Attachment 6

Stormwater Flood Management Grant Proposal
Lower Silver Creek, Reaches 4 – 6, and Lake Cunningham
Monitoring, Assessment, and Performance Measures

Attachment 6 consists of the following items:

- ✓ **Performance Measures**. The purpose of Attachment 6 is to describe the monitoring, assessment, and performance measures that will be used to evaluate each proposed project. These measures will ensure that this proposal meets its intended goals, achieves measurable outcomes, and provides value to the Region and the State of California.
- ✓ **Appendix 6-1.** This appendix contains supporting monitoring plan documentation.

This attachment presents the Project's monitoring, assessment, and performance measures that will demonstrate how the Project will meet its goals and objectives, achieve measurable outcomes, and provide benefit to the Region and State. The District will implement specific performance and monitoring measures to quantify and verify how well the Project is meeting objectives through Project completion in 2014 and over the long-term. Project objectives are listed Table 6-1. This attachment also will identify output indicators that will effectively track output, the monitoring system that will be used to verify project performance with respect to objectives, and data collection techniques and analysis.

Specific performance measures are required by the Letter of Map Revision (LOMR) process, in order to formally remove benefiting properties from the 100-Year flood zone. Similarly, existing regulatory permits for the Project require the implementation of a Mitigation Monitoring Plan (MMP) that sets specific performance measures for new riparian and wetland habitats in terms of percent cover at 5- and 10-years following Project completion.

This attachment also outlines methodologies for assessing the Project's performance in meeting the overall goals and objectives of the Bay Area IRWM Plan, as presented in Attachment 3, Work Plan. Table 6-3 is provided at the end of this attachment and includes the following criteria that will be applied for each of the Project goals and objectives:

- Project goals
- Desired outcomes
- Output indicators – measures to effectively track output
- Outcome indicators – measures to evaluate change that is a direct result of the work
- Measurement tools and methods
- Targets – measureable targets that are feasible to meet during the life of the project

Project: Lower Silver Creek, Reaches 4-6, and Lake Cunningham Flood Protection Project

As described in Attachment 3, Work Plan, the Project consists of two components (Lower Silver Creek, Reaches 4 – 6; and Lake Cunningham) designed with the primary goals of providing 100-year flood protection benefits to properties within northeastern sections of the City of San Jose and incorporating watershed restoration benefits. Various activities will be executed in order to meet Project objectives (listed below). Project objectives each will have performance measures that will be used to quantify and verify project performance. The Project objectives are listed in Table 6-1.

Table 6-1. Project Goals and Objectives

Project Goals	Project Objectives
Provide flood protection benefits to existing communities within the Lower Silver Creek Watershed.	Construct the necessary improvements to enable the removal of 3,800 homes in surrounding communities from the current 100-year flood zone for Lower Silver Creek as delineated by the Federal Emergency Management Agency (FEMA).
Incorporate watershed restoration benefits.	Reduce erosion and sedimentation within Lower Silver Creek by constructing improvements to reduce channel bank failures and increase the sediment storage capacity that will enable plant colonization.
	Construct improvements that will enable the reestablishment of fish passage along Lower Silver Creek.
	Improve water quality through reduced erosion and sedimentation control and creek maintenance to control trash.
	Encourage the expansion of the City of San Jose's trail system and thus recreation by constructing a maintenance road that could serve multiple uses, including trail use and increased access for maintenance purposes.
	Promote watershed restoration through the reestablishment of natural wetland, riparian, and upland habitats

Project Objectives and Performance Measures

The Project exemplifies an integrated flood protection and habitat restoration project that yields multiple benefits in terms of improved flood management and reduced flood frequency, protection of public health and public/private property, improved water quality, both in terms of ecosystem restoration and reduced sedimentation, and proactive response to the effects of climate change. Each of the Project objectives are called out below along with the general performance measures that the District will apply quantifying and/or verifying Project performance.

Remove 3,800 Homes from 100-Year Flood Zone. The Project will increase the capacity of the Lower Silver Creek channel and Lake Cunningham to safely handle a 100-year flood event. In addition, access to the creek channel will be improved, which in turn will facilitate improved access for maintenance activities to maintain the channel's engineered design capacity. The Project will contribute to the protection of public safety and property by removing homes, business, and roads from the 100-year flood zone of Lower Silver Creek.

Performance Measure 6.1: The District will coordinate the completion of the Letter of Map Revision process for applicable Flood Insurance Rate Maps (FIRM) with the City of San Jose to support the removal of communities in northeastern San Jose from the 100-year flood plain. This will include preparing the revisions to applicable FIRMs and the provision of all technical information, included revised HEC-1 and 2 data, planning level design analyses and calculations for new/revised project features, topographic mapping, and surveys for changes made to the proposed project should be incorporated into the LOMR package for final review.

Performance Measure 6.2: The District will produce "As Built" drawings for both components of the Project following the close out of construction to provide evidence of the constructed Project. Photo-documentation also will be provided to illustrate pre- and post-construction Project conditions and may correspond with those developed for compliance with the Project MMP.

Performance Measure 6.3. The Project's engineered design capacity will be maintained in perpetuity through the integration of the Project into the District's Stream Maintenance Program (SMP) (2006).

The SMP will be updated, as appropriate, to include Components 1 and 2 of the Project. Maintenance activities for the Project will be documented annually in the SMP's Annual Report.

Performance Measure 6.4. The District shall document compliance with environmental mitigation measures proposed in the Project's Mitigation Monitoring and Reporting Program (MMRP) to avoid or minimize significant adverse effects to adjacent properties.

Reduce Erosion and Sedimentation. Component 1 of the Project would include an improved channel design that would decrease banks failures and provide increased bank protection through a combination of riparian plantings and armoring of the channel.

Performance Measure 6.5. In conjunction with the implementation of Performance Measure 6.3, the District will specifically document all sediment removal, vegetation management, and bank protection activities undertaken for the Project. Documentation will include a description and photograph(s) of the maintenance issue (e.g. sedimentation, vegetation control), the measures recommended to correct the problem, the date the corrective action was completed, and confirmation that the measure is effective.

Reestablish Fish Passage. Component 1 of the Project would result in improved fish passage by creating a sediment transport channel that would facilitate the formation of habitat (e.g. pools) and removing barriers.

Performance Measure 6.6. In conjunction with the implementation of Performance Measure 6.3, the District shall maintain the low-flow channel to be free of physical obstructions that could otherwise impede fish passage. A fish passage survey should be completed biannually during the course of the implementation of the MMP to verify that the low-flow channel is free of obstructions.

Performance Measure 6.7. Water temperature and dissolved oxygen (DO) levels within Reaches 4-6 should meet applicable water quality objectives and standards.

Performance Measure 6.7a. Open Water Habitat. At Monitoring Year 10, open water habitat is provided within the base-flow channel along the entire length of Component 1 of the Project.

Performance Measure 6.7b. Riparian Habitat. By Year 5, all self-sustaining planted stock (trees and shrubs) must have either 80 percent survival or the revegetation sites must should have an absolute woody vegetation canopy cover of 30 percent or greater. After Year 10, the riparian woody canopy cover must show a steady trend towards 70 percent and no less that 50 percent absolute woody vegetation cover at each planting site.

Performance Measure 6.7c. Target Hydrologic Regime. To provide functional open water habitat and to account for possible drought years, flowing water should be present in the base flow channel for a minimum of 10 months in most years; except under exceptionally prolonged droughts.

Improve Water Quality. The Project will contribute to improvement in water quality by improving the hydrologic function of Lower Silver Creek by controlling excessive in-stream erosion and sedimentation, establishing and expanding the existing riparian corridor, and facilitating a reduction in the trash impairment for Lower Silver Creek, which is listed on U. S. EPA's 303(d) list.

Performance Measure 6.8. Implementation of measures 6.3, 6.5, and 6.7.

Performance Measure 6.9. The District shall quantify the amount of trash removed from the Project annually using the San Francisco Bay RWQCB's Rapid Trash Assessment. This information will be provided to the San Francisco Bay RWQCB (Region 2) for its use in calculating total load reductions to Lower Silver Creek.

Promote Watershed Restoration. Facilitate the restoration of wetland, shaded aquatic riparian, and upland habitats to encourage the reestablishment of native vegetation and promote biodiversity.

Performance Measure 6.10. Facilitate the creation of habitat acreages specified in the Project's permits (e.g. 404 Permit) for emergent wetlands, open water/emergent wetlands, riparian habitat, and Uplands. Component 1 of the Project will be required to demonstrate the creation of 2.27 acres of

upland habitat, 1.82 acres of riparian habitat, 1.7 acres of open water/emergent wetlands, and 0.10 acre of emergent wetland. The District will complete additional resource permitting for Component 2 of the Project to define mitigation requirements and performance measures for the post-construction condition. Permit requirements for Component 2 will be integrated into the Project MMP.

Performance Measure 6.10a. In-Channel (Wetland) Vegetative Cover**.** For the areas expected to have wetland vegetation by the end of Monitoring Year 10, the wetland areas should establish over most of the channel area and kept free of significant stands of giant reed.

Performance Measure 6.10b. Open Water Habitat*.* Implement Performance Standard 6.7b.

Performance Measure 6.10c. Upland Trees and Shrubs. By Year 5, all self-sustaining plant stock (trees and shrubs) must have either 70 percent survival or the revegetation sites must have an absolute woody vegetation canopy cover of 30 percent or greater within a specific-reach planting site. After Year 10, the riparian woody canopy cover must show a steady trend towards 70 percent and no less that 50 percent absolute woody vegetation cover at each planting site.

Performance Measure 6.10d. Invasive Plant Species**:** Weed control will be focused on controlling the invasive giant reed. Other target invasive plant species are Tier 1 and Tier 2 species listed in the Water Board's Fact Sheet for Wetland Projects http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml**.** Non-wetland invasive plant species that establish in the uplands should also be controlled**.**

Performance Measure 6.10e. Riparian Habitat. Implement Performance Standard 6.7b.

Performance Measure 6.10f. Target Hydrologic Regime. Implement Performance Standard 6.7c.

Expand Trail System

Performance Measure 6.11. The District shall coordinate with the City of San Jose Parks and Recreation Department to encourage the integration of the Project into the City's trail network as specified in its adopted Trails Master Plan (e.g. Greenprint). This District shall document and track correspondence with the City of San Jose Parks and Recreation Department to encourage the implementation of its Trails Master Plan for portions that would integrate with the Project. The District will provide documentation in support of these efforts through Year 5 of the monitoring plan.

Monitoring Methods

This section provides an overview of the monitoring system to be used to verify Project performance with respect to the project benefits or objectives identified in the Proposal. This discussion includes a description of where and how the data will be collected and the types of analyses to be used to measure the Project's performance in meeting the overall goals and objectives of the IRWM Plan.

Flood Protection and Capacity Maintenance

LOMR Process. The primary means of monitoring the benefits derived from the Project's flood control improvements is the completion of the (LOMR) process and approval of revised FIRMs for the Project vicinity. This process cannot be completed without the design work for the Component 2 flood control. Based on this circumstance, the District will likely have its design engineer for the Lake Cunningham improvements also perform the floodplain analysis.

The District has not decided on whether to apply for a conditional LOMR or a regular LOMR. If a conditional LOMR (CLOMR) is submitted based on a certain design, the approved LOMR from FEMA is then conditioned on the completion of that design. A standard LOMR can only be approved after the construction of the project is completed. Typically there is no additional work required for a conditional letter except for the notification to FEMA of the completion of project construction and submission of the 'as-built' plans as evidence of compliance with the conditions of the CLOMR.

FEMA recommends using the conditional letter since it avoids costly retrofits if, or usually when, FEMA requires something that was not anticipated during the original design and construction of the Project. A conditional letter generally guarantees that after the project is finalized the FIRM will be revised. Based on this direction, the District anticipates the submittal of a CLOMR application following the completion of a

draft Engineer's Report for Component 2. This will allow Project Team sufficient time to coordinate, resolve, and incorporate FEMA's review comments into the Final Engineer's Report and final environmental document. All submittal documents and correspondences will be carefully documented for future verification and submittal use when preparing for a LOMR package. After issuance of a CLOMR, all technical support data, including but not limited to, revised HEC-1 and 2 data, planning level design analyses and calculations for new/revised project features, topographic mapping, and surveys for changes made to the Project will be incorporated into the LOMR package for final review.

Stream Maintenance Program. Beyond the LOMR process, the District would also continue to implement its Flood Protection and Stream Stewardship Program (2010) (see Appendix 6A-1) to maintain the flood carrying capacity of the Project facilities. This program has funding through 2016 and the District is currently conducting public outreach to extend the life of the program another 10 years. The monitoring frequency and focus of District inspections for all Project facilities will include the following:

- 100 percent of flood protection facilities are inspected a minimum of two times annually to assess their condition and readiness to convey design flows.
- Field maintenance programs are provided at a 100 percent level of service for preventative and corrective maintenance as prescribed in the District's SMP.
- 100 percent of identified bank or channel bottom erosion threats to flood protection infrastructure are repaired.

These activities would be covered under the umbrella of the District SMP (included in Appendix 6A-2), which outlines the procedures for implementing all of the District's routine stream maintenance activities, including three major types of activities: sediment removal, vegetation management, and bank protection. The SMP outlines specific measures, protocols, policies, and reporting requirements to ensure that routine stream maintenance projects are implemented in an efficient and environmentally-sensitive manner. The SMP is subject to future revisions as improvements and modifications are made to reflect the best available knowledge, technology, practices, and regulations.

Actual maintenance activities for the Project under the SMP would vary from year to year. The following provides a brief discussion of the major monitoring activities that would take place under the existing SMP for the Project. These actives would occur along the entire length of Component 1 and in accordance with the MOU between the District and the City of San Jose. Decisions regarding the necessity of routine sediment removal and vegetation management activities (to restore channel flow capacities) will be made following the thresholds established in the Maintenance Guidelines. Beyond these activities, the SMP would also apply to more minor activities such as fence repair, trash removal, and removal of downed trees or other blockages.

- *Sediment Removal*. Sediment removal is the act of mechanically removing sediment that has been deposited within a stream. Typically, sediment is removed when it: (1) reduces stream capacity, (2) prevents facilities or appurtenant structures from functioning as intended, or (3) impedes fish passage.
- *Vegetation Management*. The District removes vegetation in and adjacent to creeks and canals to maintain the ability of channels to function for flood protection. In addition, vegetation is removed to meet local fire code requirements and to reduce combustible weeds and grasses on property adjacent to the streams within the District's jurisdiction. Vegetation management is typically implemented through mowing, discing, hand clearing, or herbicide applications.
- *Bank Protection*. Bank protection involves any action by the District to repair stream banks that are eroding as well as preventative erosion protection. The District implements bank protection when the problem: (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation, (4) negatively affects beneficial uses of surface water, or (5) negatively affects riparian habitat. Repairs may take several forms ranging from the installation of "hard" structures (i.e., rock, concrete, sack concrete, gabions) to the use of "soft" structures (i.e., willow brush mattresses, log crib walls, pole plantings), or a combination of hard and soft structures. Bank protection also includes preventative maintenance to ensure that banks do not erode in the future. Such bank protection can reduce sedimentation and improve water quality.

These activities would be documented annually as part of the SMP reporting protocol.

Water Quality Monitoring

Water Quality Monitoring Program. The monitoring of water quality improvements following the completion of the Project would be conducted under the existing Multi-Year Receiving Waters Monitoring Plan (see Appendix 6A-3) (Revised March 2004), which is part of the Santa Clara Valley Urban Runoff Pollution Prevention Plan (SCVURPPP) (see Appendix 6A-4). The Multi-Year Receiving Waters Monitoring Plan includes monitoring data for Coyote Creek for the following periods: 1979-1981; 1987-1996; and 2001-2009. These studies provide a baseline of information from which the water quality improvements for Lower Silver Creek can be evaluated. The District will be responsible for coordinating with its co-permittees to ensure that monitoring activities for the Project are prioritized for post-construction monitoring after 2014 and that the necessary financial resources are allocated to ensure implementation.

Monitoring parameters will be focused on general water quality parameters, including temperature, pH, conductivity, turbidity, and DO. Sampling would occur quarterly and at up to two locations: (1) downstream segment of Component 1, and (2) immediately downstream of Lake Cunningham. No sampling for pollutants of concerns (e.g. metals, herbicides, etc.) is proposed in conjunction with the monitoring program.

Rapid Trash Assessment. The District would implement the RWQCB's Rapid Trash Assessment (RTA) (see Appendix 6A-5) method to evaluate the condition of the Project reaches with respect to trash over time. Monitoring would be conducted biennially in conjunction with the District's SMP.

Ecosystem and Habitat Restoration and Functionality

Photo Documentation. Per the requirements of the Project's MMP (see Appendix 6A-6), the District will establish permanent photo documentation points for both Project components. The location of the photo documentation site will be GPS'd to facilitate relocation and a GIS map of the location will be created as part of the first monitoring report. The photo documentation points will include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. The placement of a permanent T-post or metal fence post marking the photo points will improve consistency between years.

Photos will be taken from these photo documentation points each monitoring year (see Table 6-2) at the same camera angle, using a north, south, east, west compass bearing axis at the selected photo points, as appropriate to illustrate site conditions. Photographs will be taken from approximately five feet in height, with exact height recorded using a standardized tripod or rod to ensure consistency of height from year to year. In addition to the permanent photo stations, photographs will also be taken from the origin of each vegetation monitoring transect looking north, south, east, and west.

Fish Passage. Fish passage surveys will be completed biennially during the course of the implementation of the MMP (first ten years following construction) to verify that the lows-flow channel is free of obstructions that could otherwise impede fish passage.

To monitoring and document the progression of habitat restoration, the District would undertake the following activities on an annual basis to evaluate success in relation to the performance measures in the MMP:

- Establish Monitoring Protocol for Estimating Vegetative Cover
- Non-native Invasive Plant Monitoring
- General Site Inspections
- Wetland Delineation

These general site inspections together are intended to assess the overall functioning of the site as a whole, and also to help identify localized or low-level trends such as new invasive species formations, localized changes in species abundance, and other changes that might be important to address through

remedial management actions. The following data will be collected during the site assessment and rated according to the criteria in Table 6-2:

Table 6-2. Qualitative Score for Assessing the Health and Vigor of Planted Stock

Score	Description of Score
Excellent	No evidence of stress; minor pest or pathogen damage may be present. No chlorotic leaves, no or very minor herbivory (browse). Evidence of new growth, flowering, seed set on majority (greater than 75%) of plants observed.
Good	Some evidence of stress. Pest or pathogen damage present, few chlorotic leaves (> 5%), minor evidence of herbivory (browse). Evidence of new growth, flowering, seed set on most (greater than 50%) of plants observed.
Fair	Moderate level of stress; high levels of pest or pathogen damage, some chlorotic leaves (> 10%), some herbivory damage (few snapped leaves, stems, wear marks etc.). Evidence of new growth, flowering, seed set on some (less than 50%) of plants observed.
Poor	High level of stress; high levels of pest or pathogen damage, many chlorotic leaves (> 30%), severe herbivory damage (massive forage damage, main stems/leaves stripped etc.). No evidence of new growth, flowering, or seed set, or only a few plants (less than 25%) with these characteristics.

Data should be collected at approximately the same time each year to standardize results (i.e., within a 2 week window, adjusted annually to account for seasonal variations in vegetation conditions, weather, precipitation, and temperature).

Table 6-3 provides an overview of the monitoring schedule over the first five years following the Project.

Table 6-3. Project Monitoring Timeline

Monitoring Element	Post-Construction Timeline[1]				
	Year 1	Year 2	Year 3	Year 4	Year 5
Vegetation Survey,[2] Photo Documentation, and General Site Inspection	X	X	X	X	X
Invasive Plant Inspection	X	X	X	X	X
Wetland Delineation					X
Open Water/Wetland Hydrologic Functioning Inspection	X	X	X	X	X
Trail Use Inspection[3]		X	X	X	X
Letter of Map Revision	X	X	X		
Fish Passage Surveys		X		X	
Multi-Year Receiving Water Quality Monitoring Plan	X	X	X	X	X
SMP Implementation	X	X	X	X	X

Notes:
1. Post-construction monitoring period will differ for each reach as they are completed.
2. Monitoring transects and quadrants.
3. Pending trail implementation by the City of San Jose.

If the grant application is successful, upon implementation of the proposal, Table 6-4 will be used as an outline for developing the Project monitoring plan and data management structure as described under Task 3 of the Work Plan, Attachment 3.

Table 6-4. Performance Measures Table Lower Silver Creek, Reaches 4-6 Flood Protection Project

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Provide flood protection benefits to existing communities within the Lower Silver Creek Watershed.	Enable the removal of 3,800 homes in surrounding communities from the current 100-year flood zone for Lower Silver Creek as delineated by the Federal Emergency Management Agency (FEMA).	Performance Measure 6.1 Performance Measure 6.2 Performance Measure 6.4	Performance Measure 6.3	Completion of the LOMR process and approval of revised FIRMs; Production of "As-Builts."	Decreased flood damages to homes and businesses Protect property, businesses, and transportation; Protect public health and safety.
Incorporate watershed restoration benefits.	Reduce erosion and sedimentation within Lower Silver Creek by constructing improvements to reduce channel bank failures and increase the sediment storage capacity that will enable plant colonization.	Performance Measure 6.2 Performance Measure 6.10	Performance Measure 6.3 Performance Measure 6.5	Measure turbidity; Inspect for channel erosion and sedimentation via SMP.	Channel stabilization Reduced erosion and sedimentation.
Incorporate watershed restoration benefits.	Construct improvements that will enable the reestablishment of fish passage along Lower Silver Creek.	Performance Measure 6.6	Performance Measure 6.7 Performance Measure 6.7a Performance Measure 6.7b Performance Measure 6.7c Performance Measure 6.7d	Fish passage surveys.	Improved aquatic habitat conditions for fish.
Incorporate watershed restoration benefits.	Improve water quality through reduced erosion and sedimentation control, and creek maintenance to control trash.	Performance Measure 6.2	Performance Measure 6.3 Performance Measure 6.5 Performance Measure 6.8 Performance Measure 6.9	Rapid Trash Assessment (RTA) method; Measure temperature, pH, conductivity, turbidity, and DO.	Improved water quality; Reduced trash impairment; improved stream hydrology and function.
Incorporate watershed restoration benefits.	Encourage the expansion of the City of San Jose's trail system and thus recreation by constructing a maintenance road that could serve multiple uses, including trail use and increased access for maintenance purposes.	Performance Measure 6.2	Performance Measure 6.11	Coordination with the City of San Jose in its implementation of its Trails Master Plan.	Public access and recreational trail use.

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Incorporate watershed restoration benefits.	Promote watershed restoration through the reestablishment of natural wetland, riparian, and upland habitats.	Performance Measure 6.10	Performance Measure 6.10a Performance Measure 6.10b Performance Measure 6.10c Performance Measure 6.10d Performance Measure 6.10e Performance Measure 6.10f	Implementation and compliance with Project MMRP and MMP.	Compliance with habitat mitigation requirements in MMP and successfully restored.

APPENDIX 6A-1

STREAM FLOOD PROTECTION AND STEWARDSHIP PROGRAM, DRAFT 2010

2010

DRAFT: Flood Protection and Stream Stewardship Master Plan

PRELIMINARY REVIEW DRAFT

CHAPTERS 1 THROUGH 3

Santa Clara Valley Water District

9/30/2010

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FLOOD PROTECTION AND STREAM STEWARDSHIP MASTER PLAN

PRELIMINARY REVIEW DRAFT
JUNE 2010
(Corrected: September 2010)

The mission of the district is a healthy, safe and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective and environmentally-sensitive manner for current and future generations.

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Table of Contents

1 INTRODUCTION 1-3

1.1 DISTRICT MISSION 1-1

1.2 MASTER PLAN OBJECTIVE 1-2

1.3 BUILDING ON A STRONG FOUNDATION 1-2

1.4 STUDY AREA 1-4

1.5 PLANNING HORIZON AND RELATIONSHIP TO OTHER DISTRICT PLANS 1-6

1.6 REPORT METHODOLOGY AND ORGANIZATION 1-7

1.7 STAKEHOLDER ENGAGEMENT 1-8

2 GOALS AND OBJECTIVES 2-1

2.1 BOARD POLICY FRAMEWORK - DEFINITIONS AND OVERVIEW 2-1

2.1.1 Board Policy Framework Definitions 2-1

2.1.2 Board Policy Framework Overview 2-2

2.2 MASTER PLAN GOALS AND OBJECTIVES 2-3

2.3 MASTER PLAN STRATEGIES 2-4

2.3.1 Strategies Related To the Goal of Natural Flood Protection for Residents, Businesses, and Visitors 2-4

2.3.2 Strategies Related To the Goal of a Reduced Potential for Flood Damages 2-6

2.3.3 Strategies Related To the Goal of Healthy Creek and Bay Ecosystems 2-7

2.3.4 Strategies Related To the Goal of Clean Safe Water in Creeks and Bays 2-9

2.3.5 Strategies Related To the Goal of Improved Quality of Life in Santa Clara County through Trails, Open Space and Water Resources Management 2-10

3 FLOOD PROTECTION AND STREAM STEWARDSHIP PROGRAM 3-1

3.1 FLOOD PROTECTION AND STREAM STEWARDSHIP PROGRAM OVERVIEW 3-2

3.2 FLOOD PROTECTION AND STREAM STEWARDSHIP – SUPPORTING OPERATIONAL PROGRAMS AND CAPITAL PROJECT DESCRIPTIONS 3-3

3.2.1 Natural Flood Protection 3-3

3.2.2 Reduced Potential for Flood Damages 3-18

3.2.3 Healthy Creek and Bay Ecosystems 3-23

3.2.4 Clean Safe Water in Our Creeks and Bays 3-35

3.2.5 Trails, Open Space and Water Resource Management 3-40

3.3 FINANCIAL ANALYSIS.....3-42
3.3.1 Budget Overview.....3-42
3.3.2 Long Term Forecast Overview and Assumptions.....3-43
3.3.3 Flood Protection and Stream Stewardship Program Financial Outlook – FY 2010 to FY 2016 3-44
3.3.4 Flood Protection and Stream Stewardship Program Financial Outlook - FY 2017 to FY2035 3-45
3.4 FINDINGS.....3-47

1 INTRODUCTION

The Santa Clara Valley Water District

is the primary water resource management agency for Santa Clara County, California. Its key products and services are wholesale treated water; flood protection; environmental stewardship, and open space and trails.

The district provides a reliable supply of clean, safe water for the 1.8 million people of the county. It also works to protect residents and businesses from the devastating effects of flooding; and serve as environmental stewards for the county's 800-plus miles of streams and creeks, groundwater basins and district-owned reservoirs.

The Santa Clara Valley Water District is unique in the state as an independent special district with countywide responsibility for multiple functions of water resource management.

1.1 DISTRICT MISSION

Santa Clara Valley Water District Headquarters

The mission of the Santa Clara Valley Water District (district) is a healthy, safe, and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective and environmentally sensitive manner for current and future generations. The District Board has adopted Ends Policies that describe desired ends, goals, and objectives related to core missions of water supply, flood protection, and water resource stewardship.

Protecting homes, businesses and transportation networks from the devastating effects of floods is one of three core missions of the district. Through the years, as the county's population and economy have grown, the district has worked hard to keep pace with the construction of appropriate flood protection projects.

The district employs numerous flood protection technologies that help keep creeks as natural and beautiful as possible. District goals have kept pace with changing community values. New multipurpose flood protection projects protect property while preserving habitat, improving water quality and providing creekside trails. Concern for sensitive or threatened species has resulted in dramatic changes in the ways the district constructs flood protection projects.

The field of flood protection and stream stewardship has undergone a number of significant changes over the past 35 years. These changes have included greater oversight and more stringent regulatory requirements, changes in environmental laws, changes in the public's values regarding creek and habitat protection, and changes in the ability of public agencies to fund flood protection and stream stewardship projects.

In response to changing environmental values and laws, the district modified its official mission statement in 2002 to include watershed stewardship as a key component of its charter, in addition to flood protection and water supply core missions. Another important milestone occurred in November 2000 when over two thirds of the county voters approved the Clean, Safe Creeks and Natural Flood Protection special parcel tax (Clean, Safe Creeks special tax). The special parcel tax provides critical funding to continue flood protection projects and to fund water quality, environmental enhancement, and trails and open space projects.

In December 2009, the Board approved revised policies to clarify its Policy Governance framework; which includes policies in a hierarchical framework from the broadest, to more defined levels of specificity. The framework is organized in the following order: general principles, ends, goals, objectives, strategies, and implementing measures.

In doing so, the Board revised policies and clarified desired outcomes related to two of the core missions of the district - flood protection, and water resource stewardship:

- Natural flood protection for residents, businesses, and visitors
- Reduced potential for flood damages

- Healthy creek and bay ecosystems,
- Clean, safe water in creeks and bays
- Trails, open space and water resources management

The End Policies and Policy Governance are discussed in more detail in Chapter 2. Copies of the most recent Board Policies can be obtained at: http://www.valleywater.org.

In recognition of these changes, as well as future challenges looming in the horizon, particularly in the funding arena with the approaching sunset of Clean, Safe Creeks special tax funding in 2016, the district has decided to develop this Flood Protection and Stream Stewardship Master Plan (master plan).

1.2 MASTER PLAN OBJECTIVE

The objective of the master plan is to guide the strategic investment of public funds in Santa Clara County over the next 25 years. Specifically, the master plan will serve as a tool for strategic long term planning to achieve the district's goals and objectives. It will identify project and program priorities, establish guidance and project selection criteria, identify challenges and future funding considerations.

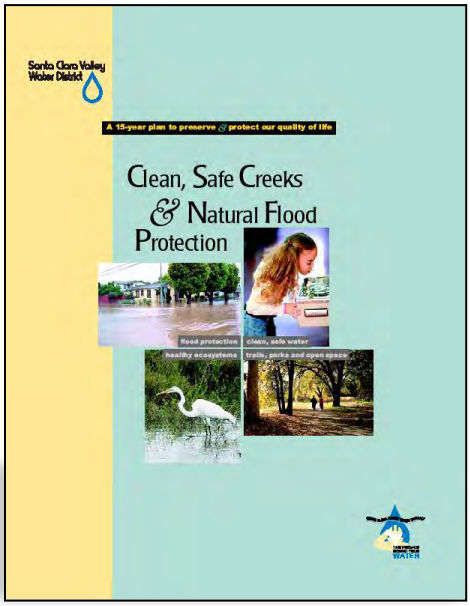
The master plan objectives apply to the following areas:

- Natural flood protection for residents, businesses, and visitors
- Reduced potential for flood damages
- Healthy creek and bay ecosystems,
- Clean, safe water in creeks and bays
- Trails, open space and water resources management

1.3 BUILDING ON A STRONG FOUNDATION

The master plan considers two distinct planning horizons: FY 2010 to FY 2016 and FY 2017 to FY 2035. The district's comprehensive Flood Protection and Stream Stewardship Program will no longer receive funding from the Clean, Safe Creeks special tax in 2016. Therefore, the master plan is divided into the two planning horizons to reflect changes in the funding outlook after 2016. Planning past 2016 allows the district to strategically build upon the Clean, Safe Creeks Plan achievements, and re-evaluate the community's values and needs. This master plan is built upon the strong foundation of the existing Clean, Safe Creeks Plan and the comprehensive Flood Protection and Stream Stewardship Program. The Clean, Safe Creeks Plan is summarized below.

Clean, Safe Creeks and Natural Flood Protection 15-year Plan



The Clean, Safe Creeks Plan is an integral part of the comprehensive Flood Protection and Stream Stewardship Program. The Clean, Safe Creeks Plan, which will sunset in 2016, was approved by Santa Clara County Voters in November 2000 and provides a significant source of funding for the overall Flood Protection and Stream Stewardship Program.

The Clean, Safe Creeks Plan was structured into the following four key outcomes to better respond to the needs and desires of the Santa Clara County community:

Outcome 1: Homes, schools, businesses and highways are protected from flooding and erosion includes six ongoing and nine new capital projects to protect homes, schools, businesses and roadways from flooding. The flood protection projects also include stream habitat restoration, removal of invasive plants, replanting of native species, improvement in water quality, and new recreational opportunities. In addition, the program also includes higher level of service for emergency response, land development review and creek maintenance to preserve the flood conveyance capacity of creeks.

Outcome 2: Clean, safe water in our creeks and bays focuses on reducing pollutants such as mercury and diazinon from local waterways. The outcome also includes an increase in the "No Dumping Flows to Bay" programs, as well as cleaning creeks of illegally dumped chemicals. The Good Neighbor Maintenance program provides staff to clean up trash and graffiti and patrol creeks for illegal dumping. In addition, this outcome includes new pollution prevention programs to detect and manage toxic materials and sediments that pollute creeks and the San Francisco and Monterey bays.

Outcome 3: Creeks and bay ecosystems protected, enhanced or restored provides for the restoration or construction of 100 acres of tidal and/or riparian habitat. The outcome also includes the removal of nonnative, invasive plants and the revegetation of riparian areas with native plant species. Furthermore, the program includes the removal of fish migration barriers, installation of fish ladders, repair of streambed erosion to decrease sedimentation and turbidity, and the improvement of water quality.

Outcome 4: Additional open spaces, trails and parks along creeks and in the watersheds provides for partnerships between the district and local jurisdictions to allow access to creekside trails and parks. The outcome also provides for access to bicycle paths for alternative transportation and increases community recreation opportunities countywide.

1.4 STUDY AREA

The master plan study area encompasses all of Santa Clara County's 1,300 square miles including the county's 15 local jurisdictions: Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale.

Watersheds of the Study Area

Santa Clara County is home to five watershed areas as shown in Figure 1.1. The Coyote, Guadalupe, Lower Peninsula and West Valley watershed areas drain north into the southern part of San Francisco Bay while the Uvas-Llagas watershed flows south into the Pajaro River and on to Monterey Bay.

Watershed Definition
A watershed is the land area from which water drains into a major body of water. Local watersheds are typically part of larger, regional basins. The point where a watershed drains to another body of water (e.g., a creek or bay) is affected by every activity that occurs within the watershed.

Our creeks and rivers carry rainfall runoff from land masses north to San Francisco Bay or south to Monterey Bay. Before rainfall is collected in creeks and rivers in the county, some of the water is used to fill reservoirs for drinking water, replenish the underground aquifer and create better habitat for fish and wildlife. In doing so, our watersheds are critical to supporting water supply for human health and welfare and the environment.

Watershed Descriptions

Lower Peninsula Watershed:
The Lower Peninsula Watershed is defined by geographic boundaries encompassing the tributaries and watersheds of San Francisquito Creek, Matadero Creek, Barron Creek, Adobe Creek, Stevens Creek, and Permanente Creek. The geographic area includes the Town of Los Altos Hills and the cities of Palo Alto, Los Altos, Mountain View, and portions of Cupertino. The watershed encompasses a 98-square-mile area whose many small-creek watersheds feed the tidal wetlands along the San Francisco Bay's southwest shoreline.

West Valley Watershed:
The West Valley Watersheds is defined by geographic boundaries encompassing the tributaries and watersheds of the Guadalupe Slough, Sunnyvale West Channel, Sunnyvale East Channel, Calabazas Creek, San Tomas Aquino Creek, and Saratoga Creek. The geographic area includes portions of the cities of Sunnyvale, Cupertino, Monte Sereno, San Jose, Santa Clara, Campbell, Saratoga and the Town of Los Gatos. The watershed encompasses an 85-square-mile area of multiple small-creek watersheds. Characterized by the contrast between its channelized creeks on the valley floor and its more natural streams in the hillsides, this watershed is the county's smallest.

Guadalupe Watershed
The Guadalupe Watershed is defined by geographic boundaries encompassing the tributaries and watersheds of the Guadalupe River. The major tributaries are Los Gatos Creek, Canoas Creek, Ross Creek, Guadalupe Creek, and Alamitos Creek. The geographic area includes portions of the cities of Santa Clara, San Jose, Campbell, Monte Sereno, and the Town of Los Gatos. This 170 square-mile area drains the Guadalupe River and its tributaries through downtown San Jose. Lexington Reservoir, one of the area's best-known landmarks, is located along the western border of this watershed.

Coyote Watershed:

The Coyote Watershed is defined by geographic boundaries encompassing the tributaries and watersheds of Coyote Creek. The major tributaries are Lower Penitencia Creek, Scott Creek, Berryessa Creek, Upper Penitencia Creek, Silver Creek, Thompson Creek, Fisher Creek, and Packwood Creek. The geographic area includes the city of Milpitas and portions of the cities of San Jose and Morgan Hill. Sixteen major creeks drain this 322 square-mile area. The north county's largest watershed, it extends from the urbanized valley floor upward to the vast natural areas of the Mt. Hamilton range. Coyote Creek, its main waterway, is the longest creek in the county.

Figure 1.1: Santa Clara County Watersheds

Uvas-Llagas Watershed:

The Uvas-Llagas Watershed is defined by geographic boundaries encompassing the tributaries and watersheds of the Pajaro River in Santa Clara County. The major tributaries are East and West Little Llagas Creeks, Llagas Creek, West Branch of Llagas Creek, Uvas-Carnadero Creek, Pescadero Creek, and Pacheco Creek. The Uvas/Llagas Watershed is comprised of mostly unincorporated area and includes the City of Gilroy and portions of the Cities of San Jose and Morgan Hill. The watershed encompasses a 369 square-mile region which is distinguished by its agricultural lands and natural areas. Part of the larger Pajaro River Watershed, the creeks in this watershed are the only waterways in Santa Clara County that flow southward to Monterey Bay.

Watershed Based Planning

A watershed-based approach to planning supports and guides protection and enhancement of the county's significant natural resources and flood protection efforts. Taking a watershed-wide view of problems and potential solutions by identifying and prioritizing stream reaches helps to direct efforts to achieve the highest possible total system function with limited resources. Since our flood protection and environmental stewardship capital improvement projects are often conducted and focused on specific watersheds, a watershed based approach supports coordinated and integrated planning.

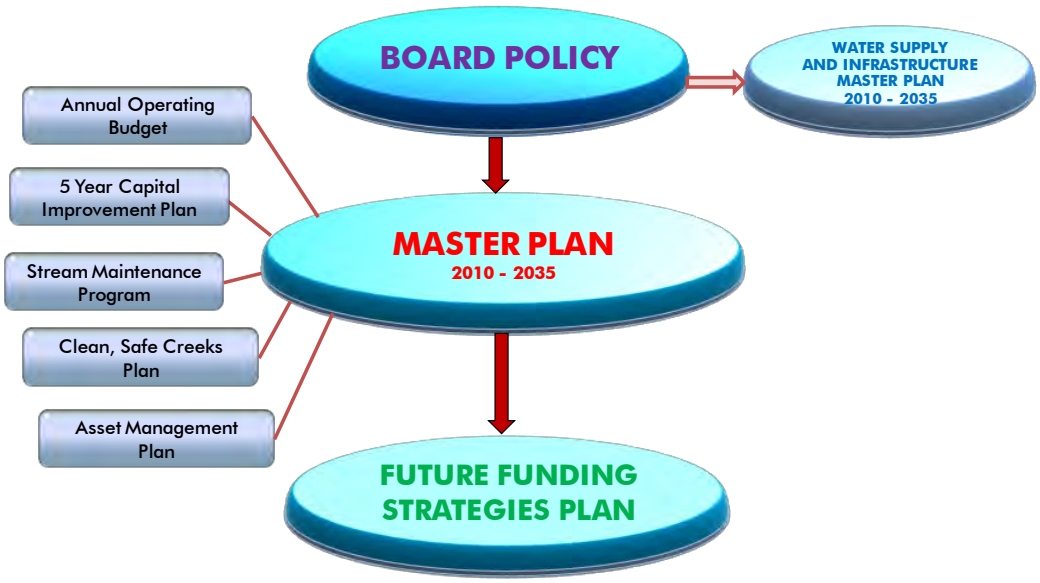
1.5 PLANNING HORIZON AND RELATIONSHIP TO OTHER DISTRICT PLANS

The 25-year planning horizon for the master plan was determined by examining its purpose and aligning it against the planning horizons of other related district plans. Another important consideration in assigning a 25-year time horizon to the master plan was to provide a sufficiently long timeline beyond the current 5-year horizon for the district's Capital Improvement Plan, while maintaining a longer term perspective that is still meaningful in the context of long range planning.

In addition, the 25-year planning horizon of the master plan facilitates the evaluation and assessment of future funding needs for the comprehensive Flood Protection and Stream Stewardship Program. It accomplishes that by incorporating the time period associated with the sunset of Clean, Safe Creeks special tax funding, as well as a longer time period following the special tax sunset to anticipate impacts to the program's future levels of service. Figure 1.2 shows the relationship between the master plan and other related planning efforts. The boxes in blue in Figure 1.2 represent significant planning processes and plans that have a connection to the master plan.

Figure 1.2 also shows the relationship of planning horizons between the master plan and the Water Supply and Infrastructure Master Plan being developed in the district's Water Utility Planning Unit. The Water Supply and Infrastructure Master Plan effort is a separate and distinct effort from the master plan process discussed in this plan. However, there will be coordination between the two planning efforts in order to find synergies and avoid conflicts between the two plans, wherever possible.

Figure 1.2 Long Term Planning Efforts in Relationship to Other Plans



In addition, Figure 1.2 shows that the highest level policy originates with district Board of Directors. The Board provides general policy direction in the form of Ends, Goals, and Objectives (Chapter 2). That policy direction is then received and interpreted by the district's Chief Executive Officer (CEO). Based on the Board's direction, the CEO generally determines strategies and implementing measures to achieve the goals and objectives in the Board's policy. The master plan embodies these as implementing strategies, as it relates to the district's overall Flood Protection and Stream Stewardship Program.

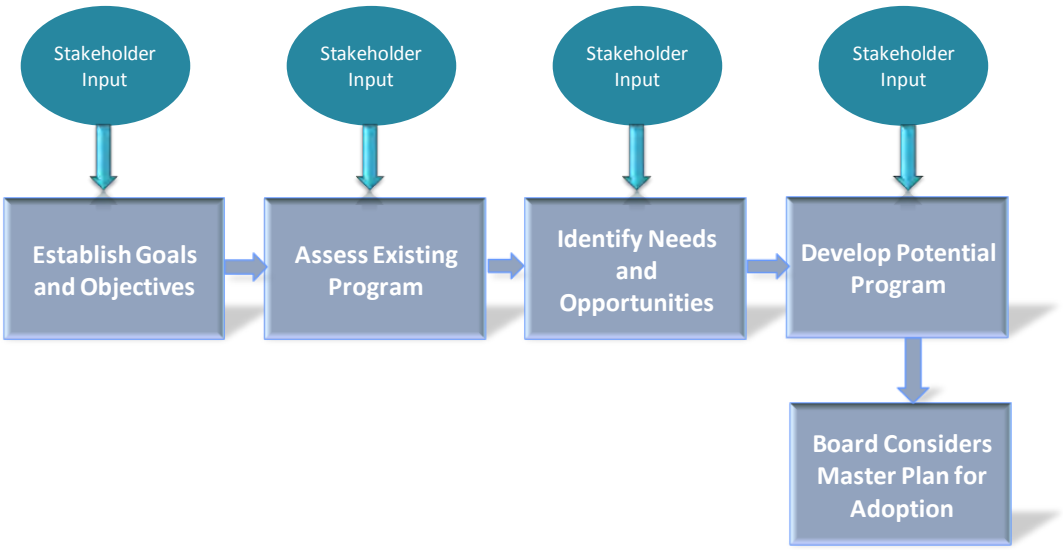
1.6 REPORT METHODOLOGY AND ORGANIZATION

At the most basic level, the methodology used to develop the master plan is based on the following four planning elements are the basis for the main chapters of the master plan.

