes		1	om																
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Psychoglypha		2	sh																
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	0	0	0	29	0	80	0	0	1	4	0	0	0	26	20	4
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	1	0	0	2	0	4	6	5	10	22	8	1	0	0	0	0
Rhyacophila sp.	Pupae	0	p																
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	0	0	1	2	0	44	43	34	118	264	33	0	0	0	0	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	0	0	0	0	0	1	7	1	32	18	41	0	0	0	0	0
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	16	72	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	8	141	215	0	265	1	2	7	4	0	4	0	0	0	0	1
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			Site Code:	**SUI-060**	**SUI-110**	**SUI-130**	**SUI-180**	**SUI-210**	**SUI-260**	**SPA-020**	**SPA-050**	**SPA-070**	**SPA-100**	**SPA-110**	**SPA-130**	**SPA-140**	**SPA-150**	**SPA-160**	**SPA-170**	**SPA-200**
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Hydroptila sp.		6	ph	0	0	4	0	0	3	4	1	1	0	4	0	0	0	0	0	1
Ochrotrichia sp.		4	ph	11	1	3	17	0	0	0	0	0	0	0	0	0	0	0	0	0
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	1	5	206	88	4	0
Lepidostoma sp.	Pupae	1	sh																	
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																	
Dicosmoecus gilvipes		1	om																	
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																	
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoglypha		2	sh																	
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	12	5	1	5	8	1	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	0	1	0	0	14	0	0	0	0	0	0	0	2	0	0	0	0
Rhyacophila sp.	Pupae	0	p																	
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	0	0	1	0	3	0	0	0	0	0	0	0	0	1	1	0	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	37	0	0	0	0	0	0	0	0	0	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																	
Gammarus sp.		6	cg	0	0	0	0	0	0	57	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Coleoptera																			
Hydroptila sp.		6	ph	2	0	0	0	0	0	0	0	0	0	0	0	0	2	8	0
Ochrotrichia sp.		4	ph	0	0	0	10	2	0	0	0	0	1	0	0	0	0	0	0
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	3	0	0	0	0	0	0	0	1	0	0	0	2	0	1	0
Lepidostoma sp.	Pupae	1	sh																
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																
Dicosmoecus gilvipes		1	om																
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoglypha		2	sh																
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	0	0	0	0	0	0	0	11	0	0	1	0	0	1	0
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	0	0	3	13	0	0	28	25	0	0	0	0	4	0	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	0	0	4	5	0	0	11	16	44	13	21	27	22	16	8	10
Rhyacophila sp.	Pupae	0	p																
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	0	0	5	0	0	0	0	31	2	0	22	18	11	1	15	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	0	0	0	3	0	0	2	4	6	3	21	4	4	0	1	2
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Site Code:	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Hydroptila sp.		6	ph	0	0	1	0	5	0	0	0	0	0	2	0	2	0	0	0	0
Ochrotrichia sp.		4	ph	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	21	0	7	1	0	0	0	0	0	0	0	0	2	0	0	6	41
Lepidostoma sp.	Pupae	1	sh																	
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																	
Dicosmoecus gilvipes		1	om																	
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																	
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Psychoglypha		2	sh																	
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	90	21	2	3	0	0	0	0	0	0	0	0	13	27	0	4	91
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	2	1	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	7	42	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	74	51	75	26	0	0	0	0	0	0	0	0	2	35	0	108	43
Rhyacophila sp.	Pupae	0	p																	
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	0	1	2	31	0	0	0	0	0	0	0	0	0	15	0	0	15
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	2	19	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																	
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Coleoptera																				
Hydroptila sp.		6	ph	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ochrotrichia sp.		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	0	0	2	0	1	0	2	11	0	0	0	0	0	9	72	0	4
Lepidostoma sp.	Pupae	1	sh																	
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																	
Dicosmoecus gilvipes		1	om																	
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																	
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoglypha		2	sh																	
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	0	160	0	0	0	3	24	0	0	0	0	0	0	0	0	0
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	0	0	0	0	0	0	2	1	0	0	0	0	0	2	3	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	2	18	40	0	3	28	7	12	0	0	1	0	1	1	43	0	1
Rhyacophila sp.	Pupae	0	p																	
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	2	0	0	9	6	2	1	3	0	0	0	0	0	0	0	3	23
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	0	1	0	0	2	5	3	2	0	0	0	0	0	0	0	0	0
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																	
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus leniseulus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
			Site Code: / *Year:*	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Hydroptila sp.		6	ph	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	2	2
Ochrotrichia sp.		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	3	0	22	27	2	1	21	0	19	4	0	21	0	0	6	35	11
Lepidostoma sp.	Pupae	1	sh																	
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Limnephilidae		4	s	0	0	0	0	0	0	1	0	1	3	0	1	1	0	0	0	0
Amphicomoecus canax		1	sh																	
Dicosmoecus gilvipes		1	om																	
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Hydatophylax hesperus		1	sh																	
Onocosmoecus sp.		1	sh	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Psychoglypha		2	sh																	
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	0	0	0	0	1	8	0	26	4	2	70	20	3	14	0	0
Philopotamidae		3	cf	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Wormaldia sp.		3	cf	0	0	0	0	0	1	0	0	0	0	0	0	0	0	18	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	4	8	7	7	17	28	10	15	27	30	30	24	18	1	20	6	13
Rhyacophila sp.	Pupae	0	p																	
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	50	0	21	1	0	0	0	0	0	0	0	2	0	0	2	29	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	2	0	2	8	9	8	0	19	0	4	2	30	12	14	8	0	21
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																	
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Hydroptila sp.		6	ph	0	0	0	0	0	0	0	0	0	1	0	0	1	18	0	0	0
Ochrotrichia sp.		4	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oxyethira sp.		3	ph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma sp.		1	sh	138	0	43	57	0	1	2	1	0	0	0	0	0	0	0	6	2
Lepidostoma sp.	Pupae	1	sh																	
Leptoceridae		4	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis disjuncta		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnephilidae		4	s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphicomoecus canax		1	sh																	
Dicosmoecus gilvipes		1	om																	
Ecclisomyia sp.		2	om	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
Hydatophylax hesperus		1	sh																	
Onocosmoecus sp.		1	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoglypha		2	sh																	
Odontoceridae		0	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parthina sp.		0	sh	0	14	0	0	1	6	4	2	4	0	0	0	0	0	0	16	3
Philopotamidae		3	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra sp.		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes sp.		2	cf'	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Wormaldia sp.		3	cf	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.		6	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Psychomyiidae		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tinodes sp.		2	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophilidae		0	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp.		0	p	22	32	33	28	59	15	17	17	45	0	0	0	0	0	33	68	18
Rhyacophila sp.	Pupae	0	p																	
Sericostomatidae		3	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gumaga sp.		3	sh	2	0	1	0	1	0	1	0	2	0	0	0	0	0	0	0	0
Uenoidae		0	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophylax sp.		3	g	2	6	17	3	6	4	10	0	33	0	0	0	0	0	2	6	1
Neothremma sp.		0	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum Crustacea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophiidae		4	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyctidae		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0
Stygobromus sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Synurella sp.		4	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eogammarus sp.		6	cg																	
Gammarus sp.		6	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decapoda		8	sh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astacidae		6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacifasticus lenisculus		6	om	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atyidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncaris		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda		8	cg	0	2	4	0	0	0	0	0	0	0	2	0	0	1	1	0
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda		8	cg	0	0	0	0	0	11	1	0	0	4	8	1	0	0	0	0	4
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda		8	cg	0	0	0	0	0	1	0	0	0	3	6	0	0	1	3	20
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																	
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda		8	cg	9	0	0	5	2	0	1	1	4	10	0	0	0	0	0	1	0
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	5	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda **Insecta** Coleoptera																				
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	488	0
Ostracoda		8	cg	1	0	0	0	0	0	0	0	59	1	3	3	0	7	4	0	0
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Site Code: / *Year:*				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	272	0	29	8	0	0	100	1	15	0	0
Ostracoda		8	cg	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0
Oribatei sp.		5		0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Isopoda		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellidae		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caecidota sp.		8	cg	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Sphaeromatidae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnorimosphaeroma		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda		8	cg	0	1	0	0	0	0	1	0	0	12	0	3	1	0	0	0	0
Subphylum Chelicerata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatei sp.		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Taxon	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	0	0	0	1	0	3	2	4	0	4	1	65	3	4	5	4
Atractides sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																
Lebertiidae		8	p	2	13	0	0	0	6	0	11	5	10	4	0	1	7	0	0
Lebertia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchontidae		8	p	0	1	1	0	0	0	2	2	6	1	15	0	0	32	22	22
Sperchon sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombidiidae		5	p																
Stygothrombium sp.		5	p																
Torrenticolidae		5	p	0	0	0	0	0	5	2	0	1	70	0	0	0	0	0	0
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified #1		5	p																
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																			
Polychaeta																			
Aciculata																			
Nereididae			cf																
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																			
Erpobdellidae		8	p	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																
Placobdella sp.		6	pa																
Oligochaeta		5	cg	194	157	85	23	43	0	3	37	12	3	23	36	27	104	47	18
Megadrili		5		0	0	2	0	0	2	0	1	4	0	3	0	0	0	3	0
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	20	1	4	0	0	0	0	2	1	0	0	0	0	0	0	0
Pisidium sp.		8	cf	0	0	1	0	0	0	0	0	0	0	6	0	0	0	0	0
Sphaerium sp.		8	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lymnaeidae		6	sc	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	9	2	1	11	3	32	0	0	1	0	1	3	3	2	2	3	0
Atractides sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																	
Lebertiidae		8	p	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1
Lebertia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchontidae		8	p	11	2	14	0	4	14	2	2	14	4	0	2	20	43	34	9	3
Sperchon sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombidiidae		5	p																	
Stygothrombium sp.		5	p																	
Torrenticolidae		5	p	0	0	0	0	0	67	0	0	0	0	0	0	0	0	0	0	0
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified #1		5	p																	
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																				
Polychaeta																				
Aciculata																				
Nereididae			cf																	
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																				
Erpobdellidae		8	p	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																	
Placobdella sp.		6	pa																	
Oligochaeta		5	cg	3	8	27	24	0	130	366	330	85	335	324	28	3	1	22	28	31
Megadrili		5		0	0	1	1	1	0	0	5	0	2	0	0	0	0	0	2	2
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	1	0	6	0	0	0	0	0	0	8	2	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium sp.		8	cf	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerium sp.		8	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		8	g	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lymnaeidae		6	sc	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

			Site Code:	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda **Insecta** Coleoptera	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)																
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0
Protzia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	0	3	0	0	5	0	0	1	0	0	0	0	0	0	0	2
Atractides sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																
Lebertiidae		8	p	0	0	5	1	0	1	2	3	0	3	0	2	0	2	2	2
Lebertia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchontidae		8	p	5	4	1	1	0	0	0	1	0	1	1	0	1	0	0	1
Sperchon sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombidiidae		5	p																
Stygothrombium sp.		5	p																
Torrenticolidae		5	p	0	0	3	0	11	0	0	14	11	0	4	3	1	1	3	3
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified #1		5	p																
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																			
Polychaeta																			
Aciculata																			
Nereididae			cf																
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																			
Erpobdellidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																
Placobdella sp.		6	pa																
Oligochaeta		5	cg	197	71	4	0	10	0	35	3	14	0	1	2	11	12	2	0
Megadrili		5		3	10	0	0	1	1	6	1	0	16	1	0	1	2	2	5
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	0	0	0	0	0	0	1	1	0	0	5	1	0	0	0	0
Pisidium sp.		8	cf	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerium sp.		8	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lymnaeidae		6	sc	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Site Code:	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
Year:				Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	0	1	2	0	0	0	0	0	0	0	1	0	0	4	0	7	0
Atractides sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																	
Lebertiidae		8	p	0	0	1	0	0	0	0	0	0	0	0	11	1	3	4	1	0
Lebertia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchontidae		8	p	0	1	8	4	3	1	2	9	0	17	3	55	1	1	2	3	8
Sperchon sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombidiidae		5	p																	
Stygothrombium sp.		5	p																	
Torrenticolidae		5	p	10	10	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified #1		5	p																	
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																				
Polychaeta																				
Aciculata																				
Nereididae			cf																	
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																				
Erpobdellidae		8	p	0	0	0	0	0	3	1	1	1	1	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Helobdella		6	pa																	
Placobdella sp.		6	pa																	
Oligochaeta		5	cg	5	2	3	0	24	127	375	85	16	314	1	12	17	2	86	30	0
Megadrili		5		0	0	0	4	0	11	4	3	0	2	0	0	0	20	2	9	1
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	10	13	16	2	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Pisidium sp.		8	cf	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Sphaerium sp.		8	gc	1	0	0	1	1	0	0	2	1	0	0	2	0	0	0	0	1
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	17	0	0	0	0	0	0	0	0	0	0	2	0	0
Lymnaeidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
Year:				Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	0	2	0	1	1	0	0	2	0	0	0	0	0	3	4	1	3
Atractides sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	2	1	8	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																	
Lebertiidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.		8	p	0	0	0	9	19	0	0	0	0	2	0	0	1	0	0	15	24
Sperchontidae		8	p	2	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon sp.		8	p	0	0	0	0	2	0	0	0	0	0	5	0	8	3	10	3	4
Sperchonopsis sp.		8	p	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Stygothrombidiidae		5	p																	
Stygothrombium sp.		5	p																	
Torrenticolidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	0	0	0	2	3	2	0	0	0	0	0	0	0	0	2
Unidentified #1		5	p																	
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																				
Polychaeta																				
Aciculata																				
Nereididae			cf																	
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																				
Erpobdellidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																	
Placobdella sp.		6	pa																	
Oligochaeta		5	cg	38	0	0	19	0	1	9	9	629	99	25	60	131	49	29	2	9
Megadrili		5		0	1	7	0	0	0	0	0	2	0	12	3	4	0	16	0	0
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2	0	0
Pisidium sp.		8	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerium sp.		8	gc	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Lymnaeidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

Taxon	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Site Code: / *Year:*				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1
Hygrobatidae		8	p	2	0	4	0	1	0	0	0	0	0	0	0	0	2	0	11	0
Atractides sp.		8	p	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Hygrobates sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Mesobates sp.		8	p																	
Lebertiidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.		8	p	3	3	2	3	3	0	0	0	0	0	0	0	0	0	0	44	2
Sperchontidae		8	p	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon sp.		8	p	1	0	1	0	2	0	0	0	1	0	2	1	0	0	0	10	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	1	5
Stygothrombidiidae		5	p																	
Stygothrombium sp.		5	p																	
Torrenticolidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	0	0	1	0	0	0	0	1	8	2	4	3	1	0	0	0	1
Unidentified #1		5	p																	
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																				
Polychaeta																				
Aciculata																				
Nereididae			cf																	
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																				
Erpobdellidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																	
Placobdella sp.		6	pa																	
Oligochaeta		5	cg	1	25	1	0	4	3	2	3	40	1	8	7	1	11	2	2	27
Megadrili		5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeriidae		8	cf	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium sp.		8	cf	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0
Sphaerium sp.		8	gc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Lymnaeidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Anisitsiellidae / Mideopsidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydryphantidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protzia sp.		8	p	2	5	6	0	1	1	0	0	1	0	0	0	0	0	0	0	0
Hygrobatidae		8	p	0	1	0	1	0	0	2	0	2	0	0	0	0	0	0	0	0
Atractides sp.		8	p	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Corticacarus sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates sp.		8	p	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesobates sp.		8	p																	
Lebertiidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.		8	p	7	6	3	2	0	0	1	0	1	0	0	0	10	5	8	0	3
Sperchontidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon sp.		8	p	0	0	1	0	0	0	0	0	0	3	1	1	11	31	3	1	0
Sperchonopsis sp.		8	p	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	5	0
Stygothrombidiidae		5	p																	
Stygothrombium sp.		5	p																	
Torrenticolidae		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus sp.		5	p	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola sp.		5	p	1	1	0	0	0	1	1	0	2	0	0	0	0	0	0	9	1
Unidentified #1		5	p																	
Phylum Annelida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aclitellata																				
Polychaeta																				
Aciculata																				
Nereididae			cf																	
Subphylum Clitellata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea		10	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngobdellida																				
Erpobdellidae		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchobdellida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae		8	pa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella		6	pa																	
Placobdella sp.		6	pa																	
Oligochaeta		5	cg	2	6	5	24	1	0	4	10	7	103	217	297	125	20	48	9	4
Megadrili		5		0	0	0	0	0	0	0	0	6	1	0	1	0	0	1	1	0
Phylum Coelenterata				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydridae				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra sp.		5	p	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
Phylum Mollusca				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia			cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veneroida				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbiculidae		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbicula sp.		10	cf	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Sphaeriidae		8	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pisidium sp.		8	cf	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Sphaerium sp.		8	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		8	g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ancylidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrissia sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobiidae		8	sc	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0
Lymnaeidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WLK-030	WLK-050	WLK-120	WLK-100	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240	SUI-010	SUI-020	SUI-050
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Fossaria sp.		8	sc	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Planorbidae		6	sc	0	0	4	0	1	0	0	0	9	0	51	4	0	0	0	0
Gyraulus sp.		8	sc	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Menetus sp.		6	sc	1	0	7	0	0	0	0	0	14	0	45	3	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		1	1	2	0	0	1	1	8	2	3	0	0	0	4	10	5

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	SPA-020	SPA-050	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Fossaria sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																	
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	0	13	0	3	1	5	0	0	0	0	3	1	0	0	0	0	10
Planorbidae		6	sc	0	6	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyraulus sp.		8	sc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Planorbella sp.		6	sc	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		2	0	8	0	0	0	0	0	0	10	2	0	0	0	0	1	1

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SPA-220	SPA-240	LAG-170	LAG-130	LAG-150	LAG-160	LAG-165	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																			
Insecta																			
Coleoptera																			
Fossaria sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planorbidae		6	sc	1	0	0	0	0	0	0	0	0	0	0	0	0	21	2	0
Gyraulus sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		3	55	3	81	0	0	2	6	15	2	16	4	2	5	1	8

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	LAG-330	LAG-335	LAG-380	LAG-390	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230
			Year:	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Fossaria sp.		8	sc	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																	
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	0	0	0	0	47	7	11	3	3	9	1	1	0	0	1	0	3
Planorbidae		6	sc	0	0	0	0	0	0	0	2	0	0	0	45	0	0	0	0	0
Gyraulus sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		13	0	27	34	37	4	14	8	61	5	0	150	0	0	7	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	WIL-100	WIL-170	WIL-190	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060
			Year:	Y1	Y1	Y1	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Fossaria sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																	
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	1	0	0	0	0	0	0	0	7	1	2	0	9	40	1	0	0
Planorbidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyraulus sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		18	1	0	0	0	0	1	1	0	0	0	0	1	0	42	0	0

Appendix E-1: Bioassessment master taxa list

Taxon	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Site Code:				PES-070	PES-080	PES-095	PES-100	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030
Year:				Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Fossaria sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																	
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Planorbidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyraulus sp.		8	sc	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0

Appendix E-1: Bioassessment master taxa list

	Life Stage	TV (Tolerance Value)	FFG (Functional Feeding Group)	SGR-040	SGR-060	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	STE-020	STE-030	STE-040	STE-060	STE-070	STE-100	STE-110	STE-120
			Year:	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
Phylum Arthropoda																				
Insecta																				
Coleoptera																				
Fossaria sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanx sp.		6	gc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stagnicola		10	sc																	
Physidae		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa/ Physella		8	sc	0	0	1	0	0	0	0	0	2	2	0	12	5	0	0	0	0
Planorbidae		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyraulus sp.		8	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Menetus sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Planorbella sp.		6	sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nematomorpha		8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum Nemertea				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostoma sp.		8	p	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Phylum Platyhelminthes		4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		4		0	0	0	0	0	0	0	0	0	2	0	0	7	0	1	5	0

Appendix E-2: Bioassessment physical habitat scores

Site ID	Collection Date	EpifaunalSubstrate	Embeddedness	Velocity/ Depth Regimes
LAG-130	36997	15	10	
LAG-150	36997	15	15	10
LAG-160	36997	6	10	13
LAG-180	36998	9	8	12
LAG-170	36998	12	15	16
LAG-190	36998	15	12	15
LAG-210	36998	16	13	16
LAG-220	36998	7	11	12
LAG-165	36999	15	15	18
LAG-240	36999	10	18	16
LAG-270	36999	9	15	16
LAG-320	36999	17	18	14
LAG-300	37000	13	12	15
LAG-330	37000	15	13	14
LAG-335	37000	15	14	14
LAG-380	37000	17	14	15
LAG-390	37000	19	20	15
WLK-180	36997	15	12	17
WLK-190	36997	14	10	12
WLK-230	36997	13	11	11
WLK-240	36997	10	12	12
WLK-170	36999	9	8	7
WLK-200	36999	12	9	14
SUI-010	37000	10	11	12
SUI-020	37000	9	9	10
SUI-050	37000	12	13	11
SUI-060	37000	11	9	10
SUI-110	37000	4	1	12
SUI-130	37000	11	9	12
SUI-180	37001	13	14	13
SUI-210	37001	7	8	12
SUI-260	37013	5	5	6
ALP-010	37001	13	16	18
ALP-040	37007	2	2	13
ALP-070	37007	14	5	15
ALP-080	37007	6	8	17
ALP-100	37007	2	4	16
ALP-110	37007	3	3	16
ALP-140	37007	8	3	14
SLE-030	37013	6	13	11
SLE-170	37013	15	16	11
SLE-180	37013	15	18	10
SLE-220	37013	6	15	6
SLE-210	37014	16	15	15
SLE-230	37014	16	16	12
SPA-020	37013	2	1	11
SPA-050	37013	3	3	14
SPA-070	37013	5	5	11
SPA-100	37013	3	5	12
SPA-110	37013	6	7	14
SPA-130	37013	8	8	13
SPA-140	37014	7	8	10
SPA-150	37014	4	6	10
SPA-160	37014	6	5	10
SPA-170	37015	13	7	16

Appendix E-2: Bioassessment physical habitat scores

Site ID	Collection Date	EpifaunalSubstrate	Embeddedness	Velocity/ Depth Regimes
SPA-200	37015	5	3	12
SPA-220	37015	5	5	11
SPA-240	37015	5	5	11
WIL-100	37014	17	15	13
WIL_170	37015	13	18	13
WIL_190	37015	9		8
BUT-010	37355	3	1	9
BUT-020	37355	10	12	17
BUT-030	37355	12	8	16
BUT-040	37355	18	8	18
BUT-050	37355	17	16	15
PES-050	37355	9	12	17
PES-140	37355	14	15	17
PES-200	37355	17	14	16
PES-210	37355	18	13	17
PES-230	37355	14	4	15
PES-240	37355	14	12	14
PES-060	37356	14	12	16
PES-070	37356	15	14	17
PES-080	37356	11	16	10
PES-095	37356	15	17	17
PES-100	37356	15	16	18
PES-120	37356	18	10	19
PES-150	37356	4	4	6
PES-160	37356	15	13	14
PES-170	37356	16	13	14
PES-180	37356	14	14	10
PES-190	37356	17	14	17
SGR-010	37357	16	12	18
SGR-030	37357	16	10	17
SGR-040	37357	14	13	15
SGR-060	37357	17	10	18
SGR-075	37357	18	14	18
SGR-080	37357	14	13	15
SGR-090	37357	16	16	17
SGR-110	37357	16	14	18
SGR-120	37357	15	15	12
SGR-130	37357	15	10	10
SGR-150	37357	16	14	17
STE-020	37354	10	10	10
STE-030	37354	5	7	6
STE-040	37354	13	9	10
STE-060	37354	12	8	15
STE-070	37354	15	10	16
STE-100	37354	14	11	16
STE-110	37358	16	15	15
STE-120	37358	12	10	11
PER-030	37357	5	13	15
PER-040	37357	2	16	6
PER-010	37358	5	2	3
PER-020	37358	3	10	6
PER-050	37358	5	6	10
PER-070	37358	12	5	15
PER-080	37358	7	15	15

Site ID	SedimentDepth	ChannelFlow	ChannelAlteration	RiffleFrequency	BankStability-Left
LAG-130	10	10	20	11	7
LAG-150	16	10	18	15	5
LAG-160	14	4	20	18	6
LAG-180	18	12	20	16	7
LAG-170	15	18	20	14	9
LAG-190	18	18	20	18	9
LAG-210	18	20	20	15	10
LAG-220	18	19	20	15	9
LAG-165	15	19	20	17	9
LAG-240	16	12	14	10	8
LAG-270	15	15	16	16	7
LAG-320	18	20	20	20	9
LAG-300	13	16	14	12	7
LAG-330	18	11	20	18	7
LAG-335	18	15	20	20	8
LAG-380	18	18	20	20	9
LAG-390	20	20	20	20	10
WLK-180	8	6	17	16	4
WLK-190	14	8	19	15	4
WLK-230	7	7	19	13	2
WLK-240	4	6	19	15	1
WLK-170	6	5	17	8	3
WLK-200	14	10	18	15	6
SUI-010	13	10	12	12	7
SUI-020	10	18	7	19	8
SUI-050	14	14	9	14	6
SUI-060	11	9	12	18	4
SUI-110	15	13	18	18	9
SUI-130	10	13	20	16	4
SUI-180	16	17	20	15	8
SUI-210	8	15	18	16	1
SUI-260	5	14	20	14	6
ALP-010	14	18	9	15	3
ALP-040	4	17	12	11	7
ALP-070	2	16	8	14	1
ALP-080	4	19	7	11	5
ALP-100	2	17	3	2	0
ALP-110	5	19	3	1	4
ALP-140	8	16	14	8	5
SLE-030	13	14	0	12	10
SLE-170	17	13	9	15	8
SLE-180	18	9	18	18	8
SLE-220	4	8	20	5	3
SLE-210	14	10	8	6	3
SLE-230	17	20	20	10	9
SPA-020	8	17	6	3	9
SPA-050	4	18	3	17	4
SPA-070	6	18	2	9	9
SPA-100	4	17	3	11	5
SPA-110	10	18	5	16	7
SPA-130	15	18	19	16	7
SPA-140	7	18	18	18	4
SPA-150	4	18	20	18	3
SPA-160	4	18	20	16	6
SPA-170	7	15	9	18	7

Appendix E-2: I

Site ID	SedimentDepth	ChannelFlow	ChannelAlteration	RiffleFrequency	BankStability-Left
SPA-200	8	18	3	17	7
SPA-220	5	18	7	17	8
SPA-240	12	18	6	17	4
WIL-100	16	8	20	9	8
WIL_170	20	12	8	17	4
WIL_190	19	5	19	18	3
BUT-010	1	18	16	10	4
BUT-020	7	18	17	10	7
BUT-030	5	18	18	18	6
BUT-040	11	18	18	19	8
BUT-050	13	19	17	18	6
PES-050	5	17	17	10	2
PES-140	12	20	18	14	9
PES-200	13	20	20	18	5
PES-210	13	20	20	18	10
PES-230	5	20	2	12	9
PES-240	12	20	20	18	4
PES-060	4	19	8	18	7
PES-070	13	18	17	16	6
PES-080	16	18	18	19	5
PES-095	12	18	18	17	6
PES-100	16	18	11	18	7
PES-120	12	18	18	18	5
PES-150	5	20	20	14	6
PES-160	14	20	20	18	7
PES-170	12	20	20	18	9
PES-180	17	20	20	18	4
PES-190	14	20	20	15	7
SGR-010	12	20	20	18	8
SGR-030	10	20	20	18	7
SGR-040	14	20	18	18	7
SGR-060	14	20	20	18	5
SGR-075	15	20	19	18	9
SGR-080	16	18	15	18	8
SGR-090	16	19	16	16	5
SGR-110	16	19	18	16	7
SGR-120	16	18	16	18	7
SGR-130	13	18	17	19	7
SGR-150	10	18	16	19	7
STE-020	3	7	7	14	3
STE-030	5	16	1	10	7
STE-040	9	18	8	17	9
STE-060	13	18	10	18	8
STE-070	15	20	20	14	9
STE-100	8	20	18	17	9
STE-110	16	20	20	17	8
STE-120	10	20	20	16	7
PER-030	15	15	15	15	5
PER-040	10	18	0	2	10
PER-010	2	15	5	1	5
PER-020	10	10	0	5	10
PER-050	10	20	17	19	8
PER-070	5	20	20	15	9
PER-080	16	20	18	16	7

Site ID	BankStability-Right	BankVegetation-Left	BankVegetation-Right	RiparianZone-Left
LAG-130	8	8	9	6
LAG-150	6	6	6	6
LAG-160	6	8	8	7
LAG-180	6	7	7	7
LAG-170	8	10	9	9
LAG-190	9	7	6	9
LAG-210	9	9	8	9
LAG-220	9	8	9	9
LAG-165	8	9	8	9
LAG-240	7	7	6	3
LAG-270	8	8	7	7
LAG-320	9	9	9	9
LAG-300	8	7	7	3
LAG-330	7	7	7	10
LAG-335	9	8	9	10
LAG-380	9	9	9	10
LAG-390	10	9	9	10
WLK-180	4	5	6	7
WLK-190	4	7	6	7
WLK-230	4	6	7	5
WLK-240	1	1	2	1
WLK-170	3	4	3	2
WLK-200	7	5	7	7
SUI-010	8	7	6	7
SUI-020	6	5	8	4
SUI-050	6	7	6	5
SUI-060	4	4	4	5
SUI-110	7	2	7	9
SUI-130	3	4	4	4
SUI-180	8	8	8	9
SUI-210	2	2	2	9
SUI-260	6	4	4	9
ALP-010	3	3	3	4
ALP-040	7	6	6	3
ALP-070	1	2	1	2
ALP-080	5	3	3	4
ALP-100	1	0	0	0
ALP-110	4	2	2	2
ALP-140	5	5	4	5
SLE-030	10	2	2	2
SLE-170	9	9	7	6
SLE-180	8	9	9	6
SLE-220	5	6	6	10
SLE-210	7	6	6	4
SLE-230	8	9	8	8
SPA-020	9	8	6	4
SPA-050	4	5	5	2
SPA-070	9	3	3	2
SPA-100	5	4	5	2
SPA-110	8	5	4	3
SPA-130	7	7	7	9
SPA-140	4	5	5	9
SPA-150	2	3	1	10
SPA-160	6	4	4	10
SPA-170	7	6	6	5

Appendix E-2: I

Site ID	BankStability-Right	BankVegetation-Left	BankVegetation-Right	RiparianZone-Left
SPA-200	6	4	5	1
SPA-220	8	2	2	3
SPA-240	2	3	1	3
WIL-100	8	9	9	10
WIL_170	5	6	4	9
WIL_190	3	4	4	8
BUT-010	4	8	8	8
BUT-020	7	6	8	4
BUT-030	7	7	7	6
BUT-040	9	8	9	7
BUT-050	7	7	8	9
PES-050	2	6	8	4
PES-140	9	7	7	10
PES-200	6	5	6	10
PES-210	8	8	7	10
PES-230	8	9	9	7
PES-240	4	5	7	10
PES-060	7	8	8	3
PES-070	7	7	7	4
PES-080	5	6	6	4
PES-095	4	7	7	8
PES-100	4	6	6	2
PES-120	5	7	8	3
PES-150	6	6	6	10
PES-160	6	8	7	10
PES-170	8	9	8	10
PES-180	7	5	8	10
PES-190	7	6	6	10
SGR-010	8	9	9	10
SGR-030	7	9	8	10
SGR-040	6	6	7	9
SGR-060	6	6	7	7
SGR-075	8	8	9	8
SGR-080	7	3	3	2
SGR-090	4	4	7	3
SGR-110	8	8	7	8
SGR-120	5	8	8	5
SGR-130	7	7	7	9
SGR-150	3	8	4	9
STE-020	3	3	1	3
STE-030	9	6	5	2
STE-040	9	6	4	3
STE-060	8	6	7	5
STE-070	9	8	9	9
STE-100	10	5	7	9
STE-110	8	6	7	10
STE-120	5	6	6	10
PER-030	5	4	4	2
PER-040	10	0	0	0
PER-010	5	5	5	0
PER-020	10	0	0	0
PER-050	8	6	7	6
PER-070	9	10	10	10
PER-080	7	5	5	10

Appendix E-2: I

Site ID	RiparianZone-Right	Canopy Cover T1	Canopy Cover T2	Canopy Cover T3
LAG-130	6	50	50	30
LAG-150	6	50	0	50
LAG-160	7	75	75	90
LAG-180	7	80	90	90
LAG-170	9	20	20	50
LAG-190	9	90	90	90
LAG-210	8	50	90	90
LAG-220	10	80	90	80
LAG-165	9	50	80	80
LAG-240	3	70	75	50
LAG-270	7	30	80	60
LAG-320	8	70	80	70
LAG-300	3	80	70	20
LAG-330	10	100	80	80
LAG-335	10	80	100	100
LAG-380	10	100	100	100
LAG-390	9	90	90	100
WLK-180	7	15	5	25
WLK-190	8	85	35	95
WLK-230	6	0	0	0
WLK-240	1	0	0	0
WLK-170	2	45	0	90
WLK-200	7	90	95	75
SUI-010	6	30	85	95
SUI-020	5	90	70	95
SUI-050	4	50	70	70
SUI-060	5	100	60	70
SUI-110	6	90	30	10
SUI-130	2	20	90	20
SUI-180	7	100	40	5
SUI-210	5	95	95	95
SUI-260	10	5	5	60
ALP-010	4	5	5	5
ALP-040	3	5	5	5
ALP-070	1	80	80	85
ALP-080	4	10	5	40
ALP-100	1	5	5	5
ALP-110	2	5	5	5
ALP-140	5	85	85	50
SLE-030	2	10	15	30
SLE-170	5	80	80	90
SLE-180	10	100	100	90
SLE-220	7	100	100	90
SLE-210	5	100	100	
SLE-230	6	100	100	100
SPA-020	4	5	10	50
SPA-050	2	90	100	35
SPA-070	2	85	65	60
SPA-100	3	100	100	50
SPA-110	2	20	85	95
SPA-130	8	70	65	80
SPA-140	8	80	90	50
SPA-150	9	20	85	95
SPA-160	10	95	60	90
SPA-170	5	30	30	45

Appendix E-2: I

Site ID	RiparianZone-Right	Canopy Cover T1	Canopy Cover T2	Canopy Cover T3
SPA-200	1	100	95	90
SPA-220	3	80	65	80
SPA-240	1	80	90	90
WIL-100	9	85	75	50
WIL_170	3	100	100	75
WIL_190	3	100	100	100
BUT-010	8	100	94	94
BUT-020	3	94	94	59
BUT-030	9	59	94	53
BUT-040	10	100	88	71
BUT-050	10	100	88	100
PES-050	6	18	53	88
PES-140	10	71	72	87
PES-200	10	99	96	99
PES-210	10	84	85	93
PES-230	10	85	43	54
PES-240	10	99	100	99
PES-060	2	47	82	
PES-070	5	6	24	94
PES-080	5	53	82	76
PES-095	3	65	53	24
PES-100	2	59	18	
PES-120	9	71	82	82
PES-150	10	100	100	100
PES-160	10	84	84	90
PES-170	10	97	100	94
PES-180	10	96	90	82
PES-190	10	91	99	93
SGR-010	10	35	41	21
SGR-030	10	81	76	93
SGR-040	7	34	78	53
SGR-060	10	90	91	93
SGR-075	10	94	79	85
SGR-080	5	94	94	82
SGR-090	2	94	100	94
SGR-110	9	100	94	100
SGR-120	7	100	94	88
SGR-130	9	100	94	94
SGR-150	7	94	100	94
STE-020	1	0	6	12
STE-030	2	94	47	82
STE-040	3	29	18	35
STE-060	4	100	88	71
STE-070	10	99	100	85
STE-100	10	97	97	94
STE-110	10	100	100	99
STE-120	10	94	100	97
PER-030	2	100	100	100
PER-040	0	24	35	35
PER-010	0	0	0	0
PER-020	0	12	12	12
PER-050	6	96	94	99
PER-070	10	100	100	100
PER-080	9	100	100	100