1) Establish Goals and Objectives
2) Conduct Assessment of Existing Program Over 25-Year Planning Horizon
3) Identify Needs and Opportunities
4) Develop Potential Program

The master plan update process, including stakeholder input opportunities is illustrated in Figure 1.3 below.

Figure 1.3: Proposed Master Plan Update Process



The methodology described above resulted in the definition of the following five chapters that comprise the master plan.

Chapter 1 – INTRODUCTION provides information on: the district mission; master plan objectives; building on strong foundation of the Clean, Safe Creeks plan; study area and watersheds; planning horizons and relationships to other plans; report methodology and organization, and stakeholder engagement. In summary, the first chapter provides background on the development of the report and describes the organization of the report and the master plan development process.

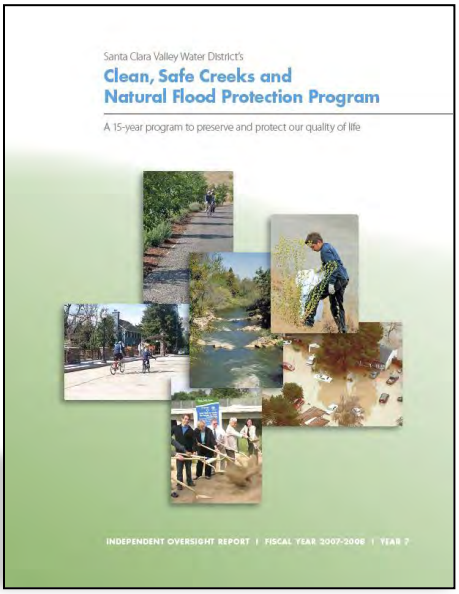
Chapter 2 – GOALS AND OBJECTIVES describes the framework for the development of the master plan. This Chapter articulates the goals and objectives for the master plan as expressed in the proposed Board Ends Policies in the areas of natural flood protection, healthy creek and bay ecosystems, clean safe water in our creeks and bays, and trails and open space.

Chapter 3 – FLOOD PROTECTION AND STREAM STEWARDSHIP PROGRAM describes the various projects and programs conducted by the district to achieve policy outcomes. The programs are presented along with the associated policies and outcomes they support. This chapter also illustrates the nature of the district's comprehensive Flood Protection and Stream Stewardship Program after the sunset of the Clean, Safe Creeks Plan.

Chapter 4 - NEEDS AND OPPORTUNITIES identifies and describes the needs and opportunities relative to the Flood Protection and Stream Stewardship Master Plan goals and objectives described in Chapter 2. Existing programs, projects and activities described in Chapter 3 were reviewed in relationship to meeting the goals and objectives. Program needs are defined as areas where master plan goals and objectives are at risk of not being met in the future planning horizon. Where needs were identified, opportunities for program improvements or new programs and projects were also identified.

Chapter 5 – POTENTIAL PROGRAM includes criteria for selecting projects in the areas of: natural flood protection; healthy creek and bay ecosystems; clean safe water in our creeks and bays; and trails and open space.

1.7 STAKEHOLDER ENGAGEMENT



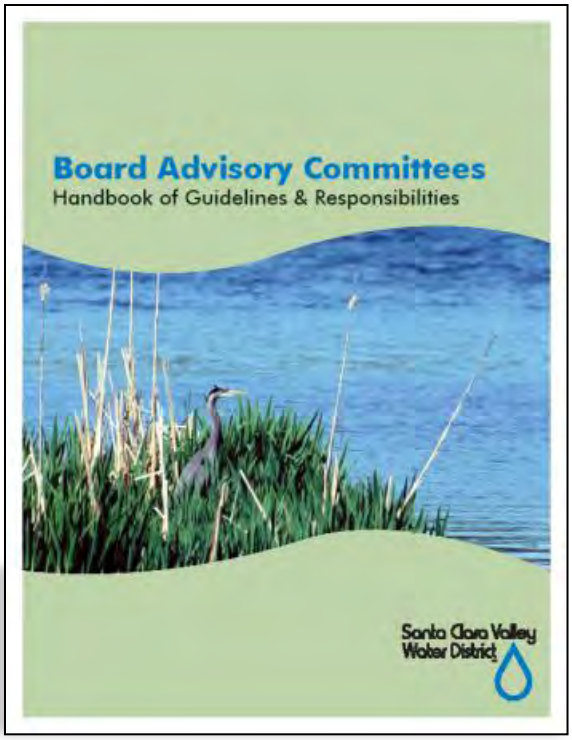
Working with the community and interested individuals is a key component in developing the master plan. An important objective of stakeholder engagement is to receive feedback throughout the master plan development process, particularly on the development of the proposed program.

Outreach efforts will focus on city representatives, environmental and other community stakeholders as represented on the Board's Flood Control and Watershed Advisory Committees and the Environmental Advisory Committee. Outreach efforts will also focus on community meetings in key geographic areas to allow for community input into the master plan. The Board of Directors relies on nine advisory committees, which primarily provide policy alternatives and implications for their deliberation, but also serve as a link with the community. The committees related to the Flood Protection and Stream Stewardship Program are comprised of knowledgeable members of the public, public employees and elected officials and will provide input on the master plan as it relates to supporting Board policy.

Broad community outreach is also planned beyond the district's Board Advisory Committees. Examples of groups and agencies that are expected to be included in outreach and engagement beyond the community stakeholders may include, but are not limited to, the following:

- Board Environmental Advisory Committee
- Coyote Flood Control and Watershed Advisory Committee
- Guadalupe and West Valley Flood Control and Watershed Advisory Committee
- Lower Peninsula Flood Control and Watershed Advisory Committee
- Uvas/Llagas Flood Control and Watershed Advisory Committee
- Bay Area Flood Protection Agencies Association
- City of Campbell
- City of Cupertino

- City of Gilroy
- City of Los Altos
- Town of Los Altos Hills
- Town of Los Gatos
- City of Milpitas
- City of Monte Sereno
- City of Morgan Hill
- City of Mountain View
- City of Palo Alto
- City of San Jose
- City of Santa Clara
- City of Saratoga
- County of Santa Clara



2 GOALS AND OBJECTIVES

INTRODUCTION

The purpose of this chapter is to describe the goals and objectives of the Flood Protection and Stream Stewardship Master Plan (hereafter referred to as Master Plan Goals and Objectives). This chapter initially describes the district's Board Policy Framework to provide perspective into the relationship between the Board's policies and the Master Plan's goals and objectives. The Master Plan goals and objectives are taken directly from the Board's Policies. This chapter then describes the Master Plan goals and objectives to provide specific focus and purpose by offering a clear vision for what the Master Plan is to accomplish. Strategies to support the Master Plan goals and objectives are described in the remainder of this chapter. Identifying strategies early in the planning process provides a foundation for development and implementation of the Master Plan. Chapter 3 provides more detail on strategic implementation by describing the district's current programs and projects that support these strategies.

The Board Policy and Master Plan Goals presented in this chapter include:

- ***Natural flood protection***
- ***Reduced potential for flood damages***
- ***Healthy creek and bay ecosystems***
- ***Clean safe water in creeks and bays***
- ***Trails, open space and water resources management.***

2.1 BOARD POLICY FRAMEWORK - DEFINITIONS AND OVERVIEW

The Board's policy framework and definitions are described in this section. The district's mission, general principles and Board Ends policies form the basis for Master Plan development.

The Board sets policy direction using a governance framework that establishes the district's mission and general principles, followed by ends policy goals and objectives. The CEO interprets this policy direction in the form of strategies and implementing measures.

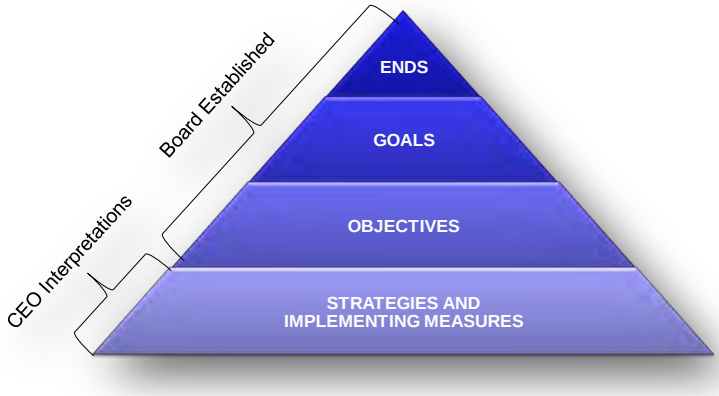
2.1.1 Board Policy Framework Definitions

- **Governance Process**- how the Board conducts its business
- **General Principles**- a statement that reflect Board's directions to guide more than one functional area or element
- **Ends Policy-** The effects the district seeks to have on the community it serves
- **Goal-** a general direction-setter provided by the Board and expressed as an ideal future related to the end
- **Objective**- a specified action either adopted by the Board or provided by the CEO that is an intermediate step toward attaining a goal
- **CEO Interpretations**- the CEO's reasonable interpretation regarding accomplishing the Board's Ends in the form of *strategies and implementing measures*
    - *Strategies* are particular courses of action that describe the means to support objectives.
    - *Implementing measures* are indicators that establish a level of quality or quantity to be satisfied when achieving the objective.

2.1.2 Board Policy Framework Overview

This section discusses the overall Board Policy Framework down to the Ends Policies level. The Board's policy framework is established from the broadest to the more defined levels. The CEO interprets the policies for implementation in form of strategies and implementing measures. Figure 2.1 illustrates the Board's policy framework hierarchy.

Figure 2.1: District Board Policy Framework



2.1.2.1 District Mission and General Principles

The *mission* of the District as established by the Board (Board Policy E-1) is as follows:

> *A healthy, safe, and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective, and environmentally-sensitive manner for current and future generations.*

The Board has established the following *general principles* for implementing the district's mission,

1. An integrated approach in managing a sustainable water supply, effective natural flood protection and healthy watersheds is essential to prepare for the future.
2. Engagement with federal, state, regional and local agencies, water retailers and the community is necessary.
3. A net positive impact on the environment is important in support of the District mission and is reflected in all that we do.
4. A positive image of the District is supported in carrying out the District's mission.

2.1.2.2 District Board Ends Policies

Ends policies prescribe what the Board has directed the CEO to accomplish in order to implement the district's mission. The Board's Ends are summarized as follows:

E-2: There is a reliable, clean water supply for current and future generations.

E-3: There is a healthy and safe environment for residents, businesses and visitors, as well as for future generations.

E-4: There is water resources stewardship to protect and enhance watersheds and natural resources and to improve the quality of life in Santa Clara County.

2.2 MASTER PLAN GOALS AND OBJECTIVES

This section summarizes the Master Plan goals and objectives (as established by Board Policy) that support the development of the Master Plan. The goals and objectives provide specific focus and purpose to the Master Plan by offering a clear vision for what the Master Plan is to accomplish.

Table 2.1 identifies the Master Plan goals and objectives as they relate to the following Board Ends Policies:

E-3: There is a healthy and safe environment for residents, businesses and visitors, as well as for future generations, and

E-4: There is water resources stewardship to protect and enhance watersheds and natural resources and to improve the quality of life in Santa Clara County.

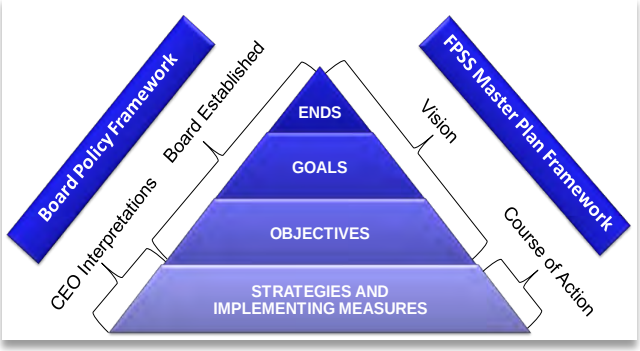
Table 2.1 Board's Ends and Master Plan Goals and Objectives

Ends	Goals	Objectives
E-3: HEALTHY AND SAFE ENVIRONMENT	3.1 Natural Flood Protection for residents, businesses, and visitors	3.1.1 Balance environmental quality and protection from flooding in a cost effective manner 3.1.2 Preserve flood conveyance capacity
	3.2 Reduced potential for flood damages	3.2.1 Reduce flood risk in flood prone areas 3.2.2 Avoid the creation of expanded flood prone areas
E-4: WATER RESOURCES STEWARDSHIP	4.1 Healthy creek and bay ecosystems	4.1.1 Balance water supply, flood protection and environmental stewardship functions 4.1.2 Improve watersheds, streams, and natural resources 4.1.3 Promote awareness of creek and bay ecosystem functions
	4.2 Clean, safe water in creeks and bay	4.2.1 Preserve or improve surface and groundwater for beneficial uses 4.2.2 Promote awareness of water quality and stream stewardship
	4.3 Improved quality of life in Santa Clara County through trails, open space and water resources management	4.3.1 Support additional trails, parks and open space along creeks and in the watersheds when reasonable and appropriate 4.3.2 Reduce greenhouse emissions when reasonable and appropriate

2.3 MASTER PLAN STRATEGIES

This section summarizes the Master Plan strategies that support the development and implementation of the Master Plan. The CEO provides policy interpretations in the form of strategies and implementing measures to direct the work of staff in reaching the Board's goals and objectives. The CEO developed strategies and implementing measures also support the Master Plan goals and objectives. The relationship between the District Board policy framework, CEO Interpretations and Master Plan development is illustrated in Figure 2.2. Strategies are outlined in Tables 2.2, 2.3, 2.4 and 2.5.

Figure 2.2: Relationship between Board Policy and Master Plan Development



Chapter 3 provides more detailed information on strategic implementation by describing the district's programs and projects that support individual strategies.

2.3.1 Strategies Related To the Goal of Natural Flood Protection for Residents, Businesses, and Visitors

This section summarizes the district's goal of natural flood protection, and lists the associated Master Plan objectives and strategies in Table 2.2.

Natural Flood Protection Overview

Protecting homes, businesses and transportation networks from the devastating effects of floods is one of the main jobs of the district. The district provides increased protection from flood damages through floodwater management activities with the general goal of "keeping the water away from the people." In response to community and stakeholder expectations and the district's commitment to water resources stewardship, the district's goals have kept pace with changing community values through the use of natural flood protection activities where possible.

Natural Flood Protection Strategies

Given community expectations, the district now employs natural flood protection principles into its flood protection activities whenever feasible. In doing so, the district balances the need to provide flood protection with the need to protect streams and natural resources. The district uses numerous flood protection technologies that help keep creeks to be as natural and beautiful as possible. New multipurpose flood protection projects protect property while preserving habitat and improving water quality. In doing so, the district evaluates alternatives for flood protection projects using a multi-criteria framework as shown in Table 2.1. The district also conducts work on existing creeks to maintain floodwater conveyance capacity and to stabilize or restore eroding stream channels. Other strategies include activities to: improve stream stability, construct erosion repair projects to create greater

environmental value, and provide technical advice to others to better manage stormwater. A detailed list of flood protection strategies is provided in Table 2.2.

Table 2.2: Strategies to Achieve Goal 3.1 Natural Flood Protection

GOAL	OBJECTIVE	STRATEGIES
3.1 NATURAL FLOOD PROTECTION FOR RESIDENTS, BUSINESSES, AND VISITORS	3.1.1: Balance environmental quality and protection from flooding in a cost effective manner	1. Evaluate alternatives for flood protection capital projects whereby natural stream functions are achieved to the extent feasible and practicable, while providing flood protection and balancing the following: a. Homes, schools, businesses, and transportation networks are protected from flooding and erosion. b. Ecological functions and processes, including habitat goals, are supported. c. Natural stream functions and processes, including stability and dynamic equilibrium of streams, are preserved, restored, and integrated. d. Maintenance requirements are minimized. e. Projects are integrated within the watershed as a whole. f. The quality and availability of water is protected. g. Cooperation with local agencies achieves mutually beneficial goals. h. Community benefits are provided beyond flood protection. i. Life-cycle costs are minimized. 2. Identify existing stream erosion conditions and stream characteristics and implement practical solutions, where appropriate, to improve stream stability and its dynamic equilibrium. 3. Use natural materials where practical in erosion repair projects to create greater environmental value while protecting streams, creeks, and levees. 4. Provide technical advice and, if appropriate, participate with municipalities to manage stormwater to address stream instability. 5. Develop and provide technical advice on the design of floodplains and channels that support the physical and dynamic equilibrium of streams.
	OBJECTIVE	**STRATEGIES**
	3.1.2: Preserve flood conveyance	1. Maintain the design floodwater conveyance capacities within District-owned channels. 2. Stabilize, rehabilitate and/or restore eroding District-owned channels. 3. Reduce debris accumulation. 4. Support and promote land use decisions to maintain stream capacity.

2.3.2 Strategies Related To the Goal of a Reduced Potential for Flood Damages

This section summarizes the district's goal of reduced potential for flood damages, and lists the associated Master Plan objectives and strategies in Table 2.3.

Reduced Potential for Flood Damages Overview

In addition to strategies related to natural flood protection, the district, local cities and agencies work together to reduce the potential for flood damages. These strategies are employed to "keep the people away from the water." It is important to note that the local cities and county play a primary role and have direct control in accomplishing these strategies. Cities and the county are also floodplain management agencies under FEMA and administer their own flood plain management programs. As shown on Table 2.3, the district's role in this area is defined as working with others and providing support to execute these strategies without having direct control over land use decisions.

Reduced Potential for Flood Damages Strategies

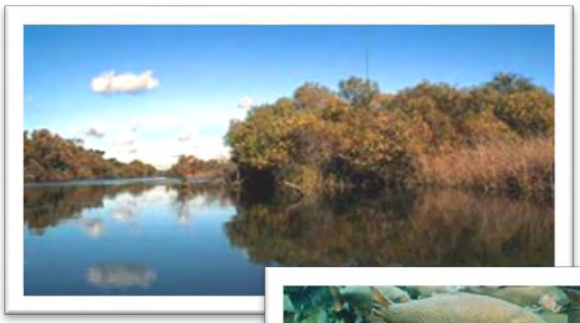
Strategies to reduce flood damage potential include floodplain management that relies on land use decisions to manage activities in order to accommodate floodwater without significant disruption to public health, safety or property. Under this goal, the district works with municipalities, communicates risk to the communities most at risk, and provides technical advice and services that seek to avoid expansion of flood prone areas. Technical advice includes incorporation of flood-wise design features and technical assistance in the mitigation of negative effects associated with new development. In addition, the district participates in and provides advice related to: storm related emergency response, community awareness, risk reduction outreach and proper stream care and management. A list of strategies associated with reducing flood damage potential is presented in Table 2.3.

Table 2.3: Strategies to Achieve Goal 3.2: A Reduced Potential for Flood Damages

GOAL	OBJECTIVE	STRATEGIES
3.2: A REDUCED POTENTIAL FOR FLOOD DAMAGES	3.2.1: Reduce flood risks in flood prone areas	1. Provide flood frequency and forecast services. 2. Prepare for effective response to storm-related emergencies. 3. Assist cities and citizens when needed to lessen potential flood impacts. 4. Work with municipalities to clearly identify roles and responsibilities for floodplain management and emergency management. 5. Work with FEMA to ensure floodplain maps are based on best available data. 6. Include municipal planners in regional or local flood management planning activities. 7. Promote community awareness about best practices to avoid or minimize exposure to flooding potential. 8. Promote risk reduction activities through targeted outreach to areas protected by levees. 9. Maintain and make available technical resources to assist municipalities in floodplain management activities. 10. Promote removal or abandonment of infrastructures located within floodplains.
	OBJECTIVE	**STRATEGIES**
	3.2.2: Avoid the creation of expanded flood prone areas	1. Assist in the incorporation of flood-wise design features (e.g., minimizing imperviousness, maximizing permeability and preserving natural drainage and vegetation) into new development projects. 2. Encourage and provide technical assistance in mitigating erosion, sedimentation and high flows from new development or redevelopments. 3. Advocate detention of runoff in areas where flood protection facilities are nearing capacity. 4. Advocate or support protection of stream functions from the negative impacts of development. 5. Promote green projects (e.g., rainwater harvesting) or other or practices to manage stormwater runoff and improve water quality. 6. Promote awareness of risks for developing in flood hazard areas.

2.3.3 Strategies Related To the Goal of Healthy Creek and Bay Ecosystems

This section summarizes the district's goal of healthy creek and bay ecosystems and lists the associated Master Plan objectives and strategies in Table 2.4



Healthy Creek and Bay Ecosystems Overview

Unique among other water districts, state legislation authorizes the district "to enhance, protect, and restore streams, riparian corridors, and natural resources." The district employs strategies to support healthy creek and bay ecosystems, and works collaboratively with others to support these efforts.

Healthy Creek and Bay Ecosystems Strategies

The health of a creek reflects the conditions throughout the watershed, not just those along its banks. The district's environmental work contributes to the protection and restoration of habitats and encourages the return of endangered species such as the red-legged frog, steelhead trout and salt marsh harvest mouse. Under the district's general goals regarding healthy creeks and bay ecosystems, the district conducts numerous activities to protect and restore environmental resource functions, improve natural resources, and promote community awareness of environmental stewardship. Some of these strategies and activities include: identifying and mitigating capital and operational impacts; implementing potential mitigation banking opportunities; implementing stream stewardship opportunities; and protecting, enhancing and restoring riparian and tidal habitat conditions. A detailed list of strategies to support healthy creeks and bay ecosystems is presented in Table 2.4.

Table 2.4: Strategies To Achieve Goal 4.1: Healthy Creek And Bay Ecosystems

GOAL	OBJECTIVE	STRATEGIES
4.1: HEALTHY CREEK AND BAY ECOSYSTEMS	4.1.1: Balance water supply, natural flood protection and water resources stewardship functions	1. Balance the protection and restoration of sensitive fisheries and aquatic species, such as steelhead trout, with a reliable water supply. 2. Identify and mitigate capital projects' and operations' impacts to watersheds, streams and natural resources. 3. Identify and implement potential mitigation banking opportunities in order to streamline future mitigation requirements. 4. Provide information on stormwater management and design of floodplains and channels.
	OBJECTIVE	**STRATEGIES**
	4.1.2: Improve watersheds, streams, and natural resources	1. Implement stream stewardship opportunities, including environmental enhancements and seek to achieve the physical stability and ecological health. 2. Engage in habitat conservation planning. 3. Protect groundwater recharge areas in creeks and riparian corridors. 4. Protect, enhance and restore riparian vegetation and in-stream and tidal habitat conditions conducive to healthy ecology, including diked historical bayland wetlands, or former salt ponds. 5. Protect, enhance and restore populations of key species indicative of watershed health.
	OBJECTIVE	**STRATEGIES**
	4.1.3: Promote awareness of creek and bay ecosystem functions	1. Provide technical expertise for applying ecosystems functions knowledge. 2. Promote the awareness of sensitive groundwater recharge areas. 3. Advocate for protection, preservation and enhancement of creek and bay ecosystems functions. 4. Promote the preservation of ecological buffers.

2.3.4 Strategies Related To the Goal of Clean Safe Water in Creeks and Bays

This section summarizes the district's goal of clean safe water in creeks and bays, and lists the associated Master Plan objectives and strategies in Table 2.5

Clean Safe Water in Creeks and Bays Overview

Preventing pollution to our creeks and bays is a major undertaking in a county with 1.8 million residents. Clean safe water benefits the community and natural resources relying on these precious resources. The district conducts programs and projects to support clean safe water in addition to collaborating with agencies and stakeholder groups.

Clean Safe Water in Creeks and Bays Strategies

Strategies employed under the district's objectives for clean safe water include: preserving and protecting water quality, promoting awareness of water quality, and stream stewardship. Other specific strategies include: hazardous material response, creek inspections, and pollution reduction activities.

In addition, the district participates in many programs in cooperation with local agencies. Through its participation, the district supports efforts to prevent urban runoff that is detrimental to water quality. The district supports efforts of agencies and stakeholders to educate and encourage county residents to prevent pollution from reaching our creeks and rivers. Specific strategies to support clean safe water in creeks and bays are presented in Table 2.5.

Table 2.5: Strategies to Achieve Board Goal 4.2 Clean Safe Water in Creeks and Bays

GOAL	OBJECTIVE	STRATEGIES
4.2 CLEAN SAFE WATER IN CREEKS AND BAYS	4.2.1: Preserve or improve surface and ground water quality for beneficial uses	1. Provide hazardous materials management and incident response. 2. Inspect and clean creeks from neighborhood litter and graffiti. 3. Protect groundwater recharge areas in creeks and riparian corridors. 4. Improve water quality of listed impaired water bodies.
	OBJECTIVE	**STRATEGIES**
	4.2.2 : Promote awareness of water quality and stream stewardship	1. Promote community awareness of benefits of preserving water quality and providing stream stewardship. 2. Promote awareness of sensitive groundwater recharge areas. 3. Promote awareness of riparian corridors and provide guidance for residential development, landowner practices and grazing activities that support watershed health. 4. Reduce pollutants in streams from urban runoff and minimize the effects on surface and ground water.

2.3.5 Strategies Related To the Goal of Improved Quality of Life in Santa Clara County through Trails, Open Space and Water Resources Management

This section summarizes the district's goal of improved quality of life in Santa Clara County through trails, open space and water resources management, and lists the associated Master Plan objectives and strategies in Table 2.6

Improved Quality of Life Overview

Watersheds, stream corridors and flood protection levees offer hundreds of acres of land for the entire community to use and enjoy. The district partners with cities and the county to provide open space and recreational opportunities along creeks and reservoirs in the county. In addition, the district seeks to provide for improved quality of life by addressing the threats of climate change

Improved Quality of Life Strategies

Strategies to support open space and recreational opportunities are currently conducted through the Trail and Open Space Grant Program. In addition, the current Environmental Enhancements Program and ensuing Environmental Enhancement Planning Grant call for the creation of additional wetlands, riparian habitat and favorable streams conditions for fisheries and wildlife.

The district is also addressing climate change issues under the goal of an improved quality of life. The district is keeping track of developments in policy and guidance at both the state and national level to help define its climate change related strategies. Currently, the district's partnership with Sustainable Silicon Valley's CO2 Initiative is a key strategy to respond to climate change resulting from the accumulation of human-generated greenhouse gases like CO2 in Santa Clara County.

The district is taking action by changing the way it manages energy usage and optimizing our operations so that they are energy efficient. In addition, the district's water conservation programs have resulted in some of the biggest energy savings of any programs in the county.

Climate change and, in particular, sea level rise are also being addressed in the district's flood protection and stream stewardship planning processes and in the district's preparation of environmental documentation for projects. Sea level rise may affect the flow conveyance of district facilities near south San Francisco Bay. A list of specific strategies related to an improved quality of life is provided in Table 2.6.

Table 2.6: Strategies to Achieve Board Goal 4.3 Improved Quality Of Life in Santa Clara County through Trails, Open Space and Water Resources Management

GOAL	OBJECTIVE	STRATEGIES
4.3 IMPROVED QUALITY OF LIFE IN SANTA CLARA COUNTY THROUGH TRAILS, OPEN SPACE AND WATER RESOURCES MANAGEMENT	4.3.1: Support additional trails, parks and open space along creeks and in the watersheds when reasonable and appropriate.	1. Work with other entities for planning, design, construction, maintenance, and operation of trails/open space amenities. 2. Increase public access to district lands as appropriate; extend trails network. 3. Support creek-side or water related recreation, as appropriate.
	OBJECTIVE	**STRATEGIES**
	4.3.2: Reduce greenhouse gas (GHG) emissions when reasonable and appropriate	1. Reduce project-specific Greenhouse Gas Emissions through district-wide programmatic actions and ensure reductions attributable to water conservation programs are properly credited to the Santa Clara County community. 2. Increase fleet fuel use efficiency. 3. Maintain a portfolio of alternative energy supplies. 4. Increase energy use efficiency. 5. Promote best practices for GHG emission reduction throughout district.

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3 FLOOD PROTECTION AND STREAM STEWARDSHIP PROGRAM

INTRODUCTION

The purpose of this chapter is to describe the current levels of service provided by the Flood Protection and Stream Stewardship Program in 2010 and to project those levels of service to the year 2035 based upon program elements anticipated to stay the same and evolving needs stemming from new anticipated obligations. This chapter also describes the potential impacts to the program if there is no new funding to replace the special parcel tax approved by the voters in November 2000 for the Clean, Safe Creeks and Natural Flood Protection Plan (Clean, Safe Creeks). The special parcel tax will automatically end after 15 years in 2016.

The objectives of this chapter are to describe the various capital projects and operational programs conducted by the district to achieve the goals and objectives of the master plan; to present financial assumptions and analysis of the Flood Protection and Stream Stewardship program for the planning horizons from 2010 to 2016 and from 2017 to 2035; and to describe the anticipated levels of service supported and funded under each planning horizon.

Capital projects as listed in this chapter are defined by those that, exceed $50,000 in cost, have long-term life spans, and are generally non-recurring. Capital projects usually fall within one of six categories. These categories include acquisitions of land for public purposes; construction of new flood protection facilities; addition to or expansion of an existing facility; rehabilitation or repair to all or part of a facility (exceeding $50,000); specific planning, engineering study, or design work related to a project; and significant one-time investment or improvements that provide benefits over several years, such as radio system upgrades to improve day-to-day operations and emergency response.

Operational programs are either operations or operating projects. Operations are ongoing, recurring activities such as stream maintenance activities. Operating projects support and complement services provided in the operations budget. Operating projects have a beginning and an ending date; in general, these projects should be completed within 2-3 years. An example of an operating project is a habitat conservation plan.

This chapter summarizes the district's overall Flood Protection and Stream Stewardship program as it exists in 2010 (Section 3.1), followed by a more detailed description of the programs and projects that support the master plan implementation (Section 3.2). Section 3.2 also includes the current and projected levels of service under anticipated funding levels for both planning horizons: 2010 to 2016 and 2017 to 2035. This chapter also provides the results of the financial analysis (Section 3.3) conducted under the assumptions that: (a) no new funding for the program is secured after the sunset of the Clean, Safe Creeks special parcel tax in 2016, and (b) that many Flood Protection and Stream Stewardship

program elements will continue, while recognizing that the program will adapt to changing needs, obligations and board direction. Following the financial analysis, Section 3.4 - Findings, provides a summary in terms of what programs and projects could be affected after 2016 by the sunset of Clean, Safe Creeks special tax funding.

3.1 FLOOD PROTECTION AND STREAM STEWARDSHIP PROGRAM OVERVIEW

The district's approach to the management of streams and flood protection facilities has experienced many changes since the program began in the 60's. These changes include new or changed regulations that affect water quality and how projects are designed and maintained; increased development in floodplains and near streams; increased public awareness and interest in habitat protection and enhancement; and the public's expectations that streams are amenities to the community that should be accessible to the public for use as trails and open space. In response to changing environmental values and laws, the district modified its official mission statement in 2002 to include watershed stewardship as a key component of its charter, in addition to flood protection and water supply. Stewardship is defined as, "Entrusting the careful and responsible management of the environment and natural resources to one's care for the benefit of the greater community."

The Flood Protection and Stream Stewardship program as it exists in 2010 was initially developed in the late 1990s through extensive community input to assess the needs, priorities and expectations of the Santa Clara County community. The goal of that effort was to build consensus with a plan that both received community support and met the Board of Directors' (board) policy direction.

The Flood Protection and Stream Stewardship program has evolved since its inception as it responded to new challenges whether they are funding-based, regulatory-based or community-driven. It is anticipated that this evolution will continue into the next planning horizons. The Flood Protection and Stream Stewardship program strives to fulfill the community interests and the board objectives by continuing or modifying over a hundred projects and programs to achieve five specific goals:

- Goal 1: Natural flood protection for residents, businesses, and visitors.
- Goal 2: Reduced potential for flood damages.
- Goal 3: Healthy creek and bay ecosystems.
- Goal 4: Clean, safe water in our creeks and bays.
- Goal 5: Improved quality of life in Santa Clara County through trails, open space and water resource management.

In support of Goal 1, the main program components include new flood protection projects; inspection and maintenance of new and existing flood protection facilities to preserve flood conveyance; stream capacity vegetation control; sediment and debris removal; and land development review.

Activities aimed at achieving Goal 2 include: conducting emergency flood response activities; providing flood frequency and forecast services; coordinating with cities, county, regional and state agencies on land use decisions and floodplain management; providing Federal Emergency Management Agency mapping services; and performing public education and school programs on flood safety.

Goal 3 activities provide for crucial environmental work to protect and restore habitats and to contribute to the protection of endangered species. Examples of this work include: repairing stream bank erosion; removing barriers to fish passage or migration, maintaining revegetation mitigation sites, managing watershed upland vegetation, removing nonnative invasive plant species, creating or restoring tidal and/or riparian habitat, and recycling or reducing solid waste and sediment from maintenance activities.

Goal 4 activities are aimed at reducing or eliminating pollutants from local waterways. The district provides for response to hazardous materials incidents; patrols creeks for illegal dumping; cleans creeks of illegally–dumped chemicals; cleans neighborhood creeks of trash; and removes graffiti from bridges and floodwalls. The district also conducts activities to help improve water quality of our creeks, reservoirs, and bays by reducing pollutants such as mercury, diazinon, copper, zinc, PCBs, and selenium.

To achieve Goal 5, the district works with cities and the county to plan, design, construct, maintain, and operate trails and open space amenities. The district has increased public access to its property and supports creek-side or water-related recreation. Additionally, the district has implemented programmatic actions to reduce greenhouse gas (GHG) emissions; maintains a portfolio of alternative energy supplies; and has increased energy use efficiency.

3.2 FLOOD PROTECTION AND STREAM STEWARDSHIP – SUPPORTING OPERATIONAL PROGRAMS AND CAPITAL PROJECT DESCRIPTIONS

This section provides a detailed description of the various capital projects and operational programs conducted by the district to achieve the goals and objectives of this Master Plan. The projects and programs have been categorized in terms of the five specific governance policy goals identified in Section 3.1. The supporting projects and programs descriptions are followed by a description of the Levels of Service applicable to those projects and programs for the two master plan planning horizons.

Levels of service for the master plan are based on agreements, regulatory obligations, and adopted board policies. Existing Levels of Service are based on existing agreements that are in effect in 2010 and existing funding levels. Future Levels of Service will be developed based on agreements that the district may enter into in the future, or based on foreseeable or anticipated changes in funding revenues.

San Francisquito Creek Flooding in 1998

3.2.1 Natural Flood Protection

The district provides floodwater management in two basic ways: it builds and restores natural flood protection capital projects, and it conducts operations programs to maintain flood conveyance capacity to carry storm runoff and to protect the public's investment in flood protection facilities.

To construct natural flood protection capital projects, the district utilizes a multiple-objective approach to providing environmental quality, community benefit, and protection from creek or tidal flooding. It does so in a cost-effective manner through integrated planning and management that considers the physical, hydrologic and ecologic functions and processes of streams within the community setting. This approach emphasizes working with creeks and rivers rather than against them. The resulting projects protect property while contributing to the preservation of habitat, improving water quality, and providing other community benefits. These principles also help keep creeks natural and restore them whenever feasible.

In addition to constructing natural flood protection projects, the district conducts operational programs designed to preserve flood conveyance capacity of channels and streams. This ensures that these facilities continue to provide the level of protection for which they were constructed; that the public's investment in these facilities is protected and not allowed to fall into disrepair; and that the district programs comply with the regulations of the federal flood insurance program. In general, these programs include regular and systematic inspections of channels and waterways, technical and engineering analysis to assess their condition, maintenance of flood protection facilities, erosion repair along stream banks, and restoration of flood conveyance capacity and stream stability.

Table 3.1 lists the specific projects and programs supporting the natural flood protection goal.

Guadalupe Multipurpose Flood Protection Project

Table 3.1 Natural Flood Protection Projects and Programs

Goal One: Natural flood protection for residents, businesses, and visitors.	
Projects and Programs	
Operations Programs as of 2010 • Basic hydrology • Geomorphic data analysis • Stream Maintenance Program (SMP) Implementation • Facility condition assessment • General field maintenance programs • Levee maintenance and safety • Erosion protection and repair (to protect facility infrastructure) • Watershed property vegetation management • Debris and obstruction removal • Sediment removal • Stream capacity vegetation control **Operating Projects as of 2010** • Stream Maintenance Program Permit Renewal • Watershed Total Asset Management Program • Levee Recertification Project	**Capital Improvement Projects as of 2010** • Adobe Creek (El Camino Real to Rhus Ridge) • Permanente Creek (S. F. Bay to Foothill Expressway) • San Francisquito Creek planning and design(S.F. Bay through Searsville Dam) • Calabazas Creek (Central Expressway to Miller Avenue) • Calabazas Creek (Miller to Wardell Road) • San Tomas Aquino Creek (Quito Road Bridge) • Sunnyvale East and West Channels Improvement • Lower Guadalupe River (Alviso Marina to I-880) • Guadalupe River Downtown (I-880 to I-280) • Upper Guadalupe River (I-280 to Blossom Hill) • Berryessa Creek (Calaveras Boulevard to Old Piedmont Road) • Berryessa Creek (L. Penitencia Cr. to Cal. Blvd.) • Coyote Creek planning and design, partial construction (Montague Expressway to I-280) • Lower Silver Creek, Reaches 1-3 (Coyote Creek to I-680) • Lower Silver Creek, Reaches 4-6 (I-680 to Lake Cunningham) • Lake Cunningham Improvements • Upper Penitencia Creek • Upper Llagas Creek • Lower Llagas Capacity Restoration • San Francisco Bay Shoreline Planning

3.2.1.1 Operations Programs – Natural Flood Protection Goal

Basic Hydrology is a program that supports and maintains the district's Hydrology Management System. This program uses hydrology models to provide flood forecasts; analyzes frequency of storm and precipitation events; determines the district's reservoirs' starting storages to optimize flood protection and water supply benefits; and updates design flows when climate change effects are known. The program provides planners and engineers with design flows for each creek in all five watersheds. These design flows are the basis for flood protection facility planning, design, construction, and operations. This program also provides hydrology information when requested by other agencies and members of the public.

Geomorphic Data Analysis is a program that collects and analyzes fluvial geomorphic data to develop an understanding of the natural streams of our watersheds. This understanding serves as a basis for project design to ensure that we co-exist harmoniously with the creeks. Data that result from this program include bankfull channel geometry, bankfull discharge, hydrologic regime, and sediment characteristics and loads.

Stream Maintenance Program (SMP) Implementation program coordinates routine maintenance activities to ensure that work is completed consistent with environmental regulatory permits. The SMP applies to all of the district's routine stream maintenance activities, including three major types of activities: sediment removal, vegetation management, and bank protection. Work areas have been pre-determined, but will evolve and expand as new capital projects are completed. The program includes: report preparation and submittal, agency meetings, adaptive management, and best management practices training. Best management practices (BMPs) are methods that protect environmental quality or reduce environmental impacts from stream maintenance activities. To be effective, BMPs must be properly selected and implemented, applied consistently, and their effectiveness evaluated onsite to assure that they are meeting the required objective. The environmental permits provide cost savings not only to the district, but also to the regulatory agencies by eliminating repetitive applications and permit processing for routine maintenance activities; by providing consistent permit requirements; and by streamlining reporting requirements.

Facilities Condition Assessment programs provide for scheduled inspections of district facilities where the district holds property rights either in fee title or easement (including areas in and around creeks and fish ladders), and includes non-scheduled citizen-initiated inspections and emergency inspections. Inspections document deficiencies in categories such as erosion, sediment accumulation, debris blockages, vegetation, trash, graffiti, and fence, gate and sign damage.

Bank repair and stabilization

General Field Maintenance programs provide for small construction projects, repairs and preventative maintenance needed to maintain flood protection infrastructure such as, flood walls, outfalls and channels. Routine work also includes access road work, fence repair and installation, sign installation

and miscellaneous property maintenance. This operation includes engineering, inspection, planning, design, construction, and environmental review to repair these facilities.

Levee Maintenance and Safety is an ongoing program that includes levee inspections, structural stability evaluations after earthquakes or flood events, and preparation and implementation of corrective designs and action plans for levee upgrades to ensure that levees are maintained to design conditions.

Erosion Protection and Repair programs provide erosion control and repair of stream banks to protect facility infrastructure and reduce sediment deposition downstream. Practical solutions are implemented to improve stream stability and to restore the stream's dynamic equilibrium. Natural materials are used in erosion repair projects, where practical, to create greater environmental value to those waterways.

Watershed Property Vegetation Management- This operation provides for upland vegetation management activities on 2,638 acres in all five watersheds throughout the county. Work activities in this project include upland vegetation management for right of way access and fire code compliance.

Debris and Obstruction Removal activities include emergency, routine and miscellaneous debris removal activities such as fallen tree removal, debris removal from bridge supports, and fish passage structure maintenance to preserve the existing flood water conveyance capacity in creeks. Removal of large urban trash and debris removes pollutants and provides for healthy creeks and bay ecosystems. Removal of obstructions to creek flows also eliminates blockages that could cause bank erosion.

Sediment Removal

Sediment Removal activities provide for routine and emergency sediment removal and sediment management from creeks to preserve flood conveyance. Sediment is removed using best management practices in accordance with the Stream Maintenance Program.

Stream Capacity Vegetation Control- This operation provides for in-stream vegetation management of 619 acres annually on predetermined sections of creeks in all five watersheds. Work activities in this project include a variety of integrated vegetation control methods to manage and control stream vegetation, including non-native plants and other vegetation obstructing flood conveyance.

3.2.1.2 Operating Projects – Natural Flood Protection Goal

Stream Maintenance Program Renewal- This operating project provides for continuous operations of the district's routine stream maintenance by renewing the current environmental permits for an additional ten years. The SMP currently provides a predictable and efficient process for completing routine maintenance tasks. Because management of the long term program necessarily involves cumulative tracking of operations, the SMP implementation project and the SMP renewal have significant

interrelationships of staff and tasks. The SMP renewal project includes the underlying program activities and the increased extent of those activities, such as new reaches of sediment removal and vegetation management. It also includes new work types, such as levee protection elements and larger woody vegetation removal, which must be negotiated with various regulatory agencies. This project lays out a strategy to accomplish this. The operating project started in 2002 and is scheduled to be completed in 2012.

Watershed Total Asset Management Program- This operating project provides an Asset Management Program (AMP) that will provide management tools for watershed operation of district facilities in an efficient and effective manner. The goals of this project are to establish a systematic approach for reducing the cost of operating and maintaining capital assets; maintain reliability of service; predict and plan for maintenance far into the future; forecast maintenance and capital cost; and stabilize expenses with respect to the risks and service levels. Specifically the AMP will provide an estimate of life-cycle costs and liabilities of assets in relation to an identified Level of Service. The strategic outcomes of the AMP are 1) An inventory of all watershed operations assets, 2) Current condition of assets, 3) Identify the required sustainable level of Service, 4) The life-cycle cost for operations and maintenance and capital improvements, 5) Identification of cost options for sustainable level of service, 6) Liabilities incurred in the absence of improvement or replacement and 7) Strategy of implementation to maximize the liability reduction to investment ratio. The operating project started in August 2008 and is scheduled to be completed in June 2012.

Levee Recertification Project- This project assesses the district's existing levees and floodwalls according to FEMA's published standards, ascertains whether individual levees are certifiable to today's standards, and provides certification documentation to FEMA for those levees that are certifiable. This effort will continue to include intensive coordination with FEMA, the Army Corps of Engineers (Corps) and cities which are responsible for floodplain management and administering the National Flood Insurance Program. The operating project started in 2008 and all certification materials have been submitted to FEMA in 2010.

3.2.1.3 Capital Projects- Natural Flood Protection Goal

Natural Flood Protection projects are designed to meet multiple objectives, whenever feasible. Some of the benefits or outcomes of multi-objective projects may include: stream habitat restoration, removal of invasive plants, replanting of native species, improvement in water quality through stream stabilization, and new recreational enhancements. These capital projects not only support the goal of Natural Flood Protection, they support the other four goals identified in Section 3.1.

As of FY 2010 there are 20 projects that plan for, and/or construct, improvements on 46 miles of creeks to protect homes, schools, businesses and roadways from flooding. These projects combine to protect over 30,000 parcels from potential flood risks. These projects include:

The district maintains and implements a Capital Improvement Program (CIP) which contains flood protection construction projects. The CIP process includes prioritization of all projects to ensure the projects in the CIP reflect Board priorities. The CIP prioritizes projects through a system that quantifies potential benefits, using weighted criteria to determine a ranking for future funding and construction. Once the district ranks a project as high priority, it evaluates a number of alternative designs, taking into account a variety of objectives—natural resource protection, property protection, community benefits and costs.

Adobe Creek project, from El Camino Real to Rhus Ridge, plans, designs, and constructs improvements to accomplish the following objectives: provide 1-percent protection to 328 parcels against flooding and erosion; improve sediment transport; protect and

enhance the creek ecosystem, and provide for fish passage. This project is funded by the district's watershed and stream stewardship fund. Clean, Safe Creeks special tax funds the creek ecosystem enhancement component of this project. The Adobe Creek project was started in July 1991 and is scheduled to be completed in April 2012. Planning and design phases are complete as of 2010.

Permanente Creek project plans, designs, and constructs improvements along 10.6 miles from San Francisco Bay to Foothill Expressway; Hale Creek from its confluence with Permanente Creek to Foothill Expressway; and the Permanente Diversion Channel between Permanente and Stevens creeks. These construction elements will accomplish the following objectives: provide natural flood protection by taking a multiple-objective approach; reduce erosion and sedimentation; reduce maintenance costs; improve safety and stability of the failing channel between the bay and Foothill Expressway; provide environmental restoration and enhancement benefits; and allow for recreation enhancements where opportunities exist. This project will provide 1-percent flood protection to 1,664 parcels. This project is funded by the district's watershed and stream stewardship fund and by Clean, Safe Creeks. It was started in July 2001 and is scheduled to be completed in June 2016.

San Francisquito Creek project, from San Francisco Bay through Searsville Dam, provides coordination and support to the San Francisquito Joint Powers Authority, in partnership with the U.S. Army Corps of Engineers, to complete planning and design documents for an approved project alternative to accomplish the following objectives: define a project that will eventually provide flood protection to 3,000 homes and businesses; reduce bank erosion and sedimentation-related impacts; avoid potential adverse impacts on fish and wildlife habitats; minimize impacts to the creek's environmental resources; restore the riparian corridor where feasible; and develop public support for the preferred alternative. This project is funded by the district's watershed and stream stewardship fund and by Clean, Safe Creeks with contributions from the Corps and San Mateo County for feasibility study activities only. This is predominantly for planning and design phases only. This project was started in July 2004 and is scheduled to be completed in June 2016.

Calabazas Creek project, from Central Expressway to Miller Avenue, plans, designs, and constructs approximately 2 miles of improvements to accomplish the following objectives: provide 1-percent flood protection to 2,250 parcels, and correct invert erosion along Calabazas Creek downstream of Miller Avenue. Successful completion of this project will have the added benefit of reducing sediment deposition in the downstream reaches that would otherwise compromise stream capacity. This project was funded by the district's watershed and stream stewardship fund. It was started in January 2005 and completed in December 2009.

Calabazas Creek project, 3.3 miles from Miller Avenue to Wardell Road, plans, designs and constructs improvements to accomplish the following objectives: provide 1-percent flood protection to 2,483 homes, businesses, and schools; reduce erosion, sedimentation, and maintenance costs; provide environmental restoration and enhancement benefits; and allow for recreation enhancements where opportunities exist. This project is funded by Clean, Safe Creeks. It was started in December 2003 and is scheduled to be completed in June 2014.

San Tomas Aquino Creek at Quito Road project partners with the City of Saratoga, the Town of Los Gatos, and Caltrans to plan, design, and construct two bridge replacements and to provide 1-percent flood capacity. This project was funded by the district's watershed and stream stewardship fund. It was started in July 2001 and is scheduled to be completed in March 2013.

Sunnyvale East and West Channels Improvement project plans, designs, and constructs improvements to approximately 6.4 miles of the Sunnyvale East Channel, from Guadalupe Slough to Interstate 280, and 2.3 miles of the Sunnyvale West Channel, from Guadalupe Slough to Highway 101. This project will provide flood protection to 1,629 parcels; provide environmental enhancement benefits where opportunities exist; provide recreation enhancements where opportunities exist; reduce erosion, sedimentation, and maintenance costs; and protect fish and wildlife habitat. This project is funded by the district's watershed and stream stewardship fund and by Clean, Safe Creeks. It was started in March 2006 and is scheduled to be completed in December 2015.

Sunnyvale East Channel bank erosion

Lower Guadalupe River project, approximately 6 miles from the Alviso Marina to Interstate 880, plans, designs, and constructs improvements to accomplish the following objectives: eliminate the potential for flood damage to 1,602 homes and businesses during a 1-percent flood event; reduce bank erosion and sedimentation-related impacts along the lower Guadalupe River; avoid potential adverse impacts on fish and wildlife habitats within the riparian corridor where feasible; provide long-term riparian habitat improvement to offset impacts resulting from constructing flood control facilities; provide, where possible, continuous maintenance access along the river, which can be used as a trail; provide opportunities to protect and enhance the existing wetlands and riparian habitat, and improve conditions favoring Chinook salmon and steelhead trout; identify potential project impacts on Alviso and bay land areas and mitigate for unavoidable adverse impacts; provide mitigation for unavoidable adverse impacts on environmental resources; and specify best management practices to protect water quality. This project was funded by the district's watershed and stream stewardship fund. It was started in June 1999 and completed in June 2010.

Guadalupe River Downtown Flood Protection, from Interstate 880 to Interstate 280, partners with the U.S. Army Corps of Engineers (Corps), State of California, City of San Jose, and San Jose Redevelopment Agency to plan, design, and construct improvements along 2.6 miles of the Guadalupe River, to accomplish the following objectives: provide 1-percent flood protection to 3,292 parcels in downtown San Jose's technology and commercial industries and residential neighborhoods; provide recreational and open space benefits in cooperation with the Corps, City of San Jose, and San Jose Redevelopment Agency; preserve and enhance the river's habitat, fish and wildlife; and protect and improve water quality of the river. This project is funded by the district's watershed and stream stewardship fund with contributions from federal, state, and local agencies. It was started in March 1990 and is scheduled to be completed in June 2011.

Guadalupe River Multipurpose Flood Control Project

Upper Guadalupe River project along approximately 6 miles of the Guadalupe River, from Interstate 280 to Blossom Hill Road, partners with the Corps to plan, design, and construct improvements to accomplish the following objectives: provide 1-percent flood protection to nearly 7,000 parcels along

the Guadalupe River, from I-280 to Blossom Hill Road, including portions of Ross Creek and Canoas Creek; provide access to an additional 19 miles of suitable upstream spawning and rearing habitat, which would result in significant long-term beneficial impacts on fisheries resources; provide an opportunity to incorporate a continuous 6-mile trail by connecting the trail at Interstate 280 to the Alamitos Creek trail; provide long-term net gains of 15 acres in riparian forest acreage, quality, and continuity of wildlife habitat, and conditions favoring Chinook salmon and steelhead trout; improve water quality by reducing bank erosion and sedimentation-related impacts along the river and tributaries; and address and resolve permit coordination activities and watershed integration issues through the Guadalupe Watershed Integration Working Group. This project is funded by Clean, Safe Creeks with contributions from federal, state, and local agencies. It was started in July 2001 and is scheduled to be completed in May 2015.

Berryessa Creek project partners with the Corps to plan, design, and construct improvements along approximately 4.3 miles of Berryessa Creek, from Calaveras Boulevard to Old Piedmont Road. This project will provide 1-percent flood protection to more than 2,900 homes, businesses, and public buildings; reduce sedimentation and maintenance requirements, mitigate for project impacts, improve stream habitat values, and identify opportunities to integrate recreation improvements consistent with the Cities of San Jose's and Milpitas' Trail Master Plans. This project is funded by Clean, Safe Creeks with contributions from state and federal partners. It was started in July 2001 and is scheduled to be completed in December 2018.

Berryessa Creek project, from the confluence with Lower Penitencia Creek to Calaveras Boulevard and the lower reaches of both Calera and Tularcitos Creeks, plans, designs, and constructs improvements along approximately 3 miles of Berryessa Creek and its tributaries to accomplish the following objectives: provide 1-percent flood protection to the surrounding area; improve the structural integrity of the levees; improve maintenance access and safety for district staff, and identify opportunities to integrate recreation inputs consistent with the City of Milpitas' Trail Master Plan. This project is funded by the district's watershed and stream stewardship fund. It was started in March 2001 and is scheduled to be completed in June 2021.

Coyote Creek project, from Montague Expressway to Interstate 280, plans, designs, and partially constructs improvements along approximately 6.1 miles of Coyote Creek to accomplish the following objectives: provide flood protection to the surrounding area; identify opportunities to improve water quality within the project limits; identify opportunities to provide for public recreation and access; obtain community support; mitigate for project impacts to stream habitat and fisheries; and create a self-sustaining system within the project limits to reduce long-term operations and maintenance costs. This project is funded by Clean, Safe Creeks. It was started in September 2002 and is scheduled to be completed in June 2016.

Lower Silver Creek (Reach 1-3) project from Coyote Creek to Interstate 680 partners with the Natural Resource Conservation Service (NRCS) to plan, design, and construct improvements along approximately 2.3 miles of the Lower Silver Creek, to accomplish the following objectives; provide 1-percent flood protection to properties in the surrounding area; identify opportunities for additional enhancement of existing habitat values by increased wetlands and riparian habitat; provide on-site mitigation for project impacts; improve stream habitat values and improve fisheries potential; improve pedestrian bridges crossing Lower Silver Creek; and facilitate the opportunity for future pedestrian trails along Lower Silver Creek. This project is funded by the district's watershed and stream stewardship fund. Clean, Safe

Creeks funded the wetland and riparian habitat enhancement component of this project. The Lower Silver Creek project was started in January 1990 and is scheduled to be completed in June 2010.

Lower Silver Creek Reimbursable (Reaches 4-6) project, from I-680 to Lake Cunningham, is part of a flood control project that partners with the NRCS to plan, design and construct improvements along approximately 2.3 miles of the Lower Silver Creek. This project includes elements that are eligible for reimbursement from the State and helps to accomplish the following objectives: increase flood protection to 5,400 properties in the surrounding area; allow for on-site mitigation of project impacts, and in some cases enhancement of existing habitat values by increased wetlands and riparian habitat; and improve vehicle and pedestrian bridges crossing Lower Silver Creek. This project is funded by the district's watershed and stream stewardship fund and with contributions from state and federal partners. It was started in August 2008 and is scheduled to be completed in March 2014.

Lake Cunningham Improvements- This project plans, designs, and constructs improvements to Lake Cunningham in the City of San Jose between Cunningham Avenue and Tully Road, to function as a detention basin. When completed, this project will provide 1-percent flood protection to at least 3,800 parcels. This project is funded by the district's watershed and stream stewardship fund. It was started in August 1999 and is scheduled to be completed in June 2014.

Flooding at King Road on Upper Penitencia Creek

Upper Penitencia Creek project, from Coyote Creek to Dorel Drive, partners with the Corps to plan, design, and construct improvements along approximately 4.2 miles of Upper Penitencia Creek, to accomplish the following objectives: provide 1-percent flood protection to more than 5,000 homes, businesses, and public buildings; mitigate for project impacts; improve stream habitat values and fisheries potential; reduce sedimentation and maintenance requirements; obtain a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (FEMA); and identify opportunities to integrate recreation improvements consistent with the City of San Jose's and Santa Clara County Parks' Master Plan. In FY 2010, this project is funded through the planning and partial design phases only. The scope, schedule, costs and funding sources of the remaining design and construction phases will be determined at the completion of planning. Planning and partial design are funded by the district's watershed and stream stewardship fund. This project started in March 1996. Preliminary design is scheduled to be completed in December 2010 with final design to resume in FY 2017 due to funding constraints. Final design is scheduled to be completed in FY 2019.

Upper Llagas Creek project, from Buena Vista Road to Wright Avenue, partners with the Corps to plan, design, and construct improvements on approximately 13.6 miles of Upper Llagas Creek, from Buena Vista Avenue to Wright Avenue, to accomplish the objective of providing an increased level of flood protection with adequate freeboard. Approximately 1,397 parcels will be protected. This project is funded by Clean, Safe Creeks and with contributions from state and federal partners and the City of Morgan Hill. It was started in August 2000 and is scheduled to be completed in December 2015. The project schedule may vary considerably and is dependent upon the Corps and Congressional appropriations.

Lower Llagas Creek Capacity Restoration Project, from Highway 152 to Pajaro River, is a partially-funded (planning phase only) project that plans, designs, and constructs improvements on approximately 3.35 miles of Lower Llagas Creek, from Hwy 152 to Pajaro River, to accomplish the following objectives: restore flood capacity in Lower Llagas Creek; coordinate with South County Wastewater Authority as a principal stakeholder and water resource co-planner; and integrate flood protection with habitat protection to satisfy Endangered Species Act regulations. This project is funded by the district's watershed and stream stewardship fund. It was started in July 2008 and is scheduled to be completed in December 2014.

San Francisco Bay Shoreline is a partially-funded (planning phase only) project that provides district coordination with the California Coastal Conservancy, Corps, and other project partners to plan, design, and construct improvements to accomplish the following objectives: provide integrated fluvial and tidal flood protection; restore and/or enhance tidal marsh and related habitats; provide recreational and public access opportunities throughout the tidal floodplain of Santa Clara County; and pursue continued federal funding. This project is funded by the district's watershed and stream stewardship fund with contributions from various partners. Clean, Safe Creeks funded the enhancement component of this project. The project is currently funded for the planning phase only. The scope, schedule, costs and funding sources for the design phase and construction phase will be determined at the completion of the planning phase. The San Francisco Bay Shoreline project was started in July 2003 and is scheduled to be completed in June 2020.

Marshland in San Francisco Bay near shoreline project

3.2.1.4 Levels of Service - Natural Flood Protection Goal

Through the ends policies, the board has adopted the goal of natural flood protection for residents, businesses, and visitors. To attain this goal, the Flood Protection and Stream Stewardship program is structured to achieve a 100% Level of Service around two objectives:

- Objective 1- Balance environmental quality and protection from flooding in a cost effective manner
- Objective 2- Preserve flood conveyance capacity

The ability of the district to satisfy the target Levels of Service is determined by setting key performance measures or indicators and tracking progress of that performance. The first objective is centered on having a capital improvement program that provides additional protection from flooding through multiple-objective projects that also identify opportunities for environmental enhancements, trails, parks, and open spaces. Key performance indicators for capital projects are the number of parcels protected from 1-percent flooding (although, in response to a community's desires, the board may approve projects that provide an alternative level of protection) and miles of streams that are modified or studied.

The second objective is centered on stream maintenance program activities, total asset management principles, and other activities that preserve flood conveyance capacity. Key performance indicators for

preserving flood conveyance capacity include average annual sediment removal quantities, number of facility condition assessments performed annually, miles of levees inspected and maintained, and acres of vegetation control for restoring in-stream capacity.

Natural Flood Protection Operating Programs Existing Levels of Service

Operations

Under the Flood Protection and Stream Stewardship program as it exists in 2010, all the operating projects and operations programs identified in Section 3.2.1 can be provided at a 100% Level of Service through 2016. This includes all the objectives stated in each of the operating projects and all the routine activities in the operations programs. These levels of service are listed below in terms of measurable key performance indicators, which will be adjusted as newly-constructed creek projects are completed:

- 100% of flood protection facilities are inspected a minimum of two times annually to assess their condition and readiness to convey design flows.
- Field maintenance programs are provided at a 100% level of service for preventative and corrective maintenance as prescribed in the operation and maintenance manuals.
- Levee maintenance and safety activities are conducted for 7.6 miles of levees annually (out of a total of 107 miles of levees).
- 100% of identified bank or channel bottom erosion threats to flood protection infrastructure are repaired.
- Average 80,000 cubic yards of sediment are removed annually, as necessary, to preserve flood conveyance capacity.

Capital Projects

In the existing 2010 capital improvement program there are 20 capital projects to protect homes, schools, businesses and roadways from flooding. These projects were selected due to their high priority to solve problems in areas which have experienced flooding at least once over the last 20 years. In addition to flood protection, these projects also include stream habitat restoration, removal of invasive plants, replanting of native species, improvement in water quality, and new recreational opportunities.

The current capital improvement program for flood protection will receive a 100% Level of Service to plan, design, and construct 18 projects that are on track to be completed by 2016. Two other projects (San Francisquito and mid-Coyote creeks) are primarily planning and design projects for which a 100% Level of Service will be given to complete those studies by 2016.

Key performance indicators for meeting this Level of Service are:

- Constructing channel modifications to 32 miles of streams.
- Providing 1-percent flood protection to over 30,000 parcels.
- Completing planning, design, and partial construction on 14 miles of streams to provide eventual 1-percent flood protection to over 3,000 homes and businesses.

Natural Flood Protection Levels of Service 2017 to 2035 with no New Funding

If no new funding is secured after the sunset of the Clean, Safe Creeks special parcel tax, future Levels of Service may change over time for certain activities because of this anticipated constraint in the district's revenue. Factors that may change the desired Levels of Service in the future include new agreements or obligations stemming from current operating programs or capital projects; changes in regulations which can raise the minimum Levels of Service required; funding and implementation of new projects; requests from community interests; and board policy changes relative to the expected or required Levels of Service to be provided.

Construction on Lower Guadalupe River

In terms of Objective 1, under the scenario of no new funding to replace the Clean, Safe Creeks special parcel tax, it is likely that no new major flood protection projects will be started in this planning horizon. Two projects on Berryessa Creek projects will be mostly complete by 2016, but have off-stream construction and plant establishment elements that will extend into this planning horizon. The future Levels of Service for providing additional protection to parcels that are currently subject to 1-percent flooding is anticipated to decrease to a 0% Level of Service.

In terms of Objective 2, operating programs that currently support preserving flood conveyance capacity are anticipated to continue in this planning horizon for both existing and newly constructed facilities. These operating programs include stream maintenance program implementation, sediment removal, facility condition assessments, general field maintenance, repairing bank or channel bottom erosion that threatens facility infrastructure, levee maintenance and safety, and debris and obstruction removal. It is anticipated that most of these programs will be continued at a 100% Level of Service. Some programs such as stream capacity vegetation control may be provided at reduced Levels of Service if funding constraints or the board dictate that only the required elements of a program are to be continued.

Table 3.2 summarizes projected Levels of Service in each planning horizon.

Table 3.2 Natural Flood Protection Projects, Programs, and Levels of Service

Goal One: Natural flood protection for residents, businesses, and visitors		
Projects and Programs	**Levels of Service 2010 to 2016**	**Levels of Service 2017 to 2035**
Operations Programs as of 2010	**Operations Programs Levels of Service**	**Operations Programs Levels of Service**
• Basic hydrology	• 100% to maintain Hydrology Management System	100%
• Geomorphic data analysis	• 100% to develop geomorphic database	100%
• Stream Maintenance Program (SMP) Implementation	• 100% to comply with permit conditions and BMPs	100%
• Facility condition assessment	• 100% to provide annual inspection for all facilities	100%
• General field maintenance programs	• 100% of preventative and corrective maintenance	100%
• Levee maintenance and safety	• 100% to maintain average of 7.6 miles of levees annually	100%
• Erosion protection and repair (infrastructure protection)	• 100% to correct threats to infrastructure	100%
• Watershed property vegetation management	• 100% on 2638 acres of upland vegetation maintenance	100%
• Debris and obstruction removal	• 100% to remove identified obstructions	100%
• Sediment removal	• 100% to remove average of 80,000 cubic yards annually	100%
• Stream capacity vegetation control	• 100% to maintain 619 acres annually of in-stream vegetation control	60% (natural channel component eliminated due to CSC sunset in 2016)
Operating Projects as of 2010	**Operating Projects**	**Operating Projects**
• Stream Maintenance Program Permit Renewal	• 100% to obtain new ten-year permits to conduct stream maintenance activities	None identified at this time. There may be new operating projects that stem from current watershed total asset management program.
• Watershed Total Asset Management Program	• 100% to provide a watershed asset management program	
• Levee Recertification Project	• 100% to recertify all levees that FEMA indicates are non-certified to current standards	

Table 3.2 Natural Flood Protection Projects, Programs, and Levels of Service

Goal One: Natural flood protection for residents, businesses, and visitors		
Projects and Programs	**Levels of Service 2010 to 2016**	**Levels of Service 2017 to 2035**
Capital Improvement Projects as of 2010 • Adobe Creek • Permanente Creek • San Francisquito Creek (Plan & Design) • Calabazas Creek (Central Expressway to Miller Avenue • Calabazas Creek (Miller to Wardell Road) • San Tomas Aquino Creek (Quito Road Bridge) • Sunnyvale East and West Channels Improvement • Lower Guadalupe River (Alviso Marina to I-880) • Guadalupe River Downtown (I-880 to I280) • Upper Guadalupe River (I-280 to Blossom Hill) • Berryessa Creek (Calaveras Boulevard to Old Piedmont Road) • Berryessa Creek (L. Penitencia Cr. to Cal. Blvd.) • Coyote Creek Planning and Design, Partial Construction (Montague Expressway to I-280) • Lower Silver Creek (Reach 1-3) • Lower Silver Creek (Reach 4-6) • Upper Penitencia Creek • Upper Llagas Creek • Lower Llagas Capacity Restoration • San Francisco Bay Shoreline Planning	**CIP Levels of Service** 100% to complete planning, design, and construction on Adobe, Permanente, Calabazas (two projects), San Tomas Aquino, Lower Silver (two projects), Upper Llagas, and Lower Llagas creeks; Sunnyvale East and Sunnyvale West Channels; and Lower, Downtown, and Upper Guadalupe River by 2016. 100% to complete planning and design for two projects on Berryessa Creek by 2016. 100% to complete planning and preliminary design for Upper Penitencia by 2016 100% to complete planning, design, and partial construction on San Francisquito and Coyote creeks. 100% to complete planning for San Francisco Bay Shoreline project by 2016.	**CIP Levels of Service** 0% for new major capital improvement projects for flood protection (planning, design, or construction) without a new source of funding. 100% to complete construction on Berryessa Creek (Calaveras Blvd. to Old Piedmont) by 2018. 100% to complete construction on Berryessa Creek (Lower Penitencia Creek to Calaveras Blvd.) by 2021. 100% to complete final design on Upper Penitencia Creek by 2019.

3.2.2 Reduced Potential for Flood Damages

This section summarizes the supporting projects and programs associated with the Reduced Potential for Flood Damages goals and objectives. The supporting projects and program descriptions are followed by the section that identifies the levels of service applicable to those projects and programs.
The goal of reduced potential for flood damages has two primary objectives. These objectives are to reduce flood risks in flood prone areas, and to avoid the creation of expanded flood areas.

The first objective is centered on providing flood forecasting and emergency response services. Other activities are aimed at conducting an effective floodplain management program. This entails working with municipalities to clearly identify roles and responsibilities for flood plain management and emergency response; responding to development proposals that could impact district facilities; promoting community awareness about best practices to avoid or minimize exposure to flooding; and working with FEMA to ensure that floodplain maps are based on the best available data.

The second objective is centered around providing technical support on subjects such as flood-wise designs, mitigating erosion, sedimentation, and high flows from new developments; promoting green projects or other practices to manage stormwater runoff and improve water quality; and to promote awareness of the risks for developing in flood hazard areas. Table 3.3 lists the specific programs and projects that support the goal of reduced potential for flood damages.

Table 3.3 Reduced Potential for Flood Damages Projects and Programs

Goal Two: Reduced potential for flood damages	
Projects and Programs	
Operations Programs as of 2010	**Capital Improvement Projects as of 2010**
• Hydrologic Data Measurement and Management • Flood Warning System • Flood Management Policy and Coordination • Emergency Services • Watershed Asset Protection Support • Sandbag Program • Public Outreach and Flood Awareness	• Radio Repeater System Infill

3.2.2.1 Operations Programs- Reduced Potential for Flood Damages

Hydrologic Data Measurement and Management- This ongoing operation provides for collection, processing, analysis, storage, and dissemination of hydrologic data and maintenance of 39 precipitation stations, 70 stream flow gauges, 11 reservoir stations, and 1 evaporation and weather station. This program also manages ALERT, a database program which provides for real time data from most stations and is displayed on the district's web site.

Flood Warning System– This operation program intends to predict the stream flows and reservoir spills a few hours before the actual occurrence. The objective is to provide warnings to residents who are affected by the imminent flood event to allow emergency actions to reduce flood damage. The system involves developing and calibrating a hydrologic model for each watershed that can properly account for the rainfall-runoff process. It also develops an information dissemination system that automatically dispatches warning messages.

Flood Management Policy and Coordination- This program provides for coordination with local municipal floodplain managers on matters to increase local flood risk awareness, to encourage actions to mitigate the local flood risk, and to maintain the district's influence in activities affecting local flood risk management. To increase local flood awareness, the project will work with Federal Emergency Management Agency (FEMA) to improve the accuracy and usefulness of local flood maps and economic assessments of flood risk. The project will coordinate this information with the district's asset management program to facilitate prioritization of maintenance and capital expenditures. The project also continues the district's participation in FEMA's Community Rating System (CRS), for which the district receives credit for specific flood risk-reducing activities. CRS credit translates to lower flood insurance rates for policies in Santa Clara County.

This project will also coordinate information with district's automated flood warning system. Detailed maps produced in this project will be linked to the flood warning system. Information will also be developed for use by local emergency management staff in planning, preparing and responding to flood emergencies. This project will provide for an increased understanding - internally and externally - of local flood risks through improved mapping and strong partnerships with local municipalities and assure the district's voice in matters of local, state and national policy.

Emergency Services**-** The district conducts various ongoing activities of the Emergency Services program. Among these activities, the district maintains the Emergency Operation Center (EOC) emergency equipment and supplies to be available at anytime for activations for an emergency event. This project also includes activities to address FEMA requirements for the National Incident Management System (NIMS). Other activities include preparing staff to effectively respond to emergencies; timely operation of the EOC during emergency activations; partnering with other emergency professionals; and providing project management to ensure compliance with FEMA requirements and deadlines to ensure state and federal eligibility for reimbursements and grants.

Watershed Asset Protection Support**-** Following the adoption of the Water Resources Protection Ordinance in 2006, the district's role in land development review shifted from a regulatory permit basis to one of collaboration and technical support. The regulatory permit component of land development review is defined as the protection of district assets through the enforcement of the ordinance and the issuance of encroachment permits on district rights of way. Among the services that the district provides are:

District Emergency Operations Center

- Review and evaluate projects for compliance with CEQA and/or issuance and inspection of encroachment permits
- Enforce Water Resources Protection Ordinance
- Administer the Underground Service Alert program

- Maintain District right of way maps
- Renew and prepare leases and joint use agreements
- Prepare land surveys, title searches, or appraisals as needed to determine district land rights or value
- Negotiate land dedications, exchanges or deed outs associated with development
- Research and respond to requests for flood zone information
- Coordinate and maintain accessibility to FEMA flood maps on District's Geographic Information System (GIS) system

Sandbag Program

Sandbag Program- The district sandbag program provides filled sandbags or sand and empty bags for public use during winter storm events. The purpose of this program is to assist homeowners and businesses in protecting their property and assets. The district also provides educational materials on the proper usage of sandbags to divert storm waters and minimize storm-related damage to properties. On average, about 250,000 sandbags are provided between November 1 and April 30 at seven satellite facilities throughout the county.

Public outreach and flood awareness- This program focuses on efforts to raise the general public's awareness of flood safety, flood protection and stream stewardship issues. The objectives are to provide information and education to residents, businesses and commuters about the risks associated with flooding in Santa Clara County and how to be flood safe and reduce the loss of life and property. It is also designed to demonstrate the district's value to the community in terms of flood protection and stream stewardship.

3.2.2.2 Capital Projects- Reduced Potential for Flood Damages

Radio Repeater System Infill- The objective of this project is to expand the district's ability to communicate quickly and securely with Santa Clara County public agencies during day-to-day operations, large scale events, and regional disasters. This project studies the extent of repeater and receiver system infill and considers existing antenna sites that are available through the county, cities, and other public agencies. This project is funded by the district's watershed and stream stewardship fund and the water utility enterprise fund. It was started in July 2008 and is scheduled to be completed in April 2012.

3.2.2.3 Levels of Service- Reduced Potential for Flood Damages

The board has adopted the goal of reduced potential for flood damages. To attain this goal, the Flood Protection and Stream Stewardship program is structured to achieve a 100% Level of Service around two objectives:

- Objective 1- Reduce flood risks in flood prone areas, and
- Objective 2- Avoid the creation of expanded flood areas.

Under current and projected levels of funding, it is anticipated that the operating programs can be funded through 2035. To satisfy the target Level of Service, key performance measures or indicators have been determined to meet these objectives. Key performance indicators for achieving these

objectives include collecting, maintaining, and disseminating hydrologic data from precipitation and streamflow stations and reservoirs; incorporating standardized emergency management practices into emergency response preparedness activities; providing sandbags to cities and the public; conducting outreach and awareness programs; and responding to requests for development review. Table 3.4 indicates the level of service for each program activity.

Table 3.4 Reduced Potential for Flood Damages Projects, Programs, and Levels of Service

Goal Two: Reduced Potential for Flood Damages		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
Operations Programs as of 2010	**Operations Programs Levels of Service**	**Operations Programs Levels of Service**
• Hydrologic data measurement and management	• 100% Maintenance and data dissemination from 39 precipitation stations, 70 stream flow stations, 11 reservoirs, and 1 evaporation and weather station	100%
• Emergency Services	• 100% to comply with state standards, conduct emergency drills, prepare flood team to respond during winter season. 100% availability of EOC for emergency activations.	100%
• Watershed Asset Protection Support	• 100% to respond to land development review request within 30 days	100%
• Sandbag Program	• 100% to provide 40,000 filled sandbags at district facilities and provide empty bags and sand at seven satellite locations	100%
• Public outreach and flood awareness	• 100% to produce advertisements to promote flood awareness. Provide direct contact with the community to help increase flood protection and flood safety awareness	100%
• Flood Warning System	• 100% to develop the flood warning system	100%
Capital Improvement Projects as of 2010	**Capital Improvement Projects**	**Capital Improvement Projects**
• Radio Repeater System Infill	• 100% to provide county-wide radio system reliability	100%

3.2.3 Healthy Creek and Bay Ecosystems

This section summarizes the supporting projects and programs associated with the Healthy Creek and Bay Ecosystems goals and objectives. These services provide for crucial environmental work to protect and restore habitats. The projects and program descriptions are followed by the section that identifies the Levels of Service applicable to those projects and programs.

Coyote Parkway freshwater wetlands

The goal of healthy creeks and bay ecosystems has three primary objectives. These objectives are 1) to balance water supply, flood protection, and environmental stewardship functions, 2) to improve watersheds, streams, and natural resources, and 3) to promote awareness of stream and bay ecosystem functions.

The first objective is centered around activities aimed at protecting and restoring sensitive fisheries and aquatic species; identifying and mitigating impacts to watersheds, stream, and natural resources by capital projects and operations programs; identifying and implementing potential mitigation banking opportunities to streamline future mitigation requirements; and providing information on stormwater management and design of floodplains and channels.

The second objective is centered around implementing stream stewardship opportunities, including environmental enhancements, and seeking to achieve the physical stability and ecological health; engaging in habitat conservation planning; protecting groundwater recharge areas in creeks and riparian corridors; protecting, enhancing, and restoring riparian vegetation and in-stream and tidal habitat conditions; and protecting, enhancing, and restoring populations of key species.

The third objective is centered around providing technical expertise for applying ecosystems functions knowledge; promoting awareness of sensitive groundwater recharge areas; and promoting the preservation of ecological buffers.

The projects and programs supporting the goal of healthy creeks and bay ecosystems are listed in Table 3.5.

Table 3.5 Healthy Creeks and Bay Ecosystems Projects and Programs\

Goal Three: Healthy creeks and bay ecosystems	
Projects and Programs	
Operations Programs as of 2010 • Revegetation mitigation maintenance • Watershed property vegetation management • Watershed erosion protection • Downtown Guadalupe River mitigation monitoring • Pond A4 operations • SMP biodiversity monitoring • Ecological monitoring and assessment **Operating Projects as of 2010** • Island ponds mitigation and monitoring • Tick Creek enhancement • Lower Uvas fish passage at Bolsa Road • Guadalupe Creek cape ivy control • Adobe Creek mitigation monitoring • Coyote Creek mitigation monitoring • Lower Silver Creek mitigation monitoring • Lower Llagas mitigation monitoring • Smooth cordgrass control • SMP Mitigation, Arundo Control Program • Carnadero preserve management • Alviso Collaborative • Comprehensive Habitat Conservation Plan	**Capital Projects as of 2010** • Stream Maintenance Program Mitigation, Coyote Parkway freshwater wetland • SMP Mitigation, Laguna Seca freshwater wetland • SMP Mitigation, Pajaro Basin freshwater wetland • SMP Mitigation, Stream and watershed land preservation • Alviso Slough restoration • Clean, Safe Creeks Stevens Creek Corridor restoration • Gold Street education center • Jacques Gulch restoration • Pond A8 Applied study final design and construction • Thompson Creek stream stabilization • Fish and Aquatic Habitat Collaborative Effort (FAHCE) Stevens Creek fish passage enhancement • Clean, Safe Creeks Soap Lake floodplain property acquisition

3.2.3.1 Operations Programs- Healthy Creek and Bay Ecosystems

Bank repair on Saratoga Creek

Revegetation Mitigation Maintenance- This ongoing operation provides for management of 327 acres of revegetation plantings throughout the five watersheds. Work activities conducted under this program include maintenance of mitigation plantings on completed capital improvement projects and other watershed mitigation projects. The scope of work for this operation will expand as new capital projects are completed.

Watershed Erosion Protection- This operation provides for on-going routine and emergency stream bank stabilization to protect property, protect public health and safety, and reduce sediment deposits downstream. This project also provides stream bank stabilization to maintain improved facilities to ensure they continue to function as designed; prevent environmental degradation; and improve water

quality. This operation emphasizes the use of the "softest" feasible solution to stabilize stream banks and provide vegetation and habitat. Fluvial geomorphic stream management methods will be used where feasible with follow-up monitoring to evaluate effectiveness. On average 4,800 lineal feet of stream banks are stabilized annually.

Downtown Guadalupe River Mitigation Monitoring Program**-** This ongoing operation satisfies monitoring and reporting requirements in compliance with the permits issued by regulatory agencies for the Downtown Guadalupe River Project. The district, regulatory agencies, and interested parties participate on an Adaptive Management Team (AMT) that meets annually to review the Mitigation and Monitoring Report and come to consensus on recommended changes to the monitoring plan. The goal of the AMT is to recommend adaptive management strategies that will result in a successful mitigation program for the Guadalupe River Project. This is an ongoing operation.

Pond A4 Operations maintains and operates Pond A-4 as stipulated by the memorandum of understanding (MOU) with the United States Fish and Wildlife Service (USFWS). This project maintains the current state of Pond A-4, preventing its environmental and tidal flood benefit degradation. Ongoing facility maintenance and improvements such as levee repair, road grading, pump operation, fencing and signage are also components of this project. A potential benefit of the pond is its use for sediment disposal.

SMP Biodiversity Monitoring- This operation addresses mitigation requirements under the Stream Maintenance Program (SMP). It was developed under Best Management Practice 3.19 in the SMP as a 10-year program, designed to identify and evaluate the habitats and the distribution and abundance of sensitive species in areas covered under the SMP. The program provides advanced information on sensitive species which will help with the planning and implementation of maintenance and other types of projects. In FY 2010, the program will be adding the collection of biological information needed to support the expected SMP permit renewal process in FY2012 and support the Asset Management Program. Collecting biological information will help establish level of service for some district assets and also contribute to the condition assessments for these assets. SMP Biodiversity Monitoring is coordinating with the SMP Permit Renewal Project to ensure that the species data collection efforts of both projects supplement each other and do not duplicate efforts.

Ecological Monitoring and Assessment Program is being designed to ensure that timely and cost-effective scientific information of known quality on the health of stream ecosystems within the jurisdiction of the district is available to inform, evaluate, and improve watershed management decisions. The goals of the program are to programmatically manage district monitoring activities; to develop the strategies, tools, and procedures to improve the efficiency and effectiveness of district ecological monitoring activities; and to ensure that cost-effective and timely ecological information is available.

3.2.3.2 Operating Projects- Healthy Creek and Bay Ecosystems

Several mitigation, conservation, and monitoring projects are underway on several creeks, former salt ponds, and lands acquired for mitigation and enhancement purposes. Each is described in more detail below. These projects are implemented to fulfill regulatory permit requirements, agreements, or to provide enhancements. The mitigation and monitoring requirements vary in length, but are usually

either five years or ten years of monitoring. At the end of the appropriate time, ongoing mitigation maintenance may be conducted.

Island Ponds Mitigation site changes from April 2008 to Sep. 2009

Island Ponds Mitigation and Monitoring is an operating project to conduct long term monitoring activities to track the progress of the restoration efforts and to determine if there are adverse effects from the project. The district obligations are documented in the Final Restoration and Mitigation Monitoring Plan for the Island Ponds Restoration Project (RMMP; Feb 2006). This restoration project satisfies the district's tidal wetland mitigation needs of 30 acres for the Stream Maintenance Program (SMP) and approximately 36 acres for the Lower Guadalupe River Flood Control Project (LGRP). It also provides enhancement opportunities to help achieve the Clean, Safe Creeks fifteen-year goal for creation of additional wetlands. It consists of three former salt production ponds flanked by Mud Slough to the north and Coyote Creek to the south. In addition to satisfying the approximately 66 acres of tidal wetlands mitigation needs, this project will result in an enhancement of 299 acres of tidal wetlands. The operating project started in 2005 and is scheduled to be completed in February 2020.

Tick Creek Riparian Enhancement project will provide for the active revegetation of channel bank and/or near channel bank along Tick Creek within the Carnadero Preserve. This project will result in 2.3 acres of riparian habitat. The district acquired the Carnadero Preserve in 2004 primarily for Stream and Watershed Protection requirements under the Stream Maintenance Program. Additional acreage was purchased at the time in anticipation of future enhancement and mitigation opportunities, including fifty feet on either side of Tick Creek and adjacent fields which exhibit high groundwater and frequently flooded conditions. This project is included in the Pajaro Integrated Regional Water Management Plan. Benefits expected from the planting include increases to riparian vegetation, erosion control and habitat for beneficial insects. The operating project started in 2005 and is scheduled to be completed in December 2013.

Lower Uvas Fish Passage at Bolsa Road- This operating project proposes to design an appropriate fish way to accommodate fish passage at a larger range of flows throughout the migration period for steelhead (see fish ladder at Evelyn photo for a sample redesign). This project is an enhancement for fisheries increasing connectivity to seven miles of upstream fish habitat. A number of variables will be considered to select an appropriate fish way design. These variables include species and age class to be passed; hydraulic analysis of channel; degree of flow control available; dependability; and cost of operations and maintenance. Specific data required for collection during the design phase consists of bathymetry of pools, identification of channel and bar configuration to aid in the understanding of high flow hydraulics, ordinary and high water marks, and surveying channel cross sections to develop a hydraulic model and tailwater rating curve. In addition, bed and debris load quantity and quality and characterization of site soil conditions will be considered in the planning phase. The operating project started in 2009 and is scheduled to be completed in April 2014.

Guadalupe Creek Cape Ivy Control- This operating project is an enhancement that consists of removal of Cape Ivy (Delaria odorata) on Guadalupe Creek between Camden Avenue and Masson Dam. The area is vegetated with mature riparian vegetation which provides rich, stream-side habitat for wildlife and migrating salmonids. The native vegetation has been heavily infested with Cape Ivy which has degraded the habitat and threatens the downstream watershed, including a habitat restoration area located immediately downstream of Masson Dam. The project consists of physically removing invasive Cape Ivy biomass from riparian vegetation and the stream edge, treating the remaining Cape Ivy with specified herbicides, and performing follow up monitoring and treatment for an additional year to ensure adequate control of the vegetation. This project will restore 9.5 acres of quality riparian habitat along Guadalupe Creek by removing the negative impacts of this invasive exotic species. The operating project started in 2008 and is scheduled to be completed in June 2010.

Adobe Creek Mitigation Monitoring- This operating project provides for the management and maintenance of mitigation sites for three projects in Adobe Creek Reaches 1-4 and one site for Adobe Creek Reach 5. The district is required by three resource agency permits to mitigate for impacts to vegetation from project construction. Additional monitoring is required by the agencies for geomorphic monitoring of the project site and monitoring for San Francisco dusky-footed woodrat nests. Monitoring will be for ten years. After ten years, ongoing maintenance for this and other mitigation monitoring projects will be conducted under the Revegetation Mitigation Maintenance program. The operating project started in 2005 and is scheduled to be completed in February 2018.

Matadero Overflow Channel Mitigation Monitoring- This operating project will monitor biological mitigation for the Matadero Creek Overflow Channel Project to ensure that 2.46 acres of riparian habitat and 0.28 acres of wetland habitat are successfully established and meet the permit conditions from the agencies for construction related impacts. In 2005, the first year monitoring report was submitted to the regulatory agencies for this project. The district is required to submit mitigation monitoring reports for ten years ending in December 2014. In addition, the district was required to submit mitigation monitoring reports for five years for the created wetland area. This requirement ended in 2009. The project end date is June 30, 2015.

Bollinger Road Bridge Mitigation Monitoring- This project will monitor mitigation efforts consisting of non-native vegetation removal and revegetation with native species. The mitigation is a permit requirement for the removal of the old Bollinger Road bridge abutments and the new bridge modifications at Calabazas Creek. Monitoring will be for five years. The operating project started in 2005 and is scheduled to be completed in June 2011.

Coyote Creek Mitigation Monitoring- This project will restore a self-sustaining riparian forest and suitable wildlife habitat in order to replace the similar habitats which were removed during construction of the flood control project. This project will satisfy the permit conditions of the 1984 Coyote Creek Flood Control Project from San Francisco Bay to Montague Expressway through the management, monitoring, and reporting of results for reaches 1B, 2, and 3 of Coyote Creek.

Lower Silver Creek Mitigation Monitoring- This project will monitor revegetation sites for survivorship, cover, etc.; jurisdictional wetlands for species diversity and wetland hydrology; and channel features for geomorphic processes as required by the project's updated Lower Silver Creek Mitigation Monitoring Program (SCVWD 2001). The 4.6 mile flood protection and creek restoration project is divided into six reaches starting at the Lower Silver and Coyote Creek confluence, extending north to the Cunningham Avenue creek crossing. As reaches are completed, the mitigation components will be monitored for ten

years and reported annually to the permitting agencies. Mitigation for the project impacts includes 12.7 acres of jurisdictional waters, including wetlands, six acres of upland habitat, and five acres of riparian/shaded riverine aquatic. The operating project started in 2001 and is scheduled to be completed in June 2014.

Lower Llagas Mitigation and Monitoring- The Llagas Creek Watershed Project Plan was approved by the three local sponsoring agencies and the governing bodies of Santa Clara County, Gilroy, and Morgan Hill in 1968 and authorized by Congress in 1969 under Public Law 83-566. Different reaches have been constructed in phases starting in the early 1970s and continuing in the early 1980's and 1990's following further environmental review. Mitigation for construction impacts included restoring riparian resources with vegetative plantings, installing low flow channels and fish ladders, establishing plantings to mitigate visual impacts, and complying with various local and state ordinances for air and water quality. This will investigate and document mitigation and monitoring responsibilities agreed to in the permitting of the Lower Llagas Flood Control Project. The investigation will determine whether mitigation responsibilities have been fulfilled or, if not, whether a systematic mitigation and monitoring plan needs to be developed and implemented.