Appendix E-2: I

Site ID	Substrate Complexity T1	Substrate Complexity T2	Substrate Complexity T3
LAG-130	10	10	
LAG-150	12	12	5
LAG-160	7	9	8
LAG-180	17	15	15
LAG-170	8	11	15
LAG-190	17	16	18
LAG-210	15	20	15
LAG-220	8	8	16
LAG-165	13	13	14
LAG-240	12	10	9
LAG-270	10	17	
LAG-320	17	16	16
LAG-300	15	12	12
LAG-330	17	18	16
LAG-335	16	16	16
LAG-380	18	16	18
LAG-390	16	18	19
WLK-180	14	14	13
WLK-190	16	13	13
WLK-230	8	6	6
WLK-240	8	8	7
WLK-170	16	5	5
WLK-200	17	15	14
SUI-010	10	11	9
SUI-020	10	12	12
SUI-050	12	10	10
SUI-060	10	11	11
SUI-110	5	3	3
SUI-130	12	11	13
SUI-180	11	14	15
SUI-210	8	5	10
SUI-260	5	5	5
ALP-010	10	10	10
ALP-040	2	2	2
ALP-070	4	6	6
ALP-080	12	10	12
ALP-100	7	8	2
ALP-110	4	5	7
ALP-140	6	8	10
SLE-030	7	13	7
SLE-170	15	16	15
SLE-180	14	12	16
SLE-220	3	5	11
SLE-210	16	15	
SLE-230	15	15	15
SPA-020	7	1	1
SPA-050	6	6	6
SPA-070	13	13	3
SPA-100	10	8	6
SPA-110	13	11	8
SPA-130	5	9	5
SPA-140	5	5	5
SPA-150	12	12	12
SPA-160	11	11	10
SPA-170	12	11	12

Site ID	Substrate Complexity T1	Substrate Complexity T2	Substrate Complexity T3
SPA-200	8	9	8
SPA-220	13	11	11
SPA-240	14	14	14
WIL-100	16	18	16
WIL_170	18	18	17
WIL_190	17	16	16
BUT-010	2	6	4
BUT-020	7	8	6
BUT-030	14	12	13
BUT-040	17	14	12
BUT-050	12	11	11
PES-050	6	8	7
PES-140	15	15	16
PES-200	18	16	17
PES-210	17	17	18
PES-230	14	5	8
PES-240	14	14	13
PES-060	12	13	11
PES-070	12	12	12
PES-080	12	14	13
PES-095	12	12	11
PES-100	14	13	11
PES-120	17	16	15
PES-150	8	10	8
PES-160	15	14	15
PES-170	12	11	16
PES-180	17	16	16
PES-190	17	17	16
SGR-010	14	15	15
SGR-030	13	17	15
SGR-040	15	12	13
SGR-060	13	14	15
SGR-075	14	14	12
SGR-080	13	13	9
SGR-090	8	9	15
SGR-110	12	13	12
SGR-120	10	10	11
SGR-130	16	14	15
SGR-150	16	16	16
STE-020	10	8	10
STE-030	10	11	16
STE-040	15	12	15
STE-060	4	10	16
STE-070	16	14	14
STE-100	15	15	14
STE-110	17	14	17
STE-120	13	14	15
PER-030	8	10	8
PER-040	5	3	5
PER-010	2	2	2
PER-020	1	1	1
PER-050	12	11	11
PER-070	10	10	10
PER-080	11	11	11

Appendix E-2: I

Site ID	Riffle Embeddedness T1	Riffle Embeddedness T2	Riffle Embeddedness T3
LAG-130	15	15	16
LAG-150	15	15	15
LAG-160	16	8	8
LAG-180	9	7	8
LAG-170	16	16	12
LAG-190	10	16	12
LAG-210	13	14	11
LAG-220	10	10	14
LAG-165	15	15	15
LAG-240	18	18	18
LAG-270	15	15	16
LAG-320	18	18	18
LAG-300	10	14	12
LAG-330	13	14	12
LAG-335	14	14	14
LAG-380	13	14	14
LAG-390	20		
WLK-180	12	12	12
WLK-190	8	14	8
WLK-230	11	11	11
WLK-240	12	12	12
WLK-170	10	7	7
WLK-200	6	13	8
SUI-010	10	14	8
SUI-020	7	7	12
SUI-050	12	14	12
SUI-060	8	9	9
SUI-110	2	1	1
SUI-130	8	7	12
SUI-180	12	14	15
SUI-210	8	5	12
SUI-260	8	8	8
ALP-010	16	16	16
ALP-040	4	4	4
ALP-070	2	10	10
ALP-080	9	9	9
ALP-100	6	6	1
ALP-110	4	4	8
ALP-140	3	3	3
SLE-030	13	9	13
SLE-170	16	16	18
SLE-180	18	18	15
SLE-220	15	15	15
SLE-210	15	15	15
SLE-230	17	15	15
SPA-020	8	0	0
SPA-050	10	10	10
SPA-070	7	14	13
SPA-100	8	7	7
SPA-110	10	14	12
SPA-130	7	12	7
SPA-140	10	10	10
SPA-150	9	9	9
SPA-160	8	8	8
SPA-170	12	8	10

Appendix E-2: I

Site ID	Riffle Embeddedness T1	Riffle Embeddedness T2	Riffle Embeddedness T3
SPA-200	4	4	4
SPA-220	6	6	5
SPA-240	6	6	6
WIL-100	16	15	15
WIL_170	18	18	18
WIL_190	16	16	17
BUT-010	1	1	1
BUT-020	10	16	12
BUT-030	8	10	15
BUT-040	6	10	8
BUT-050	17	17	17
PES-050	12	14	12
PES-140	17	17	17
PES-200	17	14	15
PES-210	16	16	16
PES-230	6	10	8
PES-240	16	16	16
PES-060	10	16	13
PES-070	18	16	10
PES-080	17	16	15
PES-095	17	18	16
PES-100	12	17	18
PES-120	10	10	10
PES-150	6	6	5
PES-160	14	16	16
PES-170	16	16	16
PES-180	15	17	17
PES-190	16	16	16
SGR-010	14	14	14
SGR-030	13	14	14
SGR-040	17	17	16
SGR-060	10	12	13
SGR-075	16	16	16
SGR-080	17	8	18
SGR-090	17	16	17
SGR-110	15	16	17
SGR-120	12	17	18
SGR-130	12	10	12
SGR-150	14	14	18
STE-020	10	10	13
STE-030	10	10	8
STE-040	4	10	16
STE-060	2	8	9
STE-070	12	12	12
STE-100	12	12	10
STE-110	17	14	17
STE-120	12	12	13
PER-030	14	14	16
PER-040	10	10	10
PER-010	1	1	1
PER-020	10	10	10
PER-050	8	8	8
PER-070	8	8	8
PER-080	16	16	16

Appendix E-2: I

Site ID	Substrate Consolidation T1	Substrate Consolidation T2	Substrate Consolidation T3	Fines T1
LAG-130	Low	Low	Low	45
LAG-150	Low	Low	Low	30
LAG-160	Low	Med	Med	45
LAG-180	High	Med	Med	10
LAG-170	Low	Low	Low	40
LAG-190	Med	Low	Med	10
LAG-210	Med	Low	Med	10
LAG-220	Med	Med	Low	30
LAG-165	Low	Low	Low	50
LAG-240	Low	Low	Low	20
LAG-270	Low	Med	Low	25
LAG-320	Low	Low	Med	10
LAG-300	Low	Low	Low	20
LAG-330	Med	Med	Med	10
LAG-335	Med	Med	Med	10
LAG-380	Med	Med	Med	15
LAG-390	Low	Low	Low	5
WLK-180	Med	Med	Med	25
WLK-190	Med	Med	Med	15
WLK-230	Low	Low	Low	45
WLK-240	Low	Low	Low	35
WLK-170	High	Low	Low	20
WLK-200	High	Med	Med	20
SUI-010	Med	Low	Low	40
SUI-020	Med	Med	Med	50
SUI-050	Med	Med	Med	25
SUI-060	Med	Med	Med	30
SUI-110	High	High	High	10
SUI-130	Med	Med	Med	40
SUI-180	Med	Med	Med	25
SUI-210	Low	Low	Low	50
SUI-260	Low	Low	Low	35
ALP-010	Low	Low	Low	10
ALP-040	Low	Low	Low	50
ALP-070	Low	Low	Low	70
ALP-080	Med	Med	Low	35
ALP-100	Med	Med	High	60
ALP-110	Med	Med	Med	80
ALP-140	High	High	High	60
SLE-030	Low	Low	Low	40
SLE-170	Low	Low	Low	20
SLE-180	Low	Low	Med	5
SLE-220	Low	Low	Low	50
SLE-210	Low	Low	Low	35
SLE-230	Low	Low	Low	10
SPA-020	High	High	High	10
SPA-050	Low	Low	Low	30
SPA-070	High	Low	High	20
SPA-100	Med	Low	Low	30
SPA-110	Med	Med	High	20
SPA-130	Low	Low	Low	60
SPA-140	Low	Low	Low	40
SPA-150	Med	Low	Low	40
SPA-160	Low	Low	Low	50
SPA-170	Low	Med	Med	20

Appendix E-2: I

Site ID	Substrate Consolidation T1	Substrate Consolidation T2	Substrate Consolidation T3	Fines T1
SPA-200	High	Med	Med	40
SPA-220	Med	Med	High	25
SPA-240	Med	High	High	30
WIL-100	Med	Med	Med	5
WIL_170	Low	Low	Low	<5
WIL_190	Low	Low	Low	10
BUT-010	Low	Low	Low	95
BUT-020	Med	Low	Low	40
BUT-030	Low	Low	Low	35
BUT-040	Med	Med	High	20
BUT-050	Low	Low	Low	20
PES-050	Low	Low	Low	50
PES-140	Low	Low	Low	30
PES-200	Low	Med	Low	15
PES-210	Low	Low	Low	10
PES-230	Low	Low	Low	50
PES-240	Low	Low	Low	20
PES-060	Low	Low	Low	40
PES-070	Low	Low	Low	20
PES-080	Low	Low	Low	20
PES-095	Low	Low	Low	30
PES-100	Low	Low	Low	25
PES-120	Med	Med	High	20
PES-150	Med	High	Low	60
PES-160	Med	Low	Med	30
PES-170	Low	Low	Low	30
PES-180	Low	Low	Low	15
PES-190	Low	Low	Low	15
SGR-010	Med	Med	Med	20
SGR-030	Low	Med	Med	30
SGR-040	Low	Low	Med	15
SGR-060	Low	Med	High	20
SGR-075	Med	Low	Med	25
SGR-080	Med	High	Med	25
SGR-090	Med	Med	Med	15
SGR-110	High	Med	Med	35
SGR-120	Med	Med	Med	30
SGR-130	High	High	High	20
SGR-150	High	High	Low	10
STE-020	Low	Low	Low	25
STE-030	Low	Low	Hogh	30
STE-040	Med	Med	Low	10
STE-060	High	Low	Med	5
STE-070	Low	Low	Low	30
STE-100	Low	Low	Low	40
STE-110	Low	Low	High	15
STE-120	Low	Low	Med	30
PER-030	Med	Low	Low	40
PER-040	Low	Low	Low	50
PER-010	Low	Low	Low	90
PER-020	High	High	High	15
PER-050	Low	Low	Low	40
PER-070	Low	Low	Low	40
PER-080	Low	Low	Low	25

Site ID	Fines T2	Fines T3	Gravel T1	Gravel T2	Gravel T3	Coble T1	Coble T2	Coble T3
LAG-130	45	40	45	45	30	10	10	30
LAG-150	30	65	60	60	30	10	10	5
LAG-160	30	50	50	50	40	5	20	10
LAG-180	20	20	30	40	40	60	40	40
LAG-170	30	25	50	40	30	10	30	40
LAG-190	10	10	25	20	20	25	20	25
LAG-210	10	10	20	20	25	65	20	60
LAG-220	30	10	35	35	30	30	30	50
LAG-165	50	50	50	45	40	0	5	10
LAG-240	25	13	20	30	35	55	40	50
LAG-270	20	25	65	30	65	10	20	10
LAG-320	10	10	20	25	20	60	60	60
LAG-300	20	10	50	60	60	25	20	30
LAG-330	15	10	20	15	40	30	30	10
LAG-335	10	10	10	10	10	30	30	30
LAG-380	10	10	20	10	10	40	65	55
LAG-390	5	3	15	15	7	20	30	30
WLK-180	20	50	30	25	45	40	50	5
WLK-190	15	15	30	45	35	40	35	50
WLK-230	60	60	50	40	35	5	0	5
WLK-240	55	55	50	40	40	15	5	5
WLK-170	65	65	30	30	30	30	5	5
WLK-200	30	30	20	30	35	35	35	30
SUI-010	25	40	30	45	50	30	25	5
SUI-020	40	30	30	30	30	20	25	35
SUI-050	20	30	40	50	40	30	30	30
SUI-060	20	25	40	50	45	30	30	30
SUI-110	5	5	5	5	5	5	0	0
SUI-130	40	30	25	30	30	30	30	40
SUI-180	15	15	25	35	30	30	35	40
SUI-210	70	40	30	20	40	20	10	20
SUI-260	39	39	60	60	60	5	1	1
ALP-010	5	0	0	0	0	10	15	0
ALP-040	40	60	40	60	35	10	0	5
ALP-070	40	40	30	50	50	0	10	10
ALP-080	30	30	45	50	40	20	20	30
ALP-100	70	95	30	15	5	10	10	0
ALP-110	60	15	15	35	15	5	10	50
ALP-140	50	10	30	20	15	5	20	50
SLE-030	30	40	60	30	60	0	30	0
SLE-170	15	15	20	25	25	30	40	50
SLE-180	10	15	15	50	15	60	30	30
SLE-220	45	35	50	45	40	0	10	15
SLE-210	35	20	30	35	35	25	20	25
SLE-230	10	10	5	5	5	25	35	30
SPA-020	0	0	10	0	0	30	0	0
SPA-050	40	40	55	60	60	10	<5	<5
SPA-070	20	10	20	40	10	30	20	10
SPA-100	40	40	40	30	30	20	20	<5
SPA-110	10	20	50	30	20	10	30	10
SPA-130	30	60	40	70	40	0	<5	0
SPA-140	50	50	60	50	50	0	0	0
SPA-150	40	40	40	40	50	20	20	10
SPA-160	50	45	50	50	55	<5	<5	<5
SPA-170	30	10	70	50	70	10	20	20

Appendix E-2: I

Site ID	Fines T2	Fines T3	Gravel T1	Gravel T2	Gravel T3	Coble T1	Coble T2	Coble T3
SPA-200	35	40	50	40	50	10	10	10
SPA-220	30	30	35	30	20	15	20	20
SPA-240	30	30	25	25	25	40	40	40
WIL-100	10	10	20	15	10	65	25	30
WIL_170	<5	<2	15	20	5	25	30	30
WIL_190	5	5	25	20	25	35	25	30
BUT-010	75	85	5	25	15	0	0	0
BUT-020	40	50	30	50	30	15	10	20
BUT-030	30	35	30	40	40	35	30	25
BUT-040	30	25	30	10	15	25	20	50
BUT-050	20	40	5	30	30	75	50	30
PES-050	30	40	40	60	55	10	10	5
PES-140	30	30	40	40	35	30	30	30
PES-200	25	20	20	25	20	40	35	40
PES-210	10	5	30	40	30	40	30	40
PES-230	50	40	20	40	40	15	10	10
PES-240	20	20	30	50	50	40	30	25
PES-060	50	45	40	25	40	20	25	15
PES-070	30	20	30	50	30	50	20	50
PES-080	35	25	50	30	50	30	35	25
PES-095	35	20	40	35	40	30	30	40
PES-100	20	20	25	40	30	50	40	50
PES-120	20	30	20	20	10	35	40	15
PES-150	60	70	30	20	20	10	10	10
PES-160	20	20	20	20	10	30	40	40
PES-170	40	25	30	45	30	30	15	30
PES-180	10	10	20	15	15	30	40	40
PES-190	15	10	30	35	20	35	35	30
SGR-010	25	25	50	35	40	30	30	30
SGR-030	15	25	30	15	15	10	30	25
SGR-040	25	20	30	45	40	45	30	40
SGR-060	20	15	30	30	30	40	40	35
SGR-075	25	20	40	40	35	35	35	30
SGR-080	25	15	40	40	25	35	35	60
SGR-090	15	20	15	25	40	70	60	30
SGR-110	30	25	20	25	20	40	30	50
SGR-120	30	30	20	20	40	50	50	30
SGR-130	30	10	10	25	10	30	30	30
SGR-150	15	20	15	20	20	60	60	60
STE-020	15	35	30	30	25	40	50	40
STE-030	5	15	60	60	35	10	30	15
STE-040	25	40	15	10	20	5	5	20
STE-060	20	25	10	55	30	0	25	40
STE-070	30	35	20	25	25	40	35	35
STE-100	45	45	30	35	35	20	10	5
STE-110	30	15	30	45	30	30	15	35
STE-120	20	20	25	35	30	20	30	40
PER-030	28	40	20	20	40	40	50	20
PER-040	40	40	50	60	60	0	0	0
PER-010	0	0	5	0	0	5	0	0
PER-020	15	15	0	0	0	0	0	0
PER-050	40	40	40	45	45	10	15	15
PER-070	50	50	40	40	40	20	10	10
PER-080	25	25	35	35	35	30	30	30

Appendix E-2: I

Site ID	Boulder T1	Boulder T2	Boulder T3	Bedrock T1	Bedrock T2	Bedrock T3	Gradient T1
LAG-130	0	0	0	0	0	0	1.3
LAG-150	0	0	0	0	0	0	7
LAG-160	0	0	0	0	0	0	2.2
LAG-180	0	0	0	0	0	0	1.8
LAG-170	0	0	5	0	0	0	1.3
LAG-190	15	20	30	30	30	15	1.2
LAG-210	5	30	5	0	20	0	1
LAG-220	0	0	10	0	0	0	0.5
LAG-165	0	0	0	0	0	0	1.5
LAG-240	5	5	2	0	0	0	1
LAG-270	0	30	0	0	0	0	1
LAG-320	5	5	10	5	0	0	2
LAG-300	5	0	0	0	0	0	1
LAG-330	40	40	40	0	0	0	3
LAG-335	50	50	50	0	0	0	1
LAG-380	25	15	25	0	0	0	2
LAG-390	0	40	60	60	10	0	7
WLK-180	5	5	0	0	0	0	4
WLK-190	15	5	0	0	0	0	2
WLK-230	0	0	0	0	0	0	1
WLK-240	0	0	0	0	0	0	1
WLK-170	20	0	0	0	0	0	7
WLK-200	25	5	5	0	0	0	5
SUI-010	0	5	5	0	0	0	1
SUI-020	0	5	5	0	0	0	2
SUI-050	5	0	0	0	0	0	2
SUI-060	0	0	0	0	0	0	2
SUI-110	0	0	0	80	90	90	2
SUI-130	5	0	0	0	0	0	3
SUI-180	20	15	15	0	0	0	2
SUI-210	0	0	0	0	0	0	4
SUI-260	0	0	0				
ALP-010	20	30	20	60	60	80	1.8
ALP-040	0	0	0	0	0	0	2
ALP-070	0	0	0	0	0	0	1
ALP-080	0	0	0	0	0	0	0.5
ALP-100	0	5	0	0	0	0	2
ALP-110	10	5	20	0	0	0	1
ALP-140	5	10	25	0	0	0	2
SLE-030	0	10	0	0	0	0	1
SLE-170	30	20	10	0	0	0	1.3
SLE-180	20	10	40	0	0	0	4
SLE-220	0	0	5	0	0	5	0.4
SLE-210	10	10	20	0	0	0	1
SLE-230	60	50	55	0	0	0	3.5
SPA-020	50	0	0	0	100	100	8
SPA-050	5	0	0	0	0	0	
SPA-070	30	20	70	0	0	0	4.5
SPA-100	10	10	30	0	0	0	
SPA-110	20	30	50	0	0	0	11
SPA-130	0	0	0	0	0	0	10
SPA-140	0	0	0	0	0	0	2
SPA-150	0	0	<5	0	0	0	3
SPA-160	0	0	0	0	0	0	2
SPA-170	0	0	0	0	0	0	3

Appendix E-2: I

Site ID	Boulder T1	Boulder T2	Boulder T3	Bedrock T1	Bedrock T2	Bedrock T3	Gradient T1
SPA-200	<5	15	<5	0	0	0	0.5
SPA-220	20	20	30	0	0	0	2
SPA-240	5	5	5	0	0	0	
WIL-100	10	50	50	0	0	0	4.5
WIL_170	60	50	60	0	0	5	5
WIL_190	30	50	40	0	0	0	7
BUT-010	0	0	0	0	0	0	1
BUT-020	15	0	0	0	0	0	1
BUT-030	0	0	0	0	0	0	2
BUT-040	25	40	10	0	0	0	1
BUT-050	0	0	0	0	0	0	5
PES-050	0	0	0	0	0	0	1
PES-140	0	0	5	0	0	0	0.5
PES-200	25	20	20	0	0	0	5
PES-210	20	20	20	0	0	5	3
PES-230	15	0	10	0	0	0	2.5
PES-240	10	0	5	0	0	0	2.5
PES-060	0	0	0	0	0	0	1.5
PES-070	0	0	0	0	0	0	1
PES-080	0	0	0	0	0	0	5
PES-095	0	0	0	0	0	0	1
PES-100	0	0	0	0	0	0	1.5
PES-120	25	20	45	0	0	0	1.5
PES-150	0	0	0	0	0	0	2
PES-160	20	20	30	0	0	0	2.5
PES-170	10	0	15	0	0	0	3.5
PES-180	20	15	30	15	20	5	2.5
PES-190	10	10	30	10	5	10	2.5
SGR-010	0	10	5	0	0	0	1
SGR-030	0	40	35	30	0	0	2.5
SGR-040	10	0	0	0	0	0	4.5
SGR-060	10	10	20	0	0	0	3
SGR-075	0	0	15	0	0	0	3.5
SGR-080	0	0	0	0	0	0	1
SGR-090	0	0	10	0	0	0	2
SGR-110	5	15	15	0	0	0	3
SGR-120	0	0	0	0	0	0	15
SGR-130	40	15	50	0	0	0	5
SGR-150	15	5	0	0	0	0	4
STE-020	5	5	0	0	0	0	2
STE-030	0	5	35	0	0	0	1
STE-040	70	60	20	0	0	0	3
STE-060	0	0	5	85	0	0	3
STE-070	10	10	5	0	0	0	4
STE-100	10	10	10	0	0	5	3.5
STE-110	25	10	20	0	0	0	5
STE-120	25	15	10	0	0	0	1.5
PER-030	0	2	0	0	0	0	1
PER-040	0	0	0	0	0	0	1
PER-010	0	0	0	0	100	100	1
PER-020	0	0	0	85	85	85	1
PER-050	10	0	0	0	0	0	1
PER-070	0	0	0	0	0	0	2.5
PER-080	0	0	0	0	0	0	1.5

Site ID	Gradient T2	Gradient T3	Specific Conductance	Disolved Oxygen	pH	WaterTemp
LAG-130	1.3	1.5	200	11.5	8.1	11.5
LAG-150	4	3	201	11	8	15.2
LAG-160	1.5	1.3	150	5.8	8.1	11.6
LAG-180	1	1.5	236	10.74	8.3	11.3
LAG-170	1	1.8	139	11.23	8.2	11.1
LAG-190	2.9	1.8	270	10.3	8.5	12.7
LAG-210	1.8	1.5	131	11.75	8.4	11.6
LAG-220	0.5	1	176	9.5	8.4	12.2
LAG-165	1	1.25	139	11.37	8.2	10.5
LAG-240	1	1	340	12	8.6	11.5
LAG-270	1.5	1	394	11	8.4	11.6
LAG-320	1.5	2	106	11.26	8.2	10.4
LAG-300	1	2.5	383	11.2	8.3	11.3
LAG-330	3	1.7	390	10.2	8.4	9.6
LAG-335	5	3	560	10.34	8.4	10.8
LAG-380	3.5	3	323	11	8	9.7
LAG-390	9	4.5	179	13.24	8.1	9.1
WLK-180	2.5		152	10.37	8.7	12.4
WLK-190	2		219	98.3	8.5	15.5
WLK-230	1	5	285	12.7	8.2	14.9
WLK-240	1	1	126	10	7.6	16.2
WLK-170	4	2	288	9.3	8.2	12.9
WLK-200	2	6	152	12.63	8.5	11.6
SUI-010	1	1	465	10.5		13.4
SUI-020	2	2	441	11.3		13.9
SUI-050	1	2	350	11.1		14.4
SUI-060	1	2	350	11.1		14.4
SUI-110	4	1	481	9.6		18.8
SUI-130	2	3	414	11.3		14.3
SUI-180	3	4	169	12.1		10.8
SUI-210	2	4	486	10.3		10.7
SUI-260			612	8.6	7.7	14.3
ALP-010	2	2	1043	7.7	8.2	14
ALP-040	1	1	1533	12.2	8.6	18.6
ALP-070	3	0.5	1630	9.4	8.5	18.3
ALP-080	1	0.5	1610	8.6	8.4	18.4
ALP-100	2	2	2640	13.06	8.4	21.8
ALP-110	2	4	1114	10	7.4	22.9
ALP-140	5	6.5	1145	7.76	8.6	17.4
SLE-030	0.5	0.3	548	12.76	8.1	18.4
SLE-170	2	1.2	410	8.92	8.3	13
SLE-180	1	1.5	497	8.4	7.8	13.5
SLE-220	0.2	4	495	8.48	8.2	12.8
SLE-210	1.5		640	8	8.2	13.9
SLE-230	4.5	2	498	8.12	8.2	10.9
SPA-020	12	2	1238	11.7	8.3	16.2
SPA-050			1119	9.9	8.1	16.7
SPA-070	3	4	1.5	11.43	8.1	15.6
SPA-100			1609	9.62	7.8	14
SPA-110	2	7	1845	11.35	7.8	15.2
SPA-130	3	4	1713	11.46	8.1	13.9
SPA-140	3	1	813	12.69	8.1	14.7
SPA-150	3	2	920	11.91	8.4	15
SPA-160	1.5		932	10.57	8.3	14.4
SPA-170	1	2	319.2	13.09	7.6	11.9

Appendix E-2: I

Site ID	Gradient T2	Gradient T3	Specific Conductance	Disolved Oxygen	pH	WaterTemp
SPA-200	2	2	1455	10.5	7.9	12.3
SPA-220	2	1.5	737	11.35	8.3	13.6
SPA-240			695	10.2	8.1	14.4
WIL-100	1.5	1	477	7.81	8.4	16.2
WIL_170	5	3	527	8.37	8.4	12
WIL_190	5		472	8.51	8.2	10.4
BUT-010	1.5	1	295	10.6		13.5
BUT-020	3	1	283	10.1		13.3
BUT-030	1	1	281	11.1		11.2
BUT-040	1	0.5	274	11.8		11
BUT-050	2	4	149	10.1		10.8
PES-050	1	1	500	10.1		13.9
PES-140	3	1	543	10.8	8.5	12.2
PES-200	4	3.5	664	10.5	8.4	10.7
PES-210	2	4	606	10.5	8.5	10.9
PES-230	0.5	1	672	9.8	8.2	11.8
PES-240	2	3	465	10.3	8.3	11.2
PES-060	1	2	493	10.1		12.5
PES-070	1	1	490	10.7		13.1
PES-080	2	2	535	10.4		12.8
PES-095	1	2	489	10.2		15.9
PES-100	2	1.5	491	11.2		13.5
PES-120	2		479	9.08		13.1
PES-150	2.5	1	307	9.98	8.1	11.7
PES-160	2.5	3.5	519	10.9	8.4	12
PES-170	1	1.5	421	9.84	8.1	11.1
PES-180	2.5	3.5	667	10.9	8.5	13
PES-190	2.5	5	551	9.62	8.3	13.4
SGR-010	4	2	726	11.6	8.5	13.6
SGR-030	6.5	6	435	11.28	8.4	9.9
SGR-040	2.5	4.5	791	10.9	8.5	13.9
SGR-060	3	6	608	10.81	8.5	13
SGR-075	1.5	5	645	10.5	8.5	14.7
SGR-080	1	2	703	10.83		11.2
SGR-090	0.5	2	689	11.1		11.5
SGR-110	2	3	229	10.6		11.8
SGR-120	5	3	351	10.9		9.8
SGR-130	3		649	11		12.3
SGR-150	3	5	820	10.7		12.5
STE-020	1	1	930	9.8		18.1
STE-030	8	14	235	8.5		16.2
STE-040	1	3	481	9.8		16.7
STE-060	1	4	429	83.8		13.8
STE-070	3	4	448	9.98	7.9	9.9
STE-100	2	2	515	10.7	8.5	11.8
STE-110	2.5	4	501	10.7	8.5	10.1
STE-120	4	5	372	10	8.2	9.8
PER-030	4	1	1802	9.5		15.3
PER-040	1	1	902	9.9		16.4
PER-010	1	1	1180	12.3		16.6
PER-020	1	1	1280	13.2		15.3
PER-050	2	1.5	980	10	8.5	15.5
PER-070	3	2	914	9.85	8.3	15.4
PER-080	1.5	0.5	849	8.53	7.9	14.6

Appendix E-2: I

Site ID	Average Depth T1	Average Depth T2	Average Depth T3	Average Velocity T1
LAG-130	11	10	14	0.36
LAG-150	8	10	7	0.67
LAG-160	5	8	5	0.35
LAG-180	5	5	5	0.18
LAG-170	8	8	16	0.6
LAG-190	11	12	13	0.62
LAG-210	20	15	12	0.4
LAG-220	13	10	15	0.35
LAG-165	8	6	7	0.54
LAG-240	5	4	7	0.38
LAG-270	5	6	7	0.32
LAG-320	9	8	13	0.44
LAG-300	3	4	5	0.3
LAG-330	3	3	3	0.24
LAG-335	5	6	3	0.26
LAG-380	4	3	5	0.25
LAG-390	6	1	6	0.58
WLK-180	18	13	17	0.85
WLK-190	9	7	6	0.24
WLK-230	5	5	3	0.32
WLK-240	4	9	6	0.31
WLK-170	6	5	6	0.27
WLK-200	16	33	22	0.35
SUI-010	10	19	14	0.38
SUI-020	13	12	17	0.26
SUI-050	9	10	9	0.3
SUI-060	9	19	17	0.47
SUI-110	7	13	10	0.5
SUI-130	11	15	16	0.35
SUI-180	12	8	9	0.27
SUI-210	5	9	5	0.35
SUI-260	9	5	4	0.51
ALP-010	20	16	13	0.87
ALP-040	5	3	8	0.4
ALP-070	16	5	3	0.5
ALP-080	9	7	11	0.65
ALP-100	11	13	10	0.39
ALP-110	16	11	8	0.45
ALP-140	6	10	2	0.23
SLE-030				
SLE-170				
SLE-180				
SLE-220				
SLE-210				
SLE-230				
SPA-020	15	9	6	0.33
SPA-050	9	7	13	0.37
SPA-070	17	7	11	0.24
SPA-100	6	6	5	0.13
SPA-110	13	9	5	0.45
SPA-130	6	5	5	0.3
SPA-140	4	4	3	0.21
SPA-150	5	4	2	0.25
SPA-160	5	3	3	0.17
SPA-170	27	21	13	0.9

Appendix E-2: I

Site ID	Average Depth T1	Average Depth T2	Average Depth T3	Average Velocity T1
SPA-200	6	10	7	0.21
SPA-220	10	15	12	0.36
SPA-240	8	8	9	0.13
WIL-100	.			
WIL_170				
WIL_190				
BUT-010	14	10	10	0.45
BUT-020	13	9	10	0.25
BUT-030	12	15	10	0.24
BUT-040	13	15	11	0.5
BUT-050	6	5	6	0.35
PES-050	8	7	8	0.12
PES-140	12	13	19	0.4
PES-200	10	10	9	0.45
PES-210	12	12	8	0.503
PES-230	8	11	7	0.34
PES-240	6	6	6	0.237
PES-060	5	6	10	0.3
PES-070	17	17	11	0.5
PES-080	10	8	11	0.58
PES-095	15	18	14	0.35
PES-100	13	19	13	0.7
PES-120	25	19	31	0.5
PES-150	4	4	5	0.15
PES-160	15	18	12	0.45
PES-170	6	3	4	0.21
PES-180	16	12	8	0.23
PES-190	18	10	15	0.42
SGR-010	9	21	19	0.17
SGR-030	14	13	14	0.66
SGR-040	17	8	11	0.8
SGR-060	9	8	9	0.17
SGR-075	10	12	13	0.42
SGR-080	12	13	7	0.5
SGR-090	12	5	12	0.75
SGR-110	12	15	7	0.6
SGR-120	12	11	4	0.65
SGR-130	14	14	14	0.72
SGR-150	7	10	7	0.33
STE-020	10	9	13	0.4
STE-030	2	3	5	0.08
STE-040	17	20	13	0.3
STE-060	20	15	13	1.35
STE-070	16	14	17	0.38
STE-100	8	13	16	0.4
STE-110	8	12	8	0.45
STE-120	7	6	5	0.22
PER-030	5	5	4	0.2
PER-040	3	3	3	0.19
PER-010	16	17	5	0.05
PER-020	4	4	4	0.2
PER-050	8	6	6	0.28
PER-070	13	16	10	0.43
PER-080	5	5	5	0.2

Site ID	Average Velocity T2	Average Velocity T3
LAG-130	0.6	0.65
LAG-150	0.55	0.48
LAG-160	0.3	0.25
LAG-180	0.32	0.3
LAG-170	0.38	0.75
LAG-190	0.4	0.25
LAG-210	0.61	0.7
LAG-220	0.28	0.5
LAG-165	0.53	0.63
LAG-240	0.33	0.26
LAG-270	0.32	0.59
LAG-320	0.64	0.34
LAG-300	0.28	0.26
LAG-330	0.28	0.19
LAG-335	0.13	0.19
LAG-380	0.27	0.33
LAG-390	0.24	0.44
WLK-180	0.67	0.65
WLK-190	0.19	0.21
WLK-230	0.18	0.3
WLK-240	0.27	0.09
WLK-170	0.33	0.42
WLK-200	0.3	0.42
SUI-010	0.37	0.3
SUI-020	0.43	0.34
SUI-050	0.43	0.39
SUI-060	0.41	0.59
SUI-110	0.43	0.47
SUI-130	0.38	0.55
SUI-180	0.3	0.23
SUI-210	0.32	0.11
SUI-260	0.26	0.11
ALP-010	0.78	0.73
ALP-040	0.26	0.33
ALP-070	0.7	0.35
ALP-080	0.45	0.75
ALP-100	0.33	0.48
ALP-110	0.45	0.78
ALP-140	0.2	0.3
SLE-030		
SLE-170		
SLE-180		
SLE-220		
SLE-210		
SLE-230		
SPA-020	0.24	0.4
SPA-050	0.31	0.43
SPA-070	0.4	0.43
SPA-100	0.15	0.1
SPA-110	0.14	0.13
SPA-130	0.12	0.47
SPA-140	0.26	0.2
SPA-150	0.26	0.11
SPA-160	0.15	0.19
SPA-170	0.75	0.38