Smooth Cordgrass Control- This project is a mitigation condition of the Corps, USFWS, and CDFG permits for the SMP. The district is responsible for controlling existing and limiting future infestations of invasive smooth cordgrass (Spartina alterniflora) in the South San Francisco Bay tidal marshes. This project provides regional coordination, plant distribution monitoring, and control of up to 10 acres of invasive smooth cordgrass in Santa Clara County and Coyote Slough over a 5-year period, with an additional 3 years of retreatment work, if necessary. The operating project started in 2002 and is scheduled to be completed in July 2011.

Arundo Control Program- The Arundo donax control program is required mitigation for vegetation management activities under the long-term regulatory permits for the SMP. The program objective is to control 125 acres of existing Arundo donax, commonly referred to as giant reed, located in various riparian corridors throughout Santa Clara County. The program provides identification and control of 125 acres of Arundo donax over a ten year period (12.5 acres annually) with up to three years of ongoing control beyond the ten year project expiration.

Control consists of removal of above-ground biomass, chemical treatment of remaining rhizomes, removal and disposal of biomass and follow-up control (re-treatment). Arundo donax offers little to no wildlife habitat value but is highly used by homeless populations. Left unattended, Arundo donax infestations will expand in Santa Clara county streams, reducing flow conveyance, eliminating valuable wildlife habitat, and causing other negative impacts to the county's riparian resources. The operating project started in 2002 and is scheduled to be completed in June 2015.

Carnadero Preserve revegetation project

Carnadero Preserve Management- This project purchased and manages the Carnadero Preserve, located between Uvas-Carnadero Creek and Highway 101 south of Gilroy. The acquisition earned mitigation credits for the SMP. The site encompasses the areas of the confluences of Uvas-Carnadero Creek with the Pajaro River, Tick Creek,

and Tar Creek. This project provides stream and watershed protection mitigation credits for the district to conduct activities under the SMP in the Pajaro Basin. One of the project objectives is to identify and develop opportunities for potential wetland and riparian enhancements or enhancement of the site for ecosystem and water quality benefits. The operating project started in 2004 and is scheduled to be completed in June 2020.

Alviso Collaborative- The Alviso and Lower Guadalupe Collaborative was formed to collectively work toward effective flood protection, habitat enhancement and restoration, and recreation in the Alviso area. The collaborative participants include district staff and the Alviso Water Task Force, which consists of Alviso residents, interested parties, and legislators. The members of the collaborative understand that there are a multitude of projects such as the Lower Guadalupe Flood Protection Project and the Alviso Slough Restoration Project. The goal of the collaborative is to create a model in combining effective flood protection, habitat enhancement and restoration, and recreation in an urban area. The operating project started in 2004 and is scheduled to be completed in June 2016.

Comprehensive Habitat Conservation Plan- This project, the Santa Clara Valley Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/ NCCP), addresses development and implementation of a cooperative program that will provide long-term protection of habitats and biodiversity in much of Santa Clara County. The district has formed a partnership with the County of Santa Clara (lead agency), the City of San José, and Valley Transportation Authority as full partners and the City of Gilroy and Morgan Hill as half-partners. This project will improve efficiency and certainty of the Endangered Species Act/California Endangered Species Act (ESA/CESA) permitting for public and private infrastructure and development projects, and assure that the costs of mitigation are equitably spread among the planning partners. Stakeholder input will be included throughout plan development and implementation to ensure that all perspectives are considered. The end result will include streamlined permitting, incidental take coverage for covered activities within the geographic scope of the Habitat Conservation Plan/Natural Communities Conservation Plan and more effective conservation efforts. The operating project started in 2004 and is scheduled to be completed in December 2012.

3.2.3.3 Capital Projects- Healthy Creek and Bay Ecosystems

SMP Mitigation, Coyote Parkway Freshwater Wetland**-** This project plans, designs, and constructs a freshwater wetland basin at the Coyote Parkways Lakes area, near Monterey Road and south of the Highway 101 and Highway 85 interchange in San Jose. This project will provide seven acres of freshwater wetland habitat and in part meet the district's mitigation requirements for the multi-year SMP in the Santa Clara Basin. This project is funded by the district's watershed and stream stewardship fund. It was started in July 2003 and completed in June 2011.

SMP Mitigation- Pajaro Basin Freshwater Wetland**-** This project plans, designs, and constructs improvements to create a freshwater wetland in the Pajaro Basin. It is located in the district's Carnadero Preserve, approximately two miles south of Gilroy. This project will create about four acres of freshwater wetland habitat to meet the district's mitigation requirements for implementing the SMP in the Pajaro Basin. Another of the project objectives is to identify possible enhancement opportunities for presentation to the board of directors. This project is funded by the district's watershed and stream stewardship fund. It was started in July 2002 and is scheduled to be completed in June 2011.

SMP Mitigation, Laguna Seca Freshwater Wetland- This project plans, designs, and constructs improvements at Coyote Valley Research Park detention basin, formerly known as the Laguna Seca wetland site. It is located in San Jose where Fisher Creek intersects Santa Teresa Boulevard, north of Bailey Avenue. This project will create about 30 acres of freshwater wetland habitat, and in part, will meet the district's mitigation requirements for implementing the SMP in the Santa Clara Basin. This project is funded by the district's watershed and stream stewardship fund. It was started in July 2007 and is scheduled to be completed in June 2015.

Laguna Seca Freshwater Wetland

SMP Mitigation, Stream and Watershed Land Preservation- This project preserves streams and watershed lands in the Santa Clara Basin and implements appropriate restorations in these lands. This project will provide 71 acres of SMP mitigation credits through preservation of approximately 720 to 950 acres of stream and watershed to provide long-term protection of unique and valuable local stream resources and watersheds. Approximately 108 acres of the total land preservation will be for protection of riparian and upland habitats that are known to support California red-legged frogs and Western pond turtles. This project is funded by the district's watershed and stream stewardship fund. It was started in April 2004 and is scheduled to be completed in December 2012.

Alviso Slough Restoration- This project plans, designs, and constructs improvements to Alviso Slough between Gold Street and the Santa Clara County Marina. Upon completion, this project will restore the slough's open water channel width to conditions that existed prior to 1983. Navigation will be improved so the community can expand boating and other recreational opportunities. This project is funded by the district's watershed and stream stewardship fund. It was started in November 2004 and is scheduled to be completed in January 2012. This project is currently funded for the planning phase only.

Clean, Safe Creeks Stevens Creek Corridor Restoration- This project partners with the City of Cupertino, which will construct improvements to Stevens Creek from Stevens Creek Boulevard to McClellan Road near Blackberry Farms. This project will restore four acres of Stevens Creek riparian habitat, thereby fulfilling part of the district's Fish and Aquatic Collaborative Effort (FAHCE) requirements. In addition to removing four fish barriers, this project will implement environmental, floodplain, and water quality benefits.

Gold Street Educational Center- This project plans, designs, and constructs improvements at Gold Street adjacent to Guadalupe River in Alviso to provide an outdoor educational center for the Alviso community. This project is funded by the district's watershed and stream stewardship fund. It was started in December 2004 and is scheduled to be completed in February 2011.

Jacques Gulch Restoration- This project plans, designs and constructs improvements to Jacques Gulch, a tributary to Almaden Reservoir. Project objectives include removing mercury calcine deposits, stabilizing stream banks, and restoring habitat along Jacques Gulch. This project is funded by the water utility enterprise fund with contributions from local partners. It was started in July 2003 and is scheduled to be completed in March 2013.

Pond A8 Applied Study Final Design and Construction- This project constructs a pilot project at Pond A8 that provides a reversible tidal connection between a former salt pond and Alviso Slough. This project will convert Pond A8 from its previous use for salt production to a muted or fully tidal connection, resulting in the restoration of up to 200 acres of tidal wetland habitat. This project is funded by the district's watershed and stream stewardship fund with contributions from federal and state agencies. Clean, Safe Creeks funded the wetlands and riparian habitat enhancement component of this project. Planning and some design activities were funded by the San Francisco Bay Shoreline Project. This project was started in July 2008 and is scheduled to be completed in June 2011.

The Thompson Creek Stream Stabilization, Quimby Road to Aborn Road- This project provides coordination with the U. S. Army Corps of Engineers under the Aquatic Ecosystem and Restoration Program (Section 206 Program) to plan, design, and construct improvements along 1.2 miles of Thompson Creek. The project objectives include restoring the low-flow channel to an equilibrium state; restoring riparian habitat adjacent to the low-flow channel; improving water quality and providing diverse stream channel habitats; providing erosion protection along the creek; and identifying enhancement opportunities. This project is funded by the district's watershed and stream stewardship fund with a contribution from the Corps. It was started in July 2003 and is scheduled to be completed in June 2012.

Fish and Aquatic Habitat Collaborative Effort (FAHCE) Stevens Creek Fish Passage Enhancement- This project plans, designs, and modifies or reconstructs fish passages on Stevens Creek at Evelyn Avenue, Fremont Avenue and Moffett Boulevard and constructs a portable, gravity-fed outlet at Stevens Creek Dam. This project is funded by the district's watershed and stream stewardship fund and the water utility enterprise fund. It was started in July 2008 and is scheduled to be completed in June 2013.

Clean, Safe Creeks Soap Lake Floodplain Property Acquisition- This project partners with regional stakeholders to acquire easements or property as recommended by the Pajaro River Flood Prevention Authority. By securing rights on these properties, development in the Soap Lake floodplain will be prevented. This project is funded by the district's watershed and stream stewardship fund. Clean, Safe Creeks funded the wetlands and riparian habitat enhancement component of this project. This project was started in July 2007 and is scheduled to be completed in June 2011.

3.2.3.4 Levels of Service- Healthy Creek and Bay Ecosystems

The board has adopted the goal of healthy creeks and bay ecosystems. To attain this goal, the Flood Protection and Stream Stewardship program is structured to achieve a 100% Level of Service around three objectives:

- Objective 1- Balance water supply, natural flood protection, and water resources stewardship functions.
- Objective 2- Improve watersheds, streams, and natural resources.
- Objective 3- Promote awareness of stream and bay ecosystem functions

To satisfy the target Levels of Service, key performance indicators have been established to meet these objectives. Key performance indicators include establishing annual amounts in acres for revegetation mitigation maintenance, acres of watershed vegetation control, acres of mitigation to offset operations programs and capital projects impacts, length in feet of stream bank erosion protection projects, acres of tidal wetlands or riparian habitat creation, and acres of invasive plant control.

Healthy Creek and Bay Ecosystems Levels of Service 2010 to 2016

Coyote Parkways and Laguna Seca Wetlands

Under current levels of funding, the district anticipates that it can provide the operating programs identified in Section 3.2.2.1 at a 100% Level of Service through 2016. Additionally, many of the flood protection capital projects described in Section 3.2.2.3 and the mitigation or enhancement capital projects described in this section will have permit conditions for mitigation monitoring upon completion. Operating projects have been or will be initiated for these monitoring activities and will receive a 100% Level of Service to comply with permit requirements. Some of these operating projects will be funded past 2016 until regulatory requirements for monitoring have been satisfied. Typically, mitigation monitoring has been required for a period of ten years after installation of mitigation measures. At the end of the reporting period, routine maintenance of the mitigation sites will be conducted as part of the operations programs. This includes all the objectives stated in each of the operating projects and all the routine activities in the operating programs.

In the current capital improvement program, twelve capital projects are included to construct, or plan for, the creation, preservation, and protection of riparian, freshwater and tidal wetlands and habitats; remove vegetation; improve water quality; and improve fish passage. Approximately 1000 acres of habitat enhancement or improvement are planned under these projects. Some of these projects are also designed to meet multi-objectives, whenever feasible, and may include: erosion protection, floodplain improvements, recreation opportunities, ecosystem improvements, and SMP mitigation credits. The district will provide a 100% Level of Service to complete planning, design, and construction of these projects and the planning-only effort (at this time) for Alviso Slough restoration.

Healthy Creek and Bay Ecosystems Levels of Service 2017 to 2035 with no New Funding

Under current and projected funding, it is anticipated that all the operating programs that exist in 2010 will be continued through 2035 except for two operations, SMP biodiversity monitoring and ecological monitoring and assessment. The two operations are SMP permit requirements and will be completed by 2016. Most operations will be funded to provide a 100% Level of Service. Stream capacity vegetation control will be provided at a 60% Level of Service, eliminating the natural channel component of this operation due to Clean, Safe Creeks sunset in 2016.

For the capital improvement program, it is anticipated that there will be new obligations and agreements that will result from current projects, such as the Comprehensive Habitat Conservation Plan, Three Creeks Habitat Conservation Plan, and the stream maintenance permit renewal project. Capital projects will be established to provide a 100% Level of Service to comply with these new obligations and agreements. New capital projects to create, preserve, or enhance riparian habitats, tidal and freshwater wetlands; improve water quality; or improve fish passage will be subject to funding availability and board direction.

The Levels of Service for both planning horizons are listed for each program or project in terms of measurable key performance indicators in Table 3.6.

Table 3.6 Healthy Creeks and Bay Ecosystems Capital Projects Levels of Service

Goal Three: Healthy Creek and Bay Ecosystems		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
Operations Programs as of 2010	**Operations Programs Levels of Service**	**Operations Programs Levels of Service**
• Revegetation mitigation maintenance	• 100% on 327 acres of revegetation planting	100%
• Watershed erosion protection	• 100% to stabilize 4,800 LF of stream banks and channel bottoms annually to reduce sediment, improve water quality, and prevent environmental degradation	100%
• Downtown Guadalupe River mitigation monitoring	• 100% to satisfy monitoring and reporting requirements	100%
• Pond A4 operations	• 100% to maintain environmental and tidal flood benefits	100%
• SMP biodiversity monitoring	• 100% to comply with SMP mitigation requirements	0% (pending new requirements)
• Ecological monitoring and assessment	• 100% to comply with SMP mitigation requirements	0% (pending new requirements)
Operating Projects as of 2010	**Operating Projects Levels of Service**	**Operating Projects Levels of Service**
• Island ponds mitigation and monitoring	• 100% to satisfy mitigation requirements for the SMP and the Lower Guadalupe River Flood Control Project impacts to tidal wetlands.	100% until project completion in 2020. 0% hereafter
• Tick Creek enhancement	• 100% to provide 2.3 acres of riparian habitat	0%
• Lower Uvas fish passage at Bolsa Road	• 100% to modify fish ladder to improve fish passage and maintenance	0%
• Guadalupe Creek cape ivy control	• 100% to restore 9.5 acres of quality riparian habitat	0%
• Adobe Creek mitigation	• 100% to provide	100% until project

Table 3.6 Healthy Creeks and Bay Ecosystems Capital Projects Levels of Service

Goal Three: Healthy Creek and Bay Ecosystems		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
monitoring	mitigation at four sites for vegetation and construction impacts	completion in 2018
• Matadero Overflow Channel mitigation monitoring	• 100% to establish 2.46 acres of riparian habitat and 0.28 acres of wetlands	0%
• Coyote Creek mitigation monitoring	• 100% to restore a self-sustaining riparian forest and suitable wildlife habitat	100% until mitigation monitoring requirements have been fulfilled
• Lower Silver Creek mitigation monitoring	• 100% to provide mitigation for 12.7 acres of jurisdictional waters, including wetlands, six acres of upland habitat, and five acres of riparian/shaded riverine aquatic.	0%
• Lower Llagas mitigation monitoring	• 100% to provide mitigation monitoring until responsibilities have been fulfilled	100% until mitigation monitoring requirements have been fulfilled
• Smooth cordgrass control	• 100% to control up to 10 acres of invasive smooth cordgrass	0%
• SMP Mitigation, Arundo Control Program	• 100% to control 125 acres of existing arundo donax	0%
• Carnadero preserve management	• 100% to comply with provisions of the site management plan	100% until project completion in 2020
• Alviso Collaborative	• 100% to create a model combining effective flood protection, habitat enhancement and restoration, and recreation	Undetermined at this time
• Comprehensive Habitat Conservation Plan	• 100% to complete the plan that will streamline permitting and provide incidental take coverage for covered activities	0%

Table 3.6 Healthy Creeks and Bay Ecosystems Capital Projects Levels of Service

Goal Three: Healthy Creek and Bay Ecosystems		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
Capital Projects as of 2010 • SMP Mitigation, Coyote Parkway freshwater wetland • SMP Mitigation, Laguna Seca freshwater wetland • SMP Mitigation, Pajaro Basin freshwater wetland • SMP Mitigation, Stream and watershed land preservation • Alviso Slough restoration • Clean, Safe Creeks Stevens Creek Corridor restoration • Gold Street education center • Jacques Gulch restoration • Pond A8 Applied study final design and construction • Thompson Creek stream stabilization • FAHCE Stevens Creek fish passage enhancement • Clean, Safe Creeks Soap Lake floodplain property acquisition	**Capital Improvement Projects Levels of Service** 100% to complete planning for Alviso Slough restoration project 100% to complete all other water resources stewardship capital projects by 2016.	**Capital Improvement Projects Levels of Service** 100% to satisfy new obligations and agreements 0% for new major capital improvement projects for water resources stewardship (planning, design, or construction)without a new source of funding except when directed by the board.

3.2.4 Clean Safe Water in Our Creeks and Bays

Services supporting the goal of clean safe water in our creeks and bays are aimed at reducing and preventing pollution in Santa Clara County creeks and San Francisco and Monterey bays. These services ensure the safety of drinking water, detect and monitor toxic materials and sediments, protect ecosystems, and increase hazardous-material emergency response countywide.

The district also provides trash and graffiti removal services that improve creek aesthetics and the quality of life throughout the county.

The supporting programs and projects are described followed by a section that identifies the levels of service applicable to those projects and programs.

Table 3.7 lists the specific projects and programs supporting the goal of clean safe water in our creeks and bays.

Table 3.7 Clean Safe Water in Our Creeks and Bays Projects and Programs

Goal Four: Clean safe water in our creeks and bays	
Projects and Programs	
Operations Programs as of 2010 • District urban runoff program • Good neighbor maintenance • Illegal encampment cleanup program • HAZMAT emergency response • Water quality/stream stewardship awareness • Creekwise education and volunteer program **Operating Projects as of 2010** • Inter-agency urban runoff program • Pollution prevention activity • Surface water quality improvement • Urban runoff program South County	**Capital Projects as of 2010** There are no capital projects identified to support this goal

3.2.4.1 Operations Programs- Clean Safe Water in our Creeks and Bays

District Urban Runoff Program- This program ensures that the district is in compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit and the provisions related to the permit. Activities performed under this program include compiling and preparing the Annual Report of Pollution Prevention Activities; preparing the annual work plan of activities the district will complete in support of the NPDES permit; and participating in regional public outreach activities that reinforce the stormwater pollution prevention message.

Good Neighbor Maintenance- This element provides greatly expanded creek side trash removal services to improve the appearance of waterways and enhance quality of the life in Santa Clara County. Services include inspection of creeks for illegal dumping, trash removal events, removal of graffiti from flood walls and bridges, repair of fences for aesthetic purposes, and a five-day response time for trash, graffiti, and other complaints.

Illegal Encampment Cleanup Program- This project provides for the removal of trash and reduction of damages to district assets from illegal encampments in the creeks. This is accomplished by a monthly program coordinated by the City of San Jose which targets large encampments and a weekly program coordinated by the district. These programs locate and remove trash at illegal encampments along creeks. Both weekly and monthly programs include collaboration with City of San Jose. The city

provides trash disposal, homeless possessions storage, housing department support to homeless individuals and police support. The district provides labor and equipment for clean-up and trash transport to disposal locations. The coordination with the city is under a Memorandum of Agreement (MOA).

HAZMAT Emergency Response**-** This operation provides a 24-hour-a-day, 7-day-a-week hotline for reporting hazardous materials and other pollutants that impact or threatens water quality in creeks and reservoirs throughout the county. Response to hazardous material incidents along creeks, lakes, and reservoirs occurs within two hours of the report. The district advertises and conducts four hazardous material disposal events per year for creekside communities.

Creekwise Education and Volunteer Program- This project raises awareness, educates, and affects behavior change in creek side landowners. Programs and services will be developed addressing such topics as proper creek care, native plant species, runoff issues/concerns, pollution prevention tips, upstream and downstream implications, and suggestions for working as a community on creek protection. This project also manages the district's Adopt-A-Creek and Creek Connections volunteer programs.

3.2.4.2 Operating Projects- Clean Safe Water in our Creeks and Bays

Inter Agency Urban Runoff Program**-** This operating project provides for district coordination with 14 co-permittees for compliance with the Bay Area wide National Pollutant Discharge Elimination System (NPDES) permit which will soon be replaced by the Municipal Regional Permit, issued by the San Francisco Bay Regional Water Quality Control Board (Regional Board). This permit imposes waste discharge requirements for reduction of stormwater pollutants and effective elimination of non-stormwater discharges. The co-permittees jointly developed and established in 1988 the Santa Clara Valley Urban Runoff Pollution Prevention Program to collaborate on compliance with the joint permit. Under this collaborative approach, compliance with the permit is achieved by: (1) each agency developing and implementing agency specific activities to achieve compliance specific to its own facilities and jurisdiction, and (2) all of the agencies collaboratively developing and implementing area-wide activities to comply with permit conditions common to all, or that are most effectively and efficiently addressed collectively. The operating project started in 1998 and is scheduled to be completed in June 2014.

Pollution Prevention Activity**-** This operating project provides funding to County of Santa Clara, other public agencies, and community organizations under the district's public commitment to partner in various pollution prevention efforts. This project is completely funded by the Clean, Safe Creeks and Natural Flood Protection Plan special tax. The operating project started in 2002 and is scheduled to be completed in June 2016.

Laboratory water quality testing

Surface Water Quality Improvement- This operating project addresses existing regulations under the Clean Water Act to develop and implement Total Maximum Daily Loads (TMDL) for impaired water bodies within Santa Clara County and for San Francisco Bay and Monterey Bay. The district implements the Surface Water Quality Improvement Management Plan to support Regional Water Quality Control Board and Environmental Protection Agency regulations in reducing pollutants in our waterways. This project includes evaluation and prioritizing actions to address pollutant sources under district ownership and/or control. Several pollutants, such as mercury, diazinon, copper, zinc, PCBs and selenium, affect 18 freshwater bodies (which include 14 creeks and 4 reservoirs) designated as impaired in Santa Clara County. The primary pollutant being addressed by this project is mercury in fish in the Guadalupe River Watershed. Near-term actions (through 2011) include removal of mine waste deposits on district land along Alamitos Creek and applied studies of treatment alternatives to reduce the bioaccumulation of mercury in fish. This operating project started in July 2001 and is scheduled to be completed in June 2016, except for any project elements that become regulatory requirements and will need to be continued.

Urban Runoff Program South County- This operating project provides funding to the cities of Gilroy and Morgan Hill to help reduce pollution in the Uvas/Llagas watershed. The operating project started in 2002 and is scheduled to be completed in June 2016.

3.2.4.3 Capital Projects- Clean Safe Water in our Creeks and Bays

There are no capital projects identified that support this goal.

3.2.4.4 Levels of Service- Clean Safe Water in our Creeks and Bays

The board has adopted the goal of clean safe water in our creeks and bays. To attain this goal, the Flood Protection and Stream Stewardship program is structured to achieve a 100% Level of Service around two objectives:

- Objective 1- Preserve or improve surface and groundwater quality for beneficial uses, and
- Objective 2- Promote awareness of water quality and stream stewardship.

To satisfy the target Level of Service, key performance indicators have been established to meet these objectives. Key performance indicators include providing hazardous material management and incident response within two hours; inspecting creeks for illegal dumping of trash and pollutants; removing graffiti; repairing fences; complying with regulatory requirements or agreements with cities; and conducting Creekwise education and volunteer programs.

Under current levels of funding, it is anticipated that the operating programs and operating projects identified in Section 3.2.4 will be provided at a 100% Level of Service through 2016. There are currently no capital projects identified to support the goal of clean safe water in our creeks and bays.

From 2017 to 2035 without new funding, the district urban runoff program and the creek wise education and volunteer program will be provided at 100% Level of Service. Good neighbor maintenance, illegal encampment cleanup, and HAZMAT emergency response will be provided at a

decreased Level of Service due to the sunset of the Clean, Safe Creeks special parcel tax. The Inter Agency Urban Runoff Program will be continued at a 100% Level of Service, but it is anticipated that Pollution Prevention Activities and the Urban Runoff Program South County will be eliminated due to funding limitations. The Surface Water Quality Improvement operating project will be provided after 2016 at a greatly reduced Levels of Service or eliminated without new funding. New obligations stemming from those projects will be provided at a 100% Level of Service subject to available funding. Table 3.8 indicates the level of service for each project and program.

Table 3.8 Clean, Safe Water in our Creeks and Bays Projects, Programs, and Levels of Service

Goal Four: Clean, Safe Water in our Creeks and Bays		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
Operations Programs as of 2010	**Operations Programs Levels of Service**	**Operations Programs Levels of Service**
• District urban runoff program	• 100% to comply with district NPDES permit	100%
• Good neighbor maintenance	• 100% to provide four creek cleanup events per year and five-day response to remove litter and graffiti	40%
• Illegal encampment cleanup	• 100% to comply with the terms of the MOA	90%
• HAZMAT emergency response	• 100% to provide 24/7 hotline for reporting hazardous materials and two-hour response to incidents and increased services to south county	70%
• Creekwise education and volunteer program	• 100% for education and Adopt-A-Creek and Creek Connections volunteer programs.	100%
Operating Projects as of 2010	**Operating Projects Levels of Service**	**Operating Projects Levels of Service**
• Inter-agency urban runoff program	• 100% to comply with bay area NPDES and the municipal regional permit	100%
• Pollution prevention activity	• 100% to fund to pollution prevention efforts	0%
• Surface water quality improvement	• 100% to support regulations to reduce pollutants in our waterways	80%
• Urban runoff program South County	• 100% to expand the urban runoff program to the Uvas/Llagas watershed	0%

3.2.5 Trails, Open Space and Water Resource Management

The district partners with cities and the county to provide access to creek-side trails and parks, such as those identified by the County Trail Master Plan: Upper Llagas Creek, Sunnyvale East and West Channels, Upper Guadalupe River, Berryessa Creek and Permanente Creek.

This program provides access to bicycle paths for alternative transportation and increases community recreational opportunities countywide. The district is working with the cities and county to implement 70 miles of new trails by 2016 to meet the community expectations stated in the Clean, Safe Creeks program.

Guadalupe River bike trail

3.2.5.1 Operations Programs- Trails, Open Space and Water Resource Management

Open Spaces and Trail Administration**-** This program provides community access to additional trails and open space along creeks and in watersheds to meet the Clean, Safe Creeks commitment to the community. By collaborating with outside entities such as the County of Santa Clara, the county's 15 cities, and other various organizations, the district will help provide 70 miles of trails or the equivalent in open space by 2016. This will be accomplished through the execution of Trails, Parks and Open Space Grant Program Agreements, and the development and adoption of joint-use agreements and joint-trail agreements.

3.2.5.2 Operating Projects- Trails, Open Space and Water Resource Management

Prepare for Climate Change**-** This operating project will develop strategies to mitigate for and adapt to the changing local and regional weather and precipitation patterns while addressing water supply, flood risk management and ecosystem stewardship needs. Integrating climate change considerations into water supply planning, groundwater protection programs and water supply operations are critical for providing reliable water supply. Climate change also brings new focus on water conservation, desalination and recycling. Stewardship efforts such as habitat conservation, tidal wetlands or riparian habitat restorations could also benefit from a comprehensive strategy for climate change adaptation.

3.2.5.3 Capital Projects- Trails, Open Space and Water Resource Management

There are no capital projects identified that support this goal.

3.2.5.4 Levels of Service- Trails, Open Space and Water Resources Management

The board has adopted the goal of improved quality of life through trails, open spaces and water resources management. To attain this goal, the Flood Protection and Stream Stewardship program is structured to achieve a 100% Level of Service around two objectives:

- Objective 1- Support additional trails, parks and open space along creeks and in the watersheds when reasonable and appropriate, and
- Objective 2- Reduce green house gas emissions when reasonable and appropriate.

To satisfy the target Levels of Service, key performance indicators have been established to meet these objectives. Key performance indicators include providing additional miles of trails along creeks and access to open space by 2016 and preparing a climate action plan.

Under current levels of funding, it is anticipated that the open spaces and trail administration program will continue at a 100% Level of Service until 2016. The operating project, Prepare for Climate Change, will be completed within the 2010-2016 planning horizon. There are currently no capital projects identified to support the goal of trails, open space and water resource management.

From 2017 to 2035 without new funding, the open spaces and trails administration program will be unfunded due to the sunset of the Clean, Safe Creeks special parcel tax. Currently, no other operations, operating projects, or capital projects have been identified for the 2017 to 2035 planning horizon.

Table 3.9 indicates the level of service for each project and program.

Table 3.9 Trails, Open Space and Water Resources Projects, Programs, and Levels of Service

Goal Five: Trails, Open Space and Water Resources Management		
Projects and Programs	**Levels of Service through 2016**	**Levels of Service 2017 to 2035**
Operations Programs as of 2010 • Open Spaces and Trail Administration	**Operations Programs Levels of Service** 100% for 70 miles of trails or the equivalent in open space	**Operations Programs Levels of Service** 0% (District will partner with cities to provide access to open space or trails along creeks by providing right of way.)
Operating Projects as of 2010 • Prepare for Climate Change	**Operating Projects Levels of Service** 100% to develop strategies to mitigate for and adapt to climate change	**Operating Projects Levels of Service** 0%

3.3 FINANCIAL ANALYSIS

STRATEGIC VISION
We are a fiscally responsible water resources agency valued by the community.

This section summarizes the financial analysis of the Flood Protection and Stream Stewardship program for the two planning horizons: from FY 2010 to FY 2016 and from FY 2017 to FY 2035. This analysis was conducted under the assumptions that: (a) no new funding for the Flood Protection and Stream Stewardship program is secured after the sunset of the Clean, Safe Creeks special parcel tax in FY 2016, (b) only required elements of programs and projects funded fully or in part by the Clean, Safe Creeks special parcel tax will be continued after FY 2016, and (c) the remainder of the Flood Protection and Stream Stewardship projects and programs will continue through the year FY 2035, except for eliminating enhanced elements of some programs and projects to balance outlays to revenue sources.

The financial analysis presented in this section is based on the district's operating and capital budget for FY 2010, project priority rankings, and the district's Long Term Forecast financial model.

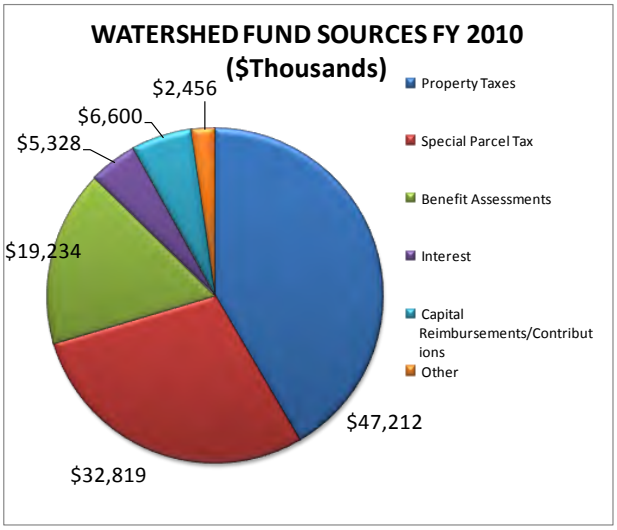
3.3.1 Budget Overview

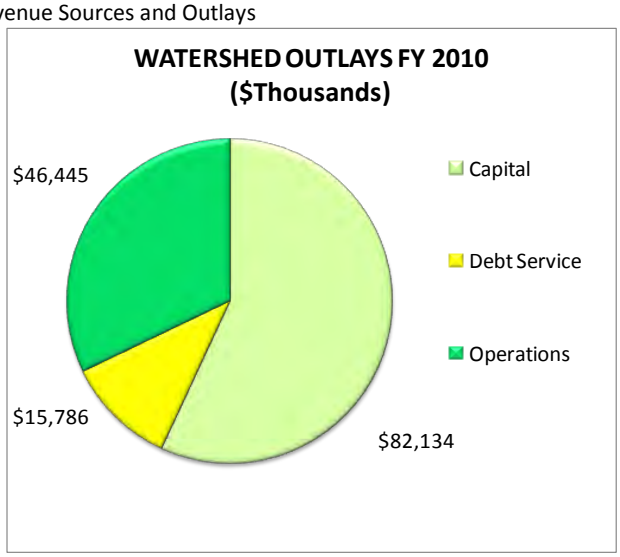
The Flood Protection and Stream Stewardship Program derives its revenues from a) a portion of the County ad valorem property tax, b) the Clean, Safe Creeks special parcel tax, c) benefit assessments, d) proceeds from debt financing, and e) income from investments. Capital reimbursements from local, state, and federal sources and grants, to a lesser degree, provide the balance of available funding.

In FY 2010, the overall value of the Santa Clara County assessment roll declined and resulted in reduced ad valorem property tax revenues that were less than projected. Benefit assessments, which are levied to meet debt service obligations, are projected to be relatively constant from year to year. Clean, Safe Creeks special parcel tax revenue is anticipated to increase 3 percent in FY 2010. Under the pay-as-you-go structure of the Clean, Safe Creeks plan, projects are prioritized and constructed as money becomes available. In any given year, when revenues exceed outlays, those funds are added to the capital and operating reserves. When planned outlays exceed anticipated revenues, funds are drawn from reserves.

Total revenue for the Flood Protection and Stream Stewardship program in FY 2010 is estimated to be $113.6 million. Outlays for FY 2010 are budgeted among capital improvement projects, operations programs and projects, and debt service obligations, and are projected to be approximately $144.4 million. The $30.7 million difference between revenues and outlays will be funded by capital and operating reserves. The amount and distribution of these revenues for FY 2010 is shown in Figure 3.1.

Figure 3.1: Flood Protection and Stream Stewardship FY 2010 Revenue Sources and Outlays





3.3.2 Long Term Forecast Overview and Assumptions

Long Term Forecast Process

Projected revenues, outlays, and reserves for the Flood Protection and Stream Stewardship program are maintained in the district's Long Term Forecast (LTF) financial model. The financial model is updated annually and covers a 10-year financial planning horizon. By financing with a combination of state and federal reimbursements, current year revenues and reserves, and other non-operating revenues, the district evaluates its ability to meet operations and capital investment plans. The objectives of the financial model are to balance outlays and revenues, and at the same time, comply with district policy of maintaining minimum operating reserves (6 months of operational outlays). In subsequent figures the minimum reserve levels are indicated by a dotted line.

For the purposes of the LTF financial model, projected operation outlays over the 10-year forecast period are proposed by operations program managers. The projections are based on anticipated needs and services for their various activities. Future cost savings or increases in work activities, regulatory requirements, or other factors such as inflation or disposal costs for sediment and vegetation are considered in making these projections. Other factors that affect projections include future increases in operational activities and requirements as new projects are completed and transferred to operations programs.

For capital expenditures, the LTF financial model utilizes data from the annual 5-Year Capital Improvement Plan which identifies resource needs and financial constraints to complete the projects. During the capital project planning phase, capital project staff estimate cost impacts to operations programs that will be incurred when projects are completed. This information is used to project future operations and maintenance cost increases or cost savings as a result of project completion. These costs are then included in the Long Term Forecast model.

Long Term Forecast Assumptions

The standard inflation rate used in the LTF financial model for operations cost projections beyond the 10-year forecast is 4% annually. Interest earnings (revenue) are increased at 3% annually beyond the 10-year forecast. Property tax revenue inflation for North County is calculated at 3.6% annually and in South County at 6% annually for the extended financial projections beyond the 10-year forecast.

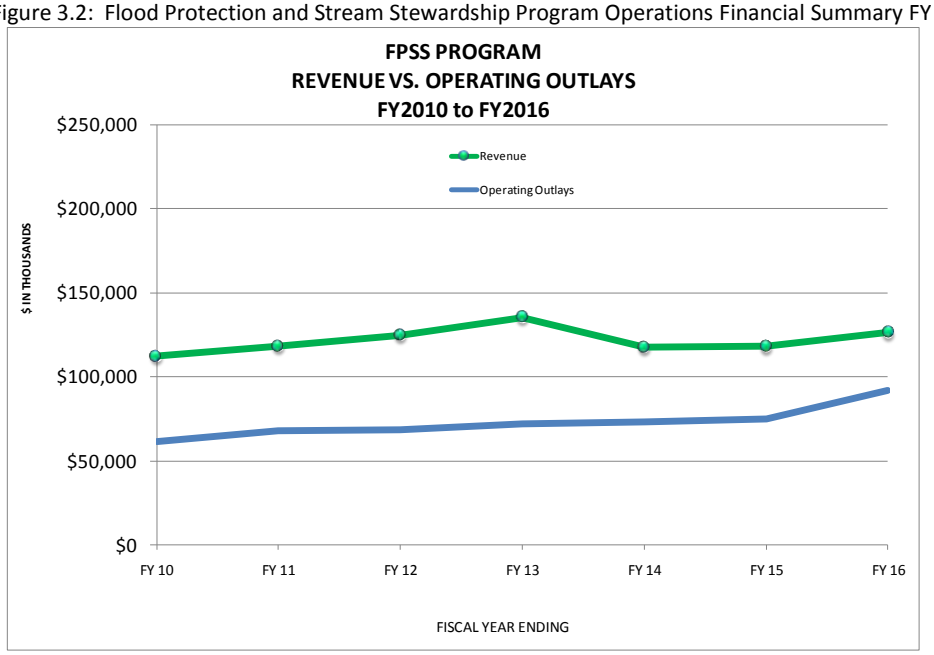
As described in more detail in the following sections, some Clean, Safe Creek special tax funded activities are extended beyond FY 2016 due to the high priority nature of the work or due to requirements or commitments of the district. Outlays for these activities are included in the FY 2017 to FY 2035 planning horizons. Conversely, outlays for some low priority or enhanced activities have been reduced in the financial outlook to balance outlays with revenue.

3.3.3 Flood Protection and Stream Stewardship Program Financial Outlook – FY 2010 to FY 2016

Operations Programs Financial Outlook FY 2010 to FY 2016

Based on the LTF financial model, there are sufficient revenues available to cover projected operating outlays (expenditures) during this planning horizon as shown in Figure 3.2. Where annual revenue exceeds operating and capital outlays, unspent funds are added to reserves for future allocations and expenditures.

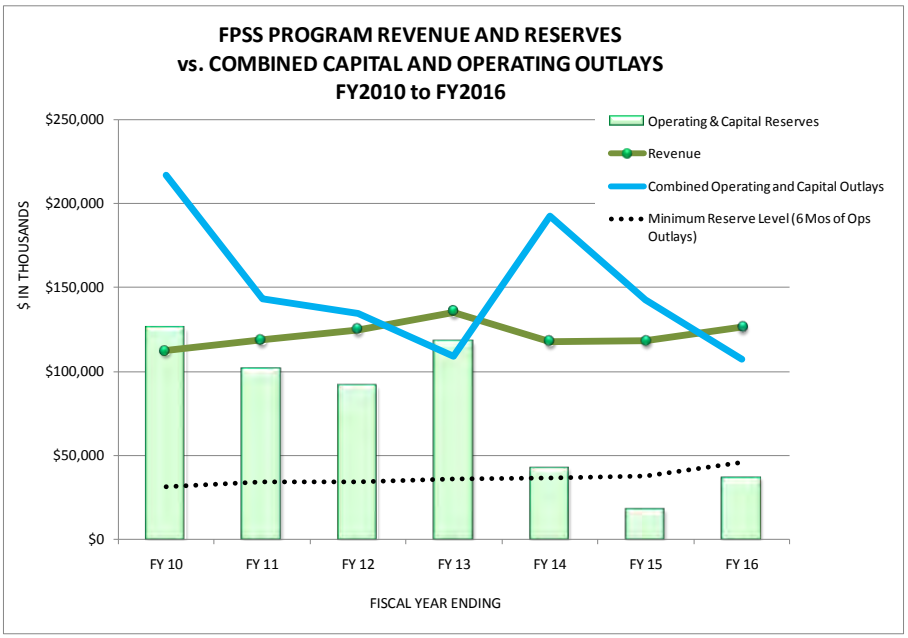
Figure 3.2: Flood Protection and Stream Stewardship Program Operations Financial Summary FY 2010 to FY 2016



Combined Capital Improvement Program and Operations Programs Financial Outlook FY 2010-FY 2016

Figure 3.3 shows the effect on program reserves when the Capital Improvement Program outlays are combined with operational outlays. Based on the LTF financial model, there appears to be sufficient revenues and reserves (with minor adjustment to outlays to maintain minimum reserves) available to cover projected operations and capital program outlays during this planning horizon. This figure illustrates the combined operations and capital improvement programs outlays (blue line) over the planning horizon and the annual revenues (green line) and reserves available on an annual basis (vertical bars). In some years, the total available revenues are less than planned expenditures. In those years, the district will draw from reserves to make up the difference.

Figure 3.3: Flood Protection and Stream Stewardship Program Operations and Capital Financial Summary FY 2010 to FY 2016



3.3.4 Flood Protection and Stream Stewardship Program Financial Outlook - FY 2017 to FY2035

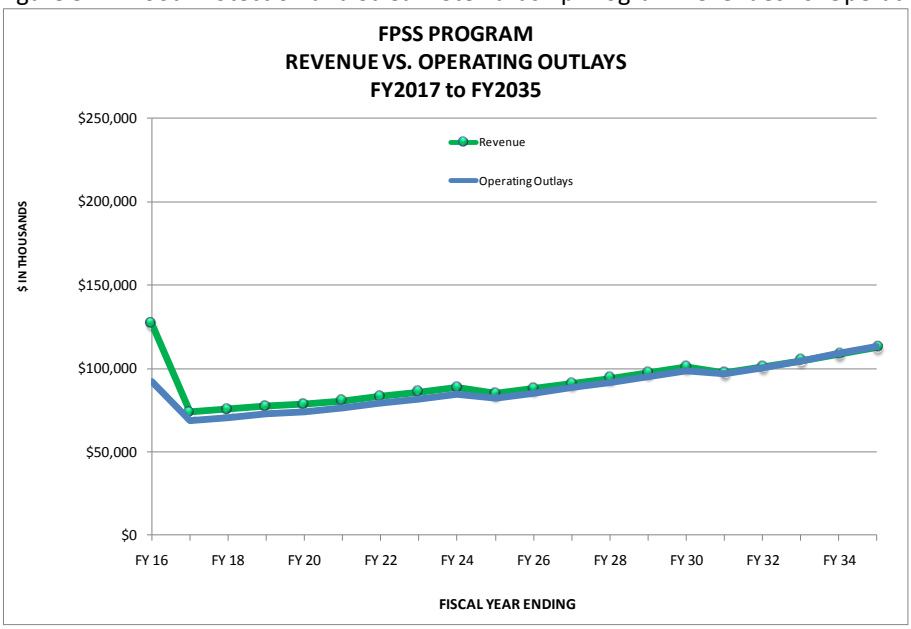
Operating Programs Financial Outlook FY 2017 to FY 2035

The Clean, Safe Creeks special parcel tax is due to sunset in 2016. Many of the services that the Flood Protection and Stream Stewardship program provides, including some of the activities that this tax funds, will need to continue past 2016. They need to continue because they are now required due to changes in regulations or because of agreements or commitments that the district has made. For the purposes of establishing a financial outlook that includes required and high priority activities, changes were made to the LTF financial model assumptions for the long term planning horizon. These planning assumptions are: (a) activities funded by the Clean, Safe Creeks special tax that are considered required and/or high priority by the district's project priority ranking system need to continue, (b) only the

required components of those activities will be continued, and (c) enhanced components of other programs and projects were removed from the LTF financial model to balance outlays with revenues. Under these planning assumptions, there appears to be sufficient projected revenues available to cover anticipated operating outlays during this planning horizon, as shown in Figure 3.4.

Assumptions used in the projected revenues include increases (due to inflation) in property tax revenues, interest earnings, and other non-operating revenues. This figure also illustrates anticipated increases in operational costs, primarily due to assumptions of increasing costs of services and supplies over the planning horizon. Some of these increasing operational costs are also associated with increased maintenance and operations of the soon to be constructed capital projects. Despite the sunset of the Clean, Safe Creeks special tax, the LTF financial model shows that revenues closely match operating outlays over the planning horizon.

Figure 3.4: Flood Protection and Stream Stewardship Program Revenues vs. Operating Outlays FY 2017 to FY 2035



Combined Capital Improvement Program and Operations Programs Financial Outlook FY 2017-FY 2035

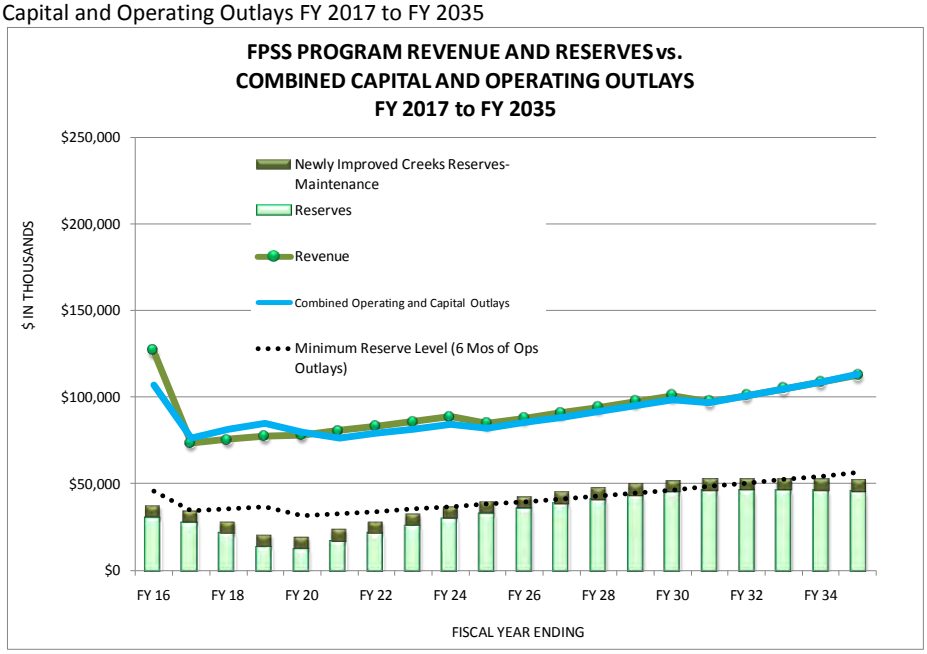
In this analysis, revenues and reserves are compared to the combined Capital Improvement Program and operating outlays. It is assumed that no new major flood protection projects will be started after 2016 without new funding. However, the 2009-2010 Capital Improvement Plan (CIP) anticipates expenditures for four projects to occur in FY 2019 to FY 2021. These projects include Upper Penitencia Creek, Berryessa Creek from Lower Penitencia to Calaveras, Berryessa Creek from Calaveras to Old Piedmont and SMP Mitigation at Laguna Seca Freshwater Wetland. Although these capital expenditures are not considered significant, the effect on the LTF financial model is that operating reserves fall below the minimum reserve requirement set by district policy (indicated by the dotted line in Figure 3.5). Note that operational and capital reserves depicted in this figure are distinguished from the designated reserves for newly modified creek maintenance as the designated reserve is not available to meet the

minimum reserve policy. Therefore, the minimum reserve level should be compared to the base reserve bars.

Figure 3.5 shows that revenues, overall, are higher than projected operations early in this planning horizon. This is shown by the gradual increase in operating reserves. Nonetheless, in this scenario the reserves do not rise to the minimum reserve policy level. These deficits will be evaluated in future financial planning efforts for the FY 2017 to FY 2035 planning horizon. During the latter part of the planning horizon, expenditures are greater than available revenue and reserves begin to decline. The result is that further cuts and adjustments will need to be made to enhanced elements of programs and projects. Adjustments to close gaps between revenues and expenditures will be explored in future financial planning efforts for the FY 2017 to FY 2035 planning horizon.

Figure 3.5: Flood Protection and Stream Stewardship Program Revenue and Reserves vs.

Capital and Operating Outlays FY 2017 to FY 2035



3.4 FINDINGS

The master plan is divided into two planning horizons- a 6-year planning horizon from FY 2010 to FY 2016 and a 19-year planning horizon from FY 2017 to FY 2035. An examination of the funding mechanism for all identified projects and programs in the current program indicates that funding levels are sufficient to support all identified activities in the 6-year planning horizon.

After FY 2016, revenues cannot sustain the current levels of service. The most significant impacts will be on projects and programs funded by the Clean, Safe Creeks special parcel tax, which include: flood protection and other capital programs, environmental enhancements, impaired water bodies improvements, and trails and open space programs.

In the 19-year planning horizon following the sunset of Clean, Safe Creeks special parcel tax, program activities funded by revenue sources other than Clean, Safe Creeks are sustainable except for the

enhanced elements of some programs. Other activities that are funded fully, or in part, by Clean, Safe Creeks special parcel tax through 2016 must either be discontinued, reprogrammed to receive funding from other programs, or be provided with alternative sources of funding. For the purposes of this analysis, it is assumed that the required portions of these programs continued and will be funded by the remaining funding sources.

This section lists a number of projects and programs that support each of the five goals of the master plan. Below are the major projects and programs that will be impacted by the sunset of Clean, Safe Creeks special parcel tax.

Goal One- Natural Flood Protection

- Nearly all 20 capital projects in the current Flood Protection and Stream Stewardship program are scheduled to be completed, for the most part, by 2016. Some projects, such as the two Berryessa Creek flood protection projects, will be nearly complete, but will have follow up elements, such as revegetation establishment contracts, mitigation monitoring, or other offsite construction, extending into 2021. After 2016, there will be limited funding for new major capital improvement projects.
- Factors such as sea level rise may affect the flow conveyance capacity of district facilities near south San Francisco Bay. Preserving or restoring flow conveyance capacity and freeboard to these facilities will require additional funding or reprogramming of existing revenues.

- Stream capacity vegetation control activities and watershed upland vegetation management (maintenance and removal) are performed to preserve flood conveyance capacity and to ensure healthy creek habitat. Forty percent of these activities are funded by Clean, Safe Creeks special parcel tax. Additional funds will be needed after 2016 to continue these activities at the current 100% Level of Service.
- Approximately 10% of the total annual sediment removal is currently funded by Clean, Safe Creeks special parcel tax. Without additional funding, the annual sediment removal quantities will be reduced from 88,000 cubic yards to 80,000 cubic yards.
- Ten percent of the Stream Maintenance Program implementation is currently funded by Clean, Safe Creeks special parcel tax. The state and federal permits are due for renewal in 2012. This ongoing operation will ensure that routine maintenance activities will be conducted consistent with the environmental permit requirements. Additional funding may be needed after 2016 to continue this activity at the current 100% Level of Service.

Goal Two- Reduced Potential for Flood Damages

- Operations programs can continue through 2035 at the current 100% Level of Service.

Goal Three- Healthy Creeks and Bay Ecosystems

- Vegetation management activities, including revegetation site maintenance and nonnative vegetation removal, are performed to protect healthy creek and bay ecosystems. Forty percent of these activities are funded by Clean, Safe Creeks special parcel tax. Additional funds will be needed after 2016 to continue these activities at the current 100% Level of Service.
- Creation or restoration of 100 acres of additional tidal or riparian habitat is currently funded by Clean, Safe Creeks special parcel tax. Funding for this activity will not be available after 2016.

Goal Four- Clean Safe Water in Our creeks and Bays

- The program that supports public outreach activities in south county cities to reduce urban runoff pollutants is funded 100% by Clean, Safe Creeks special parcel tax. The funding portion needed to support this program will not be available after 2016.
- The hazardous materials management and incident response program (including reservoirs in Uvas/Llagas Watersheds) is funded 30% by Clean, Safe Creeks special parcel tax. The funding portion needed to support this activity will not be available after 2016.
- Trash removal and graffiti removal elements of good neighbor maintenance are funded 60% by Clean, Safe Creeks special parcel tax. Additional funds will be needed to maintain the current level of service.
- The illegal encampment cleanup program is funded 60% by Clean, Safe Creeks special parcel tax. Additional funds will be needed to maintain the current level of service.
- County-wide pollution prevention activities are currently funded 100% by Clean, Safe Creeks. Additional funds will need to be reallocated after 2016 to fund the required portion of this program stemming from new obligations and agreements.
- Surface water quality improvement (impaired water bodies improvement) activities are currently funded 100% by Clean, Safe Creeks special parcel tax. Portions of this program are now required (e.g., water bodies impaired by mercury). Additional funds will need to be reallocated after 2016 to fund this portion of the program.

Goal Five- Trails, Open Space and Water resource Management

- Open spaces and trail administration is funded 100% by Clean, Safe Creeks. After 2016 funding for this program will not be available.

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Key term	Definition
1-percent flood	A flood that has a 1-percent chance of occurring in any given year; also referred to as the 100-year flood.
Aquifer	Geological formation that holds or conducts groundwater
Baseline program	The water district's flood protection and stream stewardship program, which consists of only those services which can be supported by revenue available in fiscal year 2016, after the sunset of the clean, safe creeks special tax
Bathymetry	The study of underwater depth of lake
Biodiversity	The existence of a wide range of different types of organisms in a given place at a given time.
Board policies	Written governing policies which, at the broadest levels, address each category of organizational decision
Diversion channel	A waterway used to divert water from its natural course
Ecosystems	An ecological community together with its environment, functioning as a unit
Environmental enhancement	Action taken by the district that benefits the environment, is not mitigation, and is undertaken voluntarily. Enhancement actions may include environmental restoration, rehabilitation, preservation or creation. In instances where enhancements are located in the same vicinity as a mitigation project, actions must exceed required compliance to compensate for environmental impacts to be considered environmental enhancements.
Erosion	The process by which soil is removed from one place by forces such as water or construction activity and eventually deposited at a new place as sediment
Fish passage	A generic term for several methods incorporated into flood protection projects which allow native fish species to travel upstream to spawn
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas from inland or tidal waters
Flood conveyance capacity	The maximum amount of water that can flow through a channel, stream, or culvert before flooding of surrounding properties would result
Flood plain	The low, flat, periodically flooded lands adjacent to creeks and rivers

Freeboard	Vertical distance between the top of an embankment adjoining a channel and the water level in the channel
Geomorphic/geomorphology	The study of the natural relationship between a stream and its bank and bed. Pertaining to those processes that affect the form or shape of the surface of the earth (creeks)
Habitat	The specific and physical location or area in which a particular type of plant or animal lives. To be complete, an organism's habitat must provide all of the basic requirements of life for that organism.
Hydrology	The behavior (properties, distribution, and circulation) of water in the atmosphere, on land surface, and in soil
Invasive plants	A non-native species that has spread into native or minimally managed plant communities (habitats)
Levee	An embankment constructed to provide flood protection from seasonal high water
Mitigation	Action taken to fulfill permit requirements and court mandated mitigation to avoid, minimize, rectify or reduce adverse environmental impacts, or compensate for the impact(s) by replacing or providing substitute resources or environments
Natural flood protection	A multiple-objective approach to providing environmental quality, community benefit and protection from creek flooding in a cost effective manner through integrated planning and management that considers the physical, hydrologic and ecologic functions and processes of streams within the community setting
Nonpoint source pollutants	Pollutants that are carried by storm water runoff into receiving waters; contrasted with “point” source pollutants such as effluent from wastewater treatment facilities.
Permitting requirements	There are a number of state and federal laws and regulations to protect the environment. These laws and regulations are often enforced by requiring specified government agencies to issue a permit prior to work in environmentally sensitive areas. The district regularly is required to obtain permits from the U.S. Army Corps of Engineers, U.S. Fish And Wildlife Service, NOAA Fisheries, Regional Water Quality Control Board, and the California Department of Fish And Game. Each permit gives the permitting agency an opportunity to attach specific measures to the project to reduce the impact to the environment.

Reach (creek)	A portion of a creek or watercourse usually defined by both an upstream and a downstream unit
Recharge	The addition of new water to an aquifer or to the zone of saturation
Restore/restoration	Action taken by the district, to the extent practicable, toward the re-establishment as closely as possible of an ecosystem's pre-disturbance structure, function, and value, where it has been degraded, damaged, or otherwise destroyed
Re-vegetate	Re-establishing vegetation in areas which have been disturbed by project construction
Riparian	Pertaining to the banks of a body of water, (the banks of a stream), and other adjacent terrestrial environments of freshwater bodies and watercourses
Riparian corridor	The corridor along the bank or shore of a body of water sediments materials in a lake or reservoir which are either suspended in the water column or deposited on the bottom. They usually consist of the remains of aquatic organisms, precipitated minerals and eroded material from the watershed
Riparian ecosystem	Natural association of soil, plants and animals existing within the floodplain of a stream and dependent for their survival on high water tables and river flow
Sediment/ sedimentation	Mineral or organic material that is deposited by moving water and settles at the bottom of a waterway
Stewardship	To entrust the careful and responsible management of the environment and natural resources to one's care for the benefit of the greater community
Threatened species	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range
Watershed	Land area from which water drains into a major body of water
Watershed stewardship	Protecting and enhancing the county's creeks, streams and water bodies in order to preserve a vibrant, healthy ecosystem and provide recreational opportunities when appropriate
Wetland	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions

APPENDIX 6A-2

STREAM MAINTENANCE PLAN

DRAFT Stream Maintenance Program

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ACKNOWLEDGEMENTS

We wish to thank all the individuals, organizations, municipalities, and agencies who participated in the external stakeholder process for the development of the Stream Maintenance Program.

Keith Anderson, *Streams for Tomorrow*
Bob Batha, *San Francisco Bay Conservation and Development Commission*
Nancy Bernardi, *Guadalupe-Coyote Resource Conservation District*
Jim Bombaci, *City of Sunnyvale*
Dale Bowyer, *San Francisco Bay Regional Water Quality Control Board*
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Margaret Roper, *CA Dept. Fish and Game*
Pat Showalter, *Peninsula Conservation Foundation*
Mary Tucker, *City of San Jose*
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TABLE OF CONTENTS

		Page
CHAPTER 1	INTRODUCTION	1-1
	A. PROGRAM PURPOSE AND OBJECTIVES	1-1
	B. APPLICABILITY AND USE OF THE STREAM MAINTENANCE PROGRAM	1-2
	C. STREAM MAINTENANCE ACTIVITIES	1-4
	1. Sediment Removal	1-5
	2. Vegetation Management	1-5
	3. Bank Protection	1-5
	D. OVERVIEW OF THE STREAMS AND CANALS WITHIN THE DISTRICT'S JURISDICTION	1-6
	E. RELATED PROGRAMMATIC DOCUMENTATION	1-7
	F. THE ROLE OF STAKEHOLDERS IN THE PLANNING PROCESS	1-8
	G. ORGANIZATION OF THIS DOCUMENT	1-9
CHAPTER 2	AN OVERVIEW OF STREAM MAINTENANCE ACTIVITIES	2-1
	A. SEDIMENT REMOVAL	2-1
	1. Overview	2-1
	2. Sediment Removal Methods	2-3
	3. Annual Sediment Removal Activity	2-3
	B. VEGETATION MANAGEMENT	2-4
	1. Overview	2-4
	2. Vegetation Management Methods	2-5
	3. Annual Vegetation Management Activity	2-12
	C. BANK PROTECTION	2-13
	1. Overview	2-13
	2. Bank Protection Methods	2-14
	3. Annual Bank Protection Activity	2-15
	D. MINOR MAINTENANCE ACTIVITIES	2-17
CHAPTER 3	STREAM MAINTENANCE PROCESS OVERVIEW	3-1
	A. PROGRAM DEVELOPMENT AND DOCUMENTATION	3-1
	B. IMPLEMENTATION OF ANNUAL ROUTINE STREAM MAINTENANCE WORK	3-1
	C. ANNUAL REPORTING	3-4
CHAPTER 4	RESOURCE PROTECTION POLICIES	4-1
	A. PROCESS AND PROTOCOLS	4-3
	B. WATERSHED RESTORATION AND MANAGEMENT	4-5
	C. PROTECTION OF LISTED SPECIES AND SPECIES OF CONCERN	4-9
	D. FISHERIES PROTECTION AND ENHANCEMENT	4-10
	E. MAINTENANCE SITE DEWATERING	4-12
	F. MINIMIZATION OF EROSION	4-13

G. PRESERVATION AND REPLACEMENT OF RIPARIAN AND SHADED RIVERINE HABITAT 4-14
H. WETLANDS PROTECTION 4-15
I. USE AND MANAGEMENT OF HERBICIDES 4-16
J. HAZARDOUS MATERIAL MANAGEMENT AND CONTROL 4-17
K. ADDITIONAL WORK SITE MANAGEMENT PRACTICES 4-18

CHAPTER 5 COMPENSATORY MITIGATION 5-1
A. COMPENSATORY MITIGATION--SEDIMENT REMOVAL AND VEGETATION MANAGEMENT 5-2
1. Tidal Wetland Restoration 5-3
2. Freshwater Wetland Creation 5-5
a. Los Capitancillos Site 5-6
b. Coyote Lakes Park Site 10A 5-7
c. Church Pond No. 2 5-9
B. STREAM AND WATERSHED PROTECTION 5-10
C. CONTROL OF GIANT REED 5-14
D. COMPENSATORY MITIGATION--BANK PROTECTION 5-17
E. MITIGATION FOR SPECIAL STATUS SPECIES 5-18
F. REPORTING 5-18
G. EXISTING MITIGATION COMMITMENTS 5-18

CHAPTER 6 LINKAGES TO OTHER PROGRAMS AND PROJECTS 6-1
A. METHODOLOGY 6-3
1. Overview of the Stream Maintenance Program 6-4
B. RELATED PROGRAMS AND PROJECTS 6-9
1. Annual Maintenance Work (1997, 1998, and 2000) 6-9
2. Capital Improvements Projects (Various District Project Numbers) 6-10
3. Comprehensive Flood Management Projects (District Project No. 000404) 6-11
4. Fisheries Aquatic Habitat Collaborative Effort (District Project No. 920414) 6-12
5. Guadalupe Collaborative (District Project No. 301517) 6-13
6. Maintenance Wetlands Mitigation Project (District Project No. 000413) 6-13
7. Multispecies Habitat Conservation Plan (District Project No. 000408) 6-14
8. Natural Resources Management Program (District Project No. 000406) 6-15
9. District Urban Runoff Program (District Project No. 007902) 6-16
10. Regional Water Quality Control Board Watershed Management Initiative (District Project No. 0007914) 6-18
11. Solid Materials and Waste Management Project (District Project No. 000412) 6-20
12. Wetland Vegetation Regrowth Study (District Project No. 000415) 6-21

CHAPTER 7 REFERENCES 7-1

TABLES

TABLE 2-1
Recent Sediment Removal Activity

TABLE 2-2
Herbicide Use for the Multiyear Stream Maintenance Program

TABLE 5-1
Wetland and Riparian Compensatory Mitigation for Sediment Removal and Vegetation Management Impacts

TABLE 5-2
Guiding Principles for Mitigation to Stream Vegetation Multiyear Stream Maintenance Program

TABLE 5-3
Multiyear Stream Maintenance Program

TABLE 5-4
Prior Mitigation Commitments for Completed Maintenance Projects (1996 to 2000)

TABLE 6-1
Linkages Between The Stream Maintenance Program and Other District Activities

TABLE 6-2
Participant Linkages

FIGURES

Index - Creeks in Santa Clara Valley Water District Maintenance Creek System

FIGURE 1-1
Streams and Canals in District Jurisdiction

FIGURE 2-1
Projected Sediment Removal Work Areas

FIGURE 2-2
Projected Channel Vegetation Management Work Areas

FIGURE 2-3
Projected Upland Vegetation Management Work Areas

FIGURE 2-4
Historical Bank Protection Work Areas

FIGURE 3-1
Resource Protection Protocol

FIGURE 5-1
Compensatory Mitigation Sites

APPENDICES

APPENDIX A
Glossary

APPENDIX B
Maintenance Guidelines

APPENDIX C
Nesting Migratory Bird Procedure

APPENDIX D
Dryback/Fish Relocation Operation Guidelines

APPENDIX E
Programmatic Impact Assessment and Mitigation for Routine Bank Protection Activities

APPENDIX F
Bank Protection Locations

APPENDIX G
Best Management Practices List

APPENDIX H
District Use Pesticide Literature Review

LIST OF ACRONYMS

BAAQMD	Bay Area Air Quality Management District
BCDC	San Francisco Bay Conservation and Development Commission
BMP	Best Management Practices
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CFMP	Comprehensive Flood Management Program

CIP	Capital Improvement Projects
DO	Dissolved Oxygen
DPR	Department of Pesticide Regulation
EIR	Environmental Impact Report
ESA	Endangered Species Act
FAHCE	Fisheries Aquatic Habitat Collaborative Effort
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HCP	Habitat Conservation Plan
MMP	Mitigation and Monitoring Plan
NMFS	United States National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
NRMP	Natural Resources Management Program
PCA	Pest Control Advisor
PM_{10}	Particulate Matter less than 10 microns in size
Program	Stream Maintenance Program
RWQCB	California Regional Water Quality Control Board
SCVWD	Santa Clara Valley Water District
SMMP	Solid Materials and Waste Management Project
SRA	Shaded Riverine Aquatic
SWRCB	California State Water Resources Control Board
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WDR	Waste Discharge Requirements
WMI	Watershed Management Initiative
WWMM	Water Ways Management Model

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Stream Maintenance Program

DRAFT STREAM MAINTENANCE PROGRAM

Chapter 1
INTRODUCTION

This chapter describes the objectives and applicability of the Santa Clara Valley Water District's (District) Stream Maintenance Program (Program). As a foundation for understanding the resource protection and maintenance issues discussed in this report, this chapter also defines routine stream maintenance and briefly describes the District's facilities where stream maintenance is required. In conclusion, this chapter provides a summary of related programmatic documentation that is required for implementation of the Stream Maintenance Program and the organization of subsequent chapters.

A. PROGRAM PURPOSE AND OBJECTIVES

The Stream Maintenance Program is designed to provide long-term guidance to the District to implement routine stream and canal maintenance projects in order to meet the District's flood protection and water supply mandates in a feasible, cost-effective, and environmentally-sensitive manner. This authority is provided by the District Act, as amended. The main goals of preparing the Stream Maintenance Program are to maintain streams and canals to meet their original design to provide flood protection and water supply, coordinate the various aspects of routine stream maintenance to better achieve this goal, and assist in obtaining multiyear permits. The Stream Maintenance Program only applies to District facilities.

The objectives of the Stream Maintenance Program are as follows:

1. Standardize practices and protocols for routine sediment removal, vegetation management, and bank protection in and around the streams and related facilities within the District's jurisdiction.

2. Identify cost-effective routine stream maintenance practices and protocols.

3. Ensure routine stream maintenance activities reflect the District's policies of environmental protection and stewardship.

4. To the extent practical, avoid or minimize adverse environmental effects and encourage preservation and restoration.

5. Establish effective and economically-practical compensatory mitigation for environmental impacts from routine stream maintenance activities.

6. Establish practices and protocols that optimize operational flexibility and allow the integration of lessons learned and improvements in Best Management Practices.

The Stream Maintenance Program will be used by District staff to ensure that routine stream maintenance practices are conducted in an efficient, consistent, and environmentally-sensitive manner.

B. APPLICABILITY AND USE OF THE STREAM MAINTENANCE PROGRAM

The Stream Maintenance Program applies to all of the District's routine stream maintenance activities, including three major types of activities: sediment removal, vegetation management, and bank protection. Many of these activities are undertaken to ensure flood conveyance capacity is maintained in existing streams. In addition, routine maintenance includes vegetation removal in and around the streams and canals within the District's jurisdiction to ensure appropriate access and fire control. More minor maintenance activities are also included in the definition of routine stream maintenance.

The stream maintenance work area addressed by this Stream Maintenance Program includes the streams, canals, and any adjacent property that the District owns or holds an easement for access and maintenance. The District does not provide maintenance on private property when no easement exists. The maintenance work area is the stream channel or canal itself, typically extending to 20 feet past the top of bank when access is provided, and less when access is not provided. Creeks with constructed levees may require a wider maintenance easement. The maintenance work area is typically less than the District's permitting jurisdiction, which is within 50 feet of the top of bank of the streams.

The Stream Maintenance Program is designed to be a process and policy document that can be adopted by the District. Once adopted, the Stream Maintenance Program will be used by the District to guide the implementation of routine stream maintenance activities and projects. The Stream Maintenance Program outlines specific measures, protocols, policies, and reporting requirements to ensure that routine stream maintenance projects are implemented in an efficient and environmentally-sensitive manner. This Stream Maintenance Program is subject to future revisions as improvements and modifications are made to reflect the best available knowledge, technology, and practices.

The Stream Maintenance Program is intended to establish an ongoing District program of indefinite length. The Stream Maintenance Program uses a 20-year planning time frame to project the level of future work, and this same time frame is used by the Environmental Impact Report (EIR) to evaluate cumulative impact. Permits for stream maintenance from regulatory agencies are expected to last for a period of 10 years, after which the District would apply for a renewal. The Stream Maintenance Program will be reviewed annually as described in Chapter 3 to determine if adjustments to the BMPs need to be made. The overall program will be reviewed in 10 years as part of the permit renewal process.

The 20-year time frame was used because this is the period of time over which future work areas and impacts can be reliably projected. Projections for future work under the Stream Maintenance Program are based on an analysis of historical data going back to 1977. All forms of maintenance show a consistent pattern; however, projections of future stream maintenance activities for the Stream Maintenance Program cannot represent the exact extent of work that will occur. Actual stream maintenance activities vary from year to year. There may be some future routine maintenance activities that are within the District's jurisdiction and are consistent with the descriptions of work and impacts evaluated for the program overall but which were not specifically included in the District's projection of work areas. Maintenance at such sites is still included in the program as long as it does not result in significant environmental effects substantially different than those evaluated for the program as a whole.

If routine stream maintenance practices are substantially changed at any time, the program will be updated. If these changes would result in significant impacts not evaluated in the EIR, then the EIR will also be updated. New mitigation measures would not be required unless new significant impacts are identified.

Routine stream maintenance does not include emergency repair. A situation is considered an "emergency" if it is a sudden, unexpected occurrence involving a clear and imminent danger that demands immediate action to prevent or mitigate loss of or damage to life, health, property, or essential public services (Public Resource Code Section 21060.3).

Routine stream maintenance does not alter the flood conveyance or water supply capacity of a stream or canal. Large construction projects and Capital Improvement Projects (CIP) are not considered routine stream maintenance and are not addressed through the Stream Maintenance Program. For new CIPs, long-term maintenance impacts and any new mitigation will be analyzed under the CIP's separate future environmental review and compared to those impacts and mitigation previously evaluated for that reach of stream under the Stream Maintenance Program. New mitigation will only be required if

the impacts of the maintenance under the CIP are in excess of impacts included in the Stream Maintenance Program for the same reach of creek. After the environmental review is completed for the CIP, the Stream Maintenance Program will be updated to incorporate any revisions to the mitigation program, and the implementation of the new maintenance and its annual reporting will be conducted in the same manner as indicated in Chapter 3.

The installation of new or major modification of fish ladders is not included in the Stream Maintenance Program. See also the "Overview of the Streams and Canals within the District's Jurisdiction" below for clarification on what areas are included or excluded from the Stream Maintenance Program.

C. STREAM MAINTENANCE ACTIVITIES

The following provides a brief discussion of the major activities addressed by the Stream Maintenance Program. For more information on these activities and why they are implemented, please refer to Chapter 2. In addition, the Stream Maintenance Program applies to more minor activities such as fence repair, trash removal, and removal of downed trees or other blockages.

1. Sediment Removal

Sediment removal is the act of mechanically removing sediment that has been deposited within a stream. Typically, sediment is removed when it: (1) reduces stream capacity, (2) prevents facilities or appurtenant structures[1] from functioning as intended, or (3) impedes fish passage and access to fish ladders. Sediment removal can occur in the same physical area as vegetation removal.

2. Vegetation Management

The District removes vegetation in and adjacent to creeks and canals to maintain the ability of channels to function as flood protection facilities and canals to transport water. Vegetation removal can occur in the same physical area as sediment removal. In addition, vegetation is removed to meet local fire code requirements and to reduce combustible weeds and grasses on property adjacent to the streams within the District's jurisdiction. The control of invasive nonnative vegetation is another purpose for which the District undertakes vegetation control. Vegetation management can be accomplished through mowing, discing, hand clearing, or herbicide applications (depending on the environmental conditions of the site).

3. Bank Protection

Bank protection involves any action by the District to repair streambanks that are eroding as well as preventative erosion protection. The District implements bank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation, (4) negatively affects beneficial uses of surface water, or (5) negatively affects riparian habitat. Repairs may take several forms ranging from the installation of "hard" structures (i.e., rock, concrete, sack concrete, gabions) to the use of "soft" structures (i.e., willow brush mattresses, log crib walls, pole plantings), or a combination of hard and soft structures. Bank protection also includes preventative maintenance to ensure that banks do not erode in the future. Such bank protection can reduce sedimentation and improve water quality.

Routine stream maintenance includes three major activities, as follows: (1) sediment removal activities that are designed to restore the flood conveyance capacity of existing District channels or associated features (e.g., tide gates), (2) vegetation management in and around streams and canals in the District's jurisdiction, including removal of vegetation for flood capacity, access and fire control, and (3) bank protection activities necessary to protect District or other facilities. Routine stream maintenance also includes more minor maintenance activities, such as maintenance of revegetation sites, fence repair, trash removal, and removal of downed trees or other blockages from streams.

D. OVERVIEW OF THE STREAMS AND CANALS WITHIN THE DISTRICT'S JURISDICTION

For the purpose of this Stream Maintenance Program, "streams" are defined as natural watercourses and modified channels and canals that are within the District's jurisdiction. In this Stream Maintenance Program, streams include both the waterway and its immediate geographical corridor, including riparian corridors.

The District is divided into two major hydrologic basins draining either into the San Francisco Bay or the Monterey Bay, as shown in Figure 1-1. In the northern portion of the County, streams of the Santa Clara Basin drain to the San Francisco Bay. To the south, streams in the Pajaro River Basin drain ultimately to Monterey Bay. Streams in the northeast portion of Santa Clara County are not in an established flood protection zone and are not in the Stream Maintenance Program.

Only those streams within the District's jurisdiction are included in this Stream Maintenance Program. The District's jurisdiction on a stream begins at ths point where 320 acres (½ square mile) of watershed drain to the stream, and continues downstream to San Francisco Bay or the limits of the Pajaro River in Santa Clara County. The Stream Maintenance Program area consists of 191 streams for approximately 828 miles and 10 canals for 41 miles (see Figure 1-1, Streams and Canals in District Jurisdiction). The ability of the District to perform maintenance activities may be affected by District ownership, easements, or right to access.

Streams are defined as the natural watercourses and modified channels and canals within the District's jurisdiction. In this Program, streams include both the waterway and its immediate geographical corridor, including riparian corridors.

In addition to maintaining streams and canals for flood protection and water supply, the District also owns and operates ten major dams and reservoirs in Santa Clara County and other water supply facilities, such as pipelines outside of stream corridors, groundwater percolation ponds, and in-stream summer dams. Maintenance of these facilities is not addressed by the Stream Maintenance Program. In addition, the Stream Maintenance Program only addresses maintenance work that is completed by the District, or through District contracts.

E. RELATED PROGRAMMATIC DOCUMENTATION

Because this Stream Maintenance Program has been designed to guide the implementation of routine stream maintenance projects and activities over the long-term, it addresses stream maintenance at a general or "programmatic" level. As such, this document provides the guidelines and implementation measures that characterize how stream maintenance will be conducted by the District.

In addition to this document, several other programmatic requirements must be met before the Stream Maintenance Program can be implemented, as follows:

- **Program Environmental Impact Report**. Consistent with the California Environmental Quality Act (CEQA), an EIR will be prepared and certified by the District for this Stream Maintenance Program. The EIR will evaluate the potential environmental impacts of the Stream Maintenance Program and determine measures to mitigate impacts.

- **Long-Term Permits**. The District is seeking the approval of a long-term permit for routine stream maintenance activities in streams under the jurisdiction of the United States Army Corps of Engineers (USACE), including Waters of the United States and special aquatic sites (wetlands) pursuant to Section 404 of the Clean Water Act as well as Section 10 of the Rivers and Harbors Act. This Individual Permit would grant general authorization and set conditions for all routine stream maintenance activities subject to jurisdiction of the USACE. In addition, the District will be required to comply with requirements under Section 7 of the Federal Endangered Species Act (ESA). The California Regional Water Quality Control Boards (RWQCB) will also require compliance with Waste Discharge Requirements

(WDR) permits and Section 401 of the Clean Water Act. The Santa Clara Valley is divided into two RWQCBs, based on major drainage areas. These are the San Francisco Bay RWQCB and the Central Coast RWQCB.

The District will also revise Memorandums of Understanding with the California Department of Fish and Game (CDFG) for stream maintenance activities. The CDFG will review routine stream maintenance activities for consistency with California's endangered species protection regulations.

The San Francisco Bay Conservation and Development Commission (BCDC) regulates activities occurring in tidally-influenced areas. The BCDC renewed Permit No. M77-113 on July 28, 2000, to cover the District's routine stream maintenance activities that occur in or near tidal waters of San Francisco Bay. The expiration date is June 1, 2005.

The permits and approvals from these agencies for routine stream maintenance are expected to last for a period of 5 to 10 years, after which time applications will be made for renewal of these permits and approvals.

In addition to these programmatic requirements for adoption and implementation of the Stream Maintenance Program, the District uses a variety of supporting documentation to guide stream maintenance activities. These will be referenced and described in the following chapters of the Stream Maintenance Program. Examples include BMPs, the Maintenance Guidelines, and Fish Relocation Operation Guidelines. Several of these guidelines, or portions thereof, are provided as appendices to this Stream Maintenance Program.

F. THE ROLE OF STAKEHOLDERS IN THE PLANNING PROCESS

Stakeholder involvement was a primary element of the Stream Maintenance Program development process. In this planning process, a stakeholder is an individual or organization who will be affected by or has an interest in the final Stream Maintenance Program. Stakeholders include regulatory agencies, municipalities, and environmental and business groups.

Stakeholders' thoughts, questions, and recommendations were solicited through a variety of forums with the goal of developing a Stream Maintenance Program that reflects community interests and achieves maximum acceptance.

The stakeholder process included four organized meetings with over 20 organizations and representatives. These External Stakeholder Committee meetings were held on May 7, 1999, June 30, 1999, April 20, 2000, and August 31, 2000. The External Stakeholder Committee was a collaboration of key stakeholders convened to advise the District as it drafted and revised the Stream Maintenance Program.

In addition, the District held a series of informal meetings with representatives of regulatory agencies who were also part of the External Stakeholder Committee. These meetings were held at the suggestion of the agency representatives in order to facilitate the planning and permitting process.

G. ORGANIZATION OF THIS DOCUMENT

This document is organized into the following sections:

- **Chapter 1** : **Introduction**. This introduction provides a brief overview of the Stream Maintenance Program.
- **Chapter 2** : **An Overview of Stream Maintenance Activities**. This Chapter provides an overview of the extent of routine stream maintenance activities.
- **Chapter 3** : **Stream Maintenance Process Overview**. This chapter provides an overview of the stream maintenance planning, implementation, and reporting process.
- **Chapter 4** : **Resource Protection**. This chapter details the resource protection policies that are included in the

Stream Maintenance Program.

- **Chapter 5** : **Compensatory Mitigation**. This chapter describes the compensatory mitigation that is proposed as part of the Stream Maintenance Program.
- **Chapter 6** : **Linkages to Other Programs and Projects**. This chapter will explore the relationship of the Stream Maintenance Program with other District planning efforts.
- **Chapter 7** : **References**. Provides the full references of documents and correspondence used in the preparation of this Stream Maintenance Program.

Participating in this process were representatives from federal and state agencies (i.e., USACE Environmental Protection Agency, U.S. Fish and Wildlife Service (USFWS), CDFG, and RWQCBs), cities (i.e Palo Alto, Sunnyvale Milpitas, San Jose, and Gilroy), and community groups (i.e., Coordinated Resources Management and Planning, Natural Resource Conservation District, Clean South Bay Streams for Tomorrow).

Chapter 2
AN OVERVIEW OF STREAM MAINTENANCE ACTIVITIES

The Stream Maintenance Program provides long-term guidance for the implementation of routine stream maintenance work. Three major types of stream maintenance activities are sediment removal, vegetation management, and bank protection. This chapter provides an overview of these stream maintenance activities and their average frequency and extent on an annual basis. Also included in this Stream Maintenance Program are minor maintenance activities described in this chapte .

The projections for work area amount under the Stream Maintenance Program are based on approximately 20 years of historical data. The numbers provided are program-level projections of future stream maintenance activities and are not intended to represent the exact extent of work which will occur in the future. As described further below, stream maintenance activities can vary from year to year. There may be some future routine maintenance activities in streams and canals within the District's jurisdiction that are consistent with the descriptions of work and impacts overall but which were not specifically included in the District's projection of work areas. Maintenance at such sites is still included in the program as long as it does not result in significant environmental effects substantially different than those evaluated for the Stream Maintenance Program as a whole.

Routine maintenance occurs on a year-round basis. However, it is scheduled to avoid or minimize impacts to environmental resources. Typically, routine maintenance that requires the operation of heavy equipment in the channel is limited to the dry season.

A. SEDIMENT REMOVAL

1. Overview

Sediment removal is the act of mechanically removing sediment deposited within a stream. Typically, sediment removal is indicated when it (1) reduces capacity, (2) prevents facilities or appurtenant structures from functioning as intended, or (3) impedes fish passage and access to fish ladders.

The District's purposes in performing sediment removal activities are to ensure that a stream will continue to provide flood capacity and to ensure that appurtenant facilities are working as designed. Sediment is usually removed from modified channels. However, sediment is also sometimes removed from natural creeks on an occasional basis to provide proper

functioning of outfalls, culverts, bridge crossings, and stream gauging stations, for example. Occasionally, sediment is removed from canals to maintain their function as water conveyance facilities. Sediment is removed from canals on an irregular basis, with similar equipment used for sediment removal from streams. Based on seven sediment removal projects undertaken in canals from 1992 to 2000, the average annual amount of sediment removed from canals is estimated to be less than 1,000 cubic yards. Sediment removal in canals takes place primarily in Almaden-Calero Canal, Coyote-Alamitos Canal, Coyote Canal, and Coyote Canal Extension.

In most cases, sediment deposition is a natural process that occurs where the stream gradient flattens out in the valley floor or where the gradient is otherwise flat over long reaches. In developed areas, this deposition affects flood flow capacities.

Typical equipment used for sediment removal includes excavators, draglines, loaders, and 10- or 20-cubic-yard dump trucks. If water must be bypassed around the site during work, water pumps and piping, and cofferdams of earth, gravel, sandbags, hay bales, rubber, or other appropriate material may be used. In some cases, a bypass channel or detention basin is appropriate to isolate a site. Saturated sediments may be temporarily placed adjacent to the work site to dry out before being removed to a landfill or to other suitable disposal or reuse sites. Most often, sediment removal projects are implemented in the dry season (summer). The District also implements BMPs to ensure that sediment removal projects have the least impact possible. The District's equipment and work methods are updated as new equipment or better methods become available. Sediment removal projects are also revised as new CIP are completed.

2. Sediment Removal Methods

The method of sediment removal is dependent on channel configuration and geometry, equipment reach and rate of production, channel type (tidal or nontidal, concrete or earth bottom), moisture content of the silt, ramp location, and access road width. For example, wide tidal reaches with a channel bottom of wet bay muds which will not support equipment require silt removal by a dragline or an excavator positioned on the top of the creek bank. This method requires wide roads for the equipment and for truck access.

Concrete-lined channels may be cleaned by pushing sediment into a pile with a bulldozer and using a loader to place the material in trucks for removal to an approved disposal site. The trucks are located at strategic points either in the channel bottom or at the top of bank depending on the method of routing the trucks. Another example is cleaning or creating a low-flow channel with excavation equipment working in the channel bottom, loading trucks either in the channel bottom or moving the sediment to trucks at the top of bank.

3. Annual Sediment Removal Activity

The District estimates that it removes an average of 80,000 cubic yards of sediment on about 16 miles of channel per year in Santa Clara County. This average includes both concrete-lined and earth-lined channels. This is an average annual quantity and will vary from year to year depending, in part, on rainfall conditions of the past season. Table 2-1 summarizes recent annual sediment activities.

The number of sediment removal sites each year also varies widely. Historical records show that the District removes sediment from an average of 19 sites annually but may work at as few as two sites or as many as 39 in a given year.

TABLE 2-1

Recent Sediment Removal Activity

District Fiscal Year[a]	Cubic Yards	Stream Miles	Number of Sediment Removal Sites

1996	11,500	1.5	2
1997	2,900	5.5	6
1998	132,300	12.9	27
1999	115,100	7.5	12

[a]District convention: fiscal year 1998 = July 1, 1997, through June 30, 1998

B. VEGETATION MANAGEMENT

1. Overview

Management of vegetation in and adjacent to creeks and canals is necessary to maintain the ability of channels to function as flood protection facilities and canals to function for water conveyance. Dense vegetation can adversely affect the ability of the channel to contain the flow of flood waters for which it was designed. Therefore, most flood protection facilities require some type of periodic vegetation control. Depending on the original design and the characteristics of the channel, the frequency of vegetation management varies from annually to every few years.

The District also plants and maintains revegetation or mitigation projects, often along creeks. In the first few years after initial planting, it is important to control weeds at revegetation sites to increase the number of native trees and shrubs which survive and to more quickly establish a self-sustaining plant community which provides wildlife habitat.

The control of invasive, nonnative plants is another purpose for which the District undertakes vegetation control. Plant species are targeted that are not native to this area of California and are known to aggressively spread. These plants can migrate into other areas where they can affect channel capacity as well as reduce native plant populations. This can lead to reduced channel capacity and overall habitat degradation. Current practice is to assign this a lower priority and do it on an ad hoc basis as it fits in with higher-priority work.

The District manages vegetation for other purposes including the protection of levees, and concrete linings from plant roots; meeting local fire codes requiring the control of combustible weeds and grasses; providing visual clearance to inspect the condition of a facility; and providing access along maintenance roads.

2. Vegetation Management Methods

Over the past 30 years, the District has continually revised vegetation management approaches to control vegetation on District facilities. This approach consists of utilizing three basic methods: hand removal (chain saws, weed-eaters, etc.); mechanical (mowing and discing); and chemical control through the use of herbicides. A method or combination of methods is chosen for each site depending on the maintenance requirements of the facility. Efficiency, economics, and the protection of public health and environmental resources are all considered in the selection of methods.