Appendix E-2: I

Site ID	Average Velocity T2	Average Velocity T3
SPA-200	0.27	0.16
SPA-220	0.46	0.31
SPA-240	0.34	
WIL-100		
WIL_170		
WIL_190		
BUT-010	0.35	0.45
BUT-020	0.35	0.54
BUT-030	0.34	0.52
BUT-040	0.29	0.6
BUT-050	0.2	0.3
PES-050	0.31	0.3
PES-140	0.4	0.52
PES-200	0.3	0.48
PES-210	0.277	0.457
PES-230	0.34	0.32
PES-240	0.177	0.173
PES-060	0.4	0.23
PES-070	0.65	0.61
PES-080	0.4	0.33
PES-095	0.54	0.55
PES-100	0.65	0.65
PES-120	0.75	0.35
PES-150	0.2	0.26
PES-160	0.47	0.39
PES-170	0.16	0.16
PES-180	0.52	0.43
PES-190	0.39	0.36
SGR-010	0.46	0.57
SGR-030	0.36	0.35
SGR-040	0.38	0.4
SGR-060	0.25	0.41
SGR-075	0.52	0.34
SGR-080	0.58	0.4
SGR-090	0.32	0.5
SGR-110	0.6	0.25
SGR-120	0.5	0.2
SGR-130	0.5	0.5
SGR-150	0.5	0.63
STE-020	0.3	0.35
STE-030	0.05	0.03
STE-040	0.38	0.56
STE-060	0.83	0.6
STE-070	0.45	0.41
STE-100	0.3	0.4
STE-110	0.43	0.37
STE-120	0.2	0.18
PER-030	0.12	0.35
PER-040	0.19	0.2
PER-010	0.05	0.01
PER-020	0.2	0.2
PER-050	0.31	0.2
PER-070	0.63	0.32
PER-080	0.2	0.15

Appendix E, E-3: Bioassessment metrics

Site Code:	ALP-010	ALP-040	ALP-070	ALP-080	ALP-100	ALP-110	ALP-140	BUT-010	BUT-020	BUT-030	BUT-040	BUT-050	LAG-130	LAG-150
Coleoptera Taxa	1	0	0	0	0	0	0	2	2	5	8	7	6	2
Diptera Taxa	4	3	4	2	3	3	3	3	6	10	8	7	3	4
Ephemeroptera Taxa	1	0	1	1	0	0	1	4	10	10	10	12	8	8
Hemiptera Taxa	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera Taxa	0	0	0	0	0	0	0	0	3	2	3	5	5	5
Trichoptera Taxa	1	0	0	0	1	2	3	2	7	7	8	7	8	3
Non-Insect Taxa	8	7	9	10	7	7	5	5	4	2	4	7	5	4
Taxa Richness	16	11	14	13	11	12	12	16	32	36	41	45	35	26
EPT Taxa	2	0	1	1	1	2	4	6	20	19	21	24	21	16
% EPT	1	0	1	4	0	0	82	25	41	67	62	70	43	58
% Sensitive EPT	0	0	0	0	0	0	1	10	22	47	37	41	21	44
% Chironomidae	81	79	44	73	81	57	14	42	37	12	9	6	16	37
% Coleoptera	0	0	0	0	0	0	0	12	8	7	15	10	30	0
% Oligochaeta	3	15	47	9	2	35	0	12	0	0	1	1	0	1
% Non-insect	15	20	54	13	11	40	1	20	3	0	2	2	9	3
% Intolerant	0	0	0	0	0	0	1	0	15	44	36	35	17	44
% Tolerant	8	3	4	2	2	4	1	8	3	0	0	1	1	1
Tolerance Value	6.1	5.9	5.6	5.9	5.9	5.7	5.1	5.3	4.8	3.4	3.5	3.5	4.0	3.6
% Predator	1	1	1	2	0	2	2	7	5	7	5	19	2	28
% Collector-filterer	3	2	4	10	8	3	11	1	12	13	9	10	8	0
%Collector-gatherer	89	96	94	87	90	94	86	67	59	52	41	26	35	61
% Scraper	6	1	1	1	0	1	1	19	21	16	29	31	44	10
% Shredder	0	0	0	0	0	0	0	6	3	11	8	14	10	1
% Other	1	0	0	0	1	0	0	1	0	1	7	0	1	0

Appendix E, E-3: Bioassessment metrics

Site Code:	LAG-160	LAG-165	LAG-170	LAG-180	LAG-190	LAG-210	LAG-220	LAG-240	LAG-270	LAG-290	LAG-300	LAG-320	LAG-330	LAG-335
Coleoptera Taxa	0	8	4	8	7	5	7	6	7	7	6	5	7	4
Diptera Taxa	3	5	7	6	11	8	7	7	7	4	7	9	8	13
Ephemeroptera Taxa	4	8	8	9	10	8	8	7	7	5	8	8	7	7
Hemiptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Plecoptera Taxa	3	6	6	4	5	6	4	6	6	4	5	6	3	2
Trichoptera Taxa	1	8	7	8	10	7	7	6	7	4	7	6	6	8
Non-Insect Taxa	3	5	6	10	4	5	9	6	5	7	8	7	7	5
Taxa Richness	14	40	38	45	47	39	42	38	39	31	41	41	38	40
EPT Taxa	8	22	21	21	25	21	19	19	20	13	20	20	16	17
% EPT	17	51	34	43	51	47	49	49	41	23	21	60	60	40
% Sensitive EPT	10	37	21	32	36	24	34	32	28	10	11	38	34	14
% Chironomidae	80	20	20	19	30	22	25	17	38	53	58	23	20	25
% Coleoptera	0	16	22	28	11	10	18	14	9	10	12	9	7	13
% Oligochaeta	0	4	0	0	2	0	0	0	1	1	0	0	1	0
% Non-insect	0	5	2	4	5	3	4	1	2	5	2	5	5	4
% Intolerant	10	33	18	26	33	25	24	29	25	8	6	41	33	19
% Tolerant	0	0	1	1	0	1	1	0	0	0	1	3	1	0
Tolerance Value	5.5	3.9	4.4	4.0	3.8	4.2	3.9	3.5	4.2	5.1	5.2	3.6	3.6	4.3
% Predator	9	14	10	10	14	7	12	20	12	5	5	5	16	21
% Collector-filterer	1	10	22	5	5	19	3	1	4	9	4	4	2	0
%Collector-gatherer	90	41	34	34	56	40	43	43	63	71	73	47	45	43
% Scraper	0	26	30	33	16	28	35	17	10	13	13	27	12	21
% Shredder	0	9	3	18	7	5	7	18	11	2	4	16	25	13
% Other	0	0	0	0	0	0	0	0	0	0	1	1	0	1

Appendix E, E-3: Bioassessment metrics

Site Code:	LAG-380	LAG-390	PER-010	PER-020	PER-030	PER-040	PER-050	PER-070	PER-080	PES-050	PES-060	PES-070	PES-080	PES-095	PES-100
Coleoptera Taxa	7	6	0	0	0	0	2	1	1	3	5	3	3	5	5
Diptera Taxa	10	9	4	2	5	2	6	6	6	5	6	6	5	9	6
Ephemeroptera Taxa	6	8	2	0	1	1	1	3	4	9	10	9	7	10	11
Hemiptera Taxa	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Plecoptera Taxa	5	7	0	0	1	0	0	0	2	3	3	3	1	5	6
Trichoptera Taxa	9	8	0	0	1	0	1	6	6	5	8	10	4	10	9
Non-Insect Taxa	7	7	4	4	6	4	7	5	10	6	5	5	6	7	5
Taxa Richness	44	45	11	6	14	7	17	21	30	32	37	36	26	46	42
EPT Taxa	20	23	2	0	3	1	2	9	12	17	21	22	12	25	26
% EPT	43	58	0	0	1	1	16	21	70	22	42	38	33	55	76
% Sensitive EPT	30	35	0	0	0	0	0	1	21	11	16	19	18	35	58
% Chironomidae	23	11	16	89	72	91	50	61	10	14	36	29	46	29	4
% Coleoptera	18	5	0	0	0	0	1	1	0	5	9	7	4	6	9
% Oligochaeta	0	0	75	11	3	7	21	5	3	0	1	0	3	0	0
% Non-insect	7	9	83	11	5	8	25	11	14	56	5	1	5	1	1
% Intolerant	23	31	0	0	0	0	0	1	18	7	10	11	15	30	46
% Tolerant	1	3	8	0	1	1	3	6	4	56	3	1	1	1	1
Tolerance Value	3.9	3.5	5.4	5.9	6.0	5.9	5.7	5.8	4.1	6.4	4.8	4.8	5.0	4.0	3.2
% Predator	18	16	0	0	1	0	3	3	11	11	7	5	3	6	8
% Collector-filterer	2	5	0	0	21	0	7	5	4	4	10	26	11	11	13
%Collector-gatherer	38	25	99	100	77	99	87	86	70	68	65	50	59	65	57
% Scraper	30	24	1	0	0	1	2	4	1	16	14	12	13	11	15
% Shredder	12	30	0	0	0	0	0	1	13	1	4	6	13	6	7
% Other	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0

Appendix E, E-3: Bioassessment metrics

Site Code:	PES-120	PES-140	PES-150	PES-160	PES-170	PES-180	PES-190	PES-200	PES-210	PES-230	PES-240	SGR-010	SGR-030	SGR-040	SGR-060
Coleoptera Taxa	7	6	6	7	6	10	7	8	9	8	8	7	8	5	8
Diptera Taxa	8	9	8	8	6	11	9	11	9	13	14	13	8	7	8
Ephemeroptera Taxa	10	11	7	10	10	12	11	10	11	7	11	11	10	11	11
Hemiptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera Taxa	5	6	4	4	4	6	7	5	8	5	8	4	3	5	5
Trichoptera Taxa	8	9	5	9	6	8	7	9	9	5	12	10	8	10	5
Non-Insect Taxa	5	1	4	4	8	5	4	6	6	4	2	9	6	4	8
Taxa Richness	43	42	35	42	40	52	45	49	52	42	55	54	43	42	45
EPT Taxa	23	26	16	23	20	26	25	24	28	17	31	25	21	26	21
% EPT	78	84	39	69	69	69	73	48	41	47	62	44	76	81	69
% Sensitive EPT	54	70	38	54	37	41	49	31	23	40	47	32	35	65	41
% Chironomidae	2	6	10	5	3	12	5	7	5	26	8	18	5	1	7
% Coleoptera	7	7	5	17	15	8	13	34	35	18	17	19	11	6	5
% Oligochaeta	0	0	0	0	4	0	1	1	0	1	0	0	3	0	1
% Non-insect	2	0	39	1	9	1	2	2	12	2	2	10	4	1	3
% Intolerant	47	66	24	51	35	40	46	27	20	39	41	22	31	64	37
% Tolerant	1	0	39	0	3	1	0	1	12	1	2	9	1	1	2
Tolerance Value	3.1	2.1	5.3	2.6	3.3	3.4	3.1	3.3	4.1	3.7	3.2	4.3	3.7	2.1	3.6
% Predator	8	8	25	8	22	12	11	11	9	7	27	18	5	8	9
% Collector-filterer	12	1	7	5	1	10	7	2	4	2	6	4	2	7	14
%Collector-gatherer	57	64	46	41	19	42	36	26	26	55	26	44	63	26	45
% Scraper	11	21	10	37	48	27	38	44	52	20	33	24	17	30	27
% Shredder	4	5	12	8	11	5	6	17	8	15	9	9	4	26	3
% Other	9	1	0	1	0	5	3	0	1	1	0	1	9	3	1

Site Code:	SGR-075	SGR-080	SGR-090	SGR-110	SGR-120	SGR-130	SGR-150	SLE-030	SLE-170	SLE-180	SLE-210	SLE-220	SLE-230	SPA-020	SPA-050
Coleoptera Taxa	5	5	6	6	5	7	9	0	2	2	2	2	7	0	0
Diptera Taxa	9	9	6	6	10	11	13	2	3	10	5	7	7	2	2
Ephemeroptera Taxa	12	9	11	10	10	11	9	1	2	5	1	5	6	1	1
Hemiptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Plecoptera Taxa	4	5	6	5	4	4	6	0	2	7	1	3	4	0	0
Trichoptera Taxa	8	6	7	7	9	6	6	0	4	4	0	4	9	1	1
Non-Insect Taxa	5	3	2	2	6	2	8	9	3	6	8	6	5	6	4
Taxa Richness	43	37	38	36	44	41	51	12	16	34	17	27	39	10	9
EPT Taxa	24	20	24	22	23	21	21	1	8	16	2	12	19	2	2
% EPT	79	68	84	73	69	71	75	0	12	55	14	47	66	18	32
% Sensitive EPT	58	46	50	43	17	38	53	0	3	28	0	27	48	0	0
% Chironomidae	4	6	5	4	13	7	7	48	67	30	60	28	22	32	25
% Coleoptera	9	4	3	19	7	8	8	0	6	4	1	1	9	0	0
% Oligochaeta	1	3	0	0	0	1	1	1	2	0	9	3	0	40	36
% Non-insect	2	3	0	0	1	2	3	31	2	4	12	6	2	51	36
% Intolerant	56	45	47	39	16	40	49	0	3	27	0	26	35	0	0
% Tolerant	1	0	0	0	1	1	1	8	0	1	1	1	1	0	0
Tolerance Value	2.5	3.2	2.8	2.9	4.3	3.3	2.8	5.8	5.6	4.1	5.7	4.2	3.4	5.4	5.3
% Predator	11	7	18	10	7	17	22	9	2	23	1	18	7	0	0
% Collector-filterer	5	21	10	6	5	16	3	24	11	1	14	13	3	0	6
%Collector-gatherer	39	34	28	37	72	28	38	60	79	55	84	57	54	99	93
% Scraper	26	21	32	41	10	35	31	7	6	14	1	5	15	0	0
% Shredder	14	12	11	5	7	3	5	0	2	7	0	7	18	0	0
% Other	4	6	1	1	0	0	1	0	0	0	0	0	2	0	0

Appendix E, E-3: Bioassessment metrics

Site Code:	SPA-070	SPA-100	SPA-110	SPA-130	SPA-140	SPA-150	SPA-160	SPA-170	SPA-200	SPA-220	SPA-240	STE-020	STE-030	STE-040	STE-060
Coleoptera Taxa	0	0	0	1	0	2	0	2	1	0	0	0	0	0	1
Diptera Taxa	5	5	5	7	9	6	8	6	3	4	4	3	4	4	5
Ephemeroptera Taxa	1	1	1	1	4	4	5	1	1	1	1	1	1	1	1
Hemiptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0
Megaloptera Taxa	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Plecoptera Taxa	0	0	0	0	4	4	5	1	0	1	0	0	0	0	0
Trichoptera Taxa	1	0	1	1	4	4	4	1	1	2	0	1	0	0	2
Non-Insect Taxa	4	6	6	5	3	3	4	7	7	7	7	7	2	5	9
Taxa Richness	12	14	13	17	24	25	26	18	14	15	12	12	7	10	18
EPT Taxa	2	1	2	2	12	12	14	3	2	4	1	2	1	1	3
% EPT	12	1	1	0	39	78	79	56	48	46	48	0	3	3	1
% Sensitive EPT	0	0	0	0	18	51	47	1	0	0	0	0	0	0	0
% Chironomidae	45	52	59	64	26	12	11	36	20	21	30	80	71	61	67
% Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
% Oligochaeta	9	39	36	3	0	0	2	3	3	22	8	11	25	32	14
% Non-insect	11	42	38	4	3	5	8	5	6	23	16	13	25	34	18
% Intolerant	0	0	0	0	14	40	33	1	0	0	0	0	0	0	0
% Tolerant	2	1	1	1	3	5	4	1	2	1	1	2	0	2	3
Tolerance Value	5.8	5.5	5.6	6.0	5.0	3.6	3.8	5.4	5.5	5.3	5.3	5.9	5.7	5.7	5.9
% Predator	2	2	1	3	4	9	7	4	1	1	1	1	0	0	3
% Collector-filterer	31	5	1	28	31	3	4	0	25	9	6	6	1	2	11
%Collector-gatherer	67	93	97	67	34	28	32	96	72	89	92	93	99	97	82
% Scraper	0	0	0	0	17	20	26	0	1	0	0	0	0	1	3
% Shredder	0	0	0	0	13	39	31	0	0	0	0	0	0	0	0
% Other	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0

Site Code:	STE-070	STE-100	STE-110	STE-120	SUI-010	SUI-020	SUI-050	SUI-060	SUI-110	SUI-130	SUI-180	SUI-210	SUI-260	WIL-100	WIL-170	WIL-190
Coleoptera Taxa	0	5	9	9	2	1	1	0	1	1	0	1	1	2	2	1
Diptera Taxa	5	14	15	11	2	3	2	2	6	5	3	4	9	3	5	9
Ephemeroptera Taxa	1	10	11	10	4	5	6	4	7	3	8	3	6	2	6	5
Hemiptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Megaloptera Taxa	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Plecoptera Taxa	1	4	8	6	1	1	2	1	1	2	2	2	1	1	1	3
Trichoptera Taxa	2	6	8	5	6	6	6	6	5	9	2	3	4	5	4	5
Non-Insect Taxa	8	5	7	4	9	9	5	7	7	6	10	5	7	6	8	3
Taxa Richness	17	44	58	46	24	25	22	20	27	26	25	19	28	19	27	26
EPT Taxa	4	20	27	21	11	12	14	11	13	14	12	8	11	8	11	13
% EPT	33	53	54	65	25	36	35	43	57	52	61	25	11	23	34	84
% Sensitive EPT	4	44	43	32	3	9	6	8	11	11	37	4	8	3	15	61
% Chironomidae	53	30	14	13	52	42	37	37	18	23	23	34	51	28	41	10
% Coleoptera	0	2	17	10	0	0	0	0	0	0	0	0	0	1	2	0
% Oligochaeta	2	5	1	1	11	5	2	0	1	3	3	0	15	4	0	0
% Non-insect	10	7	4	2	18	18	6	4	4	6	15	1	30	7	2	2
% Intolerant	4	40	42	32	1	7	5	7	11	11	36	3	9	3	7	46
% Tolerant	4	1	1	0	5	3	3	3	2	2	2	1	8	1	2	0
Tolerance Value	5.5	3.7	3.1	3.5	5.6	5.1	5.4	5.2	5.0	4.9	3.9	5.4	5.5	5.6	5.2	3.1
% Predator	6	9	23	17	5	3	3	3	1	3	5	4	16	1	4	20
% Collector-filterer	3	3	4	8	10	7	25	19	22	20	1	39	4	42	20	5
%Collector-gatherer	84	73	38	56	83	84	67	72	73	75	80	53	78	53	64	48
% Scraper	0	7	26	14	0	4	3	5	4	1	12	2	1	0	8	0
% Shredder	4	8	6	4	0	0	0	0	0	0	0	2	0	3	4	28
% Other	2	1	3	1	2	1	2	1	0	1	2	0	0	1	0	0

Site Code:	WLK-030	WLK-050	WLK-100	WLK-120	WLK-130	WLK-140	WLK-160	WLK-170	WLK-180	WLK-190	WLK-200	WLK-230	WLK-240
Coleoptera Taxa	1	9	2	1	0	6	4	3	3	4	0	2	1
Diptera Taxa	4	4	4	5	2	5	3	5	4	7	7	4	4
Ephemeroptera Taxa	1	2	6	3	1	7	5	5	6	5	3	2	3
Hemiptera Taxa	0	1	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera Taxa	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera Taxa	0	0	4	1	0	5	3	4	4	4	2	3	3
Trichoptera Taxa	2	1	4	2	0	12	12	9	10	9	9	1	1
Non-Insect Taxa	7	10	2	13	3	6	9	10	12	7	10	4	3
Taxa Richness	15	27	22	25	6	41	36	36	39	36	31	16	15
EPT Taxa	3	3	14	6	1	24	20	18	20	18	14	6	7
% EPT	5	23	45	37	0	70	23	52	74	59	47	4	9
% Sensitive EPT	0	1	13	28	0	47	13	26	54	53	32	1	2
% Chironomidae	44	31	15	24	58	9	49	33	9	18	32	63	64
% Coleoptera	1	3	0	0	0	16	5	0	3	7	0	1	0
% Oligochaeta	21	17	3	10	5	0	0	4	1	0	3	4	3
% Non-insect	25	35	3	37	35	2	2	9	7	10	18	12	3
% Intolerant	0	0	10	28	0	25	7	21	31	24	17	1	2
% Tolerant	4	18	0	26	30	1	1	3	2	2	4	7	0
Tolerance Value	5.8	5.9	5.1	5.1	6.5	3.7	5.2	4.7	3.6	3.6	4.8	6.0	5.8
% Predator	3	4	2	18	0	14	4	14	4	25	5	11	2
% Collector-filterer	26	8	40	1	7	13	21	2	11	1	6	18	23
%Collector-gatherer	71	86	53	79	93	41	58	65	37	26	58	70	74
% Scraper	0	0	1	2	0	25	7	2	15	13	14	1	1
% Shredder	0	0	5	0	0	8	6	17	33	35	17	0	0
% Other	0	2	0	0	0	0	3	1	0	0	0	1	0

Appendix F: Discrete field measures (by watershed and site)

	Analyte	Specific Conductance (mS/cm)			Oxygen, Dissolved (calculated, as mg/L)			Oxygen, Dissolved (% saturation)			pH		
	Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Watershed/Station													
Walker Creek													
201WLK030			0.395	0.254		14.3832	12.1464		138.3	96.4		7.43	7.39
201WLK090		1.804	0.24	0.193	8.9143	9.9498	10.992	91.9	96.6	91.6	7.69	7.47	7.1
201WLK100			0.324	0.234		10.815	11.78		105	95		7.76	7.47
201WLK140		2.33	0.183	0.148	9.3534	13.335	11.685	91.7	127	95	7.71	7.66	7.42
Lagunitas Creek													
201LAG040			0.237	0.196		10.4133	10.887		101.1	95.5		7.57	6.9
201LAG120		0.226			13.2594			135.3			7.92		
201LAG130		0.246	0.218	0.18	9.741	12.0432	10.5881	95.5	115.8	93.7	7.63	7.95	6.96
201LAG150		0.228	0.221	0.176	10.6485	11.08	11.0288	114.5	110.8	97.6		7.87	7.23
201LAG160		0.302	0.265	0.193	12.9948	10.812	11.4192	132.6	106	97.6	7.53	7.8	7.16
201LAG190		0.228	0.272	0.214	11.1201	12.4416	11.4695	110.1	115.2	101.5	7.84	8.25	6.9
201LAG210		0.233	0.204	0.181	10.9304	9.7337	11.1983	105.1	89.3	99.1	7.64	8.25	6.9
201LAG270		0.596	0.391	0.293	5.151	10.6272	11.4777	51	98.4	98.1	7.54	7	7
201LAG320		0.232	0.155	0.138	10.8562	12.639	10.791	105.4	114.9	98.1	7.29	7.06	6.9
San Leandro Creek													
204SLE030		0.844	0.598	0.541	11.9192	19.3812	8.6205	126.8	208.4	82.1	7.77	8.33	7.27
204SLE190		1.313	0.732	0.677	8.8173	11.286	12.9821	87.3	104.5	99.1	8.19	8.2	7.2
204SLE210		0.634	0.642	0.567	2.3129	10.3464	12.9559	22.9	95.8	98.9	7.38	8.17	7.38
204SLE230		0.742	0.524	0.478	8.6828	11.024	13.3196	88.6	104	99.4	8.17	8.44	7.36
Wildcat/San Pablo Creeks													
206SPA020		1.546	1.275	1.131	5.4843	8.484	13.5888	54.3	80.8	119.2	7.87	8.05	7.08
206SPA070		1.54	1.47	1.303	4.4238	9.24	11.2218	43.8	88	95.1	7.61	8.08	7.04
206SPA150		0.914	0.915	0.904	12.6582	11.473	13.3824	124.1	104.3	98.4	8.34	8.4	7.21
206SPA200		1.995	1.369	1.175	8.5162	13.413	12.2636	86.9	131.5	98.9	8.12	8.44	6.95
206SPA220		0.95	0.664	1.131	8.3323	11.3925	13.5888	85.9	108.5	119.2	8.49	8.6	7.08
206WIL020		0.879	0.705	0.63	4.3068	10.5644	12.7512	44.4	107.8	101.2	7.74	8.23	7.23
206WIL180			0.36	0.301		8.72	11.7475		80	92.5		7.59	7.19
Suisun Creek													
207SUI010		0.462	0.473	0.385	8.0444	8.0219	11.5128	88.4	82.7	98.4	7.86	8.29	7.12
207SUI020		0.43			12.9317			145.3			7.57		
207SUI060		0.557	0.456	0.367	8.8179	13.493	11.4	96.9	131	95	7.68	7.95	7.36

Appendix F: Discrete field measures (by watershed and site)

Analyte	Specific Conductance (mS/cm)			Oxygen, Dissolved (calculated, as mg/L)			Oxygen, Dissolved (% saturation)			pH		
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Watershed/Station												
207SUI110	0.545	0.437	0.354	17.5933	9.4668	13.2678	222.7	96.6	105.3	8.36	8.26	7.45
207SUI125		0.455	0.401		9.4395	12.2616		89.9	104.8		7.96	7.14
207SUI130	0.5	0.455		8.334	9.4395		92.6	89.9		7.56	7.96	
207SUI180		0.224	0.193		9.4233	12.5517		93.3	97.3		8.3	7.63
207SUI210	0.599	0.562	0.468	8.109	9.2288	11.3256	90.1	89.6	93.6	7.46	7.79	7.34
Arroyo las Positas												
204ALP010	1.641	1.781	1.755	7.5051	10.99612	13.5255	80.7	116.98	106.5	8.28	8.49	7.19
204ALP100	1.519	2.799	2.661	9.4913	9.1304	12.1412	104.3	90.4	95.6	7.94	7.94	7.19
204ALP110	1.426	1.183	1.055	7.7952	12.2576	11.844	89.6	130.4	112.8	8.03	8.04	7.12
204ALP140	0.92	1.895	1.578	9.03	9.7344	12.4614	105	93.6	98.9	8.41	8.03	7.16
Pescadero/Butano Creeks												
202BUT010	0.368	0.346	0.369	11.342	10.6488	10.857	107	104.4	98.7	8.1	7.86	7.46
202BUT020	0.393	0.333	0.332	12.524	11.7393	10.9074	124	107.7	102.9	8.06	8.11	7.49
202PES050	0.703	0.597	0.603	10.4958	11.0268	11.748	102.9	102.1	106.8	8.03	8.14	7.72
202PES070	0.703	0.578	0.55	11.6756	10.8	10.9436	115.6	108	100.4	8.01	8.18	7.67
202PES140	0.677	0.561	0.533	9.7566	11.3526	11.4663	96.6	107.1	103.3	8.4	8.44	7.42
202PES190	0.622	0.555	0.636	9.4276	11.1996	11.033	96.2	103.7	100.3	8.33	8.35	7.81
San Gregorio Creek												
202SGR010	0.903	0.773	0.723	11.0192	11.227	10.7147	113.6	103	98.3	8.3	8.32	
202SGR040	0.899	0.777	0.763	10.2554	9.646	11.066	109.1	91	100.6	8.47	8.37	
202SGR080	0.925	0.81	0.776	9.8159	10.918	10.901	95.3	103	99.1	8.27	8.51	7.55
202SGR090	0.845	0.782	0.763	10.2752	10.1304	10.945	98.8	93.8	99.5	8.45	8.48	7.86
Stevens/Permanente Creeks												
205PER010	1.296	0.73	1.457	9.88	16.2657	14.9856	104	174.9	156.1	7.9	8.91	7.62
205PER070	1.02	1.012	1.142	8.924	11.2112	10.7841	92	107.8	104.7	8.18	8.33	7.5
205STE020	1.005	1.037	0.741	10.137	16.6098	13.9536	109	178.6	136.8	7.83	8.26	8.37
205STE060	0.497	0.502	0.602	11.0797	11.352	12.18	109.7	103.2	116	8.54	8.36	7.9
205STE100	0.563	0.515	0.446	9.3728	12.0213	11.6208	92.8	108.3	107.6	8.43	8.51	7.77

Appendix F: Discrete field measures (by watershed and site)

Analyte	Salinity (ppt)			Temperature (C)			Turbidity (NTU)			Velocity (ft/s)		
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Watershed/Station												
Walker Creek												
201WLK030					13.57	5.5		4.45	11.6		1.75	0.772
201WLK090	0.92			16.48	13.83	7.6	4	0.84	11.1	0.591	0.671	0.634
201WLK100					13.98	6.02		4.64	23.7		0.611	0.578
201WLK140	0.11			14.72	12.96	6.28	1.3	2.67	9.96	2.18	5.28	0.857
Lagunitas Creek												
201LAG040					13.94	9.41		2.9	4.9		0.594	0
201LAG120				15.99			1.4			0		
201LAG130	0.12			14.7	13.29	9.77	0.6	1.46	10.75	0.171	1.77	9.32
201LAG150				18.56	15.71	9.84	0.1	0.55	1.55	1.91	2.89	1.18
201LAG160				15.8	14.39	8.56	0.45	1.46	2.52	0	0.166	0.731
201LAG190	0.11			15.12	12.09	9.93	0.4	0.65	1.7	0.621	0.993	2.95
201LAG210	0.11			13.61	11.45	9.86	0.7	3.34	2.3	0.699	2.09	0.923
201LAG270	0.29			15.37	12.2	8.32	0.55	0.42	0.9	0.849	2.4	3.23
201LAG320	0.11			14.02	10.89	10.8	0.5	1.1	2.7	0.994	2.1	3.55
San Leandro Creek												
204SLE030				17.9	18.63	12.78	1.5	0.37	0.2	2.91		4.38
204SLE190	0.66			14.83	11.75	3.8		1.5	1.7	0	0.414	0.758
204SLE210	0.31			15.04	12.06	3.82	30.2	2.6	2	0	1.78	1.36
204SLE230	0.37			15.77	12.43	2.94	4.6	11	2	0.449	0.339	0.384
Wildcat/San Pablo Creeks												
206SPA020	0.74			15.58	12.97	9.38	6.2	4	2.07	0.175	0.283	1.18
206SPA070	0.74			15.14	12.9	8.01	6.5	4	3.2	0.523	0.356	1.2
206SPA150				14.66	11.34	2.52	7.3	1.7	0.8	0.24	1.09	0.932
206SPA200	1.03			16.24	14.39	6.08	5.3	1.3	1.7	1.11	0.383	2.25
206SPA220	0.47			16.53	13.13	9.38	2.6	1.6	2.07	0.645	0.797	1.18
206WIL020				16.34	15.84	5.29	32	9.7	8.6	0	0	0
206WIL180					11.42	5.24		3.6	2.9		0.649	2.98
Suisun Creek												
207SUI010	0.22			18.86	16.43	8.43	2.3	1.3	4.12	0	3.19	5.93
207SUI020				21.08			2.4			0.456		
207SUI060	0.27			18.9	13.92	7.37	1.3	1.9	3.9	0	6.07	7.61

Appendix F: Discrete field measures (by watershed and site)

Analyte	Salinity (ppt)			Temperature (C)			Turbidity (NTU)			Velocity (ft/s)		
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Watershed/Station												
207SUI110				27.19	15.82	5.51	0.45	5.3	2.82	1.59	1.52	2.41
207SUI125					13.13	8.7		0.65	3.2		1.35	1.05
207SUI130	0.24			20.72	13.13		11	0.65		0.857	1.35	
207SUI180					15.17	4.74		8.5	5.2		1.23	0.762
207SUI210	0.29			20.4	14.08	6.99	0.85	1.6	1.5	0.606	0.904	1.59
Arroyo las Positas												
204ALP010				18.4	17.74	5.24	20.2	3.7	2.6	1.4	1.92	2.6
204ALP100	0.77			20.29	15.19	5.11	20.6	6.8	17.8	2.5	2.52	1.24
204ALP110	0.72			22	18.06	12.85	129.1	1	0.85	0.128	0.334	0.286
204ALP140				22.85	13.52	5.5	85.1	5.5	3.7	1.88	0	0.356
Pescadero/Butano Creeks												
202BUT010				12.42	14.46	11.21	7.2	11	12.8	0.697	1.434	0.869
202BUT020			0.16	15.45	11.39	12.34	6.7	8.5	6.5	0.535	0.724	
202PES050				14.54	11.93	10.99	5.2	2.7	5.6	1.36	1.79	1.21
202PES070			0.27	15.56	15.64	11.4	3.1	2.2	4.71	1.56	1.288	
202PES140			0.26	15.33	12.55	10.71	1.02	1.8	1.65	0.66	2.21	
202PES190			0.31	16.08	12.2	10.94	1.1	1.5	3.2	0.11	0.331	1.36
San Gregorio Creek												
202SGR010			0.36	16.39	11.35	11.41	1.23	1.2	3.25	0	1.16	1.07
202SGR040			0.38	17.92	12.59	11.16	1.34	1.75	1.26	1.23	1.58	0.92
202SGR080			0.38	13.89	12.4	11.21	0.76	1.2	1.75	0.828	0.824	1.02
202SGR090			0.38	13.4	11.85	11.09	0.97		1.51	0.447	2.48	1.76
Stevens/Permanente Creeks												
205PER010			0.74	17.51	18.7	17	1.02	1.6	7.8	0.534	0.31	0
205PER070			0.57	16.69	13.52	14.01	2.21	1.4	4.9	1.02	1.94	
205STE020			0.36	18.67	18.85	14.46	1	0.5	6.71	1.42	0.648	0
205STE060			0.29	15.32	11.26	12.99	1.32	2.7	11.8	1.91	1.42	0
205STE100			0.22	15.39	10.62	12.07	0.65	0	2.7	1.11	0.915	

Appendix G-1: Conventional water quality chemistry results

Analyte	Alkalinity, as CaCO3 (mg/L)			Boron (mg/L)			Chloride (mg/L)			Hardness, as CaCO3 (mg/L)			SSC (mg/L)			Sulfate (mg/L)			TDS (mg/L)			TSS (mg/L)	
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Wet
Watershed/Station																							
Walker Creek																							
201WLK030		111	69					52.3	33.2		127	92.4		13.4	1.5		22.6	19.4		231	217		2.6
201WLK090	70	75.8	64				581	22.8	18.6	238	80.8	77	17	0.4	1.9	70.7	11.6	12	1162	151	193	13.8	3.3
201WLK100		108	78					30.6	23.1		124	101		2.4	8.6		14.7	13.2		193	224		8
201WLK140	59	58.3	55				20.4	15.2	14.6	59.7	64.6	66	0.6	1.4	1.9	4.39	10.6	10.7	103	113	132	1.2	1.7
Lagunitas Creek																							
201LAG040		79.7	73					16.9	17.6		91.9	92.4		0.8	4.2		16.4	14.9		149	162		5.2
201LAG130	81	89.2	81				7.27	11.8	12.1	81.6	91.9	90.2	2.3	1.1	2.3	3.74	7.5	8.1	102	134	149	1	11.9
201LAG150	78	72.3	65	0.16			19.7	16.3	13.3	90.9	81.3	79.2	3.7	0.6	0.1	13.6	15.1	12.4	128	142	144		1
201LAG160	101	91.4	72	0.12			29.8	21.2	15.5	106	104	92.4	2.4	1.8	0.6	15.5	15.6	12.5	172	164	142		1
201LAG190	75	118	99				6.56	15.5	13	76.5	122	112	1.1	0.4	0.2	3.97	9.22	8.64	95	169	163	2.9	1
201LAG210	72	84.2	87.5				6.57	10.2	9.73	72.4	87.9	95.7	0.4	ND	0.2	3.89	6.77	8.13	92	134	144	1	1
201LAG270	202	179	148				19.7	16.6	12.7	221	194	174	4.2	0.4	ND	12.5	13.7	12.7	241	234	210	1.4	1
201LAG320	70	59.7	65				6.3	8.36	8.04	68.3	64.6	72.6	0.6	0.2	0.2	3.59	5.03	6.81	92	99	117	1	1
San Leandro Creek																							
204SLE030	224	228	232				25.3	25.8	21.8	245	258	233	3.4	ND	0.4	42.8	45.8	42.8	376	391	409	2.4	1
204SLE190	296	243	219				20.9	19.3	15.3	456	312	280	18.4	2.6		248	151	133	698	482	486	3.4	1
204SLE210	215	310	267				14.1	23.2	17.8	186	299	245	22.4	5.6	0.8	9.48	29	27.2	276	375	380	20.5	1
204SLE230	176	217	193				18.1	18.1	14.8	199	217	180	1.2	11.7	0.5	86.1	53	45.3	349	312	326	2.6	1
Wildcat/San Pablo Creeks																							
206SPA020	312	396	396				70.2	95.8	77.8	462	513	452	7.5	6.6	2.3	210	207	200	824	842	856	8.7	53
206SPA070	345	426	418				85.5	128	91.2	449	584	524	11.7	6.6	2.1	188	280	269	858	1006	1008	10.5	2.1
206SPA150	240	224	206	0.5			25.9	23.7	21.4	333	327	324	8.3	2.1	2	300	293	253	664	686	664		1
206SPA200	282	320	317				346	173	134	398	481	417	4.2	1.5	0.1	126	202	187	999	868	868	3.2	1
206SPA220	332	300	271				24.6	25.4	18	318	320	254	64.2	1.3	0.6	49.1	53.5	43.6	460	419	388	1.9	1
206WIL020	319	275	238	0.44			52.1	44	31.4	323	287	238	121.5	17.7	4.7	44.3	65	57.2	472	430	410		7.3
206WIL180		134	104					17.6	14.9		169	157		6.5	ND		35.6	27.3		231	214		1
Suisun Creek																							
207SUI010	166	175	158				5.4	17.7	11.7	175	192	232	6.5	1.5	1.6	23.3	77.3	54.3	197	299	276		1.8
207SUI020	169			0.38			12.2			202			3.1			49			268				
207SUI060	173	164	149				11.6	16.9	10.4	188	188	157	0.8	1.2	ND	51.6	83	54.2	267	290	278		1.2
207SUI110	183	151	138	0.28			19	12.6	11.2	232	180	161	1.9	4	1.1	96.4	64.5	58.9	357	290	280		1
207SUI125			135						11.1			144			1.6			60.4			265		1.5
207SUI130	150	153					9.95	17		155	180		14.3	0.9		43	90.9		225	275			
207SUI180		85.8	76					12.7	9.41		85.7	70.4		4.7	0.7		20.6	18.6		190	177		1
207SUI210	180	203	187				21.6	19.2	11.8	204	251	215	11.5	3.5	0.6	51.9	105	83.6	299	360	341		1

Appendix G-1: Conventional water quality chemistry results

Analyte	Alkalinity, as CaCO3 (mg/L)			Boron (mg/L)			Chloride (mg/L)			Hardness, as CaCO3 (mg/L)			SSC (mg/L)			Sulfate (mg/L)			TDS (mg/L)			TSS (mg/L)	
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Wet
Arroyo las Positas																							
204ALP010	261	355	367				242	354	352	304	408	380	7.4	7	2.3	81.9	128	128	751	1073	1220	8.48	2.3
204ALP100	183	405	473				265	763	610	207	427	457	9.8	18.4	24.1	63.6	151	146	705	1615	1781	12.5	22.6
204ALP110	342	343	360				140	145	111	422	412	382	3.4	1.7	2.1	77.5	98.8	75.1	722	733	735	6.4	1.3
204ALP140	91	534	489				158	281	212	131	311	309	33.4	6.7	1.6	39.2	156	137	415	1172	1114	37.2	3.4
Pescadero/Butano Creeks																							
202BUT010	112	90.6	92.8	0.21	0.13	0.13	33.3	30.4	31.9	130	113	120	11.1	18.9	8.6	37.7	40.6	44.8	245	197	225		
202BUT020	110	87.5	84.8	0.19	0.11	0.12	36.6	31.5	24.9	127	109	118	1.6	3.6	5.23	42.2	44.2	37.2	238	190	213		
202PES050	210	176	172	0.54	0.34	0.27	50.6	43.1	39.4	257	222	221	7.3	3.2	3.9	82.8	100	93.5	417	365	375		
202PES070	208	174	171	0.52	0.34	0.26	50.6	40.3	28.6	257	216	202	2	1.7	5.4	81.4	97.8	75	436	343	360		
202PES140	215	177	175	0.44	0.3	0.29	45.4	34.6	22.8	252	222	224	0.3	0.7	0.93	86.3	97.3	72.5	428	350	358		
202PES190	203	181	218	0.32	0.25	0.5	35.2	28.5	21.2	252	232	260	ND	0.3	1.48	82.6	98.2	91.3	390	347	435		
San Gregorio Creeks																							
202SGR010	241	214	194	0.4	0.3	0.31	74.4	59.4	43.5	354	289	272	2.4	1.5	5.23	139	152	112	560	463	475		
202SGR040	258	229	221	0.43		0.32	57.9	297	36.4	313	326	288	1.1	2.6	1.87	152	513	129	578	515	494		
202SGR080	255	230	216	0.38	0.31	0.26	55.6	48.5	34.9	323	168	299	0.7	1.7	1.5	175	198	144	603	528	504		
202SGR090	261	243	235	0.36		0.26	31.5	77.2	25	343	355	312	2.3	2.4	2.79	165	296	145	558	534	520		
Stevens/Permanente Creeks																							
205PER010	405	186	409	0.25	0.06	0.26	74.4	54.1	99.9	707	337	784	2.9	2.3	11.85	311	155	254	902	452	1003		
205PER070	202	189	185	0.17	0.06	0.18	55.8	49.7	42.3	424	498	533	3.5	1.5	9.74	336	326	379	720	724	850		
205STE020	369	394	250	0.3	0.16	0.2	37.9	44.8	27.1	495	530	345	15.5	0.8	1.68	137	152	113	660	684	490		
205STE060	184	201	195	0.26	0.13	0.16	21.8	23.2	27	212	232	290	1.9	2	7.71	47	47.6	108	306	294	418		
205STE100	233	217	223	0.35		0.22	16.6	14.6	13.4	252	265	239	10.3	0.6	1.5	50.8	56.3	39.9	344	294	314		

Appendix G-2: Water nutrients chemistry results

Analyte	Total Ammonia (mg/L as N)			Unionized Ammonia (calculated, mg/L as N)			Chlorophyll-*a* (ug/L)			Pheophytin-*a* (ug/L)			
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry
Watershed/Station													
Walker Creek													
WLK030		0.07	0.07		4.76E-04	2.42E-04		2.2	3.6		2.2	14	
WLK090	0.07	0.07	0.07	9.96E-04	5.22E-04	1.44E-04	1.9	20	3.6	6	2.3	9.9	0.05
WLK100		0.07	0.07		1.01E-03	2.91E-04		2.3	10.3		1.25	10.3	
WLK140	0.07	0.07	0.07	9.69E-04	7.48E-04	2.59E-04	1.25	1.4	2.3	4.5	2	2.3	0.05
Lagunitas Creek													
LAG040		0.07	0.15		6.56E-04	2.10E-04		0.9	1.5		0.9	1.5	
LAG130	0.07	0.07	0.12	8.08E-04	1.44E-03	2.07E-04	1.25	1.6	2.3	3	0.9	6.2	0.05
LAG150	0.07	0.07	0.07		1.50E-03	2.25E-04	2.8	0.75	1.25	1.25	0.75	4.3	0.102
LAG160	0.07	0.07	0.07	6.92E-04	1.11E-03	1.78E-04	0.9	0.75	1.25	0.9	0.75	2	0.113
LAG190	0.07	0.10	0.07	1.30E-03	3.76E-03	1.05E-04	1.5	0.75	1.25	5.4	0.75	3	0.05
LAG210	0.07	0.11	0.07	7.69E-04	3.85E-03	1.05E-04	1.25	0.75	1.1	5.8	1	1.1	0.05
LAG270	0.10	0.13	0.11	9.41E-04	2.85E-04	1.80E-04	1.25	0.75	1.1	3.9	0.75	1.7	0.094
LAG320	0.07	0.07	0.07	3.46E-04	1.64E-04	1.13E-04	1.25	0.75	1.25	4.9	0.75	1.25	0.05
San Leandro Creek													
SLE030	0.46	0.07	0.07	9.06E-03	5.10E-03	3.07E-04	7.9	4.3	1.25	13	5.8	4.6	6.63
SLE190	0.07	0.12	0.10	2.85E-03	4.04E-03	1.93E-04	1.25	1.1	1.1	2.1	0.75	1.1	0.16
SLE210	0.07	0.17	0.07	4.57E-04	5.35E-03	2.04E-04	5.3	0.9	1.1	11	0.9	1.8	0.16
SLE230	0.07	0.07	0.07	2.92E-03	3.99E-03	1.81E-04	1.25	1.7	1.1	3.5	1.7	2.6	0.16
Wildcat/San Pablo Creeks													
SPA020	0.14	0.07	0.07	2.99E-03	1.81E-03	1.48E-04	3.6	4.4	1.25	14	5.2	2.5	0.81
SPA070	0.14	0.14	0.07	1.54E-03	3.87E-03	1.25E-04	2.7	3.6	1.5	8.8	1.9	1.5	0.59
SPA150	0.07	0.13	0.13	3.96E-03	6.34E-03	2.39E-04	1.25	0.9	1.1	1.25	0.9	1.1	0.178
SPA200	0.07	0.07	0.07	2.62E-03	4.58E-03	8.81E-05	1.25	4.8	1.5	4.5	0.9	1.5	0.16
SPA220	0.07	0.16	0.07	6.25E-03	1.38E-02	1.48E-04	1.25	3.9	1.1	3.7	1.4	1.1	0.16
WIL020	0.37	0.20	0.10	5.90E-03	9.53E-03	2.23E-04	92	6.5	2.7	51	2.3	2.7	0.146
WIL180		0.07	0.07		5.52E-04	1.42E-04		0.9	0.85		0.9	0.85	
Suisun Creek													
SUI010	0.07	0.07	0.07	1.81E-03	3.80E-03	1.51E-04	1.5	2	1.5	5.7	1.5	1.5	0.22
SUI020	0.11			1.71E-03			1.25			1.25			0.891
SUI060	0.07	0.07	0.07	1.21E-03	1.55E-03	2.43E-04	1.9	1.1	1.5	7.2	1.5	2.7	0.05
SUI110	0.07	0.07	0.07	9.21E-03	3.56E-03	2.78E-04	3.5	1.25	1.1	0.9	1.25	2.3	0.086
SUI125			0.07			1.70E-04			5.8			5.7	
SUI130	0.12	0.07		1.83E-03	1.48E-03		2.3	1.5		6.1	1.9		0.7
SUI180		0.07	0.07		3.63E-03	3.90E-04		1.7	1.25		3.9	3.4	
SUI210	0.12	0.07	0.12	1.35E-03	1.08E-03	3.98E-04	1.25	0.75	1.25	2.9	0.75	1.25	0.05

Appendix G-2: Water nutrients chemistry results

	Nitrate (mg/L N)		Nitrite (mg/L N)			Nitrate + Nitrite (calculated, mg/L N)			Total Kjeldahl Nitrogen (mg/L)			Orthophosphate as P (mg/L)			Phosphorus, Total as P (mg/L)		
	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Watershed/Station																	
Walker Creek																	
WLK030	0.364	0.81		0.007	0.02	0	0.371	0.83		0.68	0.37		0.01	0.06		0.07	0.06
WLK090	0.153	0.84	0.02	0.007	0.02	0.07	0.16	0.86	0.37	0.37	0.37	0.1	0.032	0.08	0.121	0.06	0.08
WLK100	0.754	2.18		0.007	0.03	0	0.761	2.21		0.64	0.59		0.072	0.18		0.12	0.22
WLK140	0.067	0.36	0.02	0.007	0.02	0.07	0.074	0.38	0.37	0.54	0.37	0.093	0.014	0.04	0.097	0.04	0.05
Lagunitas Creek																	
LAG040	0.167	0.54		0.007	0.02	0	0.174	0.56		0.37	0.37		0.05	0.08		0.09	0.08
LAG130	0.165	0.37	0.02	0.007	0.02	0.07	0.172	0.39	0.37	0.37	0.37	0.04	0.018	0.04	0.04	0.04	0.04
LAG150	0.313	0.51	0.007	0.007	0.02	0.109	0.32	0.53	0.37	0.37	0.37	0.02	0.028	0.04	0.04	0.04	0.04
LAG160	0.307	0.37	0.007	0.007	0.02	0.12	0.314	0.39	0.37	0.37	0.37	0.025	0.024	0.04	0.04	0.04	0.04
LAG190	0.256	0.27	0.02	0.007	0.02	0.07	0.263	0.29	0.37	0.37	0.37	0.04	0.026	0.04	0.04	0.04	0.04
LAG210	0.181	0.27	0.02	0.007	0.02	0.07	0.188	0.29	0.37	0.37	0.37	0.04	0.015	0.04	0.04	0.04	0.04
LAG270	0.485	0.58	0.02	0.007	0.02	0.114	0.492	0.6	0.37	0.37	0.37	0.063	0.052	0.04	0.076	0.06	0.04
LAG320	0.175	0.14	0.02	0.007	0.02	0.07	0.182	0.16	0.37	0.37	0.37	0.04	0.011	0.04	0.04	0.04	0.04
San Leandro Creek																	
SLE030	7.65	6.13	0.07	0.007	0.02	6.7	7.657	6.15	0.71	0.37	0.37	0.17	0.044	0.06	0.17	0.07	0.08
SLE190	0.217	0.41	0.02	0.007	0.02	0.18	0.224	0.43	0.37	0.37	0.37	0.17	0.146	0.09	0.2	0.12	0.3
SLE210	0.096	0.28	0.02	0.007	0.02	0.18	0.103	0.3	0.71	0.37	0.37	0.36	0.144	0.07	0.46	0.15	0.1
SLE230	0.219	0.35	0.02	0.007	0.02	0.18	0.226	0.37	0.37	0.37	0.37	0.17	0.075	0.04	0.07	0.09	0.08
Wildcat/San Pablo Creeks																	
SPA020	1.2	1.72	0.04	0.015	0.02	0.85	1.215	1.74	1.25	0.37	0.37	0.34	0.239	0.21	0.391	0.3	0.22
SPA070	0.676	0.87	0.02	0.007	0.02	0.61	0.683	0.89	1.02	0.37	0.37	0.44	0.282	0.22	0.503	0.3	0.23
SPA150	0.027	0.15	0.007	0.007	0.02	0.185	0.034	0.17	0.37	0.37	0.37	0.237	0.181	0.12	0.23	0.18	0.17
SPA200	0.427	0.48	0.02	0.007	0.02	0.18	0.434	0.5	0.37	0.37	0.37	1.99	0.322	0.3	0.61	0.36	0.31
SPA220	0.15	0.27	0.02	0.01	0.02	0.18	0.16	0.29	0.37	0.37	0.37	0.17	0.123	0.07	0.12	0.14	0.13
WIL020	0.183	0.62	0.007	0.007	0.02	0.153	0.19	0.64	1.68	0.37	0.37	0.041	0.028	0.04	0.38	0.09	0.06
WIL180	0.06	0.17		0.007	0.02	0	0.067	0.19		0.37	0.37		0.039	0.04		0.04	0.04
Suisun Creek																	
SUI010	0.672	1.1	0.02	0.007	0.02	0.24	0.679	1.12	0.37	0.37	0.37	0.04	0.02	0.04	0.04	0.04	0.04
SUI020			0.007			0.898	0	0	0.37			0.024			0.04		
SUI060	0.211	0.67	0.02	0.007	0.02	0.07	0.218	0.69	0.37	0.37	0.37	0.04	0.02	0.04	0.04	0.04	0.04
SUI110	0.24	0.91	0.007	0.007	0.02	0.093	0.247	0.93	0.37	0.37	0.37	0.025	0.056	0.04	0.04	0.06	0.04
SUI125		0.16			0.02	0	0	0.18			0.37			0.04			0.04
SUI130	0.097		0.13	0.007		0.83	0.104	0	0.37	0.37		0.16	0.007		0.188	0.04	
SUI180	0.043	0.99		0.007	0.02	0	0.05	1.01		0.37	0.37		0.083	0.04		0.09	0.04
SUI210	1.31	0.98	0.02	0.007	0.02	0.07	1.317	1	0.37	0.37	0.37	0.04	0.044	0.04	0.05	0.04	0.04

Appendix G-2: Water nutrients chemistry results

Analyte	Total Ammonia (mg/L as N)			Unionized Ammonia (calculated, mg/L as N)			Chlorophyll-*a* (ug/L)			Pheophytin-*a* (ug/L)			
Season	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry
Arroyo las Positas													
ALP010	0.10	0.07	0.12	6.11E-03	6.68E-03	2.44E-04	1.7	3.1	3.9	5.4	2.2	5.7	1.59
ALP100	0.10	0.14	0.11	3.33E-03	3.26E-03	2.23E-04	7.4	9.8	5.3	6.9	8	5.3	0.48
ALP110	0.07	0.07	0.07	3.27E-03	2.53E-03	2.17E-04	1.7	3.7	3.1	4.3	2.5	4.4	6.59
ALP140	0.07	0.07	0.07	7.87E-03	1.86E-03	1.43E-04	3.3	2.6	1.9	3.3	2.8	1.9	0.35
Pescadero/Butano Creeks													
BUT010	0.41	0.07	0.05	1.10E-02	1.27E-03	3.16E-04	4.6	3.6	0.567	1.9	1.25		0.728
BUT020	0.49	0.07	0.05	1.49E-02	1.79E-03	3.44E-04	1.25	1.25	0.17	1.25	1.25		0.286
PES050	0.56	0.07	ND	1.60E-02	2.06E-03	ND	1.5	0.9	0.27	1.5	0.9		0.331
PES070	0.48	0.07	ND	1.41E-02	2.99E-03	ND	1.25	0.9	0.12	1.25	0.9		0.15
PES140	0.07	0.07	ND	4.51E-03	4.28E-03	ND	1.25	0.9	0.08	1.25	0.9		0.106
PES190	0.07	0.07	0.05	4.15E-03	3.28E-03	6.89E-04	1.25	0.75	ND	1.25	0.75		0.123
San Gregorio Creek													
SGR010	0.07	0.07	ND	3.89E-03	2.86E-03	ND	1.25	2.8	0.18	1.25	0.9		0.241
SGR040	0.07	0.07	ND	6.41E-03	3.68E-03	ND	1.25	1.4	0.15	1.25	1.5		0.107
SGR080	0.07	0.07	ND	3.17E-03	4.65E-03	ND	1.25	1.2	0.25	1.25	1.2		0.131
SGR090	0.07	0.07	ND	4.37E-03	4.36E-03	ND	1.25	2.3	0.08	1.25	2.3		0.202
Stevens/Permanente Creeks													
PER010	0.07	0.07	0.06	1.85E-03	1.61E-02	7.31E-04	1.25	22	4.5	2	4.9		0.879
PER070	0.07	0.07	ND	3.21E-03	3.61E-03	ND	1.25	1.4	0.5	1.25	0.75		0.929
STE020	0.07	0.07	ND	1.70E-03	4.39E-03	ND	4.9	6.7	4.1	2.1	3.3		2.55
STE060	0.07	0.07	ND	6.07E-03	3.13E-03	ND	6	2	1.95	1.25	1.4		0.276
STE100	0.07	0.07	ND	4.81E-03	4.34E-03	ND	1.25	1.1	0.08	1.25	0.75		0.187

Appendix G-2: Water nutrients chemistry results

	Nitrate (mg/L N)		Nitrite (mg/L N)			Nitrate + Nitrite (calculated, mg/L N)			Total Kjeldahl Nitrogen (mg/L)			Orthophosphate as P (mg/L)			Phosphorus, Total as P (mg/L)		
	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet	Dry	Spring	Wet
Arroyo las Positas																	
ALP010	4.39	5.56	0.02	0.037	0.03	1.61	4.427	5.59	0.37	0.52	0.75	0.17	0.023	0.04	0.047	0.05	0.04
ALP100	4.1	5	0.03	0.12	0.03	0.51	4.22	5.03	0.55	0.72	0.54	0.17	0.092	0.07	0.132	0.14	0.11
ALP110	8.04	6.61	0.02	0.049	0.03	6.61	8.089	6.64	0.37	0.37	0.37	0.17	0.076	0.06	0.094	0.09	0.08
ALP140	2.86	2.94	0.02	0.013	0.02	0.37	2.873	2.96	0.65	0.37	0.37	0.17	0.038	0.04	0.134	0.07	0.05
Pescadero/Butano Creeks																	
BUT010	0.484	0.574	0.007	0.007	0	0.735	0.491	0.574	0.37	0.37	0.18	0.04	0.02	0.019	0.068	0.06	0.081
BUT020	0.268	0.314	0.007	0.007	0	0.293	0.275	0.314	0.37	0.37	0.22	0.025	0.023	0.0242	0.04	0.04	0.033
PES050	0.265	0.291	0.007	0.007	0	0.338	0.272	0.291	0.37	0.37	0.21	0.107	0.092	0.08	0.14	0.1	0.115
PES070	0.145	0.178	0.007	0.007	0	0.157	0.152	0.178	0.37	0.37	0.15	0.104	0.096	0.0898	0.12	0.1	0.0896
PES140	0.132	0.0997	0.007	0.007	0	0.113	0.139	0.0997	0.37	0.37	0	0.146	0.125	0.0974	0.13	0.12	0.0876
PES190	0.094	0.154	0.007	0.007	0	0.13	0.101	0.154	0.37	0.37	0.23	0.118	0.092	0.15	0.11	0.09	0.173
San Gregorio Creek																	
SGR010	0.137	0.229	0.007	0.007	0	0.248	0.144	0.229	0.37	0.37	0.27	0.165	0.128	0.127	0.14	0.12	0.131
SGR040	0.059	0.175	0.007	0.007	0.0051	0.114	0.066	0.1801	0.37	0.37	0.17	0.204	0.149	0.143	0.18	0.14	0.131
SGR080	0.127	0.186	0.007	0.007	0	0.138	0.134	0.186	0.37	0.37	0.26	0.175	0.132	0.112	0.15	0.14	0.109
SGR090	0.13	0.21	0.007	0.007	0	0.209	0.137	0.21	0.37	0.37	0.28	0.221	0.178	0.146	0.19	0.17	0.165
Stevens/Permanente Creeks																	
PER010	0.218	1.27	0.06	0.007	0.0141	0.939	0.225	1.2841	0.37	0.37	0.72	0.334	0.074	0.167	0.31	0.1	0.262
PER070	1.54	2.11	0.007	0.007	0.0207	0.936	1.547	2.1307	0.37	0.37	0	0.025	0.012	0.014	0.04	0.04	0.056
STE020	3	1.26	0.04	0.02	0.0074	2.59	3.02	1.2674	0.37	0.37	0	0.272	0.145	0.0646	0.52	0.32	0.186
STE060	0.373	0.688	0.007	0.007	0.0057	0.283	0.38	0.6937	0.37	0.37	0.22	0.062	0.036	0.0296	0.05	0.05	0.066
STE100	0.042	0.115	0.007	0.007	0	0.194	0.049	0.115	0.37	0.37	0	0.085	0.065	0.062	0.07	0.06	0.081

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
201LAG130	Dry	1	81.6	cadmium	ND	ND	3.118223372		0.966877315		Total
201LAG270	Dry	1	221	cadmium	ND	ND	9.593900455		2.114117258		Total
204ALP010	Dry	1	304	cadmium	0.012	0.011	13.74681619	0.000872929	2.715592472	0.004418925	Total
204ALP100	Dry	1	207	cadmium	0.018	0.014	8.911181164	0.002019934	2.008224095	0.008963143	Total
204ALP110	Dry	1	422	cadmium	0.01	0.011	19.90092065	0.000502489	3.513238187	0.002846377	Total
204SLE030	Dry	1	245	cadmium	0.023	0.019	10.77705419	0.002134164	2.292373966	0.010033267	Total
204SLE230	Dry	1	199	cadmium	ND	ND	8.523677186		1.947025743		Total
206SPA020	Dry	1	462	cadmium	0.088	0.05	22.04128305	0.003992508	3.772151591	0.023328861	Total
206SPA070	Dry	1	449	cadmium	0.087	0.051	21.34295732	0.004076286	3.688553484	0.023586482	Total
206SPA200	Dry	1	398	cadmium	0.065	0.039	18.62896937	0.003489189	3.355370225	0.019371931	Total
206SPA220	Dry	1	318	cadmium	0.016	0.01	14.46300428	0.001106271	2.813312869	0.005687245	Total
206WIL020	Dry	1	323	cadmium	0.074	0.011	14.71977489	0.005027251	2.847987499	0.02598326	Total
207SUI010	Dry	1	175	cadmium	ND	ND	7.373397412		1.760134007		Total
207SUI020	Dry	1	202	cadmium	ND	ND	8.668761769		1.970035959		Total
207SUI060	Dry	1	188	cadmium	ND	ND	7.9941221		1.86200568		Total
207SUI110	Dry	1	232	cadmium	0.012	0.004	10.13423965	0.001184105	2.196308912	0.005463712	Total
201LAG040	Spring	1	91.9	cadmium	0.08	0.05	3.565665674	0.022436203	1.06146969	0.075367201	Total
201LAG130	Spring	1	91.9	cadmium	ND	ND	3.565665674		1.06146969		Total
201LAG270	Spring	1	194	cadmium	ND	ND	8.282492945		1.908508843		Total
204ALP010	Spring	1	408	cadmium	0.02	0.02	19.15778907	0.001043962	3.421390288	0.005845577	Total
204ALP100	Spring	1	427	cadmium	0.02	0.02	20.16709603	0.000991714	3.545881564	0.005640346	Total
204ALP110	Spring	1	412	cadmium	0.02	0.02	19.36978423	0.001032536	3.447700661	0.005800968	Total
204SLE030	Spring	1	258	cadmium	0.02	0.02	11.4242514	0.001750662	2.387349766	0.008377491	Total
204SLE230	Spring	1	217	cadmium	ND	ND	9.398256702		2.084013084		Total
206SPA020	Spring	1	513	cadmium	0.05	0.03	24.80465044	0.002015751	4.095400823	0.012208817	Total
206SPA070	Spring	1	584	cadmium	0.05	0.03	28.7100808	0.001741549	4.53418907	0.01102733	Total
206SPA200	Spring	1	481	cadmium	0.02	0.01	23.06642924	0.000867061	3.893431804	0.005136856	Total
206SPA220	Spring	1	320	cadmium	0.01	0.01	14.56565097	0.000686547	2.827196673	0.003537073	Total
206WIL020	Spring	1	287	cadmium	ND	0.02	12.88283673		2.595620069		Total
207SUI010	Spring	1	192	cadmium	ND	ND	8.186240685		1.893042581		Total
207SUI060	Spring	1	188	cadmium	ND	ND	7.9941221		1.86200568		Total
207SUI110	Spring	1	180	cadmium	ND	ND	7.611462447		1.799501567		Total
202BUT010	Dry	2	130	cadmium	0.034	0.021	5.272891375	0.006448075	1.393736194	0.02439486	Total
202PES050	Dry	2	257	cadmium	0.04	0.02	11.37431592	0.003516695	2.38008105	0.01680615	Total
202PES070	Dry	2	257	cadmium	0.03	0.021	11.37431592	0.002637521	2.38008105	0.012604613	Total
202SGR010	Dry	2	354	cadmium	0.023	0.019	16.32286553	0.001409066	3.06048052	0.00751516	Total
202SGR080	Dry	2	323	cadmium	0.02	0.018	14.71977489	0.001358716	2.847987499	0.007022503	Total
205PER010	Dry	2	707	cadmium	0.016	0.009	35.61769593	0.000449215	5.268371381	0.003036992	Total
205PER070	Dry	2	424	cadmium	0.074	0.071	20.00734263	0.003698642	3.526305453	0.020985136	Total
205STE020	Dry	2	495	cadmium	0.015	0.003	23.82513596	0.000629587	3.982137579	0.003766821	Total
205STE060	Dry	2	212	cadmium	0.006	0.014	9.154351297	0.000655426	2.046214586	0.002932244	Total
202BUT010	Spring	2	113	cadmium	0.02	ND	4.501872672	0.004442596	1.248502603	0.01601919	Total
202PES050	Spring	2	222	cadmium	0.01	ND	9.64288258	0.001037034	2.121624949	0.004713368	Total
202PES070	Spring	2	216	cadmium	0.02	0.01	9.349417518	0.002139171	2.076468482	0.009631738	Total
202SGR010	Spring	2	289	cadmium	0.02	ND	12.98414898	0.00154034	2.609812124	0.007663387	Total
202SGR080	Spring	2	168	cadmium	ND	0.01	7.041571493		1.704610292		Total
205PER010	Spring	2	337	cadmium	0.01	ND	15.44142056	0.000647609	2.94447083	0.003396196	Total
205PER070	Spring	2	498	cadmium	0.38	0.37	23.98807632	0.015841204	4.001075422	0.094974466	Total