As an example, herbicides can often be a more effective vegetation control method when compared to mechanical or hand removal. This is because of their ability to spread into and damage the roots of the target plants, thus preventing resprouting. When treated with mechanical or hand methods, some woody plants, such as willows, will resprout with multiple stems. The multiple sprouts result in a greater flood protection problem and require annual control. With herbicides, annual retreatment is often necessary; however, the treatment area is greatly reduced, as only a small percentage of regrowth will occur. As a result, this program includes herbicides as the primary method by which vegetation is controlled in channels and on streambanks.

Herbicides are not broadcast sprayed across the channel, but are selectively sprayed at the plants targeted for removal by the design parameters of each particular stream reach. In some streams, only woody saplings (no greater than 2 inches in diameter at breast height) are removed in the target area, while other streams require removal of both herbaceous and woody vegetation. In upland areas, herbicides are sprayed on maintenance roads to provide a clear access area and on levee slopes to eliminate broadleaf weeds.

The District only uses herbicides according to the label directions and for uses approved by the United States Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation (DPR). Currently, the primary postemergent herbicides which the District uses are Roundup® Pro and Aqua Master® (formerly known as Rodeo®). These herbicides are formulations of the chemical glyphosate, which is a nonselective broad spectrum herbicide. Aqua Master® is approved for use in aquatic areas, whereas Roundup® Pro is not approved for application directly in water or to areas where surface water is present.

Other herbicides which will be used by the District are shown in the following table.

TABLE 2-2

Herbicide Use for the Multiyear Stream Maintenance Program

Product Name	Chemical Type	Use	Average Annual Amount
Gallery	Isoxaben	Preemergent, selective to broadleaf weeds. Used on levee slopes and maintenance roads.	447 pounds
Garlon 3A	Triclopyr, triethylamine salt	Postemergent, selective to broadleaf weeds. Used on levee slopes.	5 gallons
Garlon 4	Triclopyr, triethylamine salt	Postemergent, selective to broadleaf weeds. Used on levee slopes.	62 gallons
Oust	Sulfometuron	Preemergent, nonselective. Used on access roads/firebreaks.	206 ounces
Pendulum	Pendimethalin	Preemergent, selective to grasses. Used on access roads/firebreaks.	3,576 pounds
Aqua Master (formerly known as Rodeo)	Glyphosate	Postemergent, nonselective. Approved for aquatic use. Used in channels.	750 gallons
Roundup Pro	Glyphosate	Postemergent, nonselective. Roundup used in upland areas on maintenance roads/firebreaks.	1,021 gallons
Surflan (AS)	Oryzalin	Preemergent, selective to grasses. Used on access roads, firebreaks, and landscape/ revegetation areas.	1,269 ounces
Telar	Chlorsulfuron	Preemergent, selective to broadleaf weeds. Used on levee slopes and maintenance roads.	2,140 ounces

Transline	Clopyralid	Postemergent, selective to specific broadleaf families. Some minor preemergent activity. Used for control of yellow star thistle on levee slopes/upland parcels.	16 gallons
Target Pro-spreader/ activator or Wilbur-Elias R-11 spreader activator		Surfactant used with Aqua Master®, Garlon, and Transline products.	310 gallons

In total, the District currently uses approximately 2,000 gallons of herbicides, 50 percent of which is Roundup® Pro and 35 percent is Aqua Master®. In addition, the District uses approximately 3,580 pounds of Pendulum and 450 pounds of Gallery per year. Appendix H contains a literature review of pesticides used by the District.

The Stream Maintenance Program includes the reinstatement of the use of herbicides as part of the Vegetation Management Program in the Pajaro River Basin. Herbicides are currently used as part of the Vegetation Management Program in the Santa Clara Basin, but their use was discontinued in the Pajaro River Basin (South County) at the direction of the District Board of Directors in 1974 because of complaints regarding drifting of herbicides into agricultural fields. In 1979, the District considered reinstating a herbicide program in the Pajaro River Basin. At that time, there was a general concern in the community over the use of herbicides, particularly the use of 2,4-D, and after public hearings, the District decided not to reinstate the use of herbicides in the Pajaro River Basin. As a result, the use of herbicides was also excluded on new federally-sponsored flood protection projects on Llagas Creek in the Pajaro River Basin.

Since that time, the District has revised its herbicide program to address environmental, health risk, and public safety concerns, but at the same time recognize that herbicides are a cost-effective means for maintaining flood protection and water supply facilities. Many of the improvements made to the District's herbicide program are described below:

- In 1980, the District discontinued the use of the herbicide 2,4-D.
- In 1986, the District switched to using herbicides in the sulfonylurea family which are applied at rates of ounces per acre, rather than previous herbicides which were applied at rates of pounds per acre. This step not only reduced the overall amount of herbicides being applied throughout the county, but also relied on using herbicides with a lower toxicity.
- In 1988, the District went beyond state requirements and required all District employees who handle pesticides to be certified as Qualified Applicators by the DPR. As Qualified Applicators, these employees are trained on pesticide laws and regulations, safety, and application methods and are required to receive annual training to keep updated in this field.
- Likewise, even before state requirements, the District required that a District Pest Control Advisor (PCA) prepare a pesticide use recommendation for any use of herbicide on District facilities. For the District's purposes, PCAs are required to have a relevant bachelor's degree, be trained in integrated pest management and groundwater protection, and continue to receive 40 hours of relevant training every 2 years.
- At the District, the PCA is required to conduct a field survey to assess the site conditions, types of weeds and nontarget plants, surrounding land uses, and potential wildlife use prior to writing a pesticide use recommendation. This information is used to make a recommendation with detailed instructions to the applicator regarding the type of herbicide, rate, equipment, treatment area identified on a map, target vegetation, vegetation to protect, and any special instructions relevant to the site and treatment.
- Certain types of herbicides were found as contaminants in groundwater in California's Central Valley. Although no restrictions were placed by the state on their use in Santa Clara County or on soil types found in Santa Clara County, the District voluntarily discontinued the use of certain preemergent herbicides on our facilities in 1993 to avoid any

potential problems with groundwater. This practice continues today. PCAs receive groundwater training every 2 years from the DPR and receive routine updates in changes to the regulations. Though none of the regulations currently apply to this county, the District discontinues use of products that are known groundwater contaminants in other areas of the state.

- In 1994, the District voluntarily eliminated the use of residual preemergent herbicides on our groundwater recharge facilities. Today, only herbicides that are registered for use in aquatic areas are used at these locations.
- In 1996, the District retrofitted its spray trucks to include the Patchen WeedSeeker. This device utilizes a light sensor attached to the front of the spray equipment that detects the presence of chlorophyll (and, therefore, living plants) and controls individual spray heads. Instead of spraying the entire width of a facility as the spray truck passes over it, individual spray heads are turned on only as they pass over vegetated areas. This eliminates the treatment of bare ground and reduces the amount of herbicide applied by 20 to 90 percent. This equipment is primarily limited to use on flat areas where all vegetation needs to be controlled, such as maintenance roads.
- The District currently uses primarily Category III and IV herbicides. Under a ranking system developed by the USEPA, pesticide products are given an acute toxicity rating which is reflected in the warning label of the pesticide container. Category III is considered slightly toxic ("caution" warning on label) and Category IV is considered practically nontoxic (no warning language included on label).

As a result of these improvements, the District is now proposing that herbicide use be reinstated in the Pajaro River Basin. This change would require the following actions:

- The District's Board will need to adopt implementation of the Stream Maintenance Program, changing the maintenance practices in the Pajaro River Basin to include herbicides as a routine maintenance tool.
- The maintenance documents for the federally-sponsored Llagas Flood Protection Projects (PL-566 projects) will require amendment by the federal sponsoring agency, Natural Resources Conservation Service (NRCS), to include this activity.

Staff has been working with the Board and NRCS toward the implementation of this change. Both the Board and the NRCS agree this is a beneficial change.

Hand removal of vegetation is undertaken in a few locations where it is not possible to access the area with spray equipment. In some cases, the vegetation is sprayed with herbicides, and then approximately 6 months later, the dead material is removed by hand removal methods, if necessary. This latter category of work is referred to as follow-up hand removal. Follow-up hand removal of vegetation is only necessary when herbicide spraying is new to an area and there is a larger volume of dead vegetation created in the first year or two. In subsequent years, the amount of vegetative regrowth is reduced and follow-up hand removal is necessary much less frequently.

The five types of vegetation management in upland areas are: discing, mowing, herbicide application, hand removal, and removal of overhanging growth to provide maintenance access.

Upland discing occurs on upland parcels outside of the streambanks and is conducted to create firebreaks. Upland mowing consists of operating a flail mower to eliminate or reduce grasses that would cause a fire hazard during the summer. Mowing can occur from one to three times annually at each location, usually between May and October. Mowing is conducted on the inside slope of streambanks and outboard levees slopes to create a firebreak.

Upland herbicide spraying is used on levees, unpaved maintenance roads, and along some property lines. On levees, herbicides are used primarily to keep woody vegetation and broadleaf weeds from becoming established where they will interfere with flood flow capacity, damage the levees, or hinder their inspection. Weeds and grasses are sprayed on maintenance roads to clearly define and keep open the access route. Herbicide spraying along property lines assist in establishing a firebreak. Pre and postemergent herbicides are sprayed from a truck-mounted rig or by a controlled drop

applicator.

Hand removal of vegetation is conducted in upland areas where mowers cannot access, and herbicides are either not practical due to steep terrain or not allowed. Hand removal of vegetation is generally used in upland areas along property lines to establish fire breaks. Removal of overhanging growth consists of pruning trees branches that impede access roads or hang over fence lines.

3. Annual Vegetation Management Activity

The frequency of vegetation management activities varies from semiannually to once every several years, depending on the method used. Herbicide spraying in stream channels is conducted July 1 through October 15. Removal of woody vegetation by hand is conducted July 1 through March 1. Hand removal in stream channels is conducted November through December.

Vegetation management occurs in creeks, canals, and adjacent uplands. On average, vegetation management work is annually performed on approximately 4,000 acres. Within this larger work area, the targeted treatment area consists of approximately 2,000 acres. These totals include the following approximate levels of activity:

- 923 acres of vegetation management work is conducted in 222 miles of stream channels with 132 acres of the total actually receiving treatment (585 work acres or 75 acres of treated area on 166 miles in the Santa Clara Basin, and 338 work acres or 57 acres of treated area and 56 miles in the Pajaro River Basin);
- 23 acres on which vegetation management work is conducted on 27 miles of canals with 6 acres of the total actually receiving treatment; and
- 3,021 acres of uplands on which vegetation management work is performed, with 1,885 acres actually receiving treatment. Upland vegetation management is outside of the area of inundation, and generally has a buffer of grass or vegetation on the slopes between the right of way and the stream.

Vegetation management activities are relatively the same from year to year. Slight variations in flood protection activities occur due to weather patterns. For example, historically, increases in some work activities occur during flood years, with decreases in other activities occurring during extended periods of drought. Right of way activities remain constant regardless of these weather patterns.

C. BANK PROTECTION

1. Overview

Bank protection involves an action by the District to repair streambanks that are eroding or are in need of preventative erosion protection. The District implements bank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation or recreational use, (4) negatively affects water quality or beneficial uses, or (5) negatively affects riparian habitat. Repairs may take several forms from installing "hard" structures (e.g., rock, concrete, sack concrete, gabions) to "soft" structures (e.g., willow brush mattresses, log crib walls, pole plantings) or a combination of hard and soft structures.

Streambank erosion is a natural process, which mostly happens during major storm events. Erosion can occur because of hydraulic forces and geotechnical instabilities, and can be accelerated by human intervention and land uses. Accelerated erosion is typically a result of particular land uses that affect the stream corridor, including grazing, agriculture, and road and utility construction. Erosion of banks can result in increased sediment deposition, which can lead to decreased flood flow capacities and potential flood hazards. Erosion on banks may also cause vegetation and soil loss, damage to private or public property, transportation and utility impacts, safety hazards, and turbidity injurious to fish and aquatic life. Levee erosion may lead to failure of the structure and flooding.

Bank protection work may either occur as repair of an existing bank protection project which is failing, or as new work along a bank which is eroding. The new work is considered routine maintenance because it is either restoring the flood protection function of a modified channel or it is repairing a natural bank to its approximate condition prior to becoming an erosion problem.

Repair of existing bank protection structures occurs when these structures fail and are replaced with in-kind, in-place materials. New bank protection projects are those that repair or protect the watercourse from further degradation or erosion using the most appropriate method. This type of protection is considered maintenance if the work does not significantly alter the flood conveyance capacity of the streams.

Equipment used for bank protection may include excavators, dozers, cranes, loaders and 10- and 20-cubic-yard dump trucks, concrete trucks, and pumps and water trucks. If water must be bypassed around the site during repair work, water pumps and piping, and cofferdams of earth, gravel, sandbag, hay bales, rubber, or other suitable material may be used. In some cases, a bypass channel or detention basin is appropriate to isolate a site. Most often, bank protection projects are implemented in the dry season.

2. Bank Protection Methods

The general design criteria and plan for each of the bank protection methods used by the District are included in Appendix E. In addition to these criteria, design of a particular bank protection project includes evaluation of other site-specific characteristics such as bank slope, shear stress, location (such as the inside or outside of a curve), soil type, flow velocity, characteristics of the channel adjacent to the site, and the available right of way. The site is evaluated for the repair method consistent with the characteristics of the site. Revegetation potential is also evaluated for each bank protection project. This potential is not only dependent upon the method of bank protection used, but also the physical properties of the stream where the repair is taking place.

In natural stream conditions where there are no flow capacity requirements, vegetation components for streambank repair are selected. In modified creek channels where the flow requirements must be retained (such as for the 100-year flood), this will often necessitate a roughness maximum which, depending on the channel design, may limit the vegetation component of the design.

A range of methods is used for bank protection, as can be exemplified by several District bank protection projects. Many of the following examples demonstrate how soft methods can be combined with harder methods when site conditions cannot maintain a purely natural solution.

- Log crib walls were used on Guadalupe River, downstream of Coleman and downstream of Woz Way and on Bodfish Creek upstream of Santa Teresa.
- Earth repairs with vegetated slopes were included in the Princevalle storm drain downstream of Chestnut, Sunnyvale East Channel downstream of Evelyn and Lower Penitencia Creek, downstream of Redwood Drive.
- Rock hybrids include Permanente Creek at Lundy Lane, Stevens Creek downstream of Fremont, and Los Gatos Creek downstream of Bascom Avenue.
- Cottonwood seedlings growing on articulated concrete mats are located on Guadalupe River upstream of Highway 880.

For all bank protection projects, the District makes an inspection of the stream upstream and downstream of a project site to determine if there is an identifiable cause of the erosion. In some cases, the cause of erosion is obvious, such as a blockage (e.g., downed tree) or weak streambanks of silt or gravel stratas. In other cases, a further inspection is conducted to determine if flows are being directed toward the bank from a source upstream, whether the channel invert is down cutting, or if illegal drainage is causing the problem. These factors can affect the bank protection approach implemented by the District.

3. Annual Bank Protection Activity

The District estimates that an average of 5,000 linear feet of banks may be repaired annually based on historical records, District experience, and current levels of funding. This is an average annual quantity and will vary from year to year. Facilities are inspected after the winter storms for damage and maintenance needs and a work plan is prepared. Under the Stream Maintenance Program, the District is committing to installing no more than 50 percent of future bank protection work using hardscape designs.

In the past 14 years, the total length of bank protection activities in an individual year ranged from approximately 1,500 to 13,000 feet. The District has completed an average of 38 bank protection jobs per year, based on historical records, but there is considerable deviation. For example, there were nine jobs in 1994 and 73 in 1987. A more detailed summary of historical bank protection activities is provided in Table 2-3.

TABLE 2-3

Bank Protection Activities

1987-1999

	Length (feet)				
Year	**Total**	**Live[a]**	**Mixed[b]**	**Hard[c]**	**Other[a]**
1987	1,249	130	6,414	3,564	11,357
1988	3,525	0	7,815	980	12,320
1989	210	0	3,680	2,305	6,195
1990	410	0	4,156	8,012	12,578
1991	316	0	5,298	500	6,114
1992	3,210	0	2,153	214	5,577
1993	145	0	3,412	2,288	5,845
1994	738	620	4,408	225	5,991
1995	7,659	0	155	535	8,349
1996	25	0	2,105	250	2,290
1997	205	50	2,359	1,218	3,832
1998	138	535	485	341	1,499
1999	6,442	905	195	4,027	11,569
Minimum	25	0	155	214	1,499
Maximum	7,659	905	7,815	8,012	12,578
Average/year	1,734	160	3,039	1,747	6,680

Source: SCVWD 1999e.
[a]Live: seeded or vegetated
[b]Mixed: crib walls, geoweb, hybrid rock, wooden retaining walls, all with vegetation
[c]Hardscape: concrete, shotcrete, sacked concrete, rock, without vegetation (impervious)
[d]Other: fence with brush, concrete, or rock removal, replacement of existing rock, concrete or gabions. In 1999, the "other" category consisted of installing a chain link fence and brush on a bank as temporary fix, replacing a failed wall, replacing earth fill behind a wall, placing a kickboard on a fence at top of bank, replacing failed concrete panels, and installing a drain inlet.

Unlike sediment removal and vegetation management, the historical location of bank protection activities is not a good predictor of where future bank protection will be required. The quantity and location of bank protection activities varies greatly from year to year, based upon watershed conditions, degree of safety hazard, work load, budget, and of other work to be done in a given year.

D. MINOR MAINTENANCE ACTIVITIES

Minor maintenance activities included in this Stream Maintenance Program are: trash removal at trash racks and more generalized locations; repair and installation of fences and gates; grading and other repairs to restore the original contour of access roads and levees; grading small areas without vegetation above streambanks to improve drainage and reduce erosion; repair of structures with in-kind materials within the same footprint (such as replacement of concrete linings, culverts, pipes, valves, or similar structures); cleaning and minor sediment removal at stream gages, outfalls, culverts, flap gates, tide gates, inlets, grade control structures, fish ladders, and fish screens; graffiti removal; tree pruning along maintenance roads and fence lines to provide access and to remove hazards; irrigation, weeding, replanting, and other types of ongoing maintenance at mitigation sites; removal of obstructions to flow in the immediate vicinity (not to exceed 100 feet) of bridges, streamflow measuring stations, box culverts, storm drain outfalls, and drop structures to maintain functions of such structures; removal of trees or branches that are in imminent danger of falling, fallen trees, and associated debris to maintain channel design capacity; and ground squirrel and rodent control with traps, smoke bombs, and pesticides.

Chapter 3
STREAM MAINTENANCE PROCESS OVERVIEW

This chapter provides an overview of the stream maintenance planning, implementation, and reporting process that is committed to as part of the Stream Maintenance Program.

The District's stream maintenance planning, implementation, and reporting process can be broken down into three distinct phases: program development and documentation, implementation of annual routine stream maintenance work, and annual reporting.

Specific guidelines and implementation measures which are to be followed with the implementation of stream maintenance activities are provided in Chapter 4.

A. PROGRAM DEVELOPMENT AND DOCUMENTATION

This Stream Maintenance Program has been developed to guide the long-term implementation of the District's annual routine stream maintenance work. This annual routine work consists of significant work identified in the spring as well as other work needed throughout the year that has been evaluated under the Stream Maintenance Program. This Stream Maintenance

Program (along with the Program EIR and long-term permits) provides the guidance and regulatory compliance for the District to provide routine maintenance of its streams and canals without having to perform separate CEQA review or obtain permits for each individual routine stream maintenance project. The Stream Maintenance Program will also enable the District to employ a watershed-wide approach to environmental protection. Through these programmatic documents, the District is committed to implementing individual maintenance projects in an environmentally-sensitive manner. In addition, the District has committed to a compensatory mitigation program for those impacts that cannot be avoided.

B. IMPLEMENTATION OF ANNUAL ROUTINE STREAM MAINTENANCE WORK

Maintenance work can be proposed either as part of the Annual Work Plan or as other work identified later in the year through individual work orders. All stream maintenance activities would follow the Resource Protection Protocol, which is further described in this section and illustrated in Figure 3-1.

The District has historically used work orders to describe and implement stream maintenance projects. Work orders provide a description of the project, schedule of implementation, estimated costs, and permit requirements or other special conditions. This tool will continue to be the primary vehicle for the implementation of maintenance projects. In addition, an Annual Work Plan that identifies the major (sediment removal, vegetation management, and bank protection) projects planned for the year will be developed. This plan will identify the stream maintenance work that forms the basis of the annual budget. Specific information, such as location and size of the major stream maintenance projects, will be provided in the Annual Work Plan.

As maintenance work is proposed, it will be evaluated to determine if the work is addressed under the Stream Maintenance Program. If not, the work will follow the appropriate project development process which may include individual CEQA review and individual regulatory permits or clearances. An example of this type of work may be removal of a drop structure in a stream.

The proposed work is also evaluated under the requirements of the Maintenance Guidelines to ensure that the maintenance meets preestablished engineering requirements. For example, if a sediment removal project is proposed, the Maintenance Guidelines provide the information on the allowable depth of sediment for a reach that will still provide design flood protection for a community. Maintenance Guidelines are updated as new CIP are completed, as better maintenance methods are developed or as refinements are made as to the level of maintenance required in a reach of creek.

FIGURE 3-1

Resource Protection Protocol

If a proposed project or activity is of low impact and is typically exempt from detailed environmental review, the appropriate resource protection measures and BMPs will be identified and work could proceed. Minor work activities are described in Chapter 2. The activities considered low impact will change over time with changes to CEQA, regulatory direction, and court decisions. As a separate planning effort, these types of activities are currently being evaluated for a regional general permit being prepared by the RWQCB. Should this regional general permit be approved, it will be used to help define whether or not a proposed activity is low impact.

If the project is not low impact work as described above, a more detailed review process will occur. The project will be reviewed to verify that it is covered under the long-term regulatory clearances provided in conjunction with the Stream Maintenance Program. If needed, the District will apply for individual permits or clearances. The work will be evaluated for compliance with the Migratory Bird Treaty Act. Appropriate resource protection measures and BMPs will be identified and added to the work order.

Prework conferences will be held with staff which may include the appropriate staff from Watershed or Countywide Watershed Management Units to discuss site-specific requirements, environmental constraints, and BMPs.

Annually, in November, District staff will hold a "Lessons Learned" meeting to evaluate the effectiveness of both resource protection and maintenance methods used in the preceding construction season. The information and assessments will be used to update BMPs, Stream Maintenance Program processes, and the Maintenance Guidelines and to create a greater understanding of how to accomplish environmentally-sensitive, fiscally sound maintenance work.

C. ANNUAL REPORTING

The District's Annual Stream Maintenance Work Plan, which includes the description of the proposed work, location, and extent of work area will be submitted to USACE, United States Fish and Wildlife Service (USFWS), CDFG, BCDC, and RWQCB prior to the commencement of the work (likely in May).

The sediment sampling and characterization plan will be revised in June, prior to the work season. Over the years of this program, it is expected that the requirements for sediment sampling and characterization are to be reduced as the usefulness and repetitiveness of the data of previous years is evaluated.

A final annual report detailing what work was accomplished will be submitted to USACE, USFWS, CDFG, BCDC, and RWQCB at the end of the maintenance season (prior to January 1) which will specify which projects were completed for the year including type of work, location, and size of the project.

In addition to reporting on the maintenance activity completed for the year, the District will also provide reporting on the implementation of the mitigation program. For the first 5 years of the program, the District will provide the agencies with a tour of representative work areas (especially those along target streams and watersheds) for that year and all mitigation sites. This tour will take place after completion of the work season. Preconstruction photographs will also be provided.

The District's Geographic Information System (GIS) may be utilized as a tool for reporting annual work activities and implementation of mitigation projects.

Chapter 4
RESOURCE PROTECTION POLICIES

This chapter details the policies that are included in the Stream Maintenance Program. These policies have been developed by the District through the routine stream maintenance planning process to ensure that resources are protected to the furthest extent feasible during routine stream maintenance projects. BMPs have been developed to implement these policies. These are listed in a table in Appendix G.

The policies in the Stream Maintenance Program have been developed to guide decision-making for stream maintenance projects. Policies are based on the Stream Maintenance Program objectives identified in Chapter 1 and are means to the District's Ends Guidelines (Board of Directors Policy No. E-1; October 19, 1999). Specifically, the Stream Maintenance Program resource protection policies have been developed to meet the following Ends Policies:

1.0. There is a healthy and safe environment for residents and visitors.

1.2. There is a reduced potential for flood damages.

1.2.1. The cost of reducing the potential for flood damages is balanced with benefits (including possible environmental restoration and enhancement).

1.2.2. There is a balance between the contributions of watersheds and streams in providing for public health and safety and in providing protection of natural resource benefits.

2.0. There is enhanced quality of life in Santa Clara County.

2.1. Watersheds, streams, and the natural resources therein are protected and when appropriate enhanced or restored.

2.1.1. Healthy creek and bay ecosystems are protected, enhanced, or restored as determined appropriate by the Board of Directors.

2.1.1.1. Mitigation for adverse impacts of District activities are identified.

2.1.1.2. Opportunities to enhance or restore natural resource benefits of streams and watersheds are identified.

2.1.1.3. Mitigation, enhancements, or restoration are implemented when determined appropriate by the Board of Directors.

For many of the Stream Maintenance Program policies, BMPs have been identified. A BMP is an action, procedure, program, or technique that carries out a policy. These BMPs provide specific guidance to District managers and staff in the environmental review, processing, and implementation of individual stream maintenance projects.

The policies included in this chapter are categorized by the following groups:

- Process and Protocols
- Watershed Restoration and Management
- Protection of Listed Species and Species of Concern
- Fisheries Protection and Enhancement
- Maintenance Site Dewatering
- Minimization of Erosion
- Preservation and Replacement of Riparian and Shaded Riverine Habitat
- Wetlands Protection
- Use and Management of Herbicides
- Hazardous Material Management and Control
- Additional Work Site Management Practices

These categories are both by resource type (e.g., sensitive species, fisheries, wetland) and by individual maintenance practices that require special consideration (e.g., dewatering, herbicide use). Though some activities and measures clearly fit into one category or another, they are sometimes overlapping. For example, some measures related to fisheries protection apply specifically when a site is dewatered.

All routine stream maintenance projects must adhere to the policies contained in this chapter.

A. PROCESS AND PROTOCOLS

Policy 1*: The District will process all routine stream maintenance activities according to the process and protocols established in Chapter 3 of the Stream Maintenance Program.*

Policy 2*: Decisions regarding the necessity of routine sediment removal and vegetation management activities (to restore channel flow capacities) will be made following the thresholds established in the Maintenance Guidelines. This information will be used to formulate in part an annual routine maintenance work plan.*

***Policy 3**: The District will continue to develop, implement, and update BMPs for implementation of stream maintenance projects to ensure that maintenance activities are conducted in the most effective and environmentally-sensitive way possible and are technically feasible and economically reasonable.*

Discussion of Policy 1

Through the development of the Stream Maintenance Program, the District defined a protocol for processing maintenance work orders, as summarized in Chapter 3. In addition, several other documents will provide the District with guidance when implementing stream maintenance projects.

This process described in Chapter 3 will ensure that each routine maintenance project is reviewed for its potential for negative environmental effect and that sensitive species and habitats are protected consistent with the federal and state ESA. The District is committed to performing routine maintenance activities in a manner that demonstrates an appropriate effort to avoid or minimize impacts to the environment.

Discussion of Policy 2

The District has developed detailed Maintenance Guidelines to address the ongoing need for maintenance of vegetation or sediment in modified streams and canals. The guidelines are engineering based and outline the thresholds for maintenance that are required to ensure adequate flood capacity is maintained in the streams within the District's jurisdiction. These guidelines support field evaluations of need and are consistent with the District's flood management objectives and applicable District Ends Policies.

Maintenance Guidelines are based on two concepts: (1) the maintenance standard and (2) the acceptable maintenance condition. The maintenance standard is defined as the design facility condition, where the modified stream has full design capacity and freeboard. The acceptable maintenance condition is the condition to which a channel can be allowed to deteriorate before capacity is determined to be compromised and maintenance work becomes essential. The focus of the hydraulic analysis is related to sediment accumulation and vegetation management since these two factors typically affect capacity. The Maintenance Guidelines may also apply to other activities such as trash pick-up, blockage removal, fence repairs, and access road maintenance. By conducting these routine maintenance activities, the District ensures that facilities continue to provide the level of flood protection for which they were constructed. These efforts protect the public's investment and help to comply with regulations of the federal flood insurance program (Flood Damage Reduction Objective 6, District Guidelines and Procedures 0-105).

The Maintenance Guidelines detail information for each creek to the extent it is available. This information includes whether or not the guidelines are existing (based upon construction documentation) or new (based upon new engineering calculations), background information (e.g., available studies, facility engineering reports, and applicable permits), average frequency of maintenance activities (history), and any additional supporting data and calculations.

Discussion of Policy 3

BMPs are activities, maintenance and operations procedures, or other standard management and work practices that are designed to prevent or reduce pollution or other negative environmental consequences. The District currently implements BMPs when completing stream maintenance projects.

The District will use the most current BMPs and will continually evaluate the performance of BMPs and update or otherwise modify BMPs as appropriate. The District will conduct annual BMP training for District staff who support the implementation of the Stream Maintenance Program.

The District will maintain a BMP manual which details design, installation, and work practices for stream maintenance activities. The manual includes documentation and implementation information for the District's BMPs and is updated as new

and better information, approaches, and technologies are developed. Annual training for watershed personnel is also conducted by the District to familiarize all employees with the current BMPs.

B. WATERSHED RESTORATION AND MANAGEMENT

***Policy 4**: The District will use the Stream Maintenance Program to manage its routine stream maintenance activities in a programmatic way, including BMPs and a mitigation program. The District will evaluate the environmental impact of the program in an EIR.*

Discussion of Policy 4

For the purpose of the Stream Maintenance Program, the District can be divided into two major basins: the Santa Clara Basin (which drains to the San Francisco Bay) and the Pajaro River Basin (which drains to Monterey Bay), as previously shown in Figure 1-1. Each basin is made up of numerous watersheds. A watershed is a geographic area from which water is drained by a river and its tributaries to a common outlet.

Traditional stream alteration work was done for flood hazard reduction and relied heavily on engineered channels based on straight, clean (i.e., low hydraulic resistance) channel models. Today's water and flood protection districts are faced with the high maintenance costs of these previously-developed systems, particularly in areas subject to freshwater or tidal sediment deposition. In the development of older flood protection systems, vegetated riparian corridors, wetlands, and system stability were not considered to the extent they are today.

Current District Board of Directors Ends Policies call for a balance between public health and safety and protection of natural resource benefits (Board of Directors Policy No. E-1.1.2.2). This balancing has changed the way the District now views the issue of watershed management and its role as a steward of aquatic environmental resources.

Under Board of Directors Ends Policies, the District will manage activities to be reflective of stewardship of watersheds and riparian corridors, while proactively complying with regulatory mandates. The District is committed to understanding the stream corridor, watershed, and landscape as a complex of working ecosystems that influence and are influenced by neighboring ecosystems. Future projects, programs, and initiatives are, and will continue to be, focused on a watershed and ecosystem approach, rather than a facility-by-facility approach.

Examples of such projects and programs that the District is currently involved in include the Watershed Management Initiative (WMI). This collaborative effort is being undertaken by the USEPA, California State Water Resources Control Board (SWRCB), and the RWQCB and is aimed at implementing an integrated watershed management approach to administering water pollution control programs.

The Natural Resources Management Program (NRMP) is an ongoing project that will consolidate acquisition of natural resource data and provide for the development and implementation of natural resource management plans in support of integrated water resource management. This project will develop a Districtwide strategy to identify and resolve sensitive resource issues.

The District has developed a mitigation approach for the Stream Maintenance Program that incorporates the restoration and protection of stream environments, as detailed in Chapter 5. The District will continue to look for opportunities to implement a watershed approach and to support and implement restoration efforts.

The District explores opportunities to reduce sediment loads through watershed management and restoration. The District is committed to improving the flood management system so that flood protection is provided in an efficient manner and in ways no more costly than necessary. One way to achieve this is by reducing the frequency that sediment removal activities must occur. Alternative approaches in the development of flood protection facilities can result in the reduction, if not the complete elimination, of maintenance requirements. The Stream Maintenance Program addresses routine maintenance activities only

and does not involve redesign of such facilities. However, the Stream Maintenance Program provides a means by which new CIPs can be compared to the Stream Maintenance Program, adjustments made, and then new maintenance incorporated into the program, as described in in Chapter 2.

In addition, sediment loads could potentially be reduced through a larger watershed approach and the restoration of natural systems in the area. It is important to consider the relative value of sediment reduction projects within the District's watersheds.

Sediment transport characteristics of streams and rivers are affected by many natural and human-induced agents and physical processes. The most significant agents include the local geology, regional seismicity, tidal processes, past subsidence in the region, a rising sea level, changes in land use in the watersheds and floodplains, urbanization, channel improvement projects, sediment accumulation from tidal and terrestrial sources, and bridge constrictions. All of these agents contribute to decreasing channel capacity with time and increasing annual maintenance requirements to meet present and future levels of flood protection (Northwest Hydraulic Consultants 2000).

In addition to the effect on channel capacity, increased sediment over natural conditions or sediment deposition at different life stages can negatively affect aquatic communities by clogging fish gills and suffocating eggs and aquatic insect larvae. In addition, if fine sediment settles within bottom gravels or cobbles where fish lay eggs, spawning can be negatively affected. Sediment intrusion can reduce permeability and intragravel water velocities, thereby restricting the supply of oxygenated water to developing embryos. Excessive fine sediment deposition can effectively smother incubating eggs.

In-stream sediments are used as nesting and spawning grounds for fish and habitat for bottom dwelling aquatic invertebrates, vertebrates, and plants. However, larger particle size and a low embeddedness and compaction are essential to provide appropriate habitat. These characteristics ensure adequate water flow through the sediment/gravel spaces to fully oxygenate incubating eggs and hatched larvae.

It is commonly implied that oversizing of the channel is the cause of sedimentation. However, the dominant cause of sedimentation is of a regional natural basis. Sediment deposition is primarily controlled by channel slope. Sedimentation occurs where the stream gradient flattens out in the valley floor, or where the gradient is flat over long reaches. Channel excavation provides temporary improvement of flood conveyance. However, maintaining flood capacity will require continuing excavation in perpetuity. Recognizing that sediment will continue to accumulate, future project designs should be developed to be compatible with aggrading channel dynamics. This includes programs to manage sediment production and delivery to streams and channels.

Restoration efforts may be useful for controlling loads of sediment and sediment-associated pollutants from the watershed to streams. Restoration is defined as the reestablishment of the structure and function of ecosystems (National Research Council 1992). Ecological restoration is the process of returning an ecosystem as closely as possible to predisturbance conditions and functions (Federal Interagency Stream Restoration Working Group 1998). Implicit in this definition is that ecosystems are naturally dynamic; therefore, it is not possible to restore a system exactly. The restoration process reestablishes the general structure, function, and dynamic self-sustaining behavior of the ecosystem. Successful restoration of degraded streams requires an understanding of watershed history, including both natural events and land use practices, and the adjustment process active in channel evolution (Federal Interagency Stream Restoration Working Group 1998).

Restoration efforts may range from efforts to reduce upland erosion to treatments that reduce sediment delivery through the riparian zone. To achieve success, restoration design and implementation must treat the stream corridor, watershed, and landscape as a complex of working ecosystems that influence and are influenced by neighboring ecosystems.

Future restoration efforts will require capital improvements or the approval of a specific restoration project. While the District is dedicated toward these efforts, the Stream Maintenance Program does not identify or commit to specific restoration projects. The planning and implementation process for restoration projects will be ongoing.

Regardless of the extent of future restoration efforts, the District remains committed to maintaining flood capacity within its

system in the present and must have the ability to conduct stream maintenance within the existing system for the foreseeable future. For this reason, the Stream Maintenance Program and the ongoing implementation of maintenance projects is required regardless of future restoration guidelines. However, it is acknowledged that future stream maintenance requirements may be reduced (specifically sediment removal requirements) with the successful implementation of restoration efforts. These efforts will include working with local governments to ensure planned land uses and land use guidelines do not conflict with flood protection mandates.

C. PROTECTION OF LISTED SPECIES AND SPECIES OF CONCERN

Policy 5*: The District will implement measures to avoid and minimize impacts to native species, especially special-status and riparian-dependent species.*

Discussion of Policy 5

Removal of sediment and vegetation management in streams using mechanical equipment (e.g., excavators, drag lines, bulldozers, loaders) and installation of bank protection measures using mechanical equipment (e.g., excavators, dozers, concrete pump trucks) can result in a direct take of listed species, including habitat degradation and habitat loss. Species of concern are affected in a similar manner as listed species; however, "take" has a specific legal definition and applicability to listed species.

This policy is directed at avoiding and minimizing impacts to listed species and species of concern. Issues related to maintenance site dewatering are specifically addressed in "Maintenance Site Dewatering" below.

Project-specific resource protection measures, including alterations of stream maintenance project timing, project implementation practices, special design considerations, or other BMPs will be selected as appropriate for each site. These measures will be attached to the Work Order for individual stream maintenance projects through the environmental review protocol described in Chapter 3 of the Stream Maintenance Program.

If stream maintenance activities are within an area of known or likely listed species or special-status species occurrence, the District will avoid stream maintenance activities during breeding or nesting seasons, migration periods, or other sensitive seasons. Work may occur during these seasons (exclusive of fisheries), if preconstruction surveys conducted according to species protocols do not find sensitive resources or if an adequate buffer can be established between maintenance activities and the resources. All work in an area where sensitive species are present must comply with adopted HCPs. Absent such plans, work must be approved by all applicable regulatory agencies with species and permit oversight.

For stream maintenance activities that may affect the breeding or nesting period of migratory birds (generally February 1 to August 31), the District will conduct its work in a manner consistent with the protocols established by the most current version of the Nesting Migratory Bird Procedure (Appendix C).

In addition, the District is currently developing informational pamphlets entitled "Sensitive Plants, Wildlife, and Fish at your Worksite," which are designed to inform staff about sensitive species and environmental protocols and procedures.

D. FISHERIES PROTECTION AND ENHANCEMENT

Policy 6*: The District is committed to protecting fishery resources when technically feasible and economically reasonable when individual stream maintenance projects are implemented.*

Discussion of Policy 6

The streams of Santa Clara County harbor a number of migratory fish species. The regular anadromous fish species include steelhead (*Oncorhynchus mykiss*) and Pacific lamprey (*Lampetra tridentata*). Recent records of chinook salmon (*O.*

tshawtscha) also exist. Of these species, the steelhead are considered sensitive due to their known occurrence and recognition by regulatory agencies.

Steelhead occur in many of the streams of the South San Francisco Bay including, but not necessarily limited to, the Guadalupe River, Coyote Creek, Stevens Creek, and San Francisquito Creek. Steelhead also occur in the tributaries of the Pajaro River System, including Uvas/Carnadero Creek, Llagas Creek, and Pacheco Creek. Regular upstream migration occurs typically in winter through early-mid spring (from mid/late December through early April), although estaurine areas may have upstream migrants earlier. Although no recent data exists, there may be some holdover out-migration as observed in other systems which may occur in the fall with the earliest storms.

Other, more localized movements may occur among resident species of fish. These species may make short-range movements within a system. This typically occurs during spring, fall, and winter. Breeding for a broad component of resident fish typically occurs from late winter through spring (February to May).

Installation of cofferdams and water bypass structures to isolate the work can create barriers to sensitive anadromous fish species. Cofferdams and water bypass structures are often required to create a work environment outside of stream flow to ensure that excessive erosion and sedimentation does not affect water quality and habitat value.

In addition, installation of bank protection measures using mechanical equipment (e.g., excavators, dozers, concrete pump trucks) can result in the loss of undercut banks, which provide important habitat for fish, including sensitive anadromous species.

Policy 6 is directed at ensuring that these potential impacts to fisheries do not occur and that opportunities for fisheries enhancement are realized. The District will look for cost-effective opportunities to enhance fishery resources.

Potential impacts to steelhead will be avoided by timing stream maintenance projects in streams where there are or could be steelhead so that work is conducted outside of the migration and spawning season. Steelhead migration and spawning season is generally between December 15 to June 30.

If fisheries or native aquatic vertebrates are present, a fish and native aquatic vertebrate relocation plan will be implemented when cofferdams, water bypass structures, and silt barriers are installed to ensure that fish and native aquatic vertebrates are not stranded. The District's most current version of the fish relocation guidelines at the time of this publication are provided in Appendix D.

The District will allow undercut banks to remain in place for fish habitat, as long as they remain stable and do not endanger the public.

E. MAINTENANCE SITE DEWATERING

Policy 7*: The District will take measures to reduce increases in short-term stream turbidity that can result from stream maintenance activities.*

Discussion of Policy 7

Sediment removal and bank protection activities can require the installation of cofferdams and water bypass structures (such as berms) to isolate the work area from flowing water. If improperly managed, the installation and removal of water bypass structures, channels, and silt barriers can create or increase turbidity (water cloudiness) in the stream in the short term, which can negatively affect aquatic resources, including sensitive species. Once dewatering structures are installed and removed, the turbidity levels return to normal background levels.

Short-term increased turbidity can increase water temperature and decrease dissolved oxygen (DO). Water temperature is a

crucial factor in the stream environment because temperature governs many biochemical and physiological processes in cold-blooded aquatic organisms. In addition, increases in temperature can reduce DO. DO is a basic requirement for a healthy aquatic ecosystem as most fish and aquatic insects 'breath' oxygen dissolved in the water column. DO is essential not only to keep aquatic organisms alive but also to sustain their reproduction, vigor, and development. Potential species' impacts that could result from increases in turbidity include both direct take and habitat degradation.

This policy is directed at minimizing and avoiding increases in-stream turbidity attributable to stream maintenance projects. Increases in turbidity can result from actual maintenance activities directly, from the installation of cofferdams and water bypass structures to isolate the work area, and from the reintroduction of bypassed flows to dewatered areas.

To the extent feasible, stream maintenance activities will not occur in live stream flow. If flowing water is present at the proposed maintenance area, the District will isolate the work area through the best use of cofferdams, berms, or bypass systems. For example, cofferdams would not be the appropriate dewatering method at sites where the removal of sediment is small, such as at the inlet or outlet of culverts. In such an instance, the dewatering system would create more turbidity than the actual sediment removal.

In tidal areas, cofferdams and water bypass structures will be installed at low tide when possible. This measure may not be possible when the cofferdam or other structure is large and requires an extended installation period.

Bypassed water will be discharged in a nonerosive manner. Specific project implementation measures may include the use of geotextile fabrics as a splash apron, silt fences, straw bale barriers, sand bag barriers, brush or rock filters, sediment basins, or sediment traps. When bypassed flows are reintroduced to dewatered areas, they will be reintroduced in a nonerosive manner. For example, bypassed flows could be slowly reintroduced into the dewatered area by leaving a silt barrier in place to allow water to slow and drop sediment to the extent possible.

To prevent increases in temperature and decreases in DO, if bypass pipes are used, they shall be properly sized (i.e., larger diameter pipes to better pass the flows). Bypass pipes may also be avoided by creating a low-flow channel or using other methods to isolate work area.

If fisheries or native aquatic vertebrates are present, a fish and native aquatic vertebrate relocation plan will be implemented when cofferdams, water bypasss structures, and silt barriers are installed to ensure that fish and native aquatic vertebrates are not stranded.

F. MINIMIZATION OF EROSION

***Policy 8**: Vegetation control and removal will be minimized to the extent practicable. Where appropriate, measures will be taken to leave the work site in a vegetated condition after individual projects are implemented.*

Discussion of Policy 8

Vegetation control and removal on slopes of levees and maintenance roads, via herbicides or mowing, can exacerbate erosion and sediment accumulation. This policy is directed at minimizing vegetation removal and ensuring that appropriate revegetation and erosion protection measures are implemented.