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
205STE020	Spring	2	530	cadmium	ND	ND	25.73379898		4.201590002		Total
205STE060	Spring	2	232	cadmium	ND	ND	10.13423965		2.196308912		Total
202BUT010	Wet	2	120	cadmium	0.035	0.024	4.817671335	0.007264921	1.308836424	0.02674131	Total
202PES050	Wet	2	221	cadmium	0.03	0.021	9.593900455	0.003126987	2.114117258	0.01419032	Total
202PES070	Wet	2	202	cadmium	0.031	0.021	8.668761769	0.003576059	1.970035959	0.015735753	Total
202SGR010	Wet	2	272	cadmium	0.028	0.019	12.12591297	0.002309104	2.488489208	0.011251807	Total
202SGR080	Wet	2	299	cadmium	0.025	0.026	13.49204633	0.001852944	2.680459658	0.009326759	Total
205PER010	Wet	2	784	cadmium	0.044	0.023	40.02296342	0.001099369	5.713855203	0.00770058	Total
205PER070	Wet	2	533	cadmium	0.95	1	25.89816629	0.036682134	4.220252761	0.225105001	Total
205STE020	Wet	2	345	cadmium	0.139	0.145	15.85552631	0.008766659	2.999216465	0.046345438	Total
205STE060	Wet	2	290	cadmium	0.181	0.179	13.03483881	0.013885864	2.616900234	0.069165801	Total
201LAG130	Dry	1	81.6	copper	0.929	0.796	11.55829696	0.068868277	7.840974337	0.101517996	Dissolved
201LAG270	Dry	1	221	copper	1.44	1.17	29.55192535	0.039591329	18.37020444	0.063690091	Dissolved
204ALP010	Dry	1	304	copper	2.1	1.64	39.90826719	0.041094242	24.12383054	0.06798257	Dissolved
204ALP100	Dry	1	207	copper	2.5	1.54	27.78475939	0.055426069	17.37110526	0.088652966	Dissolved
204ALP110	Dry	1	422	copper	1.25	0.902	54.35866372	0.016593491	31.92715945	0.028251809	Dissolved
204SLE030	Dry	1	245	copper	1.07	0.688	32.56654342	0.021125976	20.0619531	0.03429377	Dissolved
204SLE230	Dry	1	199	copper	0.774	0.826	26.77187258	0.030853277	16.79580197	0.049178956	Dissolved
206SPA020	Dry	1	462	copper	4.32	3.74	59.20045575	0.063175189	34.49589045	0.108418712	Dissolved
206SPA070	Dry	1	449	copper	4.17	3.13	57.6296369	0.054312332	33.66474198	0.092975612	Dissolved
206SPA200	Dry	1	398	copper	3.85	3.12	51.44097734	0.060652036	30.36902694	0.102736252	Dissolved
206SPA220	Dry	1	318	copper	2.74	2	41.63765028	0.04803345	25.07002493	0.079776546	Dissolved
206WIL020	Dry	1	323	copper	5.74	0.78	42.25421106	0.018459699	25.40647112	0.03070084	Dissolved
207SUI010	Dry	1	175	copper	6.65	6.77	23.71864256	0.285429488	15.04897097	0.449864646	Dissolved
207SUI020	Dry	1	202	copper	2.43	2.15	27.151976	0.079183924	17.01192804	0.126381912	Dissolved
207SUI060	Dry	1	188	copper	1.05	0.893	25.37528369	0.035191725	15.99921498	0.055815239	Dissolved
207SUI110	Dry	1	232	copper	1.07	0.98	30.93585761	0.031678449	19.1487432	0.051178294	Dissolved
201LAG040	Spring	1	91.9	copper	0.88	0.78	12.92811646	0.060333615	8.679283937	0.089869165	Dissolved
201LAG130	Spring	1	91.9	copper	1.54	1.29	12.92811646	0.099782517	8.679283937	0.148629773	Dissolved
201LAG270	Spring	1	194	copper	1.13	0.95	26.13762788	0.036346068	16.43453309	0.05780511	Dissolved
204ALP010	Spring	1	408	copper	2.69	2.3	52.65788193	0.043678172	31.01986484	0.074146036	Dissolved
204ALP100	Spring	1	427	copper	2.87	2.27	54.96529012	0.04129879	32.25012565	0.070387323	Dissolved
204ALP110	Spring	1	412	copper	1.43	1.29	53.14415887	0.024273599	31.27954758	0.041241006	Dissolved
204SLE030	Spring	1	258	copper	1.47	1.36	34.19223327	0.039775115	20.96813628	0.064860319	Dissolved
204SLE230	Spring	1	217	copper	1.31	0.76	29.04769942	0.026163862	18.08571298	0.04202212	Dissolved
206SPA020	Spring	1	513	copper	2.13	1.68	65.33892158	0.025712086	37.7247248	0.044533128	Dissolved
206SPA070	Spring	1	584	copper	2.44	1.96	73.82671855	0.026548654	42.14349698	0.046507768	Dissolved
206SPA200	Spring	1	481	copper	2.26	2.07	61.49169604	0.033663082	35.70456609	0.057975778	Dissolved
206SPA220	Spring	1	320	copper	1.83	1.62	41.88434135	0.038677939	25.20469511	0.064273739	Dissolved
206WIL020	Spring	1	287	copper	0.05	1.88	37.80208061	0.049732712	22.96629149	0.081859102	Dissolved
207SUI010	Spring	1	192	copper	1.77	1.56	25.88366668	0.060269668	16.2896477	0.095766344	Dissolved
207SUI060	Spring	1	188	copper	1.49	1.33	25.37528369	0.052413207	15.99921498	0.083129079	Dissolved
207SUI110	Spring	1	180	copper	1.34	1.1	24.35662642	0.045162248	15.41562536	0.071356171	Dissolved
202BUT010	Dry	2	130	copper	1.01	0.85	17.92490272	0.047420062	11.67334675	0.07281545	Dissolved
202PES050	Dry	2	257	copper	1.59	1.27	34.06735135	0.037279094	20.89866987	0.060769418	Dissolved
202PES070	Dry	2	257	copper	1.4	1.23	34.06735135	0.036104949	20.89866987	0.05885542	Dissolved
202SGR010	Dry	2	354	copper	1.67	1.59	46.06491289	0.034516509	27.47603616	0.057868609	Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
202SGR080	Dry	2	323	copper	1.69	1.66	42.25421106	0.039286025	25.40647112	0.065337685	Dissolved
205PER010	Dry	2	707	copper	2.89	2.4	88.39391155	0.027151191	49.62033373	0.048367268	Dissolved
205PER070	Dry	2	424	copper	1.85	1.74	54.60136386	0.031867336	32.05641238	0.054279312	Dissolved
205STE020	Dry	2	495	copper	1.69	1.54	63.17662176	0.024376106	36.59071824	0.042087176	Dissolved
205STE060	Dry	2	212	copper	1.29	1.1	28.41665986	0.038709687	17.72902225	0.062045159	Dissolved
202BUT010	Spring	2	113	copper	1.11	0.76	15.70760206	0.048384215	10.3558636	0.073388375	Dissolved
202PES050	Spring	2	222	copper	1.2	1.01	29.67789905	0.034032059	18.44120979	0.054768641	Dissolved
202PES070	Spring	2	216	copper	1.13	1	28.92155936	0.034576282	18.01447136	0.055510927	Dissolved
202SGR010	Spring	2	289	copper	1.28	1.19	38.05023367	0.031274447	23.1029798	0.051508507	Dissolved
202SGR080	Spring	2	168	copper	1.28	1.24	22.82368611	0.054329524	14.53307695	0.085322606	Dissolved
205PER010	Spring	2	337	copper	2.97	2.58	43.9776758	0.058666129	26.34453529	0.097933024	Dissolved
205PER070	Spring	2	498	copper	1.69	1.55	63.53731636	0.024395113	36.78013045	0.042142319	Dissolved
205STE020	Spring	2	530	copper	1.33	1.22	67.37706752	0.018107051	38.79042361	0.031451062	Dissolved
205STE060	Spring	2	232	copper	1.36	1.07	30.93585761	0.034587695	19.1487432	0.055878341	Dissolved
202BUT010	Wet	2	120	copper	0.96	0.647	16.62279124	0.038922464	10.90162319	0.05934896	Dissolved
202PES050	Wet	2	221	copper	1.17	1.01	29.55192535	0.03417713	18.37020444	0.054980335	Dissolved
202PES070	Wet	2	202	copper	1.16	0.977	27.151976	0.035982648	17.01192804	0.057430292	Dissolved
202SGR010	Wet	2	272	copper	1.54	1.32	35.93769364	0.036730237	21.93663051	0.060173325	Dissolved
202SGR080	Wet	2	299	copper	1.49	1.41	39.28952464	0.035887428	23.7843793	0.059282607	Dissolved
205PER010	Wet	2	784	copper	3.84	2.33	97.43701595	0.023912883	54.20306778	0.042986497	Dissolved
205PER070	Wet	2	533	copper	2.26	1.68	67.73634474	0.024802047	38.97796775	0.043101272	Dissolved
205STE020	Wet	2	345	copper	1.98	1.45	44.96064492	0.032250427	26.87801603	0.053947434	Dissolved
205STE060	Wet	2	290	copper	1.93	1.4	38.17427295	0.036673914	23.17127231	0.060419643	Dissolved
201LAG130	Dry	1	81.6	lead	0.062	0.015	63.02482211	0.000238001	2.455986836	0.006107525	Dissolved
201LAG270	Dry	1	221	lead	0.076	ND	224.0481802		8.73083593		Dissolved
204ALP010	Dry	1	304	lead	0.247	0.053	336.2235493	0.000157633	13.10214902	0.004045138	Dissolved
204ALP100	Dry	1	207	lead	0.513	0.043	206.1390671	0.000208597	8.032943501	0.005352957	Dissolved
204ALP110	Dry	1	422	lead	0.14	0.049	510.4495279	9.59938E-05	19.89148528	0.002463366	Dissolved
204SLE030	Dry	1	245	lead	0.483	0.107	255.4691611	0.000418837	9.955266444	0.01074808	Dissolved
204SLE230	Dry	1	199	lead	0.074	0.021	196.0514337	0.000107115	7.639842913	0.002748748	Dissolved
206SPA020	Dry	1	462	lead	0.832	0.13	572.8214751	0.000226947	22.32203052	0.005823843	Dissolved
206SPA070	Dry	1	449	lead	0.949	0.088	552.3821658	0.00015931	21.52553998	0.004088167	Dissolved
206SPA200	Dry	1	398	lead	0.504	0.021	473.7848912	4.43239E-05	18.46271703	0.001137427	Dissolved
206SPA220	Dry	1	318	lead	0.361	0.11	356.0572065	0.000308939	13.87503817	0.007927906	Dissolved
206WIL020	Dry	1	323	lead	3.61	0.086	363.1991867	0.000236785	14.15335088	0.0060763	Dissolved
207SUI010	Dry	1	175	lead	0.239	0.237	166.4629138	0.001423741	6.48682077	0.036535617	Dissolved
207SUI020	Dry	1	202	lead	0.053	0.003	199.8215621	1.50134E-05	7.786759403	0.000385269	Dissolved
207SUI060	Dry	1	188	lead	0.062	0.023	182.361434	0.000126123	7.106363276	0.003236536	Dissolved
207SUI110	Dry	1	232	lead	0.044	0.006	238.3396302	2.51742E-05	9.287753219	0.000646012	Dissolved
201LAG040	Spring	1	91.9	lead	0.03	ND	73.32139217		2.85722939		Dissolved
201LAG130	Spring	1	91.9	lead	0.09	ND	73.32139217		2.85722939		Dissolved
201LAG270	Spring	1	194	lead	0.02	ND	189.8023821		7.396326341		Dissolved
204ALP010	Spring	1	408	lead	0.22	0.05	488.990525	0.000102251	19.05525874	0.002623948	Dissolved
204ALP100	Spring	1	427	lead	0.33	0.05	518.1610228	9.64951E-05	20.19199117	0.002476229	Dissolved
204ALP110	Spring	1	412	lead	0.05	0.02	495.1014662	4.03958E-05	19.29339335	0.001036624	Dissolved
204SLE030	Spring	1	258	lead	0.13	0.08	272.8487334	0.000293203	10.63252343	0.007524084	Dissolved
204SLE230	Spring	1	217	lead	0.32	ND	218.8987581		8.530170342		Dissolved
206SPA020	Spring	1	513	lead	0.38	0.05	654.4997157	7.63942E-05	25.50491429	0.001960407	Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
206SPA070	Spring	1	584	lead	0.31	0.02	771.9223416	2.59093E-05	30.08070545	0.000664878	Dissolved
206SPA200	Spring	1	481	lead	0.05	ND	602.9769888		23.49714759		Dissolved
206SPA220	Spring	1	320	lead	0.15	0.04	358.9103471	0.000111448	13.98622096	0.002859958	Dissolved
206WIL020	Spring	1	287	lead	ND	0.05	312.4738734	0.000160013	12.17665825	0.004106217	Dissolved
207SUI010	Spring	1	192	lead	0.06	0.02	187.3149844	0.000106772	7.299396026	0.002739953	Dissolved
207SUI060	Spring	1	188	lead	0.05	ND	182.361434		7.106363276		Dissolved
207SUI110	Spring	1	180	lead	0.12	0.02	172.5408588	0.000115915	6.723669561	0.002974566	Dissolved
202BUT010	Dry	2	130	lead	0.059	0.003	114.0197131	2.63112E-05	4.443184528	0.000675191	Dissolved
202PES050	Dry	2	257	lead	0.11	0.003	271.5031811	1.10496E-05	10.58008919	0.000283551	Dissolved
202PES070	Dry	2	257	lead	0.035	ND	271.5031811		10.58008919		Dissolved
202SGR010	Dry	2	354	lead	0.043	0.006	408.1419255	1.47008E-05	15.90470489	0.000377247	Dissolved
202SGR080	Dry	2	323	lead	0.022	0.006	363.1991867	1.65199E-05	14.15335088	0.000423928	Dissolved
205PER010	Dry	2	707	lead	0.423	0.084	984.5572401	8.53175E-05	38.36678217	0.002189394	Dissolved
205PER070	Dry	2	424	lead	0.019	0.008	513.5311494	1.55784E-05	20.01157165	0.000399769	Dissolved
205STE020	Dry	2	495	lead	0.142	0.076	625.406621	0.000121521	24.37119816	0.003118435	Dissolved
205STE060	Dry	2	212	lead	0.066	0.007	212.4983721	3.29414E-05	8.280756489	0.000845333	Dissolved
202BUT010	Spring	2	113	lead	0.15	ND	95.38913597		3.717177684		Dissolved
202PES050	Spring	2	222	lead	0.03	ND	225.3395345		8.781158154		Dissolved
202PES070	Spring	2	216	lead	0.02	ND	217.615428		8.480160809		Dissolved
202SGR010	Spring	2	289	lead	0.024	ND	315.2484865		12.28478094		Dissolved
202SGR080	Spring	2	168	lead	0.02	ND	158.0333593		6.158333134		Dissolved
205PER010	Spring	2	337	lead	0.55	0.25	383.3565785	0.000652134	14.9388555	0.016734883	Dissolved
205PER070	Spring	2	498	lead	ND	0.02	630.2357136	3.17342E-05	24.55938097	0.000814353	Dissolved
205STE020	Spring	2	530	lead	0.05	ND	682.2338102		26.58567214		Dissolved
205STE060	Spring	2	232	lead	0.1	ND	238.3396302		9.287753219		Dissolved
202BUT010	Wet	2	120	lead	0.124	0.01955	102.9740473	0.000189854	4.01275079	0.00487197	Dissolved
202PES050	Wet	2	221	lead	0.057	0.00247	224.0481802	1.10244E-05	8.73083593	0.000282905	Dissolved
202PES070	Wet	2	202	lead	0.063	0.00219	199.8215621	1.09598E-05	7.786759403	0.000281247	Dissolved
202SGR010	Wet	2	272	lead	0.056	0.00614	291.8342577	2.10393E-05	11.37236205	0.000539905	Dissolved
202SGR080	Wet	2	299	lead	0.056	0.00604	329.1997367	1.83475E-05	12.82844113	0.000470829	Dissolved
205PER010	Wet	2	784	lead	1.31	0.141	1123.037877	0.000125552	43.7631738	0.003221887	Dissolved
205PER070	Wet	2	533	lead	0.108	0.00478	687.1535484	6.95623E-06	26.77738728	0.000178509	Dissolved
205STE020	Wet	2	345	lead	0.165	0.03967	394.9787804	0.000100436	15.39175602	0.002577354	Dissolved
205STE060	Wet	2	290	lead	0.205	0.01514	316.6377623	4.78149E-05	12.33891902	0.001227012	Dissolved
201LAG130	Dry	1	81.6	nickel	1.03	0.648	395.0244081	0.001640405	43.91902316	0.014754427	Dissolved
201LAG270	Dry	1	221	nickel	3.92	2.98	917.6771547	0.003247329	102.0278327	0.029207716	Dissolved
204ALP010	Dry	1	304	nickel	1.92	1.19	1201.835722	0.000990152	133.6207329	0.008905804	Dissolved
204ALP100	Dry	1	207	nickel	1.63	0.948	868.2503538	0.001091851	96.53253474	0.009820523	Dissolved
204ALP110	Dry	1	422	nickel	0.723	0.174	1586.165101	0.000109699	176.350677	0.00098667	Dissolved
204SLE030	Dry	1	245	nickel	2.48	2.42	1001.310024	0.002416834	111.3261795	0.021737924	Dissolved
204SLE230	Dry	1	199	nickel	0.135	1.55	839.7765812	0.001845729	93.36680561	0.016601189	Dissolved
206SPA020	Dry	1	462	nickel	8.91	8.42	1712.462887	0.004916895	190.3925318	0.044224424	Dissolved
206SPA070	Dry	1	449	nickel	6.81	6.04	1671.608078	0.003613287	185.8502725	0.03249928	Dissolved
206SPA200	Dry	1	398	nickel	2.41	ND	1509.507015		167.8277904		Dissolved
206SPA220	Dry	1	318	nickel	0.985	0.616	1248.496704	0.000493393	138.8085256	0.004437768	Dissolved
206WIL020	Dry	1	323	nickel	16.6	8.12	1265.08408	0.006418546	140.6527189	0.057730843	Dissolved
207SUI010	Dry	1	175	nickel	1.03	0.88	753.2588552	0.001168257	83.74771895	0.010507749	Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
207SUI020	Dry	1	202	nickel	1.04	0.89	850.4745366	0.001046475	94.55620995	0.009412391	Dissolved
207SUI060	Dry	1	188	nickel	ND	ND	800.3346083		88.98162614		Dissolved
207SUI110	Dry	1	232	nickel	0.51	0.43	956.1739154	0.000449709	106.3079229	0.004044854	Dissolved
201LAG040	Spring	1	91.9	nickel	2.11	4.39	436.8164443	0.010049988	48.5654839	0.090393416	Dissolved
201LAG130	Spring	1	91.9	nickel	2.82	1.69	436.8164443	0.003868902	48.5654839	0.034798377	Dissolved
201LAG270	Spring	1	194	nickel	4.71	1.97	821.8911806	0.002396911	91.37829728	0.02155873	Dissolved
204ALP010	Spring	1	408	nickel	2.09	1.54	1541.532036	0.000999006	171.3883492	0.008985442	Dissolved
204ALP100	Spring	1	427	nickel	2.5	1.87	1602.049899	0.001167255	178.1167573	0.010498731	Dissolved
204ALP110	Spring	1	412	nickel	1.46	1.18	1554.308068	0.00075918	172.8087953	0.006828356	Dissolved
204SLE030	Spring	1	258	nickel	2.48	2.51	1046.078625	0.002399437	116.3035762	0.021581452	Dissolved
204SLE230	Spring	1	217	nickel	2.5	0.63	903.6057618	0.000697207	100.4633678	0.006270942	Dissolved
206SPA020	Spring	1	513	nickel	5.04	4.19	1871.084269	0.002239343	208.0281412	0.020141506	Dissolved
206SPA070	Spring	1	584	nickel	4.15	3.65	2087.946302	0.001748129	232.1389771	0.01572334	Dissolved
206SPA200	Spring	1	481	nickel	4.05	3.63	1771.8575	0.002048697	196.9960564	0.018426765	Dissolved
206SPA220	Spring	1	320	nickel	1.47	1.37	1255.13644	0.001091515	139.5467349	0.009817499	Dissolved
206WIL020	Spring	1	287	nickel	ND	3.65	1144.727567	0.003188532	127.2714179	0.028678866	Dissolved
207SUI010	Spring	1	192	nickel	0.71	0.47	814.7172208	0.000576887	90.58069263	0.005188744	Dissolved
207SUI060	Spring	1	188	nickel	0.52	0.48	800.3346083	0.000599749	88.98162614	0.005394372	Dissolved
207SUI110	Spring	1	180	nickel	1.38	0.94	771.4265752	0.001218522	85.7676157	0.010959848	Dissolved
202BUT010	Dry	2	130	nickel	3.05	2.78	585.7740559	0.004745857	65.12667015	0.042686045	Dissolved
202PES050	Dry	2	257	nickel	2.92	2.52	1042.647435	0.002416924	115.9220947	0.021738738	Dissolved
202PES070	Dry	2	257	nickel	2.42	2.09	1042.647435	0.002004513	115.9220947	0.01802935	Dissolved
202SGR010	Dry	2	354	nickel	2.43	2.22	1367.0702	0.001623911	151.9915897	0.014606071	Dissolved
202SGR080	Dry	2	323	nickel	2.31	2.28	1265.08408	0.001802252	140.6527189	0.016210138	Dissolved
205PER010	Dry	2	707	nickel	3.34	2.53	2454.386089	0.001030808	272.8799469	0.009271476	Dissolved
205PER070	Dry	2	424	nickel	2.17	1.6	1592.522479	0.001004695	177.0574937	0.009036613	Dissolved
205STE020	Dry	2	495	nickel	0.83	0.63	1815.390486	0.000347033	201.8360768	0.003121345	Dissolved
205STE060	Dry	2	212	nickel	1.32	1.29	885.9601644	0.001456047	98.50152087	0.013096244	Dissolved
202BUT010	Spring	2	113	nickel	3.09	2.63	520.2815434	0.005054955	57.84517788	0.045466193	Dissolved
202PES050	Spring	2	222	nickel	2.32	1.71	921.1888509	0.001856297	102.4182649	0.016696241	Dissolved
202PES070	Spring	2	216	nickel	1.67	1.53	900.0816963	0.001699846	100.0715603	0.015289059	Dissolved
202SGR010	Spring	2	289	nickel	2.2	2.14	1151.472662	0.00185849	128.0213412	0.016715963	Dissolved
202SGR080	Spring	2	168	nickel	2.29	2.23	727.6888308	0.003064497	80.90483008	0.027563249	Dissolved
205PER010	Spring	2	337	nickel	1.68	1.56	1311.320809	0.00118964	145.7933429	0.010700077	Dissolved
205PER070	Spring	2	498	nickel	8.71	7.86	1824.694154	0.004307571	202.8704636	0.038743935	Dissolved
205STE020	Spring	2	530	nickel	0.96	0.98	1923.408108	0.000509512	213.8455333	0.004582747	Dissolved
205STE060	Spring	2	232	nickel	1.06	0.51	956.1739154	0.000533376	106.3079229	0.004797385	Dissolved
202BUT010	Wet	2	120	nickel	3.42	3.06	547.4209208	0.005589848	60.86254826	0.050277224	Dissolved
202PES050	Wet	2	221	nickel	3.01	2.73	917.6771547	0.002974902	102.0278327	0.026757405	Dissolved
202PES070	Wet	2	202	nickel	3.09	2.9	850.4745366	0.003409861	94.55620995	0.030669588	Dissolved
202SGR010	Wet	2	272	nickel	3.96	3.48	1093.90435	0.003181265	121.6208657	0.028613511	Dissolved
202SGR080	Wet	2	299	nickel	3.96	3.72	1185.091497	0.003138998	131.759101	0.028233344	Dissolved
205PER010	Wet	2	784	nickel	5.03	4.08	2678.708438	0.001523122	297.8202246	0.01369954	Dissolved
205PER070	Wet	2	533	nickel	33.7	30.9	1932.614686	0.015988702	214.8691256	0.143808469	Dissolved
205STE020	Wet	2	345	nickel	3.55	2.49	1337.608473	0.001861531	148.7160193	0.016743321	Dissolved
205STE060	Wet	2	290	nickel	4.88	3.25	1154.842512	0.002814237	128.3960029	0.025312314	Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
201LAG130	Dry	1	81.6	silver	ND	ND	2.860928809				Dissolved
201LAG270	Dry	1	221	silver	ND	ND	15.87649711				Dissolved
204ALP010	Dry	1	304	silver	ND	ND	27.47530624				Dissolved
204ALP100	Dry	1	207	silver	ND	ND	14.18629453				Dissolved
204ALP110	Dry	1	422	silver	ND	ND	48.2989171				Dissolved
204SLE030	Dry	1	245	silver	ND	ND	18.95682684				Dissolved
204SLE230	Dry	1	199	silver	0.013	ND	13.25645096				Dissolved
206SPA020	Dry	1	462	silver	0.011	ND	56.43963233				Dissolved
206SPA070	Dry	1	449	silver	0.012	ND	53.73579575				Dissolved
206SPA200	Dry	1	398	silver	ND	ND	43.67157571				Dissolved
206SPA220	Dry	1	318	silver	0.03	ND	29.68756818				Dissolved
206WIL020	Dry	1	323	silver	0.009	ND	30.49497744				Dissolved
207SUI010	Dry	1	175	silver	0.02	ND	10.62736072				Dissolved
207SUI020	Dry	1	202	silver	ND	ND	13.60204895				Dissolved
207SUI060	Dry	1	188	silver	ND	ND	12.0213012				Dissolved
207SUI110	Dry	1	232	silver	ND	ND	17.25994121				Dissolved
201LAG040	Spring	1	91.9	silver	ND	ND	3.509963963				Dissolved
201LAG130	Spring	1	91.9	silver	ND	ND	3.509963963				Dissolved
201LAG270	Spring	1	194	silver	ND	ND	12.68875329				Dissolved
204ALP010	Spring	1	408	silver	ND	0.01	45.57592151	0.000219414			Dissolved
204ALP100	Spring	1	427	silver	ND	ND	49.2874016				Dissolved
204ALP110	Spring	1	412	silver	ND	0.08	46.34716666	0.001726103			Dissolved
204SLE030	Spring	1	258	silver	ND	ND	20.71981494				Dissolved
204SLE230	Spring	1	217	silver	ND	ND	15.38546832				Dissolved
206SPA020	Spring	1	513	silver	ND	ND	67.57745718				Dissolved
206SPA070	Spring	1	584	silver	ND	ND	84.45591569				Dissolved
206SPA200	Spring	1	481	silver	ND	ND	60.49082524				Dissolved
206SPA220	Spring	1	320	silver	ND	ND	30.00944342				Dissolved
206WIL020	Spring	1	287	silver	ND	ND	24.88609991				Dissolved
207SUI010	Spring	1	192	silver	ND	ND	12.46459269				Dissolved
207SUI060	Spring	1	188	silver	ND	0.01	12.0213012	0.000831857			Dissolved
207SUI110	Spring	1	180	silver	ND	ND	11.1549772				Dissolved
202BUT010	Dry	2	130	silver	0.011	ND	6.37356683				Dissolved
202PES050	Dry	2	257	silver	ND	ND	20.58187566				Dissolved
202PES070	Dry	2	257	silver	ND	ND	20.58187566				Dissolved
202SGR010	Dry	2	354	silver	ND	0.015	35.70142809	0.000420151			Dissolved
202SGR080	Dry	2	323	silver	ND	ND	30.49497744				Dissolved
205PER010	Dry	2	707	silver	ND	ND	117.3279195				Dissolved
205PER070	Dry	2	424	silver	ND	ND	48.69330484				Dissolved
205STE020	Dry	2	495	silver	ND	ND	63.5507851				Dissolved
205STE060	Dry	2	212	silver	ND	ND	14.78079041				Dissolved
202BUT010	Spring	2	113	silver	ND	ND	5.008352648				Dissolved
202PES050	Spring	2	222	silver	ND	ND	16.000262				Dissolved
202PES070	Spring	2	216	silver	ND	ND	15.26372138				Dissolved
202SGR010	Spring	2	289	silver	ND	ND	25.18513409				Dissolved
202SGR080	Spring	2	168	silver	ND	ND	9.906766857				Dissolved
205PER010	Spring	2	337	silver	ND	ND	32.80374351				Dissolved
205PER070	Spring	2	498	silver	ND	ND	64.21469846				Dissolved
205STE020	Spring	2	530	silver	ND	ND	71.47505097				Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
205STE060	Spring	2	232	silver	ND	ND	17.25994121				Dissolved
202BUT010	Wet	2	120	silver	ND	ND	5.553818991				Dissolved
202PES050	Wet	2	221	silver	ND	ND	15.87649711				Dissolved
202PES070	Wet	2	202	silver	ND	ND	13.60204895				Dissolved
202SGR010	Wet	2	272	silver	ND	ND	22.69125378				Dissolved
202SGR080	Wet	2	299	silver	ND	ND	26.7026536				Dissolved
205PER010	Wet	2	784	silver	ND	ND	140.1598441				Dissolved
205PER070	Wet	2	533	silver	ND	ND	72.17233852				Dissolved
205STE020	Wet	2	345	silver	ND	ND	34.15456996				Dissolved
205STE060	Wet	2	290	silver	ND	ND	25.33521151				Dissolved
201LAG130	Dry	1	81.6	zinc	0.37	0.097	100.8535973	0.00096179	100.8535973	0.00096179	Dissolved
201LAG270	Dry	1	221	zinc	0.694	0.511	234.5956179	0.002178216	234.5956179	0.002178216	Dissolved
204ALP010	Dry	1	304	zinc	2.57	1.28	307.3654933	0.004164423	307.3654933	0.004164423	Dissolved
204ALP100	Dry	1	207	zinc	3.59	1.02	221.9412336	0.004595811	221.9412336	0.004595811	Dissolved
204ALP110	Dry	1	422	zinc	3	2.18	405.8294521	0.005371715	405.8294521	0.005371715	Dissolved
204SLE030	Dry	1	245	zinc	3.99	2.29	256.0098913	0.008944967	256.0098913	0.008944967	Dissolved
204SLE230	Dry	1	199	zinc	0.728	0.49	214.6517995	0.002282767	214.6517995	0.002282767	Dissolved
206SPA020	Dry	1	462	zinc	9.96	7.52	438.1950506	0.017161307	438.1950506	0.017161307	Dissolved
206SPA070	Dry	1	449	zinc	9.86	5.74	427.7250116	0.013419837	427.7250116	0.013419837	Dissolved
206SPA200	Dry	1	398	zinc	3.42	1.26	386.1866431	0.003262671	386.1866431	0.003262671	Dissolved
206SPA220	Dry	1	318	zinc	2.68	1.28	319.3175738	0.004008549	319.3175738	0.004008549	Dissolved
206WIL020	Dry	1	323	zinc	18.2	0.67	323.5665506	0.002070671	323.5665506	0.002070671	Dissolved
207SUI010	Dry	1	175	zinc	1.27	1.08	192.505198	0.005610238	192.505198	0.005610238	Dissolved
207SUI020	Dry	1	202	zinc	0.57	0.26	217.3904879	0.001196004	217.3904879	0.001196004	Dissolved
207SUI060	Dry	1	188	zinc	0.854	2.3	204.5550792	0.011243915	204.5550792	0.011243915	Dissolved
207SUI110	Dry	1	232	zinc	1.01	0.6	244.4523922	0.002454466	244.4523922	0.002454466	Dissolved
201LAG040	Spring	1	91.9	zinc	0.39	0.3	111.5407486	0.0026896	111.5407486	0.0026896	Dissolved
201LAG130	Spring	1	91.9	zinc	0.59	1.58	111.5407486	0.014165227	111.5407486	0.014165227	Dissolved
201LAG270	Spring	1	194	zinc	0.66	0.87	210.0732371	0.004141413	210.0732371	0.004141413	Dissolved
204ALP010	Spring	1	408	zinc	2.89	1.86	394.3925278	0.004716114	394.3925278	0.004716114	Dissolved
204ALP100	Spring	1	427	zinc	4.07	0.16	409.8999454	0.000390339	409.8999454	0.000390339	Dissolved
204ALP110	Spring	1	412	zinc	2.32	1.99	397.6662493	0.005004196	397.6662493	0.005004196	Dissolved
204SLE030	Spring	1	258	zinc	1.74	1.23	267.4740778	0.004598576	267.4740778	0.004598576	Dissolved
204SLE230	Spring	1	217	zinc	1.47	ND	230.9929124		230.9929124		Dissolved
206SPA020	Spring	1	513	zinc	3.38	1.76	478.8491992	0.003675479	478.8491992	0.003675479	Dissolved
206SPA070	Spring	1	584	zinc	3.31	1.9	534.438735	0.003555132	534.438735	0.003555132	Dissolved
206SPA200	Spring	1	481	zinc	1.87	1.31	453.4170481	0.002889172	453.4170481	0.002889172	Dissolved
206SPA220	Spring	1	320	zinc	3.19	1.94	321.0183799	0.006043268	321.0183799	0.006043268	Dissolved
206WIL020	Spring	1	287	zinc	ND	ND	292.7383719		292.7383719		Dissolved
207SUI010	Spring	1	192	zinc	0.56	0.29	208.2367865	0.001392645	208.2367865	0.001392645	Dissolved
207SUI060	Spring	1	188	zinc	0.54	0.32	204.5550792	0.001564371	204.5550792	0.001564371	Dissolved
207SUI110	Spring	1	180	zinc	0.93	0.29	197.1554176	0.001470921	197.1554176	0.001470921	Dissolved
202BUT010	Dry	2	130	zinc	1.51	0.61	149.644419	0.00407633	149.644419	0.00407633	Dissolved
202PES050	Dry	2	257	zinc	1.49	0.57	266.5954036	0.002138071	266.5954036	0.002138071	Dissolved
202PES070	Dry	2	257	zinc	0.81	0.48	266.5954036	0.001800481	266.5954036	0.001800481	Dissolved
202SGR010	Dry	2	354	zinc	0.88	0.56	349.6928768	0.001601405	349.6928768	0.001601405	Dissolved
202SGR080	Dry	2	323	zinc	0.87	0.76	323.5665506	0.002348821	323.5665506	0.002348821	Dissolved

Appendix G-3: Concentrations of hardness-dependent metals in water

Station	Season	Year	Hardness (mg/L)	Metal Name	Total Metal (ug/L)	Dissolved Metal (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
205PER010	Dry	2	707	zinc	5.68	3.86	628.3901825	0.00614268	628.3901825	0.00614268	Dissolved
205PER070	Dry	2	424	zinc	1.88	1.25	407.4585284	0.003067797	407.4585284	0.003067797	Dissolved
205STE020	Dry	2	495	zinc	4.57	4.08	464.5744346	0.008782231	464.5744346	0.008782231	Dissolved
205STE060	Dry	2	212	zinc	1.09	0.44	226.4752235	0.001942817	226.4752235	0.001942817	Dissolved
202BUT010	Spring	2	113	zinc	1.86	0.25	132.8892001	0.001881266	132.8892001	0.001881266	Dissolved
202PES050	Spring	2	222	zinc	0.49	0.22	235.4947324	0.000934203	235.4947324	0.000934203	Dissolved
202PES070	Spring	2	216	zinc	0.55	0.32	230.0906576	0.001390756	230.0906576	0.001390756	Dissolved
202SGR010	Spring	2	289	zinc	0.7	0.4	294.4659371	0.001358391	294.4659371	0.001358391	Dissolved
202SGR080	Spring	2	168	zinc	0.82	0.56	185.9605733	0.003011391	185.9605733	0.003011391	Dissolved
205PER010	Spring	2	337	zinc	3.57	2.19	335.410873	0.006529305	335.410873	0.006529305	Dissolved
205PER070	Spring	2	498	zinc	1.42	1.11	466.9589934	0.002377082	466.9589934	0.002377082	Dissolved
205STE020	Spring	2	530	zinc	1.89	1.7	492.2608149	0.003453454	492.2608149	0.003453454	Dissolved
205STE060	Spring	2	232	zinc	1.34	0.31	244.4523922	0.001268141	244.4523922	0.001268141	Dissolved
202BUT010	Wet	2	120	zinc	2.03	1.06	139.8320072	0.007580525	139.8320072	0.007580525	Dissolved
202PES050	Wet	2	221	zinc	1.59	1.1	234.5956179	0.00468892	234.5956179	0.00468892	Dissolved
202PES070	Wet	2	202	zinc	1.5	0.949	217.3904879	0.004365416	217.3904879	0.004365416	Dissolved
202SGR010	Wet	2	272	zinc	1.51	0.947	279.7219547	0.003385505	279.7219547	0.003385505	Dissolved
202SGR080	Wet	2	299	zinc	1.98	1.52	303.0766791	0.005015232	303.0766791	0.005015232	Dissolved
205PER010	Wet	2	784	zinc	9.62	3.17	685.915034	0.004621564	685.915034	0.004621564	Dissolved
205PER070	Wet	2	533	zinc	5.27	2.64	494.6206983	0.005337423	494.6206983	0.005337423	Dissolved
205STE020	Wet	2	345	zinc	3.83	2.73	342.1451919	0.007979069	342.1451919	0.007979069	Dissolved
205STE060	Wet	2	290	zinc	2.46	0.986	295.3290345	0.003338649	295.3290345	0.003338649	Dissolved

Appendix G-4: Concentrations of non-hardness-dependent metals in water compared to acute and chronic water quality objectives (WQO's)

Station	Season	Year	Metal Name	Metal, Total (ug/L)	Metal, Dissolved (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
201LAG130	Dry	1	arsenic	0.439	0.327	340	0.000961765	150	0.00218	Dissolved
201LAG270	Dry	1	arsenic	0.854	0.737	340	0.002167647	150	0.004913333	Dissolved
204ALP010	Dry	1	arsenic	3.15	3.06	340	0.009	150	0.0204	Dissolved
204ALP100	Dry	1	arsenic	3.26	3	340	0.008823529	150	0.02	Dissolved
204ALP110	Dry	1	arsenic	2.2	1.96	340	0.005764706	150	0.013066667	Dissolved
204SLE030	Dry	1	arsenic	0.95	5.93	340	0.017441176	150	0.039533333	Dissolved
204SLE230	Dry	1	arsenic	1.45	1	340	0.002941176	150	0.006666667	Dissolved
206SPA020	Dry	1	arsenic	6.42	5.59	340	0.016441176	150	0.037266667	Dissolved
206SPA070	Dry	1	arsenic	7.5	6.6	340	0.019411765	150	0.044	Dissolved
206SPA200	Dry	1	arsenic	6.21	1.4	340	0.004117647	150	0.009333333	Dissolved
206SPA220	Dry	1	arsenic	3.44	2.93	340	0.008617647	150	0.019533333	Dissolved
206WIL020	Dry	1	arsenic	6.18	4.57	340	0.013441176	150	0.030466667	Dissolved
207SUI010	Dry	1	arsenic	1.41	1.21	340	0.003558824	150	0.008066667	Dissolved
207SUI020	Dry	1	arsenic	1.3	1.23	340	0.003617647	150	0.0082	Dissolved
207SUI060	Dry	1	arsenic	0.892	0.776	340	0.002282353	150	0.005173333	Dissolved
207SUI110	Dry	1	arsenic	0.77	0.77	340	0.002264706	150	0.005133333	Dissolved
201LAG040	Spring	1	arsenic	1.01	0.59	340	0.001735294	150	0.003933333	Dissolved
201LAG130	Spring	1	arsenic	0.47	0.46	340	0.001352941	150	0.003066667	Dissolved
201LAG270	Spring	1	arsenic	0.62	0.96	340	0.002823529	150	0.0064	Dissolved
204ALP010	Spring	1	arsenic	3.65	3.61	340	0.010617647	150	0.024066667	Dissolved
204ALP100	Spring	1	arsenic	4.69	4.49	340	0.013205882	150	0.029933333	Dissolved
204ALP110	Spring	1	arsenic	2.12	2.04	340	0.006	150	0.0136	Dissolved
204SLE030	Spring	1	arsenic	1.03	1.09	340	0.003205882	150	0.007266667	Dissolved
204SLE230	Spring	1	arsenic	1.05	0.98	340	0.002882353	150	0.006533333	Dissolved
206SPA020	Spring	1	arsenic	4.33	4.07	340	0.011970588	150	0.027133333	Dissolved
206SPA070	Spring	1	arsenic	4.7	4.37	340	0.012852941	150	0.029133333	Dissolved
206SPA200	Spring	1	arsenic	4	3.87	340	0.011382353	150	0.0258	Dissolved
206SPA220	Spring	1	arsenic	3.09	2.9	340	0.008529412	150	0.019333333	Dissolved
206WIL020	Spring	1	arsenic	0.12	2.4	340	0.007058824	150	0.016	Dissolved
207SUI010	Spring	1	arsenic	0.93	0.96	340	0.002823529	150	0.0064	Dissolved
207SUI060	Spring	1	arsenic	0.88	0.79	340	0.002323529	150	0.005266667	Dissolved
207SUI110	Spring	1	arsenic	0.96	1	340	0.002941176	150	0.006666667	Dissolved
202BUT010	Dry	2	arsenic	0.71	0.49	340	0.001441176	150	0.003266667	Dissolved
202PES050	Dry	2	arsenic	1.38	1.2	340	0.003529412	150	0.008	Dissolved
202PES070	Dry	2	arsenic	1.32	1.2	340	0.003529412	150	0.008	Dissolved
202SGR010	Dry	2	arsenic	1.62	1.66	340	0.004882353	150	0.011066667	Dissolved
202SGR080	Dry	2	arsenic	1.15	1.36	340	0.004	150	0.009066667	Dissolved
205PER010	Dry	2	arsenic	0.88	0.89	340	0.002617647	150	0.005933333	Dissolved
205PER070	Dry	2	arsenic	0.92	0.86	340	0.002529412	150	0.005733333	Dissolved
205STE020	Dry	2	arsenic	0.85	1.09	340	0.003205882	150	0.007266667	Dissolved
205STE060	Dry	2	arsenic	1.15	0.9	340	0.002647059	150	0.006	Dissolved
202BUT010	Spring	2	arsenic	0.42	0.41	340	0.001205882	150	0.002733333	Dissolved
202PES050	Spring	2	arsenic	0.99	0.9	340	0.002647059	150	0.006	Dissolved
202PES070	Spring	2	arsenic	0.66	0.71	340	0.002088235	150	0.004733333	Dissolved
202SGR010	Spring	2	arsenic	1.26	1.01	340	0.002970588	150	0.006733333	Dissolved