Vegetation control and removal along levees and maintenance roads will be limited to removal necessary for facility inspection purposes, removal that is necessary to meet regulatory requirements, removal that is required to comply with fire codes, and removal that is required to meet capacity requirements.

If maintenance work leaves slopes in a bare soil condition, the District will plant slopes with native vegetation through hydroseeding or other vegetation methods as identified as appropriate in the Maintenance Guidelines.

G. PRESERVATION AND REPLACEMENT OF RIPARIAN AND SHADED RIVERINE HABITAT

***Policy 9**: The District will avoid and minimize impacts to the quality and extent of riparian and Shaded Riverine Aquatic (SRA) habitat.*

Discussion of Policy 9

Mechanical removal of vegetation and sediment within stream corridors and along levees and depressed access roads can result in the removal of riparian and SRA habitat and the stripping of vegetation from channel banks. SRA habitat is the aquatic area occurring along the edge of a channel or stream where the adjacent bank is composed of natural materials and supports riparian vegetation that overhangs or protrudes into the water. SRA habitat provides important habitat for fish, including sensitive anadromous species. Removal of SRA habitat can cause the increase in a stream's temperature and an associated decrease in DO. The installation of bank protection measures using excavators, dozers, and other equipment can also result in the removal of riparian habitat.

This policy is aimed at preserving and replacing riparian and SRA habitat when implementing routine stream maintenance activities.

Project-specific measures will be identified through the resource protection protocol detailed in Chapter 3 to avoid and minimize impacts of individual stream maintenance projects on the value and extent of riparian and SRA habitat.

The District will utilize biotechnical bank protection methods where appropriate that allow restoration of riparian streambank vegetation and SRA habitat. Projects where bank protection is to be performed will be evaluated for the most appropriate repair method possible given the characteristics of the site. Bank protection methods used by the District are provided in Appendix F.

Areas that must be temporarily cleared for access to routine stream maintenance project sites will be seeded as appropriate for the site. Woody material will be retained unless it is threatening a structure, results in flood capacity deficiencies, or impedes reasonable access. When retention will not compromise flood management system reliability, woody vegetation will be left in the channel to maintain SRA habitat. When woody material is removed, priority will be given to reuse of the materials in bank protection projects. Woody materials may also be used as mulch.

H. WETLANDS PROTECTION

***Policy 10**: When wetlands must be removed or have the potential to be negatively affected in order to restore flood capacity, work will be limited to that defined by the Maintenance Guidelines.*

Discussion of Policy 10

Mechanical removal of sediment and vegetation from streams using in-stream equipment (e.g., excavators, drag lines, bulldozers, loaders) can result in a loss of tidal and nontidal wetland habitat. In addition, vegetation control activities can negatively affect these wetland habitats. This policy is provided to minimize impacts to wetland habitats related to routine maintenance activities.

No wetlands will be affected over and above what is required to restore the design capacity of the stream or the proper function of structures and facilities within the stream corridor. The District will try to avoid or minimize impacts to the quality and extent of wetland habitat in all stream maintenance activities.

Project-specific measures will be identified and implemented for each individual stream maintenance project that requires

removal of wetland vegetation (and other direct or indirect impacts) to minimize the extent and negative effects of the maintenance activities.

The District will use biotechnical bank protection methods where appropriate and consistent with the Maintenance Guidelines. These methods do not preclude the establishment of wetland vegetation where site-specific conditions can support a wetland. Bank protection methods used by the District are described in the Maintenance Guidelines provided in Appendix F.

I. USE AND MANAGEMENT OF HERBICIDES

Policy 11*: The District's use of herbicides will be consistent with environmental goals, including protection, preservation, and restoration. Herbicides will be used such that negative effects to the environment are avoided or minimized.*

Discussion of Policy 11

Chemical control of vegetation in streams and along levees and depressed access roads could result in impacts to wildlife and degradation of habitat. This policy will ensure that herbicides are properly used and that negative effects to the environment are avoided or minimized.

The District's mission to provide flood protection requires that a certain amount of vegetation within the channel be controlled to maintain flood conveyance capacity. Mismanagement or inappropriate use of herbicides can have negative environmental impacts and will be avoided. Targeted use of herbicides can contribute to environmental quality and long-term ecosystem stability. This is particularly true in the case of control of exotic species and the use of herbicide for required vegetation control in place of more disruptive mechanical control methods.

All herbicide use will be consistent with approved product specifications. Applications will be made by state-certified applicators under the direction of a licensed PCA. Only herbicides and surfactants registered for aquatic use will be applied within the banks of channels when water is present.

Nonselective herbicides will not be used on levee slopes unless necessary for nonnative vegetation control; vegetation management on levees will otherwise be limited to selective broadleaf herbicides, hand removal, and mowing. Nonselective herbicides will be used on levee access roads in upland areas only.

J. HAZARDOUS MATERIAL MANAGEMENT AND CONTROL

Policy 12*: The District will implement measures to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means when removing sediments from the streams.*

Discussion of Policy 12

Mechanical removal of sediment from streams using in-stream equipment (e.g., excavators, drag lines, bulldozers, or loaders) can result in the in-channel release of hazardous materials if sediments are contaminated. In addition, the stockpiling or other storage of contaminated sediments can also result in the release of hazardous materials. Bank protection and vegetation control activities can also result in the accidental release of hazardous materials if not properly managed. This policy is designed to provide protection of the systems' water resources when handling hazardous materials.

All handling and disposal of sediments shall be performed in accordance with the WDR issued by the RWQCB. The sediment shall ultimately be disposed at a permitted landfill. Any alternative use or disposal will require RWQCB approval.

The discharge of any hazardous or nonhazardous waste as defined in Division 2, Subdivision 1, Chapter 2, of the California Code of Regulations shall be conducted in accordance with applicable state and federal regulations.

District field personnel will be appropriately trained in spill prevention, hazardous material control, and cleanup of accidental spills. Spill prevention kits shall always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations). All field personnel will be advised of these locations and trained in their appropriate use.

The District's sediment testing program allows the District to (1) effectively plan for disposal of the sediments, (2) assist with determining the BMPs for implementation, and (3) efficiently monitor the water quality impacts from the sediment removal operation. It is anticipated that the large amount of data generated under the sediment testing program (1997 to 1999) will provide valuable information regarding the general nature of sediments in Santa Clara County and will reduce the quantity of sampling and analysis which is required for future sediment removal projects.

K. ADDITIONAL WORK SITE MANAGEMENT PRACTICES

Policy 13*: The temporary stockpiling, transportation, and disposal of removed sediments from stream maintenance projects shall be implemented as sensitively as possible, avoiding or minimizing impacts to the surrounding natural environment.*

Policy 14*: Stream maintenance projects shall be implemented as sensitively as possible, avoiding or minimizing the potential for short-term noise nuisances and short-term air quality impacts to the surrounding community.*

Policy 15*: Measures shall be implemented at the work site to ensure that the potential for significant impacts to previously undiscovered cultural resources are reduced to less-than-significant levels.*

Discussion of Policy 13

Transporting and disposal of removed sediments, including temporary stockpiling and reuse and disposal of materials, can result in a number of potentially negative environmental effects related to waste generation and disposal (e.g., consistency with Assembly Bill 939, which generally required local jurisdictions to reduce the amount of waste deposited to landfills), the spread of mitten crabs, sediment and dust generation and accumulation, and noise generation related to mechanical equipment. Bank protection and vegetation control also have these potential negative environmental effects, but generally at lower impact levels.

In addition, work sites must be managed to reduce the potential for negative short-term effects with regards to air quality and noise. There is also the potential to discover cultural resources while working within the streams.

These practices are provided to avoid and reduce these potential negative effects that can occur at the work site during the implementation of stream maintenance projects.

Where practical, the District will reuse removed sediments and gravels. When sediments or gravels are reused, the District will ensure that the reuse does not cause any additional erosion, siltation, or other negative environmental consequences. In supplementing spawning gravels, imported gravels must be of the appropriate size to be beneficial. Reuse will be considered within the context of environmental, regulatory, and fiscal consequences.

To prevent the undesirable spread of mitten crabs, sediment removed from channels within the Santa Clara Basin, including that removed for reuse, will not be transported outside the Santa Clara Basin. Generally, this is the area south of Cochrane Road near the City of Morgan Hill.

Discussion of Policy 14

Implementation Measure 16a: In order to limit the generation of fine particulate matter at maintenance sites, measures shall be implemented consistent with Bay Area Air Quality Management District (BAAQMD) regulations. The District will implement BAAQMD Basic Control Measures at maintenance sites less than 4 acres in size. Current measures stipulated by the BAAQMD

CEQA Guidelines include the following:

- Active maintenance areas shall be watered at least twice per day.
- Trucks hauling sediments and other loose material shall implement appropriate sections of the California Vehicle Code regarding covering, sealing, and brushing.
- Unpaved access roads and staging areas that are being used for the maintenance activity shall be watered three times daily, or nontoxic soil stabilizers shall be applied to control dust generation.
- Paved maintenance site access roads shall be swept when visible soil material is carried onto the roadway.

For maintenance sites greater than 4 acres, the following additional BAAQMD Enhanced Control Measures will apply:

- Exposed stockpiles shall be enclosed, covered, watered twice daily, or created with nontoxic soil binders.
- Erosion control measures shall be implemented to prevent silt runoff to public roadways.

The District shall comply with local noise regulations that apply in the community where individual stream maintenance projects are implemented. In most cases, work will be limited to weekdays between 7:30 a.m. and 5 p.m. When working in communities with more stringent noise ordinances (e.g., the City of Campbell), the District will comply with the local regulations.

Discussion of Policy 15

Implementation Measure 17a: If any archaeological or historic materials or objects are unearthed during the implementation of stream maintenance projects, all work in the immediate area must cease until a qualified archaeologist has evaluated the finds. The District shall comply with all mitigation recommendations of the archaeologist prior to commencing work in the vicinity of the find.

In the event that human remains are encountered, there shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains. The Santa Clara County Coroner would be contacted and appropriate measures implemented. These actions would be consistent with the State Health and Safety Code Section 7050.5, which prohibits disinterring, disturbing, or removing human remains from any location other than a dedicated cemetery.

Chapter 5
COMPENSATORY MITIGATION

This chapter describes the compensatory mitigation actions the District will undertake to compensate for residual impacts to stream vegetation. Definitive identification of the significance of impacts occurs in the EIR.

Implementation of the program would cause temporary but repetitive impacts to 116 acres of freshwater wetlands, 30 acres of tidal wetlands, and 78 acres of in-stream riparian vegetation due to sediment removal and vegetation management in stream channels.

A one-time accounting method for potentially significant impacts was developed for the program because impacts to stream vegetation from routine sediment removal and vegetation management are temporary but repetitive. The approach of this impact analysis is to count future impacts to any one section of creek one time only. Repetitive or overlapping stream maintenance activities in the same section of creek are not progressively added to the total impact acres.

Significant residual adverse environmental effects are those that remain after implementation of the policies described in Chapter 4. Potentially significant impacts have been identified for the following biological resources: tidal wetlands, freshwater wetlands (also called nontidal wetlands), riparian vegetation, and sensitive species.

The following discussion describes the watershed-wide mitigation program that the District has developed. This program seeks to balance opportunity, feasibility, and cost to provide the greatest possible benefit to the natural values of Santa Clara County streams commensurate with District Ends Policies.

The District proposes a mitigation package for the Stream Maintenance Program to compensate for the significant residual impacts that cannot be avoided. Proposed mitigation for potential adverse effects associated with the Stream Maintenance Program has four components: (1) the policies and BMPs designed to avoid or minimize impacts as discussed in Chapter 4, (2) compensatory mitigation for impacts to stream vegetation from sediment removal and vegetation management, (3) compensatory mitigation and a mitigation exchange concept for impacts from bank protection, and (4) mitigation for potential impact to sensitive species.

A. COMPENSATORY MITIGATION--SEDIMENT REMOVAL AND VEGETATION MANAGEMENT

For impacts to stream vegetation from the sediment removal and vegetation management activities, the mitigation package provides the following components: (1) tidal wetland restoration; (2) freshwater wetland creation; (3) stream and watershed protection; and (4) control of giant reed. The four components of the stream vegetation mitigation package are summarized in Table 5-1, and proposed sites are shown in Figure 5-1.

In working to develop the proposed mitigation program to compensate for residual impacts of the Stream Maintenance Program, the District has the following goal:

"The Stream Maintenance Program compensatory mitigation program should establish an optimal set of mitigation strategies--a combination of components that best balance opportunity, feasibility, and cost--to provide the maximum benefit to the natural functions of the watersheds and streams of Santa Clara County."

In investigating and reviewing mitigation options to meet this goal, a number of guiding principles were established (Table 5-2). The guiding principles are intended to help select appropriate mitigation. In general, proposed mitigation options that meet a greater number of guiding principles or multiple functions will have greater value. Some guiding principles conflict with each other because they represent either different values or different strategies. Balancing of the guiding principles is therefore necessary. This mitigation package and the guiding principles were developed with input from external stakeholders and as a result of meetings with regulatory agencies. Table 5-3 lists preliminary agreements made between the District and the participating agencies, with many of the agreements assisting in the development of a mitigation package for stream vegetation.

The mitigation package for stream vegetation compensates for the same or similar functions as those impacted and provides mitigation within the watershed basin in which stream impacts occur.

Additional information about each component in the stream vegetation mitigation package is presented below. Final designs for each mitigation component will be developed and submitted to the regulatory agencies for their review and approval. Detailed design is underway for several of these components, and some have received preliminary review by the regulatory agencies. Maintenance work is spread out over many years, and likewise, mitigation design and implementation will be spread out over a period of approximately 10 years.

1. Tidal Wetland Restoration

The tidal wetland restoration component is proposed to compensate for impacts to 30 acres of tidal wetlands in the Santa Clara Basin (29 acres of impacts from sediment removal and 1 acre of impact from channel vegetation management).

The District plans to create self-sustaining tidal wetlands by restoring a diked salt evaporation pond, former Cargill Pond A-4, to historical tidal marsh conditions. The restoration site is expected to support tidal wetland similar to or of higher quality than the tidal wetland impacted by repetitive maintenance activities.

The pond is located in the Cities of San Jose and Sunnyvale along South San Francisco Bay in the Santa Clara Basin. It is bordered by Sunnyvale West Channel to the west, Guadalupe Slough to the northeast, and Sunnyvale East Channel along the southeastern corner. The pond is under ownership of the District, and is currently leased to Cargill Salt Division to continue their salt production operations until 2002.

The salt evaporation pond was originally created in the early 1900s when earthen levees were constructed to isolate the site from tidal and freshwater exchange. The pond has been used for salt production since that time and for duck hunting.

Currently, Pond A-4 is a low salinity pond (0 to 60 parts per thousand) with shallow and stable water levels. The perimeter of the pond is bordered by narrow bands of mudflat and pickleweed. The levees surrounding the pond support broad, relatively large areas of upland ruderal vegetation. The sloughs adjacent to the pond levees are densely vegetated with California and alkali bulrush.

Weekly surveys by District biologists between March 1999 and February 2000 recorded 82 species of birds utilizing the open water and levees of Pond A-4 for roosting, foraging, and nesting. The majority of observed birds were waterfowl (70 percent) with the highest use recorded in November and early March. Shorebirds accounted for less than 8 percent of the birds observed. Resident bird species included Black-necked Stilts (*Himantopus mexicanus*), American Avocets (*Recurvirostra americana*), Northern Shovelers (*Anas clypeata*), Ruddy Ducks (*Oxyura jamaicensis*), California Gulls (*Larus californicus*), and Caspian Terns (*Sterna caspia*). Two species of mammals were observed, California Ground Squirrel (*Spermophilus beecheyi*) and Black-tailed Jackrabbit (*Lepus californicus*).

The pond was sampled in August 2001 to determine what fish species were present. Two species were recovered during the 3-day sample period: Yellowfin Gobie (*Acanthogobius flarimanus*) and Longjaw Mudsucker (*Gillichthys mirabilis*). Associated invertebrates likely to occur in the pond include Brine Shrimp (*Artemia franciscana*) and various copepods, annelids, and others.

The restoration concept consists of lowering the outboard levees or breaching them in several strategic locations to provide full tidal action to the site. It is anticipated that a mosaic of mud flat, tidal wetland, and upland habitats will be created. A combination of natural sedimentation processes and placement of dredge fill is proposed to accelerate restoration of wetland function to the site and create beneficial reuse of clean sediment excavated from tidal streams. Modification of Sunnyvale East Channel may be included in the design to improve its hydraulic performance and eliminate the need for future sediment removal and vegetation management for flood protection purposes.

Planning and design of the Pond A-4 tidal restoration are currently underway, and construction is expected to begin in 2006. The first phase of restoration will consist of 40 or more acres. A mitigation banking instrument and funding strategy will be developed, as well as a monitoring program.

The design process will address several potential issues. Few large-scale tidal marsh restoration projects have been undertaken, and essentially no long-term studies exist to guide design and implementation of new sites. The Pond A-4 project will need to be coordinated with other large-scale tidal marsh restoration projects proposed for South San Francisco Bay. Because of ground subsidence, reuse of clean fill material may be necessary to supplement natural sedimentation in order for wetland features to develop in the short term. Control of perennial peppergrass, an invasive species that has infested

brackish and freshwater marshes in the South San Francisco Bay, may be problematic.

A Hazardous Substances Assessment indicates the presence of low concentrations of arsenic in the levee, and arsenic and copper in the soils on the pond perimeter. The concentrations of these metals preclude the use of some soils for wetland cover material but not as noncover material according to the Sediment Screening Criteria for Wetland Creation and Upland Beneficial Reuse developed by the San Francisco Bay RWQCB (Resolution 92-145).

2. Freshwater Wetland Creation

The Freshwater Wetland Creation component and the Stream and Watershed Protection component (described in next section) are proposed to compensate for impacts to 116 acres of freshwater wetlands (109 acres of impacts from work in freshwater stream channels and 7 acres of impacts from work in canals). The Freshwater Wetland Creation component is proposed for compensation of 14 acres of freshwater wetland impacts in stream channels.

The District would create 14 acres of freshwater wetlands (also known as nontidal wetlands) at locations near streams in the Santa Clara (10 acres) and Pajaro River (4 acres) Basins. Although the freshwater wetland creation sites will not be in-stream as the impacted freshwater wetlands, they have an advantage of not being subject to routine disturbance from flood protection maintenance as the impacted sites are. These created wetlands will provide habitat for common local wildlife and wetland-related plants in a streamside setting. Because of their off-stream location, they will rely on water supplied from off-site sources, and will require management of water levels.

The three freshwater wetland creation sites currently identified are:

- Los Capitancillos Site--(3 acres) along Guadalupe Creek in the Santa Clara Basin
- Coyote Lakes Park Site 10A--(7 acres) along Coyote Creek in the Santa Clara Basin
- Church Pond No. 2--(4 acres) along Llagas Creek in the Pajaro River Basin

The District's Board of Directors has expressed the desire to mitigate for wetland impacts by creating new wetlands. At this time, the mitigation proposal includes three sites where there are certainties that new wetlands can be created. The District will continue searching for additional sites for freshwater wetland creation. An extensive search initially conducted in 1997 will be reviewed. If additional freshwater wetland sites are located, then the Stream and Watershed Protection component of the mitigation package would be reduced. The sites currently identified for freshwater wetland creation are described further below.

a. Los Capitancillos Site

The Los Capitancillos freshwater wetland creation site will consist of approximately 3 acres of off-stream freshwater seasonal or perennial wetlands adjacent to Guadalupe Creek in the Santa Clara Basin. The site, located near Coleman Road and Redmond Avenue in the City of San Jose, is currently an upland field of annual grasses and is owned by the District. The Los Capitancillos site is currently under design, and is expected to be installed in the year 2002.

To create suitable conditions for development of a wetland, the site will be excavated. Water will be provided from the Almaden Valley pipeline and water control structures will be constructed to allow for adjustments of water depth and duration of inundation. Native hydrophytic species will be planted.

This site will be developed in coordination with an adjacent project, the restoration of a meander configuration, and shaded riparian aquatic habitat on Guadalupe Creek for fisheries values. The Guadalupe Creek project is not part of the Stream Maintenance Program.

Preliminary investigations indicate that mercury levels are elevated in surface and shallow-depth soils on the Los Capitancillos

site. The elevated levels are well below hazardous materials levels, but exceed wetland creation cover material levels recommended by the RWQCB. This situation is being investigated further; however, the likely solution is that soils not suitable for wetland surfaces will be removed from the site and replaced with clean soils.

b. Coyote Lakes Park Site 10A

Coyote Lakes Park Site 10A is located in the City of San Jose in the Santa Clara Basin. The land is owned by Santa Clara County and under the management of County Parks and Recreation Department (County Parks). The District has discussed potential use of this site for mitigation of the District's Stream Maintenance Program with staff of County Parks. County Parks staff has preliminarily indicated that development of the site would be consistent with their park and recreation goals, and they are considering the site for this use.

The Coyote Lakes Park site is situated on the northeast bank of Coyote Creek, just upstream of the interchange of Highways 101 and 85. The site is bounded to the northeast by Highway 101, an abandoned gravel pond to the west, and Coyote Creek, a District percolation pond and the Coyote Parkway Lakes concession to the south.

The site currently consists of nonnative annual grassland habitat. The adjacent gravel pond, percolation pond, and Coyote Creek contain open water, emergent wetland, and mixed riparian forest. Soils on the potential site appear to be heavily disturbed by former highway and levee construction activities, but may have low permeability suited for wetland creation (H.T. Harvey & Associates, et al. 2001).

Site 10A could be developed as approximately 7 acres of near perennial freshwater wetland. The site could support a matrix of full emergent, short emergent, riparian, and open water habitats. The wetland vegetation would be dominated by tall emergent marsh species such as California bulrush, tule (*Scirpus sp.*), and narrow-leaved and broad-leaved cattail (*Typha augustifolia, T. latifolia*). The design could also provide shallow, ponded areas dominated by short emergent obligate wetland species such as creeping spikerush (*Eleocharis macrostachya*) and rushes. Riparian species on the fringe could be arroyo, red and narrow-leaved willows, western sycamore, and possibly coast live and valley oak.

Minimal grading would be required to create the wetland bank on this fairly level site. Water would be delivered to the site from the adjacent percolation pond. Water is supplied to the percolation pond from releases made from Anderson Reservoir and delivered via the Coyote Creek Channel. Preliminary estimates indicate that sufficient water exists in this system to supply the proposed wetland. Inlet and outlet control structures would regulate the inflow and control the water level on the site. Outflow from the site could be either to the gravel pond or Coyote Creek; however, outflows may not occur on a regular basis.

Other alternative design approaches may be evaluated during the project design phase. For example, the adjacent abandoned 16-acre gravel pond, located between Site 10A and Coyote Creek, could potentially be incorporated into the site design. Currently, there are two breaches in the perimeter of the berm separating the gravel pond and Coyote Creek. As stream flow partially diverts into the gravel pond it may result in higher water temperatures and stranding of fish. If the gravel pond was incorporated into the wetland creation project, it might be possible to eliminate these connections. The gravel pond might remain open water or be partially converted to wetland.

Additional technical investigations, including studies of soils, hydrology, and cultural resources will need to be conducted to determine the detailed design. Although no archeological resources are known to occur at the site, Native American burials were found during deep excavation of a nearby site on Coyote Creek.

c. Church Pond No. 2

The Church pond freshwater wetland creation site will consist of converting open water at the Church Avenue groundwater recharge ponds into approximately 4 acres of freshwater wetland. Currently, three ponds provide approximately 42 acres of surface area dedicated to groundwater recharge at the intersection of Llagas and Church Avenues in the community of San

Martin in the Pajaro River Basin. The property is under the ownership of the District.

The preliminary concept calls for a 4-acre earthen bench to be installed in one pond (No. 2) in a location known to be underlain by relatively impermeable soils. Shallow groundwater investigations of the Church Avenue ponds indicate the low-permeability substrates in Pond No. 2 are likely to have relatively low infiltration rates and not contribute substantially to overall recharge performance. Therefore, converting the primary purpose and management of this pond from groundwater recharge to wetland mitigation is not expected to result in substantial loss of groundwater recharge capability. The remainder of the pond's 15-acre surface area will remain open water used for percolation. Currently, the pond is often left dry.

The project will take advantage of the existing infrastructure, pond configuration, and water management to operate the Church pond system for dual percolation and wetland mitigation purposes. For purposes of creating the wetland area, water will be supplied to the ponds from Llagas Creek and is not expected to require a substantial alteration of recent District reservoir water releases or operations. Under current operation, stored water from upstream reservoirs flows downstream as far as Church ponds during the dry season. The preliminary concept calls for water to be routed to the pond system via an existing intake pipe between Pond No. 1 and Llagas Creek. It will be necessary to construct a flashboard dam in the creek in order to divert the water. The flashboard dam will be installed and the diversion operated during the summer dry season. The flashboard dam will be designed and operated so as to not obstruct fish passage and not cause bank erosion. A fish ladder over the flashboard will be provided if necessary to allow fish passage, and the intake pipe will be screened to prevent diversion of fish into the ponds. Alternative water delivery methods, such as an infiltration gallery, will be explored during the planning phase. The design will create water levels on the bench of an adequate depth for wetland vegetation and will reliably control surface water elevation.

Construction of the Church pond wetland creation project is expected to begin in 2003.

B. STREAM AND WATERSHED PROTECTION

The Stream and Watershed Protection component and the Freshwater Wetland Creation component (described above) are proposed to compensate for impacts to 116 acres of freshwater wetlands (109 acres of impacts from work in stream channels and 7 acres of impacts from work in canals). If the three freshwater wetland creation sites are implemented as described above, then actions under the Stream and Watershed Protection component would compensate for impacts to 74 acres of impacts in the Santa Clara Basin and 21 acres of impacts in the Pajaro River Basin. The Stream and Watershed Protection component would compensate in either basin for an additional 7 acres of impacts to canals.

The District will continue searching for additional sites for freshwater wetland creation. If additional suitable freshwater wetland projects are identified, then the Stream and Watershed Protection component of the mitigation package would be reduced by approximately 10 acres for every additional 1 acre of freshwater wetland creation.

Under this component, the District would purchase approximately 920 to 1,210 acres of land and conservation easements to preserve, protect, and improve streams and their associated watersheds in the county.

The mitigation component will focus on preservation and improvement of streams that are generally in a fairly undisturbed state and in good ecological condition.

This effort consists primarily of land acquisition, but also provides for some restoration and/or management of acquired lands. Acquisition will provide 92 acres of mitigation credits; and restoration and management on selected parcels will provide 10 acres of credit. The relative contribution of these subcomponents could be adjusted based on opportunity and resource needs identified as the mitigation component progresses.

Stream and watershed protection provides a logical link to stream maintenance impacts:

- Impacts occur to habitat within streams. Stream and watershed protection provides for preservation, restoration, and

management of streams and their related habitats.

- Stream and watershed protection represents a "trade up" in stream habitat type. The type of stream habitat protected is different than that impacted, but consists of more structurally and functionally complex native riparian and riverine habitat. In-stream freshwater wetlands of the extent and type impacted occur primarily in modified earthen and concrete channels in which stream structure and function has been impaired.
- Temporary impacts to existing local stream reaches are mitigated by permanently protecting other local stream reaches. The impacts consist of repeated but temporary disturbance to existing in-stream wetland. There is no reduction in the overall amount of stream habitat present, and the wetland vegetation regrows between disturbances. The mitigation program protects other existing stream habitat from effects of human disturbance, and, where needed, will improve the stream's environmental condition.

The acquisition element will be mostly accomplished by donating funds to park and open space agencies, land trusts, and other land conservation organizations that will ultimately own title or easements and manage the property. The District's contribution will typically provide partial funding of a larger acquisition; however, in some cases the District may choose to purchase and retain sole ownership or easement. Examples of suitable land include ranch land, farm land, and other undeveloped or sparsely developed land.

Potential partners include land management agencies and private land conservation organizations that are active in the county. Examples of potential partners include, but are not limited to, County Parks, Santa Clara County Open Space Authority, Mid-Peninsula Regional Open Space District, California State Parks, Land Trust for Santa Clara County, The Nature Conservancy, and Peninsula Open Space Trust.

The District will evaluate each proposed acquisition under a standard set of criteria established to ensure that the mitigation goals are met and mitigation credit is obtained. To qualify for consideration under this Stream Maintenance Program, the land must meet a standard set of core criteria (e.g., the land must include a stream, must be located in a watershed related to District streams, would not otherwise be purchased by the District, and is available from a willing seller). Additional criteria will be used to determine the relative priority for acquisition of available parcels.

Consideration will be given to site-specific features (e.g., type and condition of stream resources, presence of endangered species or their habitat), transaction-related features (e.g., level of protection gained, time frame for purchase completion, relative cost), and regional considerations (e.g., links with adjacent protected lands, achieves multiple agency and community benefits, supports Maintenance Program mitigation goal of maximizing benefit to local streams and watersheds by focusing on areas that provide the highest natural resource values).

Each acquired property will be further evaluated to determine if the stream resources would benefit from restoration or management actions. Examples of the many types of restoration or management actions that could be undertaken to improve stream health include: removal of nonnative riparian plant species and revegetation with native species, repair and rehabilitation of denuded or otherwise degraded stream segments, replacement of in-stream road crossings with more environmentally-sensitive crossings, installation of erosion control measures on roads adjacent to streams (dirt or paved roads run parallel to most sizeable streams in the county), and installation of fencing to limit cattle access to the riparian area.

An annual report will be prepared and submitted to the relevant agencies until all required mitigation credit is obtained. The report will include a description of each parcel acquired in the past year, detailing the location, size, stream, and watershed amount present, summary of the core criteria and priority evaluation criteria analyses, mitigation credit earned, the entity that will own the fee title or conservation easement, planned land use (e.g., public park or open space, private ranch land, farm land), and planned restoration or management projects. The report will summarize all Stream and Watershed Protection Program actions and credits obtained to date.

Individual monitoring reports will be prepared for restoration and management projects appropriate for the particular action

taken (e.g., a revegetation project would require a standard Mitigation and Monitoring Plan [MMP] including the project description, performance and success criteria measures, schedule, etc.). Once land has been acquired, the District will conduct periodic surveys to ensure that land use and management is consistent with the terms and agreements of the District contribution. Ongoing periodic summary status reports will be prepared.

Credit for acquisition will be given at a 10:1 or 15:1 ratio (acquisition acreage : impact acreage) for acquisition of lands that both contain and are directly adjacent to stream resources as described below. The crediting method ensures that a substantial amount of stream and associated riparian corridor will be acquired, that immediately adjacent uplands which directly affect stream condition will also be acquired, and that the District's financial contribution will be large enough to enable purchase of appropriate parcels.

- 10:1 ratio--Up to 50 feet from the centerline of first order streams and 150 feet from the centerline of second order and greater streams, and
- 15:1 ratio--For an additional area from 150 up to 500 feet from the centerline of second order and greater streams.

Credit for restoration and management will be generated on a dollar value basis as follows: 1 acre of mitigation credit obtained for each $150,000 of projects funded. The $150,000 figure is based on the approximate per acre cost of District riparian mitigation projects recently implemented in the lower watershed. Many of the restoration or management actions that can provide substantial improvement of the stream environment cannot be quantified in the same way as traditional acre-for-acre riparian revegetation mitigation projects. This lump sum crediting approach provides the flexibility needed to implement a variety of beneficial actions, as dictated by the needs and condition of each property.

The projected total Stream Maintenance Program cost is based on an average estimated land value of $15,000 per acre. Most land is expected to cost less than this amount. Land cost under this Stream Maintenance Program is not-to-exceed $25,000 per acre.

C. CONTROL OF GIANT REED

The Giant Reed Control component is proposed to compensate for impacts from vegetation management in streams to 78 acres of riparian vegetation (32 impacts in the Santa Clara Basin and 46 acres in the Pajaro River Basin). Overall, this component includes removing giant reed (*Arundo donax)* from 125 acres along with several other associated efforts as described above. Of the total acres from which giant reed is removed, 80 acres would be credited towards the 78 acres of impacts to riparian vegetation. An additional 45 acres of giant reed control is proposed to compensate for any lag time between maintenance impacts to stream vegetation and implementation of the other three mitigation components.

Giant reed is an invasive nonnative plant. Large stands of giant reed degrade wildlife habitat, cause localized flooding, and increase the risk of wildland fires. Since giant reed displaces open water and native riparian and wetland plant communities of freshwater streams, its control is appropriate compensation for impacts to sapling riparian vegetation caused by channel vegetation management.

In Santa Clara County, substantial infestations of giant reed are known in Coyote, Calabazas, Llagas, and Uvas Creeks, and along the Guadalupe River. Currently, the District removes stands of giant reed on an occasional basis where they may cause a flooding problem and from revegetation sites. However, neither the District nor any other entity has taken a coordinated effort to remove giant reed from the county's streams.

Under this mitigation component, the District would remove giant reed from 125 acres in the county over a period of 10 years.

This component includes the following associated elements that are necessary to ensure successful control of giant reed on a long-term basis.

- Mapping--Outbreaks of giant reed throughout the county will be mapped. The goal of mapping is to assist in assessing the extent of the problem, prioritizing control efforts, and tracking and reporting annual progress. The District has already started collecting existing information and conducting field surveys. Additional surveys will be conducted in areas for which information is not currently available. Where conditions are favorable, remote sensing and aerial photography will be used. A protocol will be developed for locating and quantifying the size of existing stands to ensure consistent data collection. Most data will be collected using Global Positioning System technology. All data collected in the mapping effort will be incorporated into a GIS for generating maps and data analysis. The GIS information will be made available to non-District persons who are participating in control of giant reed or otherwise conducting research.

- Prioritization and Pilot Site--Subsequent to completion of the initial mapping effort in the first year, areas will be identified by a priority system for control. Priority will be given to those locations where sustained control efforts will provide the most habitat value, access can be gained to giant reed outbreaks at the top of the watershed and for continuous reaches, and multiple benefits can be gained in combination with the other mitigation components.

A pilot control site or sites will be selected in the first few years to experiment with different control methods such as timing of control, alternative herbicides, or rates. This information will be used to guide the remainder of the control Stream Maintenance Program and will be made available to people involved in giant reed control.

- Control--A total of 125 acres of giant reed will be controlled over a 10-year period. We assume there are more than 125 acres of giant reed in the county, but the total amount is not currently known. The Stream Maintenance Program is designed to control 10 to 15 new acres each year within the 10-year period.

Control will consist of removing giant reed plants mechanically or by hand, and treating the remaining stumps and rhizomes with herbicide. Subsequent regrowth will be spot retreated with herbicide until entire stands are eradicated. The most likely herbicide to be used is glyphosate; however, substitute herbicides may be used during the 10-year period, if they are identified as being effective and approved for this type of use. This Stream Maintenance Program assumes some level of retreatment will be required at each site for several years.

- Revegetation--In areas with significant remaining native riparian vegetation, natural recolonization of the treated site is expected after persistent eradication of giant reed stands. However, revegetation with native riparian species will be implemented in areas where natural revegetation does not occur or is unlikely to occur, and where there is sufficient channel capacity. A protocol will be developed to guide where and how initial or subsequent revegetation is undertaken.

- Educational Outreach--The District will develop educational materials and an outreach Stream Maintenance Program to inform the community about the problem of giant reed. The educational outreach will include all or some of the following: printed literature distributed to public agencies, environmental groups, gardening clubs, nurseries, and the general public; workshops; and public forums. District staff will provide technical guidance on giant reed removal to interested county landowners on their property. All mapping, research information from pilot control sites, and annual reports will be available to the public to assist in additional efforts to control giant reed.

- Regional Coordination--Control of giant reed throughout the county's creek system requires a strategic, watershed-wide approach. The District's primary effort will be for District personnel to remove giant reed on 125 acres of District land and non-District land where voluntary fee title or easement can be obtained for the control effort. The District will participate with other agencies and landowners in the county to develop additional giant reed control programs beyond the 125 acres and has already approached the county about the coordinated efforts on their lands. The District will investigate regional forums, coordination of permitting, joint participation in grants, training of staff, and cost sharing.

- Monitoring--Treatment sites will be surveyed annually to determine additional need for control of giant reed and the rate of natural recolonization or success of revegetation efforts. This information will be used to guide the subsequent year's efforts and will be included in the annual monitoring report to the agencies.

D. COMPENSATORY MITIGATION--BANK PROTECTION

The bank protection program, as described in detail in Appendix E, includes an evaluation of the biological conditions of the proposed work site (in-stream and streamside functions) and the potential biotic effect of the bank protection design. Some designs, depending on the site conditions, will have a neutral or beneficial effect on stream resources. Others may have an adverse impact on stream resources, and the mitigation for these are proposed either at other bank protection sites which will have a beneficial effect, or at another off-site location. Appendix E includes a protocol for revegetation of streambanks as mitigation for the bank protection program.

E. MITIGATION FOR SPECIAL STATUS SPECIES

The District has evaluated the potential for the program to affect 64 special-status species. BMPs would reduce impacts to the large majority of special-status species to less-than-significant levels. Significant residual impacts could occur to California Red-legged Frog (*Rana auroura draytonii*), Western Pond Turtle (*Clemmys marmorata*), California Black Rail (*Rallus jamaicensis coturniculus*), and California Clapper Rail (*Rallus longirostris obsoletus*). More detailed analysis regarding all the special-status species reviewed and potential impacts will be provided in the draft EIR and during upcoming consultations with the USFWS and the U.S. National Marine Fisheries Service (NMFS). Appropriate mitigation for impacts to these species may consist of restoring tidal marsh and purchasing stream and watershed lands that enhance and protect habitat occupied by these species. These measures would be coordinated with the proposed mitigation package for impacts to stream vegetation as described above. Additional surveys in streams within the District's jurisdiction could provide information to assist the District in avoiding impacts to special-status species.

F. REPORTING

To assess the overall progress of the mitigation program and determine the accuracy of the impact projections, annual reports will be made as described at the end of Chapter 3.

G. EXISTING MITIGATION COMMITMENTS

The District has committed to several mitigation projects as a result of permits for annual routine maintenance work completed since 1996. These commitments are identified in Table 5-4. The District and the regulatory agencies have agreed that the mitigation commitments made under these recent annual projects can be incorporated into the mitigation package of the Stream Maintenance Program.

TABLE 5-1
Wetland and Riparian Compensatory Mitigation for Sediment Removal and Vegetation Management Impacts

Mitigation Component	Location	Size of Mitigation	Compensates for Impacts to:	Description	Date

Tidal Wetland Restoration	Pond A-4	30 acres	30 acres of tidal wetlands: • 29 acres from sediment removal • 1 acre from vegetation management	Restore diked salt evaporator pond to historical tidal marsh conditions	2006
Freshwater Wetland Creation	Three sites currently identified:		14 acres of freshwater wetland in stream channels: • 10 acres in Santa Clara Basin • 4 acres in Pajaro River Basin		
	• Los Capitancillos	3 acres, Santa Clara Basin		Convert annual grasslands to seasonal or perennial wetlands adjacent to Guadalupe River	2002
	• Coyote Lakes Park Site 10A	7 acres, Santa Clara Basin		Convert ruderal grasslands to near-perennial wetlands adjacent to Coyote Creek	No date yet
	• Church Pond No. 2	4 acres, Pajaro River Basin		Convert open water in inactive percolation pond to wetland bench	2003
Stream and Watershed Protection	Undeveloped parcels with streams	Approx. 920 to 1,210 acres	102 acres of freshwater wetlands: • 74 acres in Santa Clara Basin streams • 21 acres in Pajaro River Basin streams • 7 acres in canals	Preserve, protect, and improve streams and associated wetlands	As lands become available in first 10 years
Giant Reed Control	Throughout county	125 acres	78 acres of riparian vegetation from vegetation management: • 32 acres in Santa Clara Basin • 46 acres in Pajaro River Basin And for lag time in implementing other mitigation components	Control giant reed outbreaks and provide associated mapping, revegetation, education, and coordination throughout county	2002- 2012

TABLE 5-2

Guiding Principles for Mitigation to Stream Vegetation
Multiyear Stream Maintenance Program

#1	Restoration or creation of larger, sustainable sites are preferable to smaller, fragmented sites.
#2	Compatible adjacent land uses, especially those in public ownership or other mitigation sites will be evaluated to determine sustainability and suitable size of a mitigation site.
#3	The conservation, protection from further degradation, and enhancement of existing habitats is preferable to the creation of artificially supported systems.
#4	A watershed-wide, programmatic approach is preferable to a project-by-project approach.
#5	Specific watersheds, streams, or stream reaches will be targeted for mitigation, restoration, and enhancement where the most ecological function will be obtained. When looking at ecological function, the net gain in function will be considered in addition to the existing functions. Areas outside of target streams and watersheds can also be considered.
#6	Mitigation will match impacts by basin (Santa Clara Basin versus Pajaro River Basin).
#7	In-kind mitigation opportunities are preferred over out-of-kind.
#8	Out-of-kind mitigation will be considered, however, if it benefits the overall health of streams and watersheds and has cost advantages.
#9	Technically and pragmatically feasible program elements, with a high probability of success, are preferable to those elements with a higher risk of failure or are based on speculative technology or feasibility.
#10	Proposal elements that can be scaled up or down in size, effort, and cost are preferred over those that are less flexible.
#11	It is preferable to complete mitigation prior to impacts. As much mitigation should be completed in the early years of the Stream Maintenance Program as possible.

These are concepts on the Multiyear Stream Maintenance Program agreed to between regulatory agencies and District staff in four meetings between June and September 2000. The regulatory agencies represented were USACE, USEPA, USFWS, CDFG, and RWQCB--San Francisco Region.

TABLE 5-3
Multiyear Stream Maintenance Program

	Program Description
#1	The primary types of work covered in the routine Stream Maintenance Program are sediment removal, vegetation management, and bank protection in and adjacent to stream channels and canals. Vegetation management is defined as including manual and mechanical removal and herbicide spraying of vegetation.
#2	The Stream Maintenance Program may qualify for multiyear permits (or other forms of multiyear approvals) from the USACE, the California RWQCBs, and the CDFG. Effects on species listed under the federal ESA will require review by the USFWS and/or NMFS.
#3	The permit applications will include a program description, impact assessment, mitigation proposal, monitoring plan, and assessment of effects on rare species. The permit applications will be submitted in January or February 2001, the draft EIR will be released for public review 1 month later, and the EIR will be finalized in June 2001. It is assumed that a decision on the permits can be finalized by July 2001 or 6 months after submittal of the permit application, whichever occurs latest.
#4	Work, impact, and mitigation areas will be described in both linear feet and acres in the EIR and permit applications, and will be identified separately for each basin (San Francisco Bay and Monterey Bay). Amounts of work of different types will be identified by jurisdiction of each agency.