Appendix G-4: Concentrations of non-hardness-dependent metals in water compared to acute and chronic water quality objectives (WQO's)

Station	Season	Year	Metal Name	Metal, Total (ug/L)	Metal, Dissolved (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
202SGR080	Spring	2	arsenic	1.03	0.73	340	0.002147059	150	0.004866667	Dissolved
205PER010	Spring	2	arsenic	1.01	1.03	340	0.003029412	150	0.006866667	Dissolved
205PER070	Spring	2	arsenic	1	1.04	340	0.003058824	150	0.006933333	Dissolved
205STE020	Spring	2	arsenic	0.97	1.02	340	0.003	150	0.0068	Dissolved
205STE060	Spring	2	arsenic	0.89	0.93	340	0.002735294	150	0.0062	Dissolved
202BUT010	Wet	2	arsenic	0.667	0.52	340	0.001529412	150	0.003466667	Dissolved
202PES050	Wet	2	arsenic	0.883	0.747	340	0.002197059	150	0.00498	Dissolved
202PES070	Wet	2	arsenic	0.797	0.717	340	0.002108824	150	0.00478	Dissolved
202SGR010	Wet	2	arsenic	1.13	1.05	340	0.003088235	150	0.007	Dissolved
202SGR080	Wet	2	arsenic	0.895	0.889	340	0.002614706	150	0.005926667	Dissolved
205PER010	Wet	2	arsenic	1.54	1.58	340	0.004647059	150	0.010533333	Dissolved
205PER070	Wet	2	arsenic	1.95	1.94	340	0.005705882	150	0.012933333	Dissolved
205STE020	Wet	2	arsenic	1.05	1.09	340	0.003205882	150	0.007266667	Dissolved
205STE060	Wet	2	arsenic	1.08	1.12	340	0.003294118	150	0.007466667	Dissolved
201LAG130	Dry	1	chromium	1.81	0.58	16	0.03625	11	0.052727273	Dissolved
201LAG270	Dry	1	chromium	4.7	1.35	16	0.084375	11	0.122727273	Dissolved
204ALP010	Dry	1	chromium	3.57	2.1	16	0.13125	11	0.190909091	Dissolved
204ALP100	Dry	1	chromium	2.58	1.04	16	0.065	11	0.094545455	Dissolved
204ALP110	Dry	1	chromium	11.5	8.96	16	0.56	11	0.814545455	Dissolved
204SLE030	Dry	1	chromium	15.8	14.5	16	0.90625	11	1.318181818	Dissolved
204SLE230	Dry	1	chromium	1.44	1.01	16	0.063125	11	0.091818182	Dissolved
206SPA020	Dry	1	chromium	4.59	1.66	16	0.10375	11	0.150909091	Dissolved
206SPA070	Dry	1	chromium	4.58	1.8	16	0.1125	11	0.163636364	Dissolved
206SPA200	Dry	1	chromium	2.77	0.383	16	0.0239375	11	0.034818182	Dissolved
206SPA220	Dry	1	chromium	2.69	0.851	16	0.0531875	11	0.077363636	Dissolved
206WIL020	Dry	1	chromium	5.83	0.15	16	0.009375	11	0.013636364	Dissolved
207SUI010	Dry	1	chromium	3.47	1.21	16	0.075625	11	0.11	Dissolved
207SUI020	Dry	1	chromium	0.34	0.17	16	0.010625	11	0.015454545	Dissolved
207SUI060	Dry	1	chromium	3.02	0.806	16	0.050375	11	0.073272727	Dissolved
207SUI110	Dry	1	chromium	0.12	0.05	16	0.003125	11	0.004545455	Dissolved
201LAG040	Spring	1	chromium	0.32	0.23	16	0.014375	11	0.020909091	Dissolved
201LAG130	Spring	1	chromium	1.25	0.59	16	0.036875	11	0.053636364	Dissolved
201LAG270	Spring	1	chromium	2.65	2.33	16	0.145625	11	0.211818182	Dissolved
204ALP010	Spring	1	chromium	4.88	4.16	16	0.26	11	0.378181818	Dissolved
204ALP100	Spring	1	chromium	2.98	2.31	16	0.144375	11	0.21	Dissolved
204ALP110	Spring	1	chromium	9.38	8.93	16	0.558125	11	0.811818182	Dissolved
204SLE030	Spring	1	chromium	21.9	30.6	16	1.9125	11	2.781818182	Dissolved
204SLE230	Spring	1	chromium	1.37	0.16	16	0.01	11	0.014545455	Dissolved
206SPA020	Spring	1	chromium	0.84	0.3	16	0.01875	11	0.027272727	Dissolved
206SPA070	Spring	1	chromium	0.91	0.32	16	0.02	11	0.029090909	Dissolved
206SPA200	Spring	1	chromium	0.62	0.2	16	0.0125	11	0.018181818	Dissolved
206SPA220	Spring	1	chromium	0.63	0.3	16	0.01875	11	0.027272727	Dissolved
206WIL020	Spring	1	chromium	0.17	0.28	16	0.0175	11	0.025454545	Dissolved
207SUI010	Spring	1	chromium	0.18	0.07	16	0.004375	11	0.006363636	Dissolved
207SUI060	Spring	1	chromium	0.14	0.09	16	0.005625	11	0.008181818	Dissolved
207SUI110	Spring	1	chromium	0.42	0.17	16	0.010625	11	0.015454545	Dissolved

Appendix G-4: Concentrations of non-hardness-dependent metals in water compared to acute and chronic water quality objectives (WQO's)

Station	Season	Year	Metal Name	Metal, Total (ug/L)	Metal, Dissolved (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
202BUT010	Dry	2	chromium	0.17	-0.03	16	-0.001875	11	-0.002727273	Dissolved
202PES050	Dry	2	chromium	0.32	0.12	16	0.0075	11	0.010909091	Dissolved
202PES070	Dry	2	chromium	0.14	0.05	16	0.003125	11	0.004545455	Dissolved
202SGR010	Dry	2	chromium	0.27	0.13	16	0.008125	11	0.011818182	Dissolved
202SGR080	Dry	2	chromium	0.21	0.22	16	0.01375	11	0.02	Dissolved
205PER010	Dry	2	chromium	0.45	0.25	16	0.015625	11	0.022727273	Dissolved
205PER070	Dry	2	chromium	0.87	0.46	16	0.02875	11	0.041818182	Dissolved
205STE020	Dry	2	chromium	0.47	0.06	16	0.00375	11	0.005454545	Dissolved
205STE060	Dry	2	chromium	0.32	0.33	16	0.020625	11	0.03	Dissolved
202BUT010	Spring	2	chromium	0.24	0.06	16	0.00375	11	0.005454545	Dissolved
202PES050	Spring	2	chromium	0.23	0.1	16	0.00625	11	0.009090909	Dissolved
202PES070	Spring	2	chromium	0.08	0.08	16	0.005	11	0.007272727	Dissolved
202SGR010	Spring	2	chromium	0.22	0.09	16	0.005625	11	0.008181818	Dissolved
202SGR080	Spring	2	chromium	0.2	0.14	16	0.00875	11	0.012727273	Dissolved
205PER010	Spring	2	chromium	0.52	0.35	16	0.021875	11	0.031818182	Dissolved
205PER070	Spring	2	chromium	2.72	2.31	16	0.144375	11	0.21	Dissolved
205STE020	Spring	2	chromium	0.47	0.44	16	0.0275	11	0.04	Dissolved
205STE060	Spring	2	chromium	0.45	0.19	16	0.011875	11	0.017272727	Dissolved
202BUT010	Wet	2	chromium	0.087	-0.03	16	-0.001875	11	-0.002727273	Dissolved
202PES050	Wet	2	chromium	0.085	-0.03	16	-0.001875	11	-0.002727273	Dissolved
202PES070	Wet	2	chromium	0.107	-0.03	16	-0.001875	11	-0.002727273	Dissolved
202SGR010	Wet	2	chromium	0.284	0.039	16	0.0024375	11	0.003545455	Dissolved
202SGR080	Wet	2	chromium	0.322	0.0511	16	0.00319375	11	0.004645455	Dissolved
205PER010	Wet	2	chromium	1.56	0.543	16	0.0339375	11	0.049363636	Dissolved
205PER070	Wet	2	chromium	8.12	6.8	16	0.425	11	0.618181818	Dissolved
205STE020	Wet	2	chromium	1.72	1.15	16	0.071875	11	0.104545455	Dissolved
205STE060	Wet	2	chromium	2.46	1.33	16	0.083125	11	0.120909091	Dissolved
201LAG130	Dry	1	mercury	0.00109		2.4	0.000454167	0.025	0.0436	Total
201LAG270	Dry	1	mercury	0.0000933		2.4	0.000038875	0.025	0.003732	Total
201WLK090	Dry	1	mercury	0.015		2.4	0.00625	0.025	0.6	Total
204ALP010	Dry	1	mercury	0.00304		2.4	0.001266667	0.025	0.1216	Total
204SLE030	Dry	1	mercury	0.00149		2.4	0.000620833	0.025	0.0596	Total
206SPA020	Dry	1	mercury	0.00581		2.4	0.002420833	0.025	0.2324	Total
206WIL020	Dry	1	mercury	0.0231		2.4	0.009625	0.025	0.924	Total
207SUI010	Dry	1	mercury	0.00099		2.4	0.0004125	0.025	0.0396	Total
207SUI020	Dry	1	mercury	0.00119		2.4	0.000495833	0.025	0.0476	Total
201LAG040	Spring	1	mercury	0.00129		2.4	0.0005375	0.025	0.0516	Total
201LAG130	Spring	1	mercury	0.0015		2.4	0.000625	0.025	0.06	Total
201WLK090	Spring	1	mercury	0.00463		2.4	0.001929167	0.025	0.1852	Total
204ALP010	Spring	1	mercury	0.00445		2.4	0.001854167	0.025	0.178	Total
204SLE030	Spring	1	mercury	0.00051		2.4	0.0002125	0.025	0.0204	Total
206SPA020	Spring	1	mercury	0.00224		2.4	0.000933333	0.025	0.0896	Total
206WIL020	Spring	1	mercury	0.00545		2.4	0.002270833	0.025	0.218	Total
207SUI010	Spring	1	mercury	0.00064		2.4	0.000266667	0.025	0.0256	Total

Appendix G-4: Concentrations of non-hardness-dependent metals in water compared to acute and chronic water quality objectives (WQO's)

Station	Season	Year	Metal Name	Metal, Total (ug/L)	Metal, Dissolved (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
202BUT010	Dry	2	mercury	0.00102		2.4	0.000425	0.025	0.0408	Total
202PES050	Dry	2	mercury	0.00176		2.4	0.000733333	0.025	0.0704	Total
202PES070	Dry	2	mercury	0.00157		2.4	0.000654167	0.025	0.0628	Total
202SGR010	Dry	2	mercury	0.000904		2.4	0.000376667	0.025	0.03616	Total
202SGR080	Dry	2	mercury	0.00061		2.4	0.000254167	0.025	0.0244	Total
205PER010	Dry	2	mercury	0.00192		2.4	0.0008	0.025	0.0768	Total
205PER070	Dry	2	mercury	0.0024		2.4	0.001	0.025	0.096	Total
205STE020	Dry	2	mercury	0.003		2.4	0.00125	0.025	0.12	Total
205STE060	Dry	2	mercury	0.00166		2.4	0.000691667	0.025	0.0664	Total
202BUT010	Spring	2	mercury	0.00098		2.4	0.000408333	0.025	0.0392	Total
202PES050	Spring	2	mercury	0.00077		2.4	0.000320833	0.025	0.0308	Total
202PES070	Spring	2	mercury	0.00096		2.4	0.0004	0.025	0.0384	Total
202SGR010	Spring	2	mercury	-0.00009		2.4	-0.0000375	0.025	-0.0036	Total
202SGR080	Spring	2	mercury	0.00068		2.4	0.000283333	0.025	0.0272	Total
205PER010	Spring	2	mercury	0.00207		2.4	0.0008625	0.025	0.0828	Total
205PER070	Spring	2	mercury	0.00137		2.4	0.000570833	0.025	0.0548	Total
205STE020	Spring	2	mercury	0.00062		2.4	0.000258333	0.025	0.0248	Total
205STE060	Spring	2	mercury	0.00131		2.4	0.000545833	0.025	0.0524	Total
202BUT010	Wet	2	mercury	0.00909		2.4	0.0037875	0.025	0.3636	Total
202PES050	Wet	2	mercury	0.00778		2.4	0.003241667	0.025	0.3112	Total
202PES070	Wet	2	mercury	0.0133		2.4	0.005541667	0.025	0.532	Total
202SGR010	Wet	2	mercury	0.0145		2.4	0.006041667	0.025	0.58	Total
202SGR080	Wet	2	mercury	0.0139		2.4	0.005791667	0.025	0.556	Total
205PER010	Wet	2	mercury	0.0125		2.4	0.005208333	0.025	0.5	Total
205PER070	Wet	2	mercury	0.0156		2.4	0.0065	0.025	0.624	Total
205STE020	Wet	2	mercury	0.011		2.4	0.004583333	0.025	0.44	Total
205STE060	Wet	2	mercury	0.0109		2.4	0.004541667	0.025	0.436	Total
201LAG130	Dry	1	selenium	-0.05	-0.05	20	-0.0025	5	-0.01	Total
201LAG270	Dry	1	selenium	0.232	0.291	20	0.0116	5	0.0464	Total
204ALP010	Dry	1	selenium	2.27	2.35	20	0.1135	5	0.454	Total
204ALP100	Dry	1	selenium	2.58	2.42	20	0.129	5	0.516	Total
204ALP110	Dry	1	selenium	2.56	2.19	20	0.128	5	0.512	Total
204SLE030	Dry	1	selenium	1.65	1.66	20	0.0825	5	0.33	Total
204SLE230	Dry	1	selenium	0.178	3.4	20	0.0089	5	0.0356	Total
206SPA020	Dry	1	selenium	1.6	1.53	20	0.08	5	0.32	Total
206SPA070	Dry	1	selenium	1.79	1.53	20	0.0895	5	0.358	Total
206SPA200	Dry	1	selenium	3.39	0.173	20	0.1695	5	0.678	Total
206SPA220	Dry	1	selenium	0.942	0.869	20	0.0471	5	0.1884	Total
206WIL020	Dry	1	selenium	1.33	1.11	20	0.0665	5	0.266	Total
207SUI010	Dry	1	selenium	0.318	0.165	20	0.0159	5	0.0636	Total
207SUI020	Dry	1	selenium	1.71	1.44	20	0.0855	5	0.342	Total
207SUI060	Dry	1	selenium	0.188	0.175	20	0.0094	5	0.0376	Total
207SUI110	Dry	1	selenium	0.63	0.64	20	0.0315	5	0.126	Total
201LAG040	Spring	1	selenium	1.08	0.66	20	0.054	5	0.216	Total
201LAG130	Spring	1	selenium	0.5	0.57	20	0.025	5	0.1	Total
201LAG270	Spring	1	selenium	0.68	1.17	20	0.034	5	0.136	Total

Appendix G-4: Concentrations of non-hardness-dependent metals in water compared to acute and chronic water quality objectives (WQO's)

Station	Season	Year	Metal Name	Metal, Total (ug/L)	Metal, Dissolved (ug/L)	Acute WQO (ug/L)	Acute Exceedance Factor	Chronic WQO (ug/L)	Chronic Exceedance Factor	WQO Fraction
204ALP010	Spring	1	selenium	5.13	5.13	20	0.2565	5	1.026	Total
204ALP100	Spring	1	selenium	8.6	8.58	20	0.43	5	1.72	Total
204ALP110	Spring	1	selenium	3.47	3.41	20	0.1735	5	0.694	Total
204SLE030	Spring	1	selenium	2.16	2.3	20	0.108	5	0.432	Total
204SLE230	Spring	1	selenium	0.62	0.57	20	0.031	5	0.124	Total
206SPA020	Spring	1	selenium	2.74	2.57	20	0.137	5	0.548	Total
206SPA070	Spring	1	selenium	3.14	2.78	20	0.157	5	0.628	Total
206SPA200	Spring	1	selenium	2.82	2.79	20	0.141	5	0.564	Total
206SPA220	Spring	1	selenium	1.37	1.2	20	0.0685	5	0.274	Total
206WIL020	Spring	1	selenium	0.39	1.41	20	0.0195	5	0.078	Total
207SUI010	Spring	1	selenium	0.9	1.04	20	0.045	5	0.18	Total
207SUI060	Spring	1	selenium	0.9	0.67	20	0.045	5	0.18	Total
207SUI110	Spring	1	selenium	0.85	0.95	20	0.0425	5	0.17	Total
202BUT010	Dry	2	selenium	0.96	0.83	20	0.048	5	0.192	Total
202PES050	Dry	2	selenium	1.56	1.45	20	0.078	5	0.312	Total
202PES070	Dry	2	selenium	1.46	1.49	20	0.073	5	0.292	Total
202SGR010	Dry	2	selenium	1.56	1.64	20	0.078	5	0.312	Total
202SGR080	Dry	2	selenium	1.02	1.79	20	0.051	5	0.204	Total
205PER010	Dry	2	selenium	1.97	2.06	20	0.0985	5	0.394	Total
205PER070	Dry	2	selenium	5.84	5.84	20	0.292	5	1.168	Total
205STE020	Dry	2	selenium	4.26	0.54	20	0.213	5	0.852	Total
205STE060	Dry	2	selenium	0.7	4.23	20	0.035	5	0.14	Total
202BUT010	Spring	2	selenium	0.04	0.7	20	0.002	5	0.008	Total
202PES050	Spring	2	selenium	1.37	1.26	20	0.0685	5	0.274	Total
202PES070	Spring	2	selenium	0.2	0.59	20	0.01	5	0.04	Total
202SGR010	Spring	2	selenium	1.3	0.63	20	0.065	5	0.26	Total
202SGR080	Spring	2	selenium	1.23	0.34	20	0.0615	5	0.246	Total
205PER010	Spring	2	selenium	1.74	1.83	20	0.087	5	0.348	Total
205PER070	Spring	2	selenium	10.3	5.09	20	0.515	5	2.06	Total
205STE020	Spring	2	selenium	4.92	10.1	20	0.246	5	0.984	Total
205STE060	Spring	2	selenium	0.59	0.72	20	0.0295	5	0.118	Total
202BUT010	Wet	2	selenium	0.791	1.11	20	0.03955	5	0.1582	Total
202PES050	Wet	2	selenium	1.22	1.16	20	0.061	5	0.244	Total
202PES070	Wet	2	selenium	1.12	1.16	20	0.056	5	0.224	Total
202SGR010	Wet	2	selenium	1.04	1.01	20	0.052	5	0.208	Total
202SGR080	Wet	2	selenium	0.901	0.981	20	0.04505	5	0.1802	Total
205PER010	Wet	2	selenium	3.9	3.95	20	0.195	5	0.78	Total
205PER070	Wet	2	selenium	18.7	18.8	20	0.935	5	3.74	Total
205STE020	Wet	2	selenium	4.71	4.9	20	0.2355	5	0.942	Total
205STE060	Wet	2	selenium	4.67	4.84	20	0.2335	5	0.934	Total

Appendix G-5: Organic analytes detected in water samples (detected values in bold font) ***Note: See Appendix G-6 for all organic analytes not detected.***

		Organic Carbon, Dissolved	Organic Carbon, Total	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene
Station ID	Season	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
201LAG130	Dry	**3.4**	**4**	-0.02	-0.02	**0.035**	-0.02	-0.02	-0.02
201LAG270	Dry	**2.8**	**5**	-0.02	**0.035**	**0.035**	-0.02	-0.02	-0.02
204SLE030	Dry	**5.1**	**7.7**	-0.02	**0.035**	-0.02	-0.02	-0.02	-0.02
206SPA020	Dry	**23.9**	**27.7**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
206WIL020	Dry	**17**	**58**	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02
207SUI010	Dry	-0.6	**3**	-0.02	-0.02	**0.035**	**0.035**	**0.035**	-0.02
207SUI020	Dry	**11.9**	**28**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
207SUI110	Dry	**19.8**	**24.7**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
204ALP010	Dry	**3.8**	**6.6**	-0.02	**0.035**	-0.02	-0.02	-0.02	-0.02
202BUT010	Dry	**10.9**	**11.8**	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02
202PES050	Dry	**18.4**	**19.3**	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02
202PES070	Dry	**10.2**	**11.1**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR010	Dry	**8.2**	**12.3**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR080	Dry	**5.5**	**6**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205PER010	Dry	**6.1**	**7.2**	-0.02	-0.02	-0.02	**0.035**	-0.02	**0.057**
205PER070	Dry	**1.4**	**2**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE020	Dry	**2.9**	**4.5**	-0.02	-0.02	-0.02	**0.035**	-0.02	**0.035**
205STE060	Dry	**3.3**	**3.4**	-0.02	-0.02	-0.02	-0.02	-0.02	**0.035**
201LAG040	Spring	**1.1**	**5**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
201LAG130	Spring	-1	-1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
204SLE030	Spring	**4.5**	**6.9**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
206SPA020	Spring	**11**	**21.2**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
206WIL020	Spring	**2.2**	**2.4**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
207SUI010	Spring	**3.5**	**8.5**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
204ALP010	Spring	**5.9**	**6.1**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202BUT010	Spring	**4.3**	**8.7**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES050	Spring	**2.4**	**4.4**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES070	Spring	**4.9**	**6.1**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR010	Spring	**3.1**	**5.1**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR080	Spring	-1	**4.1**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205PER010	Spring	**2.7**	**10.9**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205PER070	Spring	**5.1**	**12.9**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE020	Spring	**8.3**	**13.2**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE060	Spring	**6.1**	**8.3**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202BUT010	Wet	**0.5**	**2.6**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202PES050	Wet	**1.4**	**2.4**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202PES070	Wet	**1.3**	**2.4**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202SGR010	Wet	**1.7**	**3.1**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202SGR080	Wet	**1.6**	**2.7**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205PER010	Wet	**1.7**	**2.9**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205PER070	Wet	**0.7**	**0.9**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205STE020	Wet	**1.3**	**1.9**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205STE060	Wet	**1.4**	**2.4**	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025

Appendix G-5: Organic analytes detected in water samples (detected values in bold font)

		Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluorene	Methylnaphthalene, 1-	Naphthalene	Perylene	Phenanthrene	Pyrene
Station ID	Season	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
201LAG130	Dry	-0.02	**0.035**	-0.02	-0.02	-0.02	-0.02		-0.02	-0.02
201LAG270	Dry	-0.02	**0.035**	-0.02	-0.02	-0.02	-0.02		-0.02	-0.02
204SLE030	Dry	-0.02	**0.035**	-0.02	**0.035**	**0.043**	-0.02		-0.02	-0.02
206SPA020	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02		-0.02	-0.02
206WIL020	Dry	-0.02	-0.02	**0.035**	-0.02	-0.02	-0.02	**0.08**	**0.035**	-0.02
207SUI010	Dry	**0.035**	**0.035**	-0.02	-0.02	-0.02	-0.02		-0.02	-0.02
207SUI020	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
207SUI110	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
204ALP010	Dry	-0.02	-0.02	-0.02	-0.02	**0.045**	-0.02		-0.02	-0.02
202BUT010	Dry	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES050	Dry	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES070	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR010	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR080	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02
205PER010	Dry	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02	**0.12**	-0.02	**0.035**
205PER070	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE020	Dry	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02
205STE060	Dry	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02
201LAG040	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
201LAG130	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	**0.035**	-0.02	-0.02	-0.02
204SLE030	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
206SPA020	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
206WIL020	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
207SUI010	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
204ALP010	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202BUT010	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES050	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202PES070	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR010	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202SGR080	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205PER010	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205PER070	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE020	Spring	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
205STE060	Spring	-0.02	-0.02	**0.035**	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
202BUT010	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202PES050	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202PES070	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202SGR010	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
202SGR080	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205PER010	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205PER070	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205STE020	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
205STE060	Wet	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025

Appendix G-5: Organic analytes detected in water samples (detected values in bold font)

		Trimethylnaphthalene, 2,3,5-	Sum PAHs	PCB 005	PCB 018	PCB 101	Sum PCBs	Carbophenothion	Chlordene, gamma	Chlorpyrifos (ELISA)	Dacthal	DDE(p,p')	DDMU(p,p')
Station ID	**Season**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
201LAG130	Dry	-0.02	**0.07**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
201LAG270	Dry	-0.02	**0.105**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
204SLE030	Dry	-0.02	**0.07**	-0.001	**0.002**	**0.003**	**0.005**	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
206SPA020	Dry	-0.02	0	-0.001	-0.001	-0.001	0	**0.054**	-0.001	**0.079**	**0.005**	-0.001	-0.001
206WIL020	Dry	-0.02	**0.035**	-0.001	-0.001	-0.001	0	-0.03	**0.0015**	-0.05	-0.001	-0.001	-0.001
207SUI010	Dry	-0.02	**0.14**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
207SUI020	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	**0.002**	-0.001
207SUI110	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
204ALP010	Dry	**0.035**	**0.035**	**0.003**	-0.001	-0.001	**0.003**	-0.03	-0.001	-0.05	-0.001	-0.001	**0.002**
202BUT010	Dry	-0.02	**0.07**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202PES050	Dry	-0.02	**0.07**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202PES070	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202SGR010	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	**0.004**	-0.001	**0.0015**
202SGR080	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205PER010	Dry	-0.02	**0.07**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205PER070	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE020	Dry	-0.02	**0.07**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE060	Dry	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
201LAG040	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
201LAG130	Spring	-0.02	**0.035**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
204SLE030	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
206SPA020	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	**0.0015**	-0.001
206WIL020	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	**0.057**	-0.001	-0.001	-0.001
207SUI010	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
204ALP010	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	**0.0015**	-0.001
202BUT010	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	**0.0015**	**0.0015**
202PES050	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	**0.0015**
202PES070	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202SGR010	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	**0.0015**	-0.001	-0.001
202SGR080	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205PER010	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	**0.0015**	-0.001
205PER070	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE020	Spring	-0.02	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE060	Spring	-0.02	**0.035**	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202BUT010	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202PES050	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202PES070	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202SGR010	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
202SGR080	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205PER010	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205PER070	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE020	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001
205STE060	Wet	-0.025	0	-0.001	-0.001	-0.001	0	-0.03	-0.001	-0.05	-0.001	-0.001	-0.001

Appendix G-5: Organic analytes detected in water samples (detected values in bold font)

		DDT(p,p')	Diazinon (ELISA)	Diazinon (DFG)	Dieldrin	Dioxathion	Disulfoton	Endosulfan I	Fonofos (Dyfonate)	HCH, delta	HCH, gamma	Hexachlorobenzene	Mevinphos
Station ID	Season	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
201LAG130	Dry	-0.002	-0.03	**0.013**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	**0.002**	-0.0005	-0.03
201LAG270	Dry	-0.002	-0.03	**0.013**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
204SLE030	Dry	-0.002	-0.03	**0.013**	-0.001	-0.03	-0.01	**0.008**	-0.02	-0.001	-0.001	-0.0005	-0.03
206SPA020	Dry	-0.002	**0.174**	**0.12**	-0.001	**0.04**	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	**0.056**
206WIL020	Dry	-0.002	-0.03	**0.03**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
207SUI010	Dry	-0.002	-0.03	**0.013**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	**0.003**	-0.0005	-0.03
207SUI020	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
207SUI110	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
204ALP010	Dry	-0.002	**0.0383**	**0.03**	-0.001	-0.03	-0.01	**0.007**	-0.02	-0.001	-0.001	-0.0005	-0.03
202BUT010	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202PES050	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202PES070	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202SGR010	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	**0.03**	-0.001	-0.001	-0.0005	-0.03
202SGR080	Dry	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205PER010	Dry	-0.002	-0.03	**0.026**	**0.0015**	-0.03	**0.03**	-0.001	**0.03**	-0.001	-0.001	-0.0005	-0.03
205PER070	Dry	**0.0035**	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	**0.03**	-0.001	-0.001	-0.0005	-0.03
205STE020	Dry	-0.002	-0.03	**0.013**	**0.0015**	-0.03	-0.01	-0.001	**0.03**	-0.001	-0.001	-0.0005	-0.03
205STE060	Dry	-0.002	-0.03	-0.005	**0.0015**	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
201LAG040	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
201LAG130	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
204SLE030	Spring	-0.002	**0.096**	**0.118**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
206SPA020	Spring	-0.002	-0.03	**0.021**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
206WIL020	Spring	**0.0035**	-0.03	**0.013**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	**0.00075**	-0.03
207SUI010	Spring	-0.002	-0.03	**0.013**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
204ALP010	Spring	-0.002	-0.03	**0.02**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202BUT010	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	**0.0015**	**0.0015**	-0.0005	-0.03
202PES050	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202PES070	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202SGR010	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202SGR080	Spring	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205PER010	Spring	-0.002	-0.03	**0.013**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	**0.00075**	-0.03
205PER070	Spring	**0.0035**	-0.03	**0.013**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205STE020	Spring	-0.002	-0.03	**0.013**	-0.001	-0.03	**0.03**	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205STE060	Spring	-0.002	-0.03	**0.013**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202BUT010	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202PES050	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202PES070	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202SGR010	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
202SGR080	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205PER010	Wet	-0.002	-0.03	**0.01**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205PER070	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205STE020	Wet	-0.002	-0.03	**0.005**	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03
205STE060	Wet	-0.002	-0.03	-0.005	-0.001	-0.03	-0.01	-0.001	-0.02	-0.001	-0.001	-0.0005	-0.03

Appendix G-5: Organic analytes detected in water samples (detected values in bold font)

		Oxadiazon	Parathion, Methyl	Propazine	Secbumeton	Terbuthylazine	Thiobencarb
Station ID	**Season**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
201LAG130	Dry	-0.001	-0.01				-0.1
201LAG270	Dry	-0.001	-0.01				-0.1
204SLE030	Dry	-0.001	-0.01				-0.1
206SPA020	Dry	**0.018**	**0.03**				**0.21**
206WIL020	Dry	**0.033**	-0.01	**0.035**	**0.035**	-0.02	-0.1
207SUI010	Dry	-0.001	-0.01				-0.1
207SUI020	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
207SUI110	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
204ALP010	Dry	**0.005**	-0.01				-0.1
202BUT010	Dry	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
202PES050	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202PES070	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR010	Dry	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR080	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205PER010	Dry	**0.011**	-0.01	-0.02	-0.02	-0.02	-0.1
205PER070	Dry	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205STE020	Dry	**0.014**	-0.01	-0.02	-0.02	-0.02	-0.1
205STE060	Dry	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
201LAG040	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
201LAG130	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
204SLE030	Spring	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
206SPA020	Spring	**0.042**	-0.01	-0.02	-0.02	-0.02	-0.1
206WIL020	Spring	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
207SUI010	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
204ALP010	Spring	**0.062**	-0.01	-0.02	-0.02	-0.02	-0.1
202BUT010	Spring	-0.001	-0.01	-0.02	-0.02	**0.035**	-0.1
202PES050	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202PES070	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR010	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR080	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205PER010	Spring	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
205PER070	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205STE020	Spring	**0.0015**	-0.01	-0.02	-0.02	-0.02	-0.1
205STE060	Spring	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202BUT010	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202PES050	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202PES070	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR010	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
202SGR080	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205PER010	Wet	**0.009**	-0.01	-0.02	-0.02	-0.02	-0.1
205PER070	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205STE020	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1
205STE060	Wet	-0.001	-0.01	-0.02	-0.02	-0.02	-0.1

Appendix G-6: List of organic analytes not detected in chemical analysis of water samples

Acenaphthene
Acenaphthylene
Biphenyl
Chrysenes, C1-
Chrysenes, C2-
Chrysenes, C3
Dibenzothiophene
Dibenzothiophenes, C1-
Dibenzothiophenes, C2-
Dibenzothiophenes, C3-
Dimethylnaphthalene, 2,6-
Fluoranthene
Fluoranthene/Pyrenes, C1-
Fluorenes, C1-
Fluorenes, C2-
Fluorenes, C3-
Indeno(1,2,3-c,d)pyrene
Methylnaphthalene, 2-
Methylphenanthrene, 1-
Naphthalenes, C1-
Naphthalenes, C2-
Naphthalenes, C3-
Naphthalenes, C4-
Phenanthrene/Anthracene, C1-
Phenanthrene/Anthracene, C2-
Phenanthrene/Anthracene, C3-
Phenanthrene/Anthracene, C4-
PCB 008
PCB 015
PCB 027
PCB 028
PCB 029
PCB 031
PCB 033
PCB 044
PCB 049
PCB 052
PCB 056
PCB 060
PCB 066
PCB 070
PCB 074
PCB 087
PCB 095
PCB 097
PCB 099
PCB 105
PCB 110
PCB 114
PCB 118
PCB 128
PCB 137
PCB 138
PCB 141
PCB 149
PCB 151
PCB 153
PCB 156
PCB 157
PCB 158
PCB 170
PCB 174
PCB 177
PCB 180
PCB 183
PCB 187
PCB 189
PCB 194
PCB 195
PCB 200
PCB 201
PCB 203
PCB 206
PCB 209
Aldrin
Ametryn
Aspon
Atraton
Atrazine
Azinphos ethyl
Azinphos methyl
Bolstar
Chlordane, cis
Chlordane, trans
Chlordene, alpha
Chlorfenvinphos
Chlorpyrifos (DFG)
Chlorpyrifos methyl
Ciodrin(Crotoxyphos)
Coumaphos
DDD(o,p')
DDD(p,p')
DDE(o,p')
DDT(o,p')
Demeton-s
Dichlofenthion
Dichlorvos
Dicrotophos
Dimethoate
Endosulfan II
Endosulfan sulfate
Endrin
Endrin Aldehyde
Endrin Ketone
Ethion
Ethoprop
Famphur
Fenchlorphos
Fenitrothion
Fensulfothion
Fenthion
HCH, alpha
HCH, beta
Heptachlor
Heptachlor epoxide
Leptophos
Malathion
Merphos
Methidathion
Methoxychlor
Mirex
Molinate
Naled(Dibrom)
Nonachlor, cis
Nonachlor, trans
Oxychlordane
Parathion, Ethyl
Phorate
Phosmet
Phosphamidon
Prometon
Prometryn
Simazine
Simetryn
Tedion
Terbufos
Terbutryn
Tetrachlorvinphos
Thionazin
Tokuthion
Trichlorfon
Trichloronate