	Impact Analysis
#5	The one-time accounting approach for impacts is acceptable. Repeatedly mitigating for impacts at the same location will not be required for routine stream maintenance.
#6	Impacts to wetlands in concrete channels are currently treated in the same manner as those in earthen channels
#7	Replacement of existing bank protection structures with similar or less impacting designs has minimal impacts and is considered a routine maintenance activity.
#8	No consensus was reached on the level of impact of new bank protection work and whether it should be considered routine stream maintenance. All agencies recognize the proposals the District has incorporated into the bank protection program to incorporate more biotechnical designs; however, they find that there is still the potential for impacts which are cumulatively not minimal. They encourage the District to further investigate residual impacts of the bank protection program.
	Mitigation
#9	Mitigation will match impacts by basin (San Francisco Bay vs. Monterey Bay drainages).
#10	It is preferable to complete mitigation prior to impacts. As much mitigation should be completed in the early years of the program as possible.
#11	Larger, sustainable sites are preferable to smaller, fragmented sites. Adjacent land uses, especially those in public ownership, will be evaluated to determine sustainability and suitable size of a site.
#12	Specific streams or stream reaches will be targeted for mitigation, restoration, and enhancement, where the most value and function will be obtained. When looking at values and functions, the net gain in value and function will be considered in addition to the existing values and functions. Areas outside of target streams can also be considered. Target streams will be identified in the EIR and permit applications.
#13	Creation of freshwater and tidal wetlands must be included as part of the mitigation program. Other mitigation techniques, such as invasive species control and land preservation, are acceptable as long as the mitigation package includes creation of wetlands.
#14	Land preservation opportunities should be sought in the lower and middle watersheds as well as the upper watershed. Greater functions and values will be recognized for preservation activities that include some component of ecological restoration or management of natural resources.
#15	A comprehensive program of controlling nonnative, invasive riparian vegetation (such as *Arundo donax*) is acceptable as mitigation for the impacts of vegetation management.
#16	A comprehensive program of controlling nonnative invasive tidal vegetation (*Spartina alterniflora*) is acceptable as either partial mitigation for the impacts on tidal wetlands, or as compensation for the temporal loss of tidal wetlands when impacts precede mitigation.
#17	An equal length of creekside will be planted with riparian species for any new impervious bank protection projects (concrete lining, gunite, sack concrete but not rock riprap). Agencies recommend that this type of planting not be placed at the top of bank only and not consist of infilling among other vegetation. The District will include guidance in the EIR and permit application on how such replacement planting sites will be selected.
#18	All agencies encourage the District to reconsider the need for mitigation to address the impacts of the bank protection program
#19	Mitigation will be coordinated and linked within the Stream Maintenance Program, with other District projects (especially the multiple species Habitat Conservation Plan [HCP]), and with preservation and enhancement efforts of others.
#20	The agencies recommend that all potential mitigation sites be identified in the EIR and permit applications, or a commitment be made to have a percentage of mitigation done within specific target streams. The feasibility of providing mitigation at either the specific sites or within the target streams will be evaluated and discussed in these documents, and interim deadlines will be provided. The agencies suggest that the 5-year point of the permit may be a good period to evaluate the status of the mitigation program.

Reporting	
#21	Work areas and mitigation efforts will be tracked on an annual basis and reported to the agencies.
#22	For the first 5 years, the District will provide the agencies with a tour after completion of the work season of representative work areas (especially those along target streams) for that year and all mitigation sites. Preconstruction photographs will be provided.

TABLE 5-4
Prior Mitigation Commitments for Completed Maintenance Projects (1996 to 2000)

Project	Mitigation Acres		Proposed Mitigation Site
	Freshwater	Tidal	
1996 bank protection, six sites	0.15		Include in 10-year permit (per USACE)
1996 Wildcat and Uvas bank protection	0.00		Include in 10-year permit (per USACE)
1997 Urgent Sediment Removal	0.60		Los Capitancillos
1997 Urgent Sediment Removal		10.00	Pond A-4
1997 San Tomas Addition, sediment removal	0.20		Include in 10-year permit (per USACE)
1997 Jones & Morey, sediment removal	1.10		Church Pond No. 2
1998 maintenance projects		1.80	Pond A-4
2000 maintenance projects	1.91		Los Capitancillos
2000 maintenance projects		0.79	Pond A-4
TOTAL	3.96	12.59	

Some of the work proposed for 1 year may have actually been undertaken in a subsequent year.

Chapter 6
LINKAGES TO OTHER PROGRAMS AND PROJECTS

This chapter provides an overview of the linkages between the Stream Maintenance Program and 12 stream-related programs and projects now underway at the District. This chapter is provided for informational purposes only, and was developed in response to inquiries made by interested stakeholders and agency representatives. In this chapter, the following District efforts are compared with characteristics of the Stream Maintenance Program:

1. Annual maintenance work (work conducted in 1998, 1999, and 2000)

2. Capital Improvements Program (various District project numbers)

3. Comprehensive Flood Management Program (CFMP) (District Project No. 000404)

4. Fisheries Aquatic Habitat Collaborative Effort (FAHCE) (District Project No. 920414)

5. Guadalupe Collaborative (District Project No. 301517)

6. Maintenance Wetlands Mitigation Project (District Project No. 000413)

7. Multispecies Habitat Conservation Plan (District Project No. 000408)

8. Natural Resources Management Program (District Project No. 000406)

9. District Urban Runoff Program (formerly Nonpoint Source Pollution Protection Program (District Project No. 007902)

10. Regional Water Quality Control Board Watershed Management Initiative (District Project No. 0007914)

11. Solid Materials and Waste Management Project (District Project No. 000412)

12. Wetland Vegetation Recovery Study (Solid Materials and Waste Management Project [SMMP]) (District Project No. 000415)

The primary purpose of this chapter is to clarify the linkages between the Stream Maintenance Program and other relevant District projects and programs. As determined appropriate, these projects will be included in the cumulative impact assessment for the Stream Maintenance Program EIR. Non-District efforts, such as those by open space districts, NRCS, and the City of San Jose, are not included in this chapter although they may involve streams within District jurisdiction.

Some connections between District projects are very direct. For example, the Stream Maintenance Program is dependant upon completion of the multispecies HCP to obtain the Federal ESA portion of its regulatory clearances; relies upon the Maintenance Wetlands Mitigation Project to provide suitable habitat mitigation; and the Wetland Vegetation Recovery Study fulfilled previous maintenance permit conditions. Other linkages to the Stream Maintenance Program are less direct, such as the potential for sediment reuse through the SMMP, and data sharing with the Guadalupe Collaborative Project.

Another purpose of this chapter is to articulate shared features of the District's work in order to better coordinate District efforts. Shared features of the listed project and programs are as follows:

- All of the programs and projects listed are stream-related and/or have stream-related components.
- Due to their stream locations, these activities all have the potential to affect wetlands, aquatic resources, and/or riparian habitats, either directly or indirectly.
- All are either driven or affected by environmental regulations, and several seek to streamline regulatory requirements.
- Over half occur in areas with species of special concern.
- All seek to balance environmental concerns with District flood protection and water supply activities.

- All documents are anticipated to be substantially completed and/or implemented within the next 3 years.
- Nearly all involve District management and Environmental Resources Management Unit (ERMU) staff in consultation with regulatory agencies.

Distinctions also exist between the various activities:

- Some are programs while others are projects.

- Some are Districtwide, while others are site specific or have multiple sites throughout the District.
- Some will result in policy documents while others have more defined implementation objectives, such as completing construction.

The section below provides a more complete assessment of the linkages between the various District activities.

A. METHODOLOGY

For each of the 12 activities, linkages were considered for potential overlap with the same or similar characteristics of the Stream Maintenance Program. They were not compared with each other. The linkages are summarized in Table 6-1. Table 6-2 provides the following:

- Purpose: Primary objectives of program or project, such as facility construction or permit streamlining.
- Location: Site-specific, multiple sites throughout the District, or Districtwide.
- Environmental Resources: Types of affected habitats and biological resources.
- Type of Documents: Policy, planning, permit, or other report products.
- Schedule: Deadlines for planning and implementation.
- Participants: District staff, external agencies, individuals, and/or organizations.
- Linkages: Any related policies, processes, and other connections, such as a data exchange or shared mitigation efforts, especially if the Stream Maintenance Program is dependant upon it.

First, the characteristics of the Stream Maintenance Program are described and then the characteristics of the other 12 programs or projects are similarly described.

1. Overview of the Stream Maintenance Program

Purpose: This program will provide long-term guidance to the District to effectively implement routine stream maintenance projects in a cost-effective and environmentally-sensitive manner. The Stream Maintenance Program is a process and policy document that will be adopted by the District and used in obtaining long-term permits for routine stream maintenance activities.

Location: Districtwide. The Stream Maintenance Program addresses all routine stream maintenance activities (such as sediment removal, vegetation management, and bank protection).

Environmental Resources: Biological and other resources, including wetland (tidal and nontidal), riparian, and aquatic habitat, many with sensitive wildlife species that have a potential to be affected.

Type of Documents: Stream Maintenance Program document with associated EIR and permit applications includes policies and implementation measures to ensure that routine stream maintenance projects are implemented in a cost-effective and environmentally-sensitive manner.

Schedule for Development and Implementation: Draft Stream Maintenance Program and associated EIR public review planned for early 2001; regulatory clearances obtained by June 2001; ongoing implementation after finalization of the EIR and receipt of 10-year permits.

Participants: District Project Management and Maintenance Watershed Units and Environmental Resources Unit, plus

community stakeholders, environmental advocacy groups, and regulatory agencies primarily the USACE, RWQCB, and CDFG, and also involving the USEPA, the NMFS, and the USFWS. The Federal Emergency Management Agency (FEMA) is indirectly involved because the Stream Maintenance Program must comply with FEMA's National Flood Insurance Program requirements if the District wishes to remain in the national insurance program.

TABLE 6-1
Linkages Between The Stream Maintenance Program and Other District Activities

Activity	Program or Project	Primary Purpose	Location	Environmental Resources Affected	Type of Document	Schedule to Complete Planning	Schedule to Implement
Stream Maintenance Program	Program	Streamline permit acquisition	Districtwide	In-stream, riparian	Policy, permit	2000	2000+
Annual Maintenance Work: 1997-2000	Projects	Conduct maintenance work	Multiple sites	Wetland	Planning, permit	2000	N/A
Capital Improvement Program	Projects	Construct needed facilities	Multiple sites	In-stream, riparian	Planning, permit	Varies	Varies
Comprehensive Flood Management Project	Program	Provide flood protection	Districtwide	In-stream, riparian	Policy, planning	2000	2001+
Fisheries Aquatic Habitat Collaborative Effort	Project	Sensitize water supply activities	Site-specific	In-stream, riparian	Legal	2000	2000+
Guadalupe Collaborative	Project	Construct downtown Guad. flood protection project	Site-specific	In-stream, riparian	Legal	2000	2000+
Maintenance Wetlands Mitigation	Projects	Provide mitigation for maintenance activities	Multiple sites	Wetland and maybe ESA	Permit	2001	2002+
Multispecies Habitat Conservation Plan	Program	Streamline permit acquisition	Districtwide	Sensitive species within all habitats	Policy, permit, planning	2000	2002+
Natural Resources Management Plan	Program	Effective environmental data collection	Districtwide	All habitats	Policy	2001	2001

District Urban Runoff Program	Program	Streamline permit acquisition	Districtwide	Water quality	Planning, permit	Completed	1995+
Watershed Management Initiative	Program	Manage watershed resources	Districtwide	All habitats	Policy	2001	2002+
Solid Materials Project	Program	Reuse of sediments, other waste	Multiple sites	All habitats	Policy, planning	2000	2001+
Wetland Vegetation Regrowth	Project	Fulfill permit requirement	Multiple sites	Wetlands	Permit	2001	2001

TABLE 6-2
Participant Linkages

Activity	District										
	ERMU	Maintenance	Project Managers	Managers	USACE	RWQCB	CDFG	USFWS	NMFS	Env. Advocates	Local Agencies
Stream Maintenance Program	X	X	X	X	X	X	X	X	X	X	X
Annual Maintenance Work: 1997-2000	X	X	X	X	X	X	X			X	X
Capital Improvement Program	X		X	X	X	X	X	X	X	X	X
Comprehensive Flood Management Project	X	X	X	X	X					X	X
Fisheries Aquatic Habitat Collaborative Effort	X		X	X	X	X	X	X	X	X	X
Guadalupe Collaborative	X		X	X	X	X	X	X	X	X	X
Maintenance Wetlands Mitigation	X	X		X	X	X	X	X			X
Multispecies Habitat Conservation Plan	X	X	X	X	X	X	X	X	X	X	X
Natural Resources Management Plan	X	X	X	X	X	X	X	X	X	X	X
Nonpoint Source Pollution Protection Program											X
Watershed Management Initiative	X	X	X	X	X	X	X	X	X	X	X
Solid Materials Project		X				X	X				X

Wetland Vegetation Regrowth	X		X	X	X	X		X

B. RELATED PROGRAMS AND PROJECTS

1. Annual Maintenance Work (1997, 1998, and 2000)

Purpose: Like the Stream Maintenance Program, this work involved preparing environmental assessments and obtaining regulatory clearances for sediment removal and bank protection activities within the District's jurisdiction. However, these annual projects did not include ongoing vegetation management work because it does not require USACE permits, and Vegetation Management staff avoided locations with ESA issues.

Location(s): Multiple, site-specific locations throughout the District.

Environmental Resources: Primarily wetland habitats. Locations with sensitive species have been excluded to avoid longer regulatory processes with ESA issues.

Type of Documents: Maintenance work orders, Initial Study/Negative Declarations, and permits.

Schedule for Development and Implementation: Completed 1997 and 1998 work. CEQA documentation and permit applications were prepared for maintenance work planned for 2000.

Participants: District Project Management Group; Environmental Resources Management, Environmental Compliance and Watershed Units, plus environmental advocacy groups, and regulatory agencies (USACE, RWQCB, CDFG, and USEPA, BCDC, NMFS, and the USFWS as appropriate).

Linkages: The annual permit process has allowed the District to "test drive" updated maintenance methods and policies as the District moves toward adoption of a Districtwide Stream Maintenance Program and acquires regulatory clearances. Permit conditions have required the District to monitor turbidity and refine BMPs. Annual postmaintenance "Lessons Learned" workshops have helped to educate and develop mutual solutions with agency staff and others. Also, many of these maintenance sites are the sites used for a Vegetation Regrowth Study now underway (see No .12, below).

2. Capital Improvements Projects (Various District Project Numbers)

Purpose: Implement needed flood protection and water supply projects through planning, design, construction, and environmental assessment processes.

Location: Site-specific locations throughout the District.

Environmental Resources: Site-specific temporary and permanent impacts, usually to wetlands and aquatic resources for in-stream projects.

Type of Documents: Engineer's Reports and environmental review documents during the planning phase of CIP projects; construction plans and specifications plus associated permits.

Schedule for Development and Implementation: Various.

Participants: Typical project-specific participants include District management, Capital Program Services Division, and Countywide Watershed Management (including the Ecological Services Unit); community residents, environmental advocacy groups, and regulatory agencies. On federally-funded flood protection projects, the District serves as a local sponsor with the USACE (Engineering Branch) or NRCS. The primary regulatory agencies include USACE (Regulatory Branch), RWQCB, CDFG, and also involve USEPA, BCDC, the NMFS, the USFWS, and local planning agencies.

Linkages: Maintenance Guidelines are prepared for each flood protection project, generally during project planning, to ensure each facility is maintained at the level of flood protection for which it was constructed. These guidelines are the basis for determining when sediment removal or other stream maintenance activities that affect flood capacity should be scheduled. This is done in order to protect the public's investment and to comply with regulations of the FEMA federal insurance program.

3. Comprehensive Flood Management Projects (District Project No. 000404)

Purpose: The mission of the CFMP is to develop and implement a comprehensive flood protection and stream stewardship program supported by the community, and to secure the funding necessary for the implementation of that program. This project seeks to expand flood protection goals into a larger stream management program. The program outcomes and activities will be consistent with the following ends policies adopted by the Board of Directors for flood protection and stream stewardship:

- Homes, schools, businesses, and transportation networks are protected from flooding and erosion.
- Clean, safe water in our creeks and bays.
- Healthy creek and bay ecosystems are protected, enhanced, or restored as determined appropriate by the Board of Directors.
- Additional open spaces, trails, and parks along creeks and in the watersheds when reasonable and appropriate.

Location: Districtwide, with each of the five flood zones containing site-specific flood protection and stream stewardship projects.

Environmental Resources: All stream resources have the potential to be positively and negatively affected by CFMP activities.

Type of Documents: The CFMP resulted in a ballot measure with background finance and other reports. Subsequent projects would require necessary environmental review, permits, and construction documentation.

Implementation Plan: Currently being finalized.

Participants: Project-specific stakeholders including District management and staff, community stakeholders, environmental advocacy groups, and local government representatives. Most projects are fully within the District's jurisdiction, while San Francisquito Creek work is overseen by a Joint Powers Authority, and stream stewardship projects will involve partnerships with local governments, open space districts, and community organizations.

Linkages: The success (or defeat) of a ballot measure associated with the CFMP affects funding levels for District flood protection and stream stewardship activities, including maintenance.

4. Fisheries Aquatic Habitat Collaborative Effort (District Project No. 920414)

Purpose: FAHCE is a cooperative, multiparty stakeholder process for resolving a water rights complaint against the District filed before the SWRCB for alleged violations relative to cumulative impacts on salmon and steelhead and their habitats.

Location: Guadalupe River, Coyote Creek, and Stevens Creek (110 miles).

Environmental Resources: Salmon, steelhead, and their riverine habitats.

Type of Documents: The FAHCE participants are collecting existing information and undertaking a series of studies to provide

the technical basis to address the water rights challenge regarding fisheries and aquatic habitat management as they relate to the District's diversion of water supplies. Studies will be conducted to determine the existing limiting factors to steelhead and salmon. These studies include: habitat inventory, inventory of passage barriers, examination of habitat function as reflected by fish use, analysis of habitat streamflow relationships, temperature monitoring and modeling, examination of tributary-mainstem relationships, historical stream channel analysis, and genetic analysis of salmon and steelhead.

Schedule for Development and Implementation: Studies to be complete in 2000, followed by a negotiated settlement. Implementation is dependent on these final negotiations.

Participants: District, CDFG, the Natural Heritage Institute (on behalf of Guadalupe-Coyote Resource Conservation District), NMPS, USFWS, and the City of San Jose.

Linkages: Data acquired as a part of the FAHCE project is available for use in developing the Stream Maintenance Program. Outcomes of the FAHCE settlement may influence BMPs related to District water operations, which may in turn affect the evolving list of Stream Maintenance Program BMPs.

5. Guadalupe Collaborative (District Project No. 301517)

Purpose: Resolve threatened litigation and other concerns related to the construction, operation, and maintenance of Reaches 3A, 3B, and 3C of the Downtown Guadalupe River Flood Protection Project.

Location: The Guadalupe River through downtown San Jose, between Coleman Avenue and Grant Street, with off-site mitigation areas located in Reach A between Airport Parkway and Interstate 880, and along Guadalupe Creek by Coleman Road and the Almaden Expressway in south San Jose.

Environmental Resources: Salmon, steelhead, and their riverine habitats, wetlands, SRA habitat, riparian, and upland trees.

Type of Documents: Dispute Resolution Memorandum (September 9, 1998) and MMP for Guadalupe River construction.

Schedule for Development and Implementation: The MMP was completed fall 1999; construction implementation is dependent upon negotiated design.

Participants: District management and staff, CDFG, RWQCB, NMFS, USFWS, USACE, and the Natural Heritage Institute (on behalf of Guadalupe-Coyote Resource Conservation District).

Linkages: Guadalupe Collaborative Process and Guadalupe Fisheries Study are sharing water temperature and other data with the Stream Maintenance Program planning and environmental review process.

6. Maintenance Wetlands Mitigation Project (District Project No. 000413)

Purpose: This project complies with the existing and anticipated compensatory wetland mitigation permit and environmental review requirements for the 1997, 1998, and future maintenance work. This project involves identification, design, and implementation of compensatory mitigation for impacts to in-stream wetlands due to maintenance.

Location: Site-specific tidal (Cargill Pond A-4) and freshwater (Guadalupe Creek) mitigation locations, plus investigation of future additional mitigation sites within Santa Clara County.

Environmental Resources Impacts: Wetlands. Potential resources included in wetlands include riparian, aquatic, and other habitats, plus the sensitive species that inhabit them.

Type of Documents: Feasibility, Planning, Engineer's Reports, MMP, environmental review documents, construction, and

other implementation documents for multiple projects.

Schedule for Development and Implementation for Initial Pilot Projects: Site-specific schedules, with land purchase, plan preparation, and construction for the Cargill tidal site to be completed by December 2002, and the Los Capitancillos freshwater site by December 2002.

Participants: District Project Management and Ecological Services Unit staff, with assistance from multiple District units, landowners, regulatory agencies staff, and possibly local agencies.

Linkages: This project is responsible for past maintenance wetland mitigation commitments, as well as providing wetland mitigation for other District projects.

7. Multispecies Habitat Conservation Plan (District Project No. 000408)

Purpose: This project involves developing a multispecies HCP to meet requirements of the Federal ESA. The HCP will comply with federal laws, and will streamline District permitting processes by eliminating individual "take" permit applications.

Location: Districtwide and creek-by-creek HCP.

Environmental Resources: This plan addresses approximately 50 species of concern throughout the District's jurisdiction. Habitats include aquatic, wetland, riparian, and uplands.

Types of Documents: This HCP will document the distribution and status of listed and potentially-listed species in the county; and identify and describe conservation measures to be implemented on District projects for avoidance, minimization, and compensation of impacts to such species. The HCP will serve as an application for an Incidental Take Statement for the covered species.

Schedule for Development and Implementation: Completion of the HCP is anticipated by late 2000 and regulatory approval late in 2002. Implementation would occur over the next several decades.

Participants: Project-specific stakeholders including District management and staff, community stakeholders, environmental advocacy groups, and regulatory agencies. The primary agencies are USFWS and NMFS. Other agencies that will reference the Incidental Take Statement as part of their project, permit, or regulatory review process include USACE, NRCS, USEPA, RWQCB, CDFG, and BCDC.

Linkages: This HCP is needed to address Federal ESA impacts and mitigation for wildlife species affected by District maintenance activities. As such, the Stream Maintenance Program is dependent upon HCP completion and approval in order to obtain regulatory permits for maintenance activities at locations involving federally-recognized wildlife species. Like the Stream Maintenance Program, this Districtwide effort involves setting up guidelines for District activities to obtain long-term regulatory clearances in order to streamline environmental review processes.

8. Natural Resources Management Program (District Project No. 000406)

Purpose: The NRMP project will inventory, monitor, and assess natural resources associated with District activities and apply management prescriptions in support of integrated water resources management. The program will provide empirical information necessary to manage for healthy water resources and streamline the environmental review process. The result will be more timely implementation of District project and consistent and rigorous environmental determinations.

Location: Districtwide.

Environmental Resources: Aquatic and terrestrial resources associated with District facilities and activities.

Type of Documents: The Phase II Scope of Work outlines a strategy for developing the Program Implementation Plan. The Program Implementation Plan will detail the approach for the collection, management, and use of natural resource information, including communicating natural resource information to support development of District policies regarding stream stewardship.

Schedule for Development and Implementation: Complete planning and commence implementation in 2001.

Participants: The Implementation Program will be developed using a stakeholder process involving District staff and staff from environmental regulatory agencies, local planning agencies, natural resource management agencies, nongovernmental environmental organizations, and others having natural resource technical expertise.

Linkages: The NRMP will provide empirical data to support the assessment of cumulative impacts, development of thresholds of significance, and the planning and implementation of mitigation projects. The NRMP will also provide for the consolidation of natural resource information to expedite planning of District projects and programs.

9. District Urban Runoff Program (District Project No. 007902)

Purpose: To protect aquatic habitat, recreational water uses, and local water supply by preventing pollution of storm water runoff. The Program is comprised of: (1) "areawide" activities performed collaboratively with 14 other agencies in northern Santa Clara County under the Santa Clara Valley Urban Runoff Pollution Prevention Program and (2) "District-specific" activities performed uniquely by the District for its own operations and within its own jurisdiction.

Location: The "District-specific" portion of the NPS Program implements pollution prevention practices for all District operations and within the District's entire jurisdiction anywhere in Santa Clara County. The "areawide" portion of the NPS Program implements activities only within that portion of the county which drains to San Francisco Bay; effectively the four northern zones of the District.

Environmental Resources: The NPS Program reduces the flow of all pollutants from diffuse sources into streams, reservoirs, and the San Francisco Bay. The reduction of sediment, metals, and organic pollutants improves water and aquatic habitat quality.

Type of Documents: The NPS Program ensures that the District complies with the provisions of Municipal Separate Storm Sewer National Pollutant Discharge Elimination System (NPDES) Permit No. CAS029718. Therefore the NPDES Permit serves as one of the policy and planning documents. Other documents which guide the NPS Program are the 1997 Urban Runoff Management Plan (URMP) and Annual Work Plans completed by March 1 of each year.

Schedule for Development and Implementation: The NPS Program has been engaged in an ongoing cycle of pollution prevention activities and continuous improvement since 1990. The period from 1990-95 can best be characterized as a period of development of the scope and parameters NPS Program in conjunction with the other participating agencies and the San Francisco RWQCB. The period from 1995 to current can be characterized as a period of development and implementation of specific pollution prevention measures.

Within a few years, the federally-mandated Phase II NPDES Permit will be in place. This permit will likely require an "areawide" collaborative effort with south county agencies similar to the one currently in place between agencies in the more developed north county.

Participants: The "District-specific" portion of the NPS Program requires management and implementation activities by various District office, field, and facility organizational units. Participants in the areawide activities include 13 municipalities in the north county area, the County of Santa Clara, and the District. The RWQCB and public interest groups are also active participants in the NPS Program.

Linkages: The NPS Program will be providing assistance to construction, channel maintenance, and facilities to develop and implement BMPs and control measures which will prevent regulatory violations and reduce the amount of sediment and other pollutants release by the District during performance of these activities.

10. Regional Water Quality Control Board Watershed Management Initiative (District Project No. 0007914)

Purpose: The mission of the WMI is to protect and enhance the watershed, creating a sustainable future for the community and the environment. The participants will work toward the development and implementation of an integrated watershed management approach to address water pollution and improve the condition of the Santa Clara Basin. The WMI serves as the public stakeholder group for the Total Maximum Daily Load (TMDL) development process.

There are several goals associated with the initiative:

- Ensure that the WMI is a broad, consensus-based process;
- Ensure that the necessary resources are provided for the implementation of the WMI;
- Simplify compliance with regulatory requirements without compromising environmental protection;
- Balance the objectives of water supply management, habitat protection, flood management, and land use to protect and enhance water quality;
- Protect and/or restore streams, reservoirs, wetlands, and the Bay for the benefit of fish, wildlife, and human uses; and
- Develop an implementable Watershed Management Plan that incorporates science and is continuously improved.

Location: Watersheds within the District jurisdiction that drain to San Francisco Bay.

Environmental Resources: Aquatic and other resources of District streams, reservoirs, wetlands, and the San Francisco Bay.

Type of Documents: The WMI is charged with developing a watershed action plan to achieve WMI goals. Major milestones include:

- Watershed Characteristics Report: Describes the general physical and political characteristics of the Santa Clara Basin.
- Watershed Assessment Report: Assesses the condition of the watershed(s) using existing information from San Francisquito Creek, Guadalupe River, and Upper Penitencia Creek.
- Development of Watershed Action Alternatives: A process that would help stakeholders to explore alternatives to meet watershed goals.
- Watershed Action Plan: Describes what we agree to do to meet watershed goals.

Schedule for Development and Implementation:

- Watershed Characteristics Report: May 2000 draft for public review.
- Watershed Assessment Report: Fall 2001.
- Watershed Action Plan: Completion date to be determined by WMI Stakeholders.

Participants: This effort was initiated by the USEPA, SWRCB, and San Francisco Bay RWQCB with participation by District management and staff plus other local planning agencies and environmental advocates.

Linkages: The WMI will benefit stream maintenance by identifying impediments to beneficial uses that the District may

eliminate under their maintenance program. It will offer a mechanism for customers to provide input into the District maintenance program, thus facilitating regulatory clearances. It will also allow a sharing of data generated by other entities (e.g., regulatory, environmental, city) for use in fulfilling maintenance needs. TMDLs for sediment and other pollutants may become a maintenance criteria, and future maintenance sites may be selected based upon sediment volume and/or quality as it affects stream TMDLs. However, the WMI is distinct from the maintenance program because it is a planning effort that will not directly result in regulatory clearances.

11. Solid Materials and Waste Management Project (District Project No. 000412)

Purpose: The District's SMMP is intended to identify cheaper, cost-efficient, and streamlined methods for the disposal of solid waste generated by the District. The project is also aimed at reducing the impact of District waste streams (sediment, sludge, office waste, construction debris, and hazardous materials) on the environment. This will be accomplished by reducing solid waste disposal to landfills by ensuring that alternative solid waste management and disposal practices are utilized.

Location: All District facilities that generate solid waste streams, including, but not limited to, the stream maintenance channels and creeks where sediment is removed, water treatment plants, plus other District facilities and project sites.

Environmental Resources: The SMMP is intended to reduce solid waste disposal to landfills and reduce impact on the environment by utilizing alternative methods, namely, recycling, reuse, wetlands construction, composting. Some of the environmental resources that will be better protected are soil, groundwater, streams, rivers, reservoirs, and the San Francisco Bay.

Type of Documents: During the planning phase of the SMMP, pertinent District documents were reviewed to gain an understanding about District's waste streams, characteristics, current disposal methods, and costs. As part of the project scope, a solid materials management policy will be developed.

Schedule for Development and Implementation: Significant District solid waste streams for which a management plan is being prepared are sediment, sludge, office waste, construction debris, and hazardous materials. The SMMP has been preliminarily developed, and implementation of management options is due in April 2001.

Participants: The SMMP team is comprised of the Countywide Watershed Programs Unit (for facilitation), an SMMP Oversight Team (for guidance), and a consultant (Stellar Environmental Solutions for technical support). During development and implementation phases of the project, stakeholder input will be sought from pertinent regulatory agencies, environmental organizations, and community.

Linkages: Under the SMMP, the management options being evaluated for the District solid waste streams include: source reduction, recycling, beneficial agronomic reuse, beneficial wetlands reuse, disposal in District-owned monofill, beneficial streambed restoration/construction, disposal to landfills, etc. These methods are directly (reduction of silts delivered to landfills) or indirectly (water treatment plant sediments for agricultural reuse) linked with District routine stream maintenance activities.

12. Wetland Vegetation Regrowth Study (District Project No. 000415)

Purpose: This project, a permit requirement for 1998 maintenance work, involves studying the regrowth of wetland vegetation in flood protection channels after sediment removal projects. This study will provide background information to be used to assess environmental impacts associated with sediment removal activities.

Location: Site-specific locations of the District's 1997 and 1998 sediment removal work.

Environmental Resources: In-stream tidal and nontidal freshwater wetlands.

Type of Documents: Annual reports assessing vegetation growth at both sediment removal and undisturbed control sites over a 3-year period beginning fiscal year 1998/99.

Schedule for Development and Implementation: Final report due March 2001.

Participants: District management and staff and regulatory agency representatives.

Linkages: This study addresses wetland impacts evaluation and provides information to be used to help determine the amount and types of mitigation that should be provided by the Stream Maintenance Program.

Chapter 7
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APPENDIX A

GLOSSARY

Adaptive Management
A dynamic process that recognizes that the future cannot be perfectly predicted. In response to imperfect predictions, planning and management strategies are modified as better information becomes available. It is a continuous improvement process whereby monitoring and analysis of the results of past actions are fed back into the current decision-making process.

Anadromous
A term used to describe the movement of certain fishes from saltwater to freshwater to breed, and from freshwater to saltwater to grow and mature.

Annual Work Plan
The stream maintenance work identified that forms the basis of the annual budget. Specific information, such as location and size of sediment removal, vegetation management and erosion repair, is provided in the Annual Work Plan.

Appurtenant Structures
Accessory structures such as storm outfalls, stream gages, trash racks, flap gates, tide gates, vaults, and headwalls.

Avoidance
Strategies for the planning, design, maintenance, and operation of District facilities in order to provide water supply and flood protection which refrains from causing significant adverse environmental impacts.

Bank Protection
Bank protection involves any action by the District to streambanks that are eroding (repair) as well as preventative erosion protection. The District implements streambank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation or recreational use, (4) negatively affects water quality, or (5) negatively affects riparian habitat. Bank protection stabilizes a channel bank using rock, riprap, concrete, soft materials, vegetation, or a combination of materials or methods. Bank protection can also include preventative maintenance to ensure that banks do not erode in the future. This new work is considered routine maintenance because it is either restoring the flood protection function of a modified channel or it is repairing a natural bank to its approximate condition prior to becoming an erosion problem.

Bank Repair
Maintenance of existing bank protection structures with in-kind, in-place materials. This type of maintenance occurs when such structures fail.

Basin
For the purposes of the Stream Maintenance Program, a depression or valley that drains to a common waterbody. In Santa Clara County, there are two major hydrologic basins draining either into the San Francisco Bay or to the Monterey Bay. In the

northern portion of the county, streams of the Santa Clara Basin drain to the San Francisco Bay. To the south, streams in the Pajaro River Basin drain ultimately to Monterey Bay.

Best Management Practice (BMP)
An activity, procedure, or other standard management and work practice that provides the most effective means of preventing or reducing pollution or other negative environmental consequences.

Biotechnical
A method of bank protection emphasizing the incorporation of soft structures (e.g., vegetation). See "Soft Structures."

Bypass Channel
A flood protection facility through which a portion of a stream's flow is diverted from one point and reintroduced into the stream at the downstream end of the bypass channel. Bypass channels can be used during the construction or maintenance process. Permanent bypass channels can also be designed to accommodate flood flows.

Bypass Structures
On construction sites, a generic term for any type of structure(s) used to pond water and convey it around a work site (e.g., cofferdams, bypass pipes, channels).

California Environmental Quality Act (CEQA)
The CEQA is California Public Resources Code Sections 21000 et seq. CEQA establishes a duty for public agencies to avoid or minimize environmental damage where feasible, recognizing that a public agency has an obligation to balance a variety of public objectives, including economic, environmental, and social factors. CEQA is intended to facilitate the disclosure of the significant environmental effects of proposed activities to decision-makers and the public, the identification of ways to avoid or reduce environmental damage, and the prevention of environmental damage by requiring the implementation of feasible alternatives or mitigation measures.

Channel Stabilization
See "Bank Protection."

Clean Water Act
A broad federal statute with the goal of maintaining and restoring waters of the U.S. (See "Waters of the United States").

Compensatory Mitigation
The restoration, creation, enhancement, or preservation of wetlands and other resources expressly for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization of impacts have been achieved in compliance with law or requirements of regulatory agencies. (Reference Federal Register March 6, 1995, Federal Guidance for the Establishment, Use and Operation of Mitigation Banks.) In the Stream Maintenance Program, compensatory mitigation is mitigation that is to be provided by the District to offset significant residual impacts that cannot be avoided.

Design Capacity
An engineering term used to describe the amount of water that a modified channel was designed to convey. Generally, the design capacity for improved District facilities is to accommodate the 1 percent or 100-year flood. This is the level of protection. Capacity is in CFS or Q. See "Flood Capacity."

Emergency
A situation is considered an "emergency" if it is a sudden, unexpected occurrence involving a clear and imminent danger that demands immediate action to prevent or mitigate loss of or damage to life, health, property, or essential public services (Public Resource Code Section 21060.3). Emergency repair or activities associated with an emergency are not addressed by the Stream Maintenance Program. Most emergency projects are exempt from review pursuant to the CEQA. (Reference Public Resource Code Section 21080[b][2], [3], [4].)

Environmental Impact Report (EIR)
A detailed statement prepared under CEQA describing and analyzing the significant environmental impacts of a project and discussing ways to mitigate or avoid the effects. See also "Program Environmental Impact Report."

Erosion
The detachment and movement of soil or rock fragments by water, wind, ice, gravity, or extreme sun or heat.

Flood Capacity
The capacity of a channel to carry calculated flood flows. Capacity is dependent on cross-sectional area and frictional components (e.g., channel vegetation).

Flood Protection Facility
For the purposes of the Stream Maintenance Program, any watercourse, whether natural or man-made, in which water does or may flow and which is under ownership or controlled by the District for flood protection purposes. A watercourse over which the District is deemed to have control or jurisdiction is that portion of the watercourse where the tributary watershed areas upstream of such reach or portion is in excess of 320 acres (½ square mile).

Flood Protection Project
A project that affects the flood conveyance capacity or flood management behavior of the system, usually designed to reduce flooding hazards. These projects are not considered routine stream maintenance.

Gabion Basket or Mattress
Galvanized wire mesh panels filled with rock used for structural purposes. They can be connected together and used for retaining walls, revetments, or bank protection.

Habitat
The specific area or environment in which a particular type of plant or animal lives. To be complete, an organism's habitat must provide all of the basic requirements of life for that organism.

Hard Structures
A type of bank protection structure incorporating rock, riprap, sack concrete, gabion baskets and mattresses, or concrete. These structures are inert and rigid.

Herbicides
A chemical agent used to destroy or inhibit plant growth.

Hydrologic Basin
For the purposes of the Stream Maintenance Program, a depression or valley that drains to a common waterbody. In Santa Clara County, there are two major hydrologic basins draining either into the San Francisco Bay or to the Monterey Bay. In the northern portion of the county, streams of the Santa Clara Basin drain to the San Francisco Bay. To the south, streams in the Pajaro River Basin drain ultimately to Monterey Bay. Each basin is comprised of several watersheds.

Impact
See "Significant Environmental Impact."

Implementation Measure
An implementation measure is an action, procedure, program, or technique that carries out policy. Implementation measures provide specific guidance to District managers and staff in the environmental review and processing of individual routine stream maintenance projects.

Invasive Species
A subcategory of nonnative plants that aggressively invade natural plant communities and displace native plants or less aggressive weedy plants. Examples of invasive species in Santa Clara County wetland and riparian areas are broad-leaf peppergrass (*Lepidium latifolium*) and giant reed (*Arundo donax*).

Invert
A creek or channel bottom.

Large Construction Project
For the purposes of the Stream Maintenance Program, large flood protection construction projects affect the flood conveyance capacity of the stream. These projects are usually Capital Improvement Projects (CIP) and are not considered routine stream maintenance.

Listed Sensitive Species
See "Listed Species."

Listed Species
A species that is formally designated as endangered or threatened by the state or Federal ESAs.

Long-Term Permit
This is a nonspecific phrase for permits, authorizations, or memorandums of understanding from the United States Army Corps of Engineers, Regional Water Quality Control Boards, the State Water Resources Control Board, Bay Conservation and Development Commission, and the Department of Fish and Game that are for a specified period of time (e.g., 5 or 10 years) or indefinite.

Maintenance Guidelines
Engineering standards developed for each District flood protection facility that will give guidance on maintenance requirements for flood flow capacity. The guidelines may include design information, historical information, or special requirements for a reach of channel.

Mitigation
The term "mitigation" includes the following: (1) avoiding environmental impacts by not taking a certain action or parts of an action; (2) minimizing environmental impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the impacted environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; and (5) compensating for the environmental impact by replacing or providing substitute resources or environments (reference CEQA Guidelines, CCR Title 13 Chapter 3, Section 15370). The policies, implementation measures, and BMPs included in the Stream Maintenance Program have been designed to "mitigate" environmental impacts. It should be noted that different regulatory agencies have different definitions of the term mitigation. For example, the Regional Water Quality Control Board only considers mitigation as the compensation that is provided after impacts have been avoided or minimized to the greatest extent possible. This mitigation is provided to offset significant residual impacts that cannot be avoided. In the Stream Maintenance Program, this type of mitigation is considered "Compensatory Mitigation."

Modified Channel
A waterway in which engineered alterations have occurred to improve the passage of flood flows or to provide drainage. This includes straightening (or channelization), containing a watercourse within constructed banks or levees, or lining banks with concrete, riprap, gabions, or sack concrete.

Modified Natural Channel
A watercourse which has had improvements such as bank protection (e.g., gabions, rip rap, other revetments) and selected areas of historical channelization (e.g., widening, straightening) and/or other capacity or passage improvements.

Natural Channel
A watercourse without any significant improvements or modifications and very little evidence of historical alterations.

Nonnative Plant
A plant species which, under natural conditions, does not originate within the ecosystem in which it is found.

Nonnative Vegetation
Any vegetation which, under natural conditions, does not originate within the ecosystem in which it is found.

Policy
Policies guide decision-making, both for individual stream maintenance projects and the implementation of other related programs and projects. Policies are commitments made by the District.

Outfall Structure
The end of a pipe or culvert that delivers local drainage into a creek. Features associated with an outfall structure may include erosion control materials such as riprap below the culvert or an energy dissipater. Further, a valve, such as a flap gate, may also be part of the outfall structure.

Program
A program is a series of actions that can be described at a general level of detail. Programs include agency plans, policies, or regulatory programs.

Program Environmental Impact Report
A Program EIR can be prepared for a series of actions that can be characterized as one large project or are more general policy or regulatory guidance documents. The CEQA allows the Program EIR to generally analyze the broad environmental effects of the program with the acknowledgment that project-specific review may be required for particular aspects of the program.

Protocols
An established set of ground rules or procedures governing routine stream maintenance activities.

Reach
The smallest subdivision of a drainage system consisting of a uniform length of channel or a discrete portion of a channel.

Recharge
The replenishment of groundwater aquifers by infiltration.

Regrowth
The growth of vegetation subsequent to disruptive activities such as sediment removal which originally removed all vegetation within the work or study area.

Repair
For the purposes of the Stream Maintenance Program, repair refers to maintenance of bank protection structures with in-kind, in-place materials. This type of maintenance occurs when such structures fail.

Residual Impact
Significant environmental impacts that cannot be avoided through the implementation of feasible site-specific measures. Significant residual impacts can be offset through a provision of compensatory mitigation.

Restoration
The reestablishment of the structure and function of ecosystems. Ecological restoration is the process of returning an

ecosystem as closely as possible to predisturbance conditions and functions. Implicit in this definition is that ecosystems are naturally dynamic. It is therefore not possible to recreate a system exactly. The restoration process reestablishes the general structure, function, and dynamic but self-sustaining behavior of the ecosystem.

Revetment
A term used to describe any number of hard structures used in bank protection.

Riparian Corridors
Refers to a biological zone dominated by riparian vegetation immediately next to a channel. See "Riparian Vegetation."

Riparian Vegetation (or Habitat)
A collective term for plants that are associated with streams or rivers.

Riprap
Loose rock or concrete of varying size, typically brought to a site. Used to protect channel banks from scouring forces.

Riverine
Of, related to, or growing in rivers and streams.

Rootwad
A tree stump (dead or alive) with roots. Used in place of hard structures.

Routine Stream Maintenance
Routine stream maintenance includes three major activities, as follows: (1) sediment removal activities that are designed to restore the flood capacity of existing District channels or associated features (e.g., tide gates), (2) vegetation management in and around the District's channels, including removal of vegetation for access and fire control, and (3) bank protection activities necessary to protect District or other facilities. Routine stream maintenance also includes more minor maintenance activities, such as trash removal at trash racks and more generalized locations; repair and installation of fences and gates; grading and other repairs to restore the original contour of access roads and levees; repair of structures with in-kind materials within the same footprint (such as replacement of concrete lings, culverts, pipes, valves, or similar structures); cleaning and minor sediment removal at stream gages, outfalls, culverts, flap gates, tide gates, inlets, grade control structures, fish ladders, fishways and screens; graffiti removal; tree pruning along maintenance road to provide access and to remove hazards; irrigation, weeding, replanting, and other types of ongoing maintenance at mitigation sites; removal of downed trees and blockages from streams; and ground squirrel and rodent control with traps and pesticides.

Routine Stream Maintenance Program
See "Stream Maintenance Program."

Routine Stream Maintenance Project
For the purposes of the Stream Maintenance Program, a project is the whole of a routine stream maintenance action that is proposed for implementation through the Stream Maintenance Program. A project has a specific location, duration, and purpose. (An example of an individual project would be the removal of 3,000 cubic yards of sediment from Adobe Creek between Highway 101 and East Charleston Road.) Major construction and repair, including CIPs, are not defined as routine stream maintenance projects. In the Stream Maintenance Program, also referred to as "individual stream maintenance project," "individual project," "stream maintenance project," and "project."

Scour
The clearing and digging action of flowing air or water, especially the downward erosion caused by stream water in removing material (e.g., soil, rocks) from a channel bed or bank or around in-channel structures.

Section 404
Refers to a section of the Clean Water Act establishing a permit program for the discharge of dredged or fill materials