Appendix H: Sediment chemistry results

			Organic Carbon,Total	Fine-ASTM,Clay	Fine-ASTM,Silt	Sand-ASTM,Fine	Sand-ASTM,Medium	Sand-ASTM,Coarse	Gravel-ASTM
StationCode	StationName	SampleDate	%	%	%	%	%	%	%
201LAG270	Creamery Gulch	01/Oct/2001	0.6	1.3	2.11	15.16	78.47	2.96	0
201WLK090	Walker Creek	02/Oct/2001	1	11	21.48	33.07	22.96	10.03	1.46
204ALP010	El Charro	18/Sep/2001	0.85	16.5	36.65	36.5	7.94	2.41	0
204SLE030	Empire Road	19/Sep/2001	9.42	7	68.41	16.06	8.53	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	2.92	29	53.95	8.66	7.3	1.09	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0.45	4.25	3.63	63.22	11.61	12.16	5.13
206WIL020	Richmond Parkway	17/Jun/2002	1.79	25	42.68	31.46	0.85	0	0
207SUI020	Rockville	17/Jun/2002	0.26	2	0.72	7.34	42.86	18.64	28.45
202BUT010	Bean Hollow	19/Jun/2002	0.66	7	9.48	57.12	23.97	2.42	0
202PES050	Water Lane	19/Jun/2002	0.58	8	17.3	56.11	14.83	2.1	1.66
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0.73	10.5	23.38	54.52	10.51	1.09	0
205PER010	Charleston Rd	17/Jun/2002	2.22	10	8.87	22.73	45.18	10.43	2.79
205STE020	La Avenida	17/Jun/2002	0.72	1.9	1.07	1.63	10.11	11.37	73.92

Appendix H: Sediment chemistry results

			Aluminum	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Mercury	Nickel	Silver	Zinc	Metals	PCB 008	PCB 018
StationCode	StationName	SampleDate	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	MPECQ	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	20694	10.5	0.173	263	36.6	13.2	616	0.185	429	0.303	86.8	1.73	0	0
201WLK090	Walker Creek	02/Oct/2001	30966	6.87	0.112	114	20.1	7.96	629	0.728	73.7	0.224	50.7	0.44	0	0
204ALP010	El Charro	18/Sep/2001	41298	7.53	0.199	133	52.5	11.5	411	0.331	109	0.378	77.1	0.62	0	0
204SLE030	Empire Road	19/Sep/2001	38724	10.1	1.24	475	73.4	130	882	0.69	74	0.435	320	1.22	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	22977	5.97	0.515	47.5	25.5	16.2	4445	0.19	38.8	0.244	70.8	0.28	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	33671	5.12	0.069	192	15.3	4.39	479	0	77.3	0.171	36.1	0.53	0	0
206WIL020	Richmond Parkway	17/Jun/2002	42718	7.16	0.209	72.3	28.2	13.1	450	0	51.3	0.283	67.6	0.34	0.508	0.876
207SUI020	Rockville	17/Jun/2002	39627	11.5	0.149	58	32.8	12.3	1120	0	45.1	0.425	65.9	0.33	0	0
202BUT010	Bean Hollow	19/Jun/2002	37765	3.43	0.163	20.5	11.3	7.24	371	0	10.6	0.143	23.2	0.10	0	0
202PES050	Water Lane	19/Jun/2002	31744	5.65	0.282	54.8	13.9	8.1	293	0	22.2	0.294	5.78	0.19	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	39779	4.86	0.219	71.4	17.3	6.41	443	0	34.5	0.281	36.5	0.26	0	0
205PER010	Charleston Rd	17/Jun/2002	10150	1.04	0.202	26.8	13.6	13.6	113	0	13.7	0.0963	137	0.16	0	0.366
205STE020	La Avenida	17/Jun/2002	29394	3.12	0.171	47.2	22	20.7	840	0	44.3	0.187	61	0.27	0	0

Appendix H: Sediment chemistry results

			PCB 027	PCB 028	PCB 029	PCB 031	PCB 033	PCB 044	PCB 049	PCB 052	PCB 056	PCB 060	PCB 066	PCB 070	PCB 074	PCB 087
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0	0	0	0.189	0	0	0.129	0.136	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0.212	0	0	0.233	1.05	0	0	0	0	0	0	0	0	0.198
204SLE030	Empire Road	19/Sep/2001	0	0.771	0	0	0.671	0.85	0	1.01	0	0	1.72	1.2	0	1.24
206SPA020	3rd Ave Bridge	26/Sep/2001	0	0.43	0	0.362	0	0.418	0	0.746	0	0	0.752	0.531	0	0.438
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	0.229	0	0	0.14	0.198	0	0
206WIL020	Richmond Parkway	17/Jun/2002	0	1.15	0	1.22	0.588	1.28	0.929	1.76	0.428	0.315	1.05	1.2	0.472	1.02
207SUI020	Rockville	17/Jun/2002	0	0	0	0.163	0	0	0	0.243	0	0	0	0.152	0	0
202BUT010	Bean Hollow	19/Jun/2002	0	0.173	0	0.169	0	0.197	0	0.189	0	0	0.215	0.36	0	0.213
202PES050	Water Lane	19/Jun/2002	0	0.219	0	0.238	0.154	0.191	0	0.254	0	0	0.251	0.279	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	0	0	0	0	0.272	0	0	0	0.236	0	0
205PER010	Charleston Rd	17/Jun/2002	0	1.97	0	1.07	0	1.76	0.606	1.76	0	0.368	4.36	0.772	0.337	1.09
205STE020	La Avenida	17/Jun/2002	0	0.207	0	0.179	0	0.351	0.221	0.705	0.159	0.118	0.402	0.566	0.182	0.773

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	PCB 095 ng/g	PCB 097 ng/g	PCB 099 ng/g	PCB 101 ng/g	PCB 105 ng/g	PCB 110 ng/g	PCB 114 ng/g	PCB 118 ng/g	PCB 128 ng/g	PCB 137 ng/g	PCB 138 ng/g	PCB 141 ng/g	PCB 149 ng/g	PCB 151 ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0.144	0	0	0.22	0	0.254	0	0.217	0	0	0.215	0	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0.144	0	0.166	0	0.171	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	0	0.277	0	0.374	0	0.321	0	0	0.306	0	0	0
204SLE030	Empire Road	19/Sep/2001	1.46	0	0.74	2.55	0	3.07	0	2.48	0	0	3.57	0	1.98	0
206SPA020	3rd Ave Bridge	26/Sep/2001	0.787	0	0.343	0.93	0.265	1.23	0	0.862	0	0	1.63	0	0.863	0.27
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0.18	0	0	0.214	0	0.239	0	0.183	0	0	0	0	0	0.37
206WIL020	Richmond Parkway	17/Jun/2002	1.61	0.676	0.865	2.36	0.966	2.71	0	2.2	0.543	0	3.47	0.665	2.29	1.08
207SUI020	Rockville	17/Jun/2002	0.177	0	0	0.239	0	0.26	0	0.224	0	0	0.163	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	0.284	0	0	0.311	0.236	0.591	0	0.425	0	0	0.347	0	0	0
202PES050	Water Lane	19/Jun/2002	0.211	0	0	0.256	0.17	0.398	0	0.324	0	0	0.206	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0.209	0	0	0.247	0.178	0.386	0	0.283	0	0	0.242	0	0	0
205PER010	Charleston Rd	17/Jun/2002	3.43	0.593	1.8	4.32	0.892	4.45	0.673	2.41	1.12	0.627	11.9	2.12	10.5	3.96
205STE020	La Avenida	17/Jun/2002	1.73	0.506	0.567	2.42	0.615	2.23	0	1.57	0.615	0.155	6.11	1.48	4.64	1.96

Appendix H: Sediment chemistry results

			PCB 153	PCB 156	PCB 157	PCB 158	PCB 170	PCB 174	PCB 177	PCB 180	PCB 183	PCB 187	PCB 189	PCB 194	PCB 195	PCB 200
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0.148	0	0	0	0	0	0	0	0	0	0	0	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204SLE030	Empire Road	19/Sep/2001	2.28	0	0	0	0	0	0	1.75	0	0.7	0	0	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	1.15	0	0	0	0.324	0.301	0	0.86	0	0.564	0	0.294	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	2.51	0.314	0	0.334	0.843	1.04	0.552	2.23	0.537	1.2	0	0.628	0.206	0
207SUI020	Rockville	17/Jun/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0.181	0	0	0	0	0	0	0.308	0	0.209	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	12.1	0.731	0	0.956	3.71	4.46	2.96	9.2	2.52	5.69	0	2.36	0.94	0.454
205STE020	La Avenida	17/Jun/2002	5.25	0.495	0.117	0.622	2.17	2.71	1.52	5.48	1.42	2.9	0	1.37	0.59	0.172

Appendix H: Sediment chemistry results

			PCB 201	PCB 203	PCB 206	PCB 209	PCB AROCLOR 1248	PCB AROCLOR 1254	PCB AROCLOR 1260	Sum congeners
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0	0	0	1.652
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0.481
204ALP010	El Charro	18/Sep/2001	0	0	0	0	0	0	0	2.971
204SLE030	Empire Road	19/Sep/2001	0	0	0	0	0	0	0	28.042
206SPA020	3rd Ave Bridge	26/Sep/2001	0.483	0.422	0.381	0.348	0	0	0	15.984
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	1.753
206WIL020	Richmond Parkway	17/Jun/2002	0.723	0.523	0.425	0.287	38	21	23	44.583
207SUI020	Rockville	17/Jun/2002	0	0	0	0	0	0	0	1.621
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0	0	0	3.71
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0	0	0	3.151
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0.272	0.261	0	0	0	0	7	3.284
205PER010	Charleston Rd	17/Jun/2002	2.53	1.82	0.894	0	37	42	86	114.579
205STE020	La Avenida	17/Jun/2002	1.4	0.929	0.356	0	0	23	49	55.962

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Sum of 18 PCB Congeners x 2.01	PCB mean PEC-Q	Aldrin ng/g	Chlordane, cis ng/g	Chlordane, trans ng/g	Chlordene, alpha ng/g	Chlordene, gamma ng/g
201LAG270	Creamery Gulch	01/Oct/2001	3.791	0.006	0	0	0	0	0
201WLK090	Walker Creek	02/Oct/2001	2.836	0.004	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	4.319	0.006	0	0	0	0	0
204SLE030	Empire Road	19/Sep/2001	40.508	0.060	0	4.72	5.38	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	20.474	0.030	0	2.37	2.17	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	3.509	0.005	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	47.967	0.071	0	1.56	1.72	0	0
207SUI020	Rockville	17/Jun/2002	3.857	0.006	0	0	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	5.714	0.008	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	5.168	0.008	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	5.367	0.008	0	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	127.820	0.189	0	10	16.5	2.74	2.16
205STE020	La Avenida	17/Jun/2002	60.111	0.089	0	0	0.745	0	0

Appendix H: Sediment chemistry results

			sum Chlordanes	Chlorpyrifos	Dacthal	DCBP(p,p')	DDD(o,p')	DDD(p,p')	sum DDD	DDE(o,p')	DDE(p,p')	sum DDE	DDMU(p,p')
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0	0	0	0	0	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	0	0	0	0	0	0	0	0	0
204SLE030	Empire Road	19/Sep/2001	15.08	0	5.35	0	0	15.9	15.9	0	16.2	16.2	0
206SPA020	3rd Ave Bridge	26/Sep/2001	6.74	0	0	0	0	2.84	2.84	0	2.34	2.34	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	4.91	2.95	0	0	0	1.75	1.75	0	1.52	1.52	0
207SUI020	Rockville	17/Jun/2002	0	0	0	0	0	0	0	0	2.01	2.01	0
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0	0	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0	0	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	1.12	0	0	0	0	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	55.1	0	0	0	3.4	12.7	16.1	0	30	30	0
205STE020	La Avenida	17/Jun/2002	1.366	0	0	0	0	1.05	1.05	0	3.23	3.23	0

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	DDT(o,p') ng/g	DDT(p,p') ng/g	sum DDT op,pp ng/g	sum DDT all ng/g	sum DDT all ng/g OC	Diazinon ng/g	Dieldrin ng/g	Endosulfan I ng/g	Endosulfan II ng/g	Endosulfan sulfate ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0.00	0	0	0	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0.00	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	0	0	0.00	0	0	0	0	0
204SLE030	Empire Road	19/Sep/2001	0	0	0	32.1	340.76	0	0	0	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	0	0	0	5.18	177.40	0	1.85	0	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0.00	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	0	0	0	3.27	182.68	0	0	0	0	0
207SUI020	Rockville	17/Jun/2002	0	0	0	2.01	773.08	0	0	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0.00	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0.00	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	0	0.00	0	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	4.42	22.4	26.82	72.92	3284.68	0	5.79	0	0	0
205STE020	La Avenida	17/Jun/2002	0	0	0	4.28	594.44	0	0	0	0	0

Appendix H: Sediment chemistry results

			Endrin	HCH, alpha	HCH, beta	HCH, delta	HCH, gamma	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Mirex
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0	0	0	0	0	0
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	0	0	0	0	1.29	0	0	0
204SLE030	Empire Road	19/Sep/2001	0	0	0	0	0	0	0	0.672	0	0
206SPA020	3rd Ave Bridge	26/Sep/2001	0	0	0	0	0	0	0	0	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	0	0	0	0	0	0	0	0	0	0
207SUI020	Rockville	17/Jun/2002	0	0	0	0	0	0	0	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	0	0	0	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	0	0	0	0	0	0	1.7	0.918	0	0
205STE020	La Avenida	17/Jun/2002	0	0	0	0	0	0	0	0	0	0

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Nonachlor, cis ng/g	Nonachlor, trans ng/g	Oxadiazon ng/g	Oxychlordane ng/g	Parathion, Ethyl ng/g	Parathion, Methyl ng/g	Tedion ng/g	Toxaphene ng/g	Acenaphthene ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	0	0	0	0	0	0	2.74
201WLK090	Walker Creek	02/Oct/2001	0	0	0	0	0	0	0	0	0
204ALP010	El Charro	18/Sep/2001	0	0	3.64	0	0	0	0	0	0
204SLE030	Empire Road	19/Sep/2001	0	4.98	5.93	0	6.17	0	44.4	0	7.05
206SPA020	3rd Ave Bridge	26/Sep/2001	0	2.2	4.08	0	0	0	0	0	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	0	0	0	0	0
206WIL020	Richmond Parkway	17/Jun/2002	0	1.63	267	0	0	0	0	0	3.13
207SUI020	Rockville	17/Jun/2002	0	0	0	0	0	0	0	0	0
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	0	0	0	0	0
202PES050	Water Lane	19/Jun/2002	0	0	0	0	0	0	0	0	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	0	0	0	0	0	0
205PER010	Charleston Rd	17/Jun/2002	5.36	21.7	18.4	1.54	0	0	8.65	0	8.2
205STE020	La Avenida	17/Jun/2002	0	0.621	6.6	0	0	0	0	0	0

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			Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	0	2.35	2.57	13.8	6.56	5.61
201WLK090	Walker Creek	02/Oct/2001	0	0	0	1.69	6.19	3.16	3.35
204ALP010	El Charro	18/Sep/2001	0	0	2.38	6.72	9.24	4.86	7.7
204SLE030	Empire Road	19/Sep/2001	6.54	12.45	53	0	106.67	0	61.89
206SPA020	3rd Ave Bridge	26/Sep/2001	0	5.06	14.4	29.6	33.3	27.9	33.3
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	2.60	0	6.56
206WIL020	Richmond Parkway	17/Jun/2002	0	5.95	58.8	40.4	69.0	33.6	41.7
207SUI020	Rockville	17/Jun/2002	0	0	2.53	1.71	4.45	1.93	5.33
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	0	1.46	0	3.22
202PES050	Water Lane	19/Jun/2002	0	0	0	0	1.36	0	2.27
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	1.79	2.73	1.73	4.51
205PER010	Charleston Rd	17/Jun/2002	3.95	32.3	149	278	351	212	293
205STE020	La Avenida	17/Jun/2002	0	0	8.43	15.2	31.0	24.6	26.7

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			Benzo(k)fluoranthene	Biphenyl	Chrysene	Chrysenes, C1-	Chrysenes, C2-	Chrysenes, C3-	Dibenz(a,h)anthracene
StationCode	StationName	SampleDate	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	23.3	11.6	9.27	11.8	16.1	4.23
201WLK090	Walker Creek	02/Oct/2001	0	4.91	4.55	4.74	3.93	3.15	0
204ALP010	El Charro	18/Sep/2001	0	0	5.4	4.43	5.83	6.7	4.07
204SLE030	Empire Road	19/Sep/2001	59.95	3.53	50.39	119	100	123	9.29
206SPA020	3rd Ave Bridge	26/Sep/2001	12.4	0	27.6	24.5	26.2	36.8	11.2
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	4.65	3.83	2.62	1.65	0	14.1
206WIL020	Richmond Parkway	17/Jun/2002	20.4	2.16	28.2	40.9	47.5	51.8	21.3
207SUI020	Rockville	17/Jun/2002	0	0	2.99	1.8	0	0	5.37
202BUT010	Bean Hollow	19/Jun/2002	0	0	1.81	1.82	1.49	0	5.68
202PES050	Water Lane	19/Jun/2002	0	0	2.14	2.88	4.04	4.43	3.18
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	2.49	2.83	3.08	3.32	2.90
205PER010	Charleston Rd	17/Jun/2002	131	4.8	204	107	75.9	74.8	86.8
205STE020	La Avenida	17/Jun/2002	8.21	3.22	26.5	28.3	48.3	67.1	14.8

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Dibenzothiophene ng/g	Dibenzothiophenes, C1- ng/g	Dibenzothiophenes, C2- ng/g	Dibenzothiophenes, C3- ng/g	Dimethylnaphthalene, 2,6- ng/g
201LAG270	Creamery Gulch	01/Oct/2001	0	14.9	10.4	10.7	8.02
201WLK090	Walker Creek	02/Oct/2001	0	7.34	5.93	6.32	7.15
204ALP010	El Charro	18/Sep/2001	4.49	12.3	12.1	13.3	5.81
204SLE030	Empire Road	19/Sep/2001	38.34	142	418	694	3.57
206SPA020	3rd Ave Bridge	26/Sep/2001	0	70.6	73.8	65.8	4.64
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	0	0	0	0	4.26
206WIL020	Richmond Parkway	17/Jun/2002	5.60	10	23.2	22.1	4.36
207SUI020	Rockville	17/Jun/2002	0	0	0	0	2.73
202BUT010	Bean Hollow	19/Jun/2002	0	0	1.42	0	0
202PES050	Water Lane	19/Jun/2002	0	0	2.3	1.87	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	1.57	0	0
205PER010	Charleston Rd	17/Jun/2002	19.7	15.3	29	27.1	9.17
205STE020	La Avenida	17/Jun/2002	3.6	7.04	14.4	10.1	4.54

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Fluoranthene ng/g	Fluoranthene/Pyrenes, C1- ng/g	Fluorene ng/g	Fluorenes, C1- ng/g	Fluorenes, C2- ng/g	Fluorenes, C3- ng/g	Indeno(1,2,3-c,d)pyrene ng/g
201LAG270	Creamery Gulch	01/Oct/2001	5.86	7.55	3.48	4.47	11.8	7.88	3.4
201WLK090	Walker Creek	02/Oct/2001	2.94	7.56	2.16	4.56	8.41	7.53	2.12
204ALP010	El Charro	18/Sep/2001	6.97	3.56	0	0	4.37	0	7.22
204SLE030	Empire Road	19/Sep/2001	104.54	303	7.92	7.1	0	0	71.89
206SPA020	3rd Ave Bridge	26/Sep/2001	44.7	26.8	0	4.92	7.44	7.28	30.8
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	1.86	3.02	0	1.92	0	5.41	9.56
206WIL020	Richmond Parkway	17/Jun/2002	66.0	36.5	5.70	4.91	0	17.4	60.5
207SUI020	Rockville	17/Jun/2002	4.55	2.47	0	0	0	2.54	7.10
202BUT010	Bean Hollow	19/Jun/2002	1.97	1.83	0	0	0	1.98	4.94
202PES050	Water Lane	19/Jun/2002	1.43	2.34	0	0	0	3.03	2.81
202SGR010	San Gregorio USGS Gage	18/Jun/2002	2.50	2.45	0	0	0	2.25	5.22
205PER010	Charleston Rd	17/Jun/2002	468	113	10.5	5.12	0	35	377
205STE020	La Avenida	17/Jun/2002	18.0	32.7	2.18	3.46	0	11.8	29.6

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Methylnaphthalene, 1- ng/g	Methylnaphthalene, 2- ng/g	Methylphenanthrene, 1- ng/g	Naphthalene ng/g	Naphthalenes, C1- ng/g	Naphthalenes, C2- ng/g
201LAG270	Creamery Gulch	01/Oct/2001	5.79	20.7	3.42	13.8	27.8	20.1
201WLK090	Walker Creek	02/Oct/2001	5.67	9.4	4.07	6.2	17.1	23.6
204ALP010	El Charro	18/Sep/2001	0	0	0	3.08	0	8.52
204SLE030	Empire Road	19/Sep/2001	5.6	10.47	49.36	16.81	17.3	12.9
206SPA020	3rd Ave Bridge	26/Sep/2001	4.61	10.6	4.35	15.1	19.4	17.6
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	4.03	6.11	2.01	4.98	11.4	14
206WIL020	Richmond Parkway	17/Jun/2002	3.58	7.10	6.99	11.6	11.3	16.9
207SUI020	Rockville	17/Jun/2002	2.64	4.28	0	3.04	8	10.4
202BUT010	Bean Hollow	19/Jun/2002	0	0	0	1.46	2.34	3.38
202PES050	Water Lane	19/Jun/2002	0	0	0	1.76	2.41	3.82
202SGR010	San Gregorio USGS Gage	18/Jun/2002	0	0	0	0	2.2	3.74
205PER010	Charleston Rd	17/Jun/2002	4.86	11.7	20.0	17.7	17.1	23
205STE020	La Avenida	17/Jun/2002	2.44	7.46	1.94	5.97	10.6	12.6

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Naphthalenes, C3- ng/g	Naphthalenes, C4- ng/g	Perylene ng/g	Phenanthrene ng/g	Phenanthrene-Anthracene, C1- ng/g	Phenanthrene-Anthracene, C2- ng/g
201LAG270	Creamery Gulch	01/Oct/2001	8.29	3.59	4.82	38.1	27.9	13.3
201WLK090	Walker Creek	02/Oct/2001	12.7	2.01	8.33	16.5	4.07	15.3
204ALP010	El Charro	18/Sep/2001	0	0	2.94	5.33	5.6	8.65
204SLE030	Empire Road	19/Sep/2001	25	6.75	0	68.87	142	379
206SPA020	3rd Ave Bridge	26/Sep/2001	11.6	0	12.2	27.7	22.5	24.1
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	10.6	2.08	3.14	14.8	16.2	10.4
206WIL020	Richmond Parkway	17/Jun/2002	21.2	7.87	17.1	46.8	40.8	62
207SUI020	Rockville	17/Jun/2002	9.68	2.77	4.34	4.63	5.19	3.9
202BUT010	Bean Hollow	19/Jun/2002	5.02	1.97	11.6	2.47	3.69	5.05
202PES050	Water Lane	19/Jun/2002	6.15	2.49	8.44	2.63	5.47	7.16
202SGR010	San Gregorio USGS Gage	18/Jun/2002	5.16	1.58	11.9	2.52	3.5	4.23
205PER010	Charleston Rd	17/Jun/2002	17.1	5.77	39.3	206	106	73.2
205STE020	La Avenida	17/Jun/2002	14.3	3.81	10.5	12.7	14.3	18.4

Appendix H: Sediment chemistry results

StationCode	StationName	SampleDate	Phenanthrene-Anthracene, C3- ng/g	Phenanthrene-Anthracene, C4- ng/g	Pyrene ng/g	Trimethylnaphthalene, 2,3,5- ng/g
201LAG270	Creamery Gulch	01/Oct/2001	6	9.25	5.77	0
201WLK090	Walker Creek	02/Oct/2001	8.52	5.68	3.99	1.85
204ALP010	El Charro	18/Sep/2001	4.92	3.67	7.65	0
204SLE030	Empire Road	19/Sep/2001	521	388	176.18	0
206SPA020	3rd Ave Bridge	26/Sep/2001	13.4	23.9	50.3	0
201LAG120	Green Bridge (Hwy 1)	18/Jun/2002	3.67	0	2.58	1.86
206WIL020	Richmond Parkway	17/Jun/2002	56	19.2	56.1	4.34
207SUI020	Rockville	17/Jun/2002	2.17	0	4.46	0
202BUT010	Bean Hollow	19/Jun/2002	3.53	0	2.40	0
202PES050	Water Lane	19/Jun/2002	6.72	2.47	2.12	0
202SGR010	San Gregorio USGS Gage	18/Jun/2002	3.81	1.6	3.29	0
205PER010	Charleston Rd	17/Jun/2002	56.3	19.4	395	3.76
205STE020	La Avenida	17/Jun/2002	23.5	16.6	36.3	2.36

Appendix I-1: Summary of metals found in clam tissue samples

Station ID	Analyte	wet weight	units	SMW 85% EDL
Control	*Aluminum*	*60.12*	*ug/g*	*206.33*
201LAG040	Aluminum	5.17	ug/g	
201LAG130	Aluminum	10.24	ug/g	
201LAG270	Aluminum	28.74	ug/g	
201WLK090	Aluminum	25.92	ug/g	
202BUT010	Aluminum	53.22	ug/g	
202PES050	Aluminum	72.79	ug/g	
202SGR010	Aluminum	55.42	ug/g	
204ALP010	Aluminum	7.85	ug/g	
205PER010	Aluminum	14.15	ug/g	
205STE020	Aluminum	16.04	ug/g	
206SPA020	Aluminum	43.25	ug/g	
207SUI020	Aluminum	97.83	ug/g	
Control	*Arsenic*	*0.80*	*ug/g*	*0.9*
201LAG040	Arsenic	0.69	ug/g	
201LAG130	Arsenic	0.61	ug/g	
201LAG270	Arsenic	0.65	ug/g	
201WLK090	Arsenic	0.59	ug/g	
202BUT010	Arsenic	0.59	ug/g	
202PES050	Arsenic	0.53	ug/g	
202SGR010	Arsenic	0.56	ug/g	
204ALP010	Arsenic	0.66	ug/g	
205PER010	Arsenic	0.70	ug/g	
205STE020	Arsenic	0.79	ug/g	
206SPA020	Arsenic	0.67	ug/g	
207SUI020	Arsenic	0.78	ug/g	
Control	*Cadmium*	*0.10*	*ug/g*	*0.92*
201LAG040	Cadmium	0.12	ug/g	
201LAG130	Cadmium	0.08	ug/g	
201LAG270	Cadmium	0.10	ug/g	
201WLK090	Cadmium	0.07	ug/g	
202BUT010	Cadmium	0.11	ug/g	
202PES050	Cadmium	0.10	ug/g	
202SGR010	Cadmium	0.11	ug/g	
204ALP010	Cadmium	0.08	ug/g	
205PER010	Cadmium	0.08	ug/g	
205STE020	Cadmium	0.12	ug/g	
206SPA020	Cadmium	0.08	ug/g	
207SUI020	Cadmium	0.11	ug/g	
Control	*Chromium*	*0.50*	*ug/g*	*2*
201LAG040	Chromium	0.30	ug/g	
201LAG130	Chromium	0.28	ug/g	
201LAG270	Chromium	0.51	ug/g	
201WLK090	Chromium	0.30	ug/g	
202BUT010	Chromium	0.40	ug/g	
202PES050	Chromium	0.36	ug/g	
202SGR010	Chromium	0.39	ug/g	
204ALP010	Chromium	0.28	ug/g	
205PER010	Chromium	0.43	ug/g	
205STE020	Chromium	0.48	ug/g	
206SPA020	Chromium	0.34	ug/g	
207SUI020	Chromium	0.53	ug/g	

Appendix I-1: Summary of metals found in clam tissue samples

Station ID	Analyte	wet weight	units	SMW 85% EDL
Control	*Copper*	*8.46*	*ug/g*	*8.78*
201LAG040	Copper	7.72	ug/g	
201LAG130	Copper	6.72	ug/g	
201LAG270	Copper	7.68	ug/g	
201WLK090	Copper	5.22	ug/g	
202BUT010	Copper	6.88	ug/g	
202PES050	Copper	6.63	ug/g	
202SGR010	Copper	7.10	ug/g	
204ALP010	Copper	7.34	ug/g	
205PER010	Copper	9.54	ug/g	
205STE020	Copper	9.95	ug/g	
206SPA020	Copper	6.96	ug/g	
207SUI020	Copper	15.33	ug/g	
Control	*Lead*	*0.05*	*ug/g*	*0.21*
201LAG040	Lead	0.01	ug/g	
201LAG130	Lead	0.01	ug/g	
201LAG270	Lead	0.03	ug/g	
201WLK090	Lead	0.01	ug/g	
202BUT010	Lead	0.02	ug/g	
202PES050	Lead	0.02	ug/g	
202SGR010	Lead	0.02	ug/g	
204ALP010	Lead	0.03	ug/g	
205PER010	Lead	0.06	ug/g	
205STE020	Lead	0.04	ug/g	
206SPA020	Lead	0.08	ug/g	
207SUI020	Lead	0.05	ug/g	
Control	*Manganese*	*3.61*	*ug/g*	*9.55*
201LAG040	Manganese	2.21	ug/g	
201LAG130	Manganese	2.32	ug/g	
201LAG270	Manganese	2.55	ug/g	
201WLK090	Manganese	5.09	ug/g	
202BUT010	Manganese	6.64	ug/g	
202PES050	Manganese	6.53	ug/g	
202SGR010	Manganese	5.76	ug/g	
204ALP010	Manganese	0.79	ug/g	
205PER010	Manganese	1.22	ug/g	
205STE020	Manganese	2.16	ug/g	
206SPA020	Manganese	5.80	ug/g	
207SUI020	Manganese	6.16	ug/g	
Control	*Mercury (total)*	*0.02*	*ug/g*	*0.04*
201LAG040	Mercury (total)	0.02	ug/g	
201LAG130	Mercury (total)	0.02	ug/g	
201LAG270	Mercury (total)	0.03	ug/g	
201WLK090	Mercury (total)	0.01	ug/g	
202BUT010	Mercury (total)	0.02	ug/g	
202PES050	Mercury (total)	0.01	ug/g	
202SGR010	Mercury (total)	0.02	ug/g	
204ALP010	Mercury (total)	0.02	ug/g	
205PER010	Mercury (total)	0.02	ug/g	
205STE020	Mercury (total)	0.02	ug/g	
206SPA020	Mercury (total)	0.02	ug/g	
207SUI020	Mercury (total)	0.03	ug/g	
Control	*Nickel*	*0.34*	*ug/g*	*1*
201LAG040	Nickel	0.14	ug/g	
201LAG130	Nickel	0.16	ug/g	
201LAG270	Nickel	0.51	ug/g	
201WLK090	Nickel	0.25	ug/g	
202BUT010	Nickel	0.36	ug/g	
202PES050	Nickel	0.34	ug/g	

Appendix I-1: Summary of metals found in clam tissue samples

Station ID	Analyte	wet weight	units	SMW 85% EDL
Control	*Nickel*	*0.34*	*ug/g*	*1*
202SGR010	Nickel	0.43	ug/g	
204ALP010	Nickel	0.16	ug/g	
205PER010	Nickel	0.15	ug/g	
205STE020	Nickel	0.21	ug/g	
206SPA020	Nickel	0.32	ug/g	
207SUI020	Nickel	0.32	ug/g	
Control	*Selenium*	*0.27*	*ug/g*	*0.43*
201LAG040	Selenium	0.19	ug/g	
201LAG130	Selenium	0.18	ug/g	
201LAG270	Selenium	0.20	ug/g	
201WLK090	Selenium	0.16	ug/g	
202BUT010	Selenium	0.23	ug/g	
202PES050	Selenium	0.21	ug/g	
202SGR010	Selenium	0.23	ug/g	
204ALP010	Selenium	0.21	ug/g	
205PER010	Selenium	0.33	ug/g	
205STE020	Selenium	0.40	ug/g	
206SPA020	Selenium	0.27	ug/g	
207SUI020	Selenium	0.32	ug/g	
Control	*Silver*	*0.01*	*ug/g*	*0.03*
201LAG040	Silver	0.01	ug/g	
201LAG130	Silver	0.01	ug/g	
201LAG270	Silver	0.01	ug/g	
201WLK090	Silver	0.01	ug/g	
202BUT010	Silver	0.01	ug/g	
202PES050	Silver	0.01	ug/g	
202SGR010	Silver	0.01	ug/g	
204ALP010	Silver	0.01	ug/g	
205PER010	Silver	0.01	ug/g	
205STE020	Silver	0.02	ug/g	
206SPA020	Silver	0.01	ug/g	
207SUI020	Silver	0.01	ug/g	
Control	*Zinc*	*9.90*	*ug/g*	*19.39*
201LAG040	Zinc	7.26	ug/g	
201LAG130	Zinc	5.49	ug/g	
201LAG270	Zinc	7.69	ug/g	
201WLK090	Zinc	5.67	ug/g	
202BUT010	Zinc	7.54	ug/g	
202PES050	Zinc	7.31	ug/g	
202SGR010	Zinc	6.94	ug/g	
204ALP010	Zinc	6.90	ug/g	
205PER010	Zinc	7.76	ug/g	
205STE020	Zinc	8.88	ug/g	
206SPA020	Zinc	8.39	ug/g	
207SUI020	Zinc	9.54	ug/g	

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**26.0**	
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**19.3**	
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**14.1**	
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**44.2**	
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	-13.9	ND
201LAG040	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	-13.9	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**35.0**	
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**26.5**	
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**73.4**	
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**18.9**	
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**68.6**	
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	-17.5	ND
201LAG130	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	-17.5	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-15.3	ND

201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-15.3	ND

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**25.5**	
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**22.5**	
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**75.5**	
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**15.8**	
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**77.2**	
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	-15.3	ND
201LAG270	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	-15.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	**14.3**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**30.0**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**25.1**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**71.4**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**15.2**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**39.7**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-13.3	ND
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**61.6**	
201WLK090	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	-13.3	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**17.4**	

202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**54.8**	
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-14.0	ND

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-14.0	ND
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**21.6**	
202BUT010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	-14.0	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**15.7**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**53.2**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	-14.4	ND
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**24.6**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**26.8**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**15.0**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**25.6**	
202PES050	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	-14.4	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**18.1**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**55.5**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	**311**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	**152**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-16.3	ND

202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	**161**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	-16.3	ND

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**148**	
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	-16.3	ND
202SGR010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	-16.3	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	**29.4**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	**40.3**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	**38.4**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	**42.6**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	**20.2**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	**35.7**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**36.5**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**30.6**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**63.4**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**17.2**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-16.4	ND
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	**23.7**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	**16.7**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	**34.0**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**57.7**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**32.9**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**24.8**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**64.5**	
204ALP010	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	**33.1**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	**46.1**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	**17.0**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	**15.5**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	**16.5**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	**44.2**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	**45.3**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	**15.2**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	**35.2**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**24.9**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**93.0**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	**15.1**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	**13.8**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	**16.1**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	-13.7	ND
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**30.7**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**23.9**	
205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**19.1**	

205PER010	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	**41.6**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	**28.7**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-12.5	ND

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	**14.7**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	**24.7**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	**32.8**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	**17.5**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	**22.2**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**22.4**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**117**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	**15.3**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-12.5	ND
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	**12.7**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**94.5**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**30.3**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**31.5**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**31.7**	
205STE020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	**23.6**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	**17.5**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	**69.8**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	**75.3**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	**28.9**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	**17.2**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	**30.8**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	**51.1**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	**37.8**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	**96.2**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**80.5**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**28.5**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	**110**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**17.7**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-14.4	ND
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	**283**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	**15.1**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	**146**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	**25.4**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	**169**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	**17.8**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	**41.7**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**72.5**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	**173**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**89.7**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**82.8**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**66.2**	
206SPA020	28/Sep/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	**112**	
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benz[a]anthracene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-13.1	ND

207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C1 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-13.1	ND

Appendix I-2: PAH's detected in clam tissue samples (bold font indicates detected value)

StationCode	SampleDate	Season	LabBatch	AnalysisDate	MethodName	AnalyteName	Unit	Result	ResultQualCode
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene	ng/g	**20.2**	
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	**18.4**	
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C2 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Fluorenes, C3 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalene	ng/g	**19.5**	
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	-13.1	ND
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	**25.3**	
207BIGBRK	28/Aug/2001	Dry	L-040803-PAH	16/Jul/2003	EPA 8270M	Pyrene	ng/g	**19.4**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benz[a]anthracene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(b)fluoranthene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(e)pyrene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Benzo(g,h,i)perylene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C1 -	ng/g	**30.8**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C2 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Chrysenes, C3 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenz(a,h)anthracene	ng/g	**19.8**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C1 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C2 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Dibenzothiophenes, C3 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluoranthene/Pyrenes, C1 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C1 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C2 -	ng/g	**32.1**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Fluorenes, C3 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Indeno(1,2,3-c,d)pyrene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalene	ng/g	**15.1**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C1 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C2 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C3 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Naphthalenes, C4 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C1 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C2 -	ng/g	**30.0**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C3 -	ng/g	**19.9**	
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Phenanthrene/Anthracene, C4 -	ng/g	-12.7	ND
207SUI020	17/Jul/2002	Dry	L-032803-PAH	23/Jun/2003	EPA 8270M	Pyrene	ng/g	-12.7	ND

Appendix I-3: Summary of pesticides found in clam tissue (by site)

		28/Aug/2001	28/Sep/2001	28/Sep/2001	28/Sep/2001	28/Sep/2001	28/Sep/2001	17/Jul/2002	28/Sep/2001	17/Jul/2002	17/Jul/2002	17/Jul/2002	17/Jul/2002
Analyte	**Units**	**Control**	**201WLK090**	**201LAG040**	**201LAG130**	**201LAG270**	**206SPA020**	**207SUI020**	**204ALP010**	**202BUT010**	**202PES050**	**202SGR010**	**205PER010**
chlordane, cis	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	2.61
chlordane, trans	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	1.81
chlordene, alpha	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
chlordene, gamma	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
oxychlordane	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
nonachlor, cis	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
nonachlor, trans	ng/g ww	0.00	0.00	0.00	0.00	0.40	0.97	0.00	0.39	0.00	0.00	0.00	2.83
total chlordanes	ng/g ww	0.00	0.00	0.00	0.00	0.40	2.63	0.00	0.39	0.00	0.00	0.00	7.85
DDD, o,p'	ng/g ww	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DDD, p,p'	ng/g ww	2.20	0.00	0.91	0.96	0.00	1.60	1.81	0.00	0.00	0.00	0.00	2.04
DDE, o,p'	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DDE, p,p'	ng/g ww	19.78	12.18	14.33	14.58	10.13	8.36	17.24	9.91	5.80	5.32	7.02	11.01
DDT, o,p'	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DDT, p,p'	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00	0.00	0.00	0.00	0.00
DDMU, p,p'	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total DDTs	ng/g ww	22.81	12.18	15.24	15.53	10.13	9.96	21.51	9.91	5.80	5.32	7.02	13.05
chlorpyrifos	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
diazinon	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
aldrin	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dacthal	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DCBP, p,p'	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dieldrin	ng/g ww	0.52	0.00	0.00	0.00	0.47	1.14	0.00	0.00	0.00	0.00	0.00	0.72
endosulfan I	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
endosulfan II	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
endosulfan sulfate	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total endosulfan	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
endrin	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HCH, alpha	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HCH, beta	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HCH, delta	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HCH, gamma	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
heptachlor	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
heptachlor epoxide	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hexachlorobenzene	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
methoxychlor	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mirex	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
oxadiazon	ng/g ww	2.81	0.00	0.00	0.00	0.00	6.03	0.00	24.53	0.00	0.00	3.35	1.22
parathion, ethyl	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
parathion, methyl	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
tedion	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
toxaphene	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCB 1248	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	13.10	0.00	0.00	0.00	0.00	0.00
PCB 1254	ng/g ww	6.35	5.10	5.51	6.11	5.19	7.55	4.68	7.11	5.81	4.14	0.00	17.82
PCB 1260	ng/g ww	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.25
Total PCBs	ng/g ww	6.35	5.10	5.51	6.11	5.19	7.55	17.78	7.11	5.81	4.14	0.00	23.08
% Moisture	%	92.70	94.00	94.20	94.50	93.90	93.20	92.20	94.40	93.00	93.10	94.00	92.90
% Lipid	%	0.54	0.40	0.43	0.39	0.40	0.50	0.74	0.42	0.61	0.62	0.52	0.68

17/Jul/2002
205STE020
1.09
1.02
0.00
0.00
0.00
0.00
1.20
3.31
0.00
1.14
0.00
11.76
0.00
0.00
0.00
12.90
0.00
0.00
0.00
0.00
0.00
0.42
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
2.71
0.00
0.00
0.00
0.00
0.00
18.32
0.00
18.32
92.00
0.75

Appendix I-4: Summary of detections of PCB's in clam tissue (bold font indicates detection)

Analyte (PCB Congener)	Control	201WLK090	210LAG040	201LAG130	201LAG270	206SPA020	204ALP010	202BUT010	202PES050	202SGR010	205PER010	205STE020
8	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
18	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**3.12**	-1.767	-1.4115	-1.43025	-1.606	-1.3665	**1.38**
27	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
28	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**2.96**	**1.93**	-1.4115	-1.43025	-1.606	**1.82**	**2.32**
29	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
31	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**3.35**	-1.767	-1.4115	-1.43025	-1.606	**1.82**	**2.57**
33	-1.3395	-1.627	-1.64475	-1.73875	**1.43**	**2.16**	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
44	**3.45**	**3.91**	**4.01**	**4.14**	**3.51**	**7.14**	**4.76**	**3.55**	**3.09**	**3.41**	**5.97**	**12.4**
49	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**2.56**	-1.767	-1.4115	-1.43025	-1.606	**2.17**	**4.52**
52	**2.1**	**1.75**	**2.6**	**2.31**	**1.96**	**4.47**	**3.1**	**1.77**	-1.43025	**2.34**	**4.9**	**10.1**
56	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**2.05**	-1.767	-1.4115	-1.43025	-1.606	-1.3665	**2.92**
60	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**1.46**	-1.767	-1.4115	-1.43025	-1.606	-1.3665	**2.09**
66	**2.26**	**2.01**	**2.1**	**2.73**	**2.81**	**5.55**	**3.34**	**2.13**	**2.11**	-1.606	**7.94**	**8.6**
70	**2.64**	**2.28**	**2.21**	**3.1**	**2.16**	**4.87**	**2.45**	**2.61**	-1.43025	-1.606	**2.68**	**7.5**
74	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**2.09**	-1.767	-1.4115	-1.43025	-1.606	-1.3665	**4.02**
87	**1.74**	**1.71**	-1.64475	**2.43**	**1.51**	**3.12**	**2.85**	**1.65**	-1.43025	-1.606	**2.79**	**6.16**
95	**5.05**	**5.06**	**5.26**	**6.01**	**4.67**	**7.64**	**7.57**	**4.84**	**4.12**	**4.32**	**13.2**	**12.8**
97	**2.38**	**2.73**	**2.76**	**3.1**	**2.26**	**3.76**	**4.26**	**2.49**	**2.02**	**2.04**	**3.58**	**6.69**
99	**2.85**	**2.43**	**2.62**	**2.98**	**2.21**	**3.68**	**3.47**	**1.76**	-1.43025	-1.606	**7.84**	**6.37**
101	**5.81**	**5.34**	**5.7**	**6.59**	**5.23**	**8.5**	**8.6**	**4.35**	**2.79**	**3.19**	**16**	**15.2**
105	**2.31**	**2.04**	**2.37**	**3.32**	**2.15**	**3.4**	**3.5**	**2.09**	**1.55**	-1.606	**2.67**	**6.43**
110	**6.17**	**5.8**	**6.24**	**7.32**	**5.98**	**9.36**	**9.42**	**4.98**	**3.43**	**3.47**	**12.8**	**15.4**
114	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
118	**7.16**	**7.6**	**7.85**	**9.89**	**6.95**	**10.7**	**10.3**	**7.81**	**5.68**	**5.37**	**10.6**	**18**
128	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**1.71**	-1.767	-1.4115	-1.43025	-1.606	**2.9**	**3.25**
137	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
138	**9.81**	**9.79**	**10.9**	**11**	**9.27**	**12.6**	**14.4**	**9.13**	**7.18**	**7.05**	**33.4**	**19**
141	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
149	**5.64**	**4.96**	**5.62**	**5.81**	**5**	**6.96**	**7.82**	**3.77**	**2.76**	**2.96**	**27.7**	**10.5**
151	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	**1.57**	**1.83**	-1.4115	-1.43025	-1.606	**12.2**	**3.56**
153	**16.9**	**19.4**	**20.3**	**19.3**	**16.9**	**20.5**	**23.9**	**21.9**	**22.5**	**20.6**	**64.7**	**32**
156	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**1.85**	**1.28**
157	**1.94**	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
158	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**2.04**	**1.42**
170	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**3.16**	-1.25175
174	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**4.03**	-1.25175
177	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**9.04**	**1.71**
180	**2.94**	**3.27**	**3.56**	**3.31**	**2.66**	**3.8**	**3.89**	**3.56**	**3.59**	**3.17**	**11.6**	**4.66**
183	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**5.78**	**1.42**
187	**3.33**	**3.16**	**3.62**	**3.1**	**2.67**	**4.41**	**3.99**	**2.26**	**2.13**	**2.25**	**18.4**	**5.22**
189	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
194	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
195	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
200	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
201	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**1.45**	-1.25175
203	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	**3.59**	**1.32**
206	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175
207	**109.7**	**119.1**	**125.9**	**122.2**	**92.8**	**96.2**	**91.8**	**101.1**	**87.4**	**114.8**	**109.7**	**111.8**
209	-1.3395	-1.627	-1.64475	-1.73875	-1.31925	-1.44025	-1.767	-1.4115	-1.43025	-1.606	-1.3665	-1.25175

Appendix J: Water and sediment toxicity

ToxSpeciesName	StationCode	StationName	MatrixName	Unit	% of control--Dry	% of control--Spring	% of control--Wet
H. azteca % survival	201WLK090	Walker Creek	sediment	%	90.8		
H. azteca growth	201WLK090	Walker Creek	sediment	mg/ind	120		
C. dubia % survival	201LAG040	Olema Low	samplewater	%		100	
C. dubia young/female	201LAG040	Olema Low	samplewater	Num/Rep		137	
P. promelas % survival	201LAG040	Olema Low	samplewater	%		108	
P. promelas growth	201LAG040	Olema Low	samplewater	mg/ind		106	
S. capricornutum cell growth	201LAG040	Olema Low	samplewater	cells/ml		126	
H. azteca % survival	201LAG120	Green Bridge (Hwy 1)	sediment	%	104		
H. azteca growth	201LAG120	Green Bridge (Hwy 1)	sediment	mg/ind	84.3		
C. dubia % survival	201LAG130	Gallagher's Ranch	samplewater	%	100	100	
C. dubia young/female	201LAG130	Gallagher's Ranch	samplewater	Num/Rep	132	139	
P. promelas % survival	201LAG130	Gallagher's Ranch	samplewater	%	103	108	
P. promelas growth	201LAG130	Gallagher's Ranch	samplewater	mg/ind	90	114	
S. capricornutum cell growth	201LAG130	Gallagher's Ranch	samplewater	cells/ml	106	121	
C. dubia % survival	201LAG270	Creamery Gulch	samplewater	%	100	100	
C. dubia young/female	201LAG270	Creamery Gulch	samplewater	Num/Rep	111	132	
H. azteca % survival	201LAG270	Creamery Gulch	sediment	%	96.1		
H. azteca growth	201LAG270	Creamery Gulch	sediment	mg/ind	115		
P. promelas % survival	201LAG270	Creamery Gulch	samplewater	%	97	103	
P. promelas growth	201LAG270	Creamery Gulch	samplewater	mg/ind	98	111	
S. capricornutum cell growth	201LAG270	Creamery Gulch	samplewater	cells/ml	109	132	
C. dubia % survival	202BUT010	Bean Hollow	samplewater	%	100	100	100
C. dubia young/female	202BUT010	Bean Hollow	samplewater	Num/Rep	95.9	89.1	118
H. azteca % survival	202BUT010	Bean Hollow	sediment	%	103		
H. azteca growth	202BUT010	Bean Hollow	sediment	mg/ind	62.9		
P. promelas % survival	202BUT010	Bean Hollow	samplewater	%	108	100	103
P. promelas growth	202BUT010	Bean Hollow	samplewater	mg/ind	109	106	103
S. capricornutum cell growth	202BUT010	Bean Hollow	samplewater	cells/ml	130	109	111
C. dubia % survival	202PES050	Water Lane	samplewater	%	100	100	100
C. dubia young/female	202PES050	Water Lane	samplewater	Num/Rep	87.7	110	147
H. azteca % survival	202PES050	Water Lane	sediment	%	86.5		
H. azteca growth	202PES050	Water Lane	sediment	mg/ind	63		
P. promelas % survival	202PES050	Water Lane	samplewater	%	105	109	103
P. promelas growth	202PES050	Water Lane	samplewater	mg/ind	106	111	96
S. capricornutum cell growth	202PES050	Water Lane	samplewater	cells/ml	132	116	105
C. dubia % survival	202PES070	Cloverdale Rd	samplewater	%	100	100	100
C. dubia young/female	202PES070	Cloverdale Rd	samplewater	Num/Rep	87.4	97.7	155
P. promelas % survival	202PES070	Cloverdale Rd	samplewater	%	105	100	92
P. promelas growth	202PES070	Cloverdale Rd	samplewater	mg/ind	108	111	91
S. capricornutum cell growth	202PES070	Cloverdale Rd	samplewater	cells/ml	116	105	91.6
C. dubia % survival	202SGR010	San Gregorio USGS Gage	samplewater	%	142.9	100	100
C. dubia young/female	202SGR010	San Gregorio USGS Gage	samplewater	Num/Rep	118	95.2	119
H. azteca % survival	202SGR010	San Gregorio USGS Gage	sediment	%	104		
H. azteca growth	202SGR010	San Gregorio USGS Gage	sediment	mg/ind	70.6		
P. promelas % survival	202SGR010	San Gregorio USGS Gage	samplewater	%	95	97	100
P. promelas growth	202SGR010	San Gregorio USGS Gage	samplewater	mg/ind	109	106	88
S. capricornutum cell growth	202SGR010	San Gregorio USGS Gage	samplewater	cells/ml	107	115	116
C. dubia % survival	202SGR080	La Honda at Confluence	samplewater	%	142.9	100	100
C. dubia young/female	202SGR080	La Honda at Confluence	samplewater	Num/Rep	94.9	96.1	130
P. promelas % survival	202SGR080	La Honda at Confluence	samplewater	%	94	81	103
P. promelas growth	202SGR080	La Honda at Confluence	samplewater	mg/ind	100	113	72
S. capricornutum cell growth	202SGR080	La Honda at Confluence	samplewater	cells/ml	111	112	106
C. dubia % survival	204ALP010	El Charro	samplewater	%	90	100	
C. dubia young/female	204ALP010	El Charro	samplewater	Num/Rep	105	128	
H. azteca % survival	204ALP010	El Charro	sediment	%	83.8		
H. azteca growth	204ALP010	El Charro	sediment	mg/ind	104		
P. promelas % survival	204ALP010	El Charro	samplewater	%	105	105	
P. promelas growth	204ALP010	El Charro	samplewater	mg/ind	110	109	
S. capricornutum cell growth	204ALP010	El Charro	samplewater	cells/ml	101	61.8	
C. dubia % survival	204ALP100	Altamont Creek	samplewater	%	100	100	
C. dubia young/female	204ALP100	Altamont Creek	samplewater	Num/Rep	117	115	
P. promelas % survival	204ALP100	Altamont Creek	samplewater	%	105	103	

Appendix J: Water and sediment toxicity

ToxSpeciesName	StationCode	StationName	MatrixName	Unit	% of control--Dry	% of control--Spring	% of control--Wet
P. promelas growth	204ALP100	Altamont Creek	samplewater	mg/ind	104	96	
S. capricornutum cell growth	204ALP100	Altamont Creek	samplewater	cells/ml	91.4	79.5	
C. dubia % survival	204ALP110	Arroyo las Positas	samplewater	%	100	100	
C. dubia young/female	204ALP110	Arroyo las Positas	samplewater	Num/Rep	104	116	
P. promelas % survival	204ALP110	Arroyo las Positas	samplewater	%	105	103	
P. promelas growth	204ALP110	Arroyo las Positas	samplewater	mg/ind	105	124	
S. capricornutum cell growth	204ALP110	Arroyo las Positas	samplewater	cells/ml	64.7	55.6	
C. dubia % survival	204SLE030	Empire Road	samplewater	%	100	90	
C. dubia young/female	204SLE030	Empire Road	samplewater	Num/Rep	63	141	
H. azteca % survival	204SLE030	Empire Road	sediment	%	0		
H. azteca growth	204SLE030	Empire Road	sediment	mg/ind			
P. promelas % survival	204SLE030	Empire Road	samplewater	%	100	108	
P. promelas growth	204SLE030	Empire Road	samplewater	mg/ind	99	120	
S. capricornutum cell growth	204SLE030	Empire Road	samplewater	cells/ml	107	86.7	
C. dubia % survival	204SLE230	Kaiser Creek at Callahan	samplewater	%	90	100	
C. dubia young/female	204SLE230	Kaiser Creek at Callahan	samplewater	Num/Rep	121	91	
P. promelas % survival	204SLE230	Kaiser Creek at Callahan	samplewater	%	100	94	
P. promelas growth	204SLE230	Kaiser Creek at Callahan	samplewater	mg/ind	94	110	
S. capricornutum cell growth	204SLE230	Kaiser Creek at Callahan	samplewater	cells/ml	117	135	
C. dubia % survival	205PER010	Charleston Rd	samplewater	%	142.9	100	80
C. dubia young/female	205PER010	Charleston Rd	samplewater	Num/Rep	101	93.8	72.5
H. azteca % survival	205PER010	Charleston Rd	sediment	%	96		
H. azteca growth	205PER010	Charleston Rd	sediment	mg/ind	72.1		
P. promelas % survival	205PER010	Charleston Rd	samplewater	%	97	98	92
P. promelas growth	205PER010	Charleston Rd	samplewater	mg/ind	89	115	78
S. capricornutum cell growth	205PER010	Charleston Rd	samplewater	cells/ml	57.3	59.4	44.6
C. dubia % survival	205PER070	Rancho San Antonio	samplewater	%	128.6	100	70
C. dubia young/female	205PER070	Rancho San Antonio	samplewater	Num/Rep	78.8	86.7	80
P. promelas % survival	205PER070	Rancho San Antonio	samplewater	%	100	87	84
P. promelas growth	205PER070	Rancho San Antonio	samplewater	mg/ind	80	109	76
S. capricornutum cell growth	205PER070	Rancho San Antonio	samplewater	cells/ml	59.1	60.9	55.6
C. dubia % survival	205STE020	La Avenida	samplewater	%	142.9	100	100
C. dubia young/female	205STE020	La Avenida	samplewater	Num/Rep	99	80.5	127
H. azteca % survival	205STE020	La Avenida	sediment	%	86.5		
H. azteca growth	205STE020	La Avenida	sediment	mg/ind	71.3		
P. promelas % survival	205STE020	La Avenida	samplewater	%	91	95	95
P. promelas growth	205STE020	La Avenida	samplewater	mg/ind	87	121	92
S. capricornutum cell growth	205STE020	La Avenida	samplewater	cells/ml	93	29	76.6
C. dubia % survival	205STE060	"Belleville"/Barranca	samplewater	%	142.93	100	70
C. dubia young/female	205STE060	"Belleville"/Barranca	samplewater	Num/Rep	96.7	92.2	129
P. promelas % survival	205STE060	"Belleville"/Barranca	samplewater	%	98	73	97
P. promelas growth	205STE060	"Belleville"/Barranca	samplewater	mg/ind	101	112	90
S. capricornutum cell growth	205STE060	"Belleville"/Barranca	samplewater	cells/ml	107	132	104
C. dubia % survival	206SPA020	3rd St Bridge	samplewater	%	100	100	
C. dubia young/female	206SPA020	3rd St Bridge	samplewater	Num/Rep	121	103	
H. azteca % survival	206SPA020	3rd St Bridge	sediment	%	80.9		
H. azteca growth	206SPA020	3rd St Bridge	sediment	mg/ind	85		
P. promelas % survival	206SPA020	3rd St Bridge	samplewater	%	93	98	
P. promelas growth	206SPA020	3rd St Bridge	samplewater	mg/ind	92	117	
S. capricornutum cell growth	206SPA020	3rd St Bridge	samplewater	cells/ml	55.1	65.7	
C. dubia % survival	206SPA070	Cemetery Bridge	samplewater	%	100	100	
C. dubia young/female	206SPA070	Cemetery Bridge	samplewater	Num/Rep	125	134	
P. promelas % survival	206SPA070	Cemetery Bridge	samplewater	%	95	108	
P. promelas growth	206SPA070	Cemetery Bridge	samplewater	mg/ind	104	129	
S. capricornutum cell growth	206SPA070	Cemetery Bridge	samplewater	cells/ml	103	53.6	
C. dubia % survival	206SPA200	Lauterwasser Creek	samplewater	%	100	100	
C. dubia young/female	206SPA200	Lauterwasser Creek	samplewater	Num/Rep	99	102	
P. promelas % survival	206SPA200	Lauterwasser Creek	samplewater	%	95	100	
P. promelas growth	206SPA200	Lauterwasser Creek	samplewater	mg/ind	93	116	
S. capricornutum cell growth	206SPA200	Lauterwasser Creek	samplewater	cells/ml	128	118	
C. dubia % survival	206SPA220	Orinda Village	samplewater	%	90	100	
C. dubia young/female	206SPA220	Orinda Village	samplewater	Num/Rep	93	137	

Appendix J: Water and sediment toxicity

ToxSpeciesName	StationCode	StationName	MatrixName	Unit	% of control--Dry	% of control--Spring	% of control--Wet
P. promelas % survival	206SPA220	Orinda Village	samplewater	%	89	108	
P. promelas growth	206SPA220	Orinda Village	samplewater	mg/ind	95	113	
S. capricornutum cell growth	206SPA220	Orinda Village	samplewater	cells/ml	107	125	
C. dubia % survival	206WIL020	Richmond Parkway	samplewater	%	143	100	
C. dubia young/female	206WIL020	Richmond Parkway	samplewater	Num/Rep	145	162	
H. azteca % survival	206WIL020	Richmond Parkway	sediment	%	81.1		
H. azteca growth	206WIL020	Richmond Parkway	sediment	mg/ind	51		
P. promelas % survival	206WIL020	Richmond Parkway	samplewater	%	97	100	
P. promelas growth	206WIL020	Richmond Parkway	samplewater	mg/ind	103	121	
S. capricornutum cell growth	206WIL020	Richmond Parkway	samplewater	cells/ml	98.9	84.4	
C. dubia % survival	207SUI010	Cordelia	samplewater	%	100	100	
C. dubia young/female	207SUI010	Cordelia	samplewater	Num/Rep	118	97	
P. promelas % survival	207SUI010	Cordelia	samplewater	%	100	95	
P. promelas growth	207SUI010	Cordelia	samplewater	mg/ind	87	116	
S. capricornutum cell growth	207SUI010	Cordelia	samplewater	cells/ml	121	129	
C. dubia % survival	207SUI020	Rockville	samplewater	%	143		
C. dubia young/female	207SUI020	Rockville	samplewater	Num/Rep	132		
H. azteca % survival	207SUI020	Rockville	sediment	%	89.2		
H. azteca growth	207SUI020	Rockville	sediment	mg/ind	97.5		
P. promelas % survival	207SUI020	Rockville	samplewater	%	105		
P. promelas growth	207SUI020	Rockville	samplewater	mg/ind	87		
S. capricornutum cell growth	207SUI020	Rockville	samplewater	cells/ml	106		
C. dubia % survival	207SUI060	Putah South Canal (upstream)	samplewater	%	100	100	
C. dubia young/female	207SUI060	Putah South Canal (upstream)	samplewater	Num/Rep	104	118	
P. promelas % survival	207SUI060	Putah South Canal (upstream)	samplewater	%	97	95	
P. promelas growth	207SUI060	Putah South Canal (upstream)	samplewater	mg/ind	99	127	
S. capricornutum cell growth	207SUI060	Putah South Canal (upstream)	samplewater	cells/ml	110	129	
C. dubia % survival	207SUI110	Wooden Valley	samplewater	%	143	100	
C. dubia young/female	207SUI110	Wooden Valley	samplewater	Num/Rep	116	96.1	
P. promelas % survival	207SUI110	Wooden Valley	samplewater	%	97	95	
P. promelas growth	207SUI110	Wooden Valley	samplewater	mg/ind	90	104	
S. capricornutum cell growth	207SUI110	Wooden Valley	samplewater	cells/ml	80.2	135	

Appendix K: Summary coliform data (including 2005 re-sample of some sites)

Station ID	Station Name	Estimated Use	*E. coli* (MPN/100 ml)				
2001 Sites			**8/7/01**	**8/14/01**	**8/21/01**	**8/28/01**	**9/4/01**	**Geometric Mean**
Walker Creek Watershed								
201WLK162	Turtle Pond	beach	70	40	30	170	80	65
Lagunitas Creek Watershed								
201LAG390	Cataract		ND (2)	ND (2)	9	20	40	8
201LAG115	Hagmaier Pond		8	20	1600	80	230	86
201LAG120	Green Bridge		300	30	1600	800	1100	417
201LAG185	Swimming hole @ SPTaylor	beach	50	70	130	40	900	110
201LAG230	Inkwells		70	50	240	110	40	82
San Leandro Creek Watershed								
204SLE190	Canyon School		300	300	110	130	700	246
204SLE200	Huckleberry Preserve		170	3000	110	20	ND (20)	118
204SLE170	Redwood Park (West Fork)		220	80	13	20	130	57
204SLE090	Chabot City Park		110	230	23	40	80	71
204SLE070	Root Park		1600	170	170	>16000	220	696
Wildcat/San Pablo Creeks Watershed								
206WIL130	Lone Oak		500	120	50	40	70	97
206WIL070	Alvarado Park		170	500	500	230	40	208
206SPA060	San Pablo City Park		900	5000	1600	500	140	872
206SPA150	Briones 1		130	170	900	230	NA	260

2002 Sites			**7/22/02**	**7/29/02**	**8/5/02**	**8/12/02**	**8/19/02**	**Geometric Mean**
Pescadero/Butano Creeks Watershed								
202BUT040	Butano Falls		30	17	27	500	30	46
202BUT050	Butano State Park		7	ND (2)	4	4	4	4
202PES060	Community Church		1600	240	130	280	500	371
202PES134	Memorial Park Swim 1	beach	110	30	80	13	17	36
202PES135	Memorial Park Swim 2	beach	30	50	50	13	30	31
202PES150	Jones Gulch		2	ND (2)	23	4	ND (2)	4
202PES193	Iverson Trail		23	80	13	8	23	21
202PES194	Sequoia Nature Trail		70	4	22	8	23	16
San Gregorio Creek Watershed								
202SGR079	San Gregorio confluence		300	300	240	240	240	262
202SGR100	Playbowl		130	240	170	170	130	164
Stevens/Permanente Creeks Watershed								
205STE020	L'Avenida		>1600	>1600	500	500	500	796
205STE070	Chestnut Picnic Area		7	80	50	>1600	7	50
205STE080	Above the Reservoir		130	140	30	240	50	92
205STE090	Camp Cooley		220	23	50	>1600	500	182
205PER080	Lower Meadow/West Branch		300	240	80	50	220	145

2001 Sites			**7/12/05**	**7/19/05**	**7/26/05**	**8/2/05**	**8/9/05**	**8/16/05**	**Geo Mean**
Lagunitas Creek Watershed									
201LAG115	Hagmaier Pond		ND	10	ND	ND	10		10
San Leandro Creek Watershed									
204SLE190	Canyon School		180	160	98	150	120		138
204SLE200	Huckleberry Preserve		52	98	63	4600	400		226
204SLE070	Root Park		63	10	110	30	41		39
Wildcat/San Pablo Creeks Watershed									
206WIL070	Alvarado Park		85	120	520	74	110		134
206SPA060	San Pablo City Park			74	220	150	310	680	220
206SPA150	Briones 1		680	990	730	1100	1400		946

Appendix K: Summary coliform data (including 2005 re-sample of some sites)

Station ID	Fecal Coliform (MPN/100 ml)							
2001 Sites	**8/7/01**	**8/14/01**	**8/21/01**	**8/28/01**	**9/4/01**	**Geometric Mean**	**90th Percentile**	**Average**
Walker Creek Watershed								
201WLK162	70	40	30	170	80	65	134	78
Lagunitas Creek Watershed								
201LAG390	ND (2)	ND (2)	9	20	40	8	32	15
201LAG115	20	20	1600	80	230	103	1052	390
201LAG120	300	30	1600	800	1100	417	1400	766
201LAG185	50	70	130	40	900	110	592	238
201LAG230	70	50	240	110	40	82	188	102
San Leandro Creek Watershed								
204SLE190	300	300	110	130	700	246	540	308
204SLE200	170	3000	110	20	ND (20)	118	1868	664
204SLE170	220	80	13	20	130	57	184	93
204SLE090	110	230	23	40	80	71	182	97
204SLE070	1600	170	170	>16000	220	696	10240	3632
Wildcat/San Pablo Creeks Watershed								
206WIL150	500	120	50	40	70	97	348	156
206WIL070	170	500	500	230	40	208	500	288
206SPA060	900	5000	1600	500	140	872	3640	1628
206SPA150	130	170	900	230	NA	260	699	358

2002 Sites	**7/22/02**	**7/29/02**	**8/5/02**	**8/12/02**	**8/19/02**	**Geometric Mean**	**90th Percentile**	**Average**
Pescadero/Butano Creeks Watershed								
202BUT040	30	17	27	500	30	46	312	121
202BUT050	7	ND (2)	4	4	4	4	6	4
202PES060	1600	240	130	280	500	371	1160	550
202PES134	110	30	80	13	17	36	98	50
202PES135	30	50	50	13	30	31	50	35
202PES150	2	1	23	4	ND (2)	3	15	6
202PES193	23	80	13	8	23	21	57	29
202PES194	70	7	22	8	23	18	51	26
San Gregorio Creek Watershed								
202SGR079	300	300	240	240	240	262	300	264
202SGR100	130	240	170	170	130	164	212	168
Stevens/Permanente Creeks Watershed								
205STE020	>1600	>1600	500	500	500	796	1600	940
205STE070	7	80	50	>1600	7	50	992	349
205STE080	130	140	30	240	50	92	200	118
205STE090	220	23	50	>1600	500	182	1160	479
205PER090	300	240	80	50	220	145	276	178

Appendix K: Summary coliform data (including 2005 re-sample of some sites)

Station ID	Total Coliform (MPN/100 ml)						
2001 Sites	**8/7/01**	**8/14/01**	**8/21/01**	**8/28/01**	**9/4/01**	**Median**	**Geometric Mean**
Walker Creek Watershed							
201WLK162	70	130	1600	170	700	170	280
Lagunitas Creek Watershed							
201LAG390	ND (2)	ND (2)	1600	20	500	20	36
201LAG115	20	20	1600	110	500	110	129
201LAG120	1600	500	1600	1700	5000	1600	1612
201LAG185	170	40	1600	80	9000	170	379
201LAG230	140	1100	1600	110	300	300	382
San Leandro Creek Watershed							
204SLE190	300	700	1600	500	700	700	652
204SLE200	170	3000	1600	20	ND (20)	170	201
204SLE170	1600	230	1600	70	300	300	415
204SLE090	170	500	1600	700	130	500	415
204SLE070	1600	500	1600	>16000	500	1600	1592
Wildcat/San Pablo Creeks Watershed							
206WIL150	500	800	1600	40	140	500	324
206WIL070	900	500	1600	300	40	500	387
206SPA060	1600	9000	1600	2400	140	1600	1506
206SPA150	1600	2200	1600	2400	NA	1900	1917

2002 Sites	**7/22/02**	**7/29/02**	**8/5/02**	**8/12/02**	**7/19/02**	**Median**	**Geometric Mean**
Pescadero/Butano Creeks Watershed							
202BUT040	900	900	1600	>1600	9000	1600	1796
202BUT050	1600	900	>1600	900	1600	1600	1271
202PES060	>1600	>1600	13000	7000	13000	7000	4969
202PES134	1600	>1600	8000	1600	2200	1600	2353
202PES135	1600	1600	8000	>1600	3000	1600	2503
202PES150	300	500	1600	500	1600	500	719
202PES193	>1600	900	900	500	5000	900	1265
202PES194	1600	900	1600	1600	5000	1600	1791
San Gregorio Creek Watershed							
202SGR079	1600	1600	13000	1600	>1600	1600	2433
202SGR100	1600	1600	5000	1600	9000	1600	2839
Stevens/Permanente Creeks Watershed							
205STE020	>1600	>1600	17000	30000	30000	17000	8291
205STE070	>1600	>1600	5000	11000	8000	5000	4077
205STE080	>1600	>1600	13000	7000	17000	7000	5243
205STE090	>1600	>1600	11000	30000	16000	11000	6702
205PER090	>1600	1600	3000	17000	5000	3000	3656

2001 Sites	**7/12/05**	**7/19/05**	**7/26/05**	**8/2/05**	**8/9/05**	**8/16/05**	**Median**	**Geo Mean**
Lagunitas Creek Watershed								
201LAG115	2500	3300	1500	3700	6100		3300	3085
San Leandro Creek Watershed								
204SLE190	2100	1800	1700	2400	3900		2100	2269
204SLE200	5200	12000	8300	17000	11000		11000	9936
204SLE070	3700	9200	24000	11000	2900		9200	7642
Wildcat/San Pablo Creeks Watershed								
206WIL070	8700	8200	24000	6900	12000		8700	10723
206SPA060		3900	7700	6900	6100	7300	6900	6209
206SPA150	11000	13000	13000	8200	1800		11000	7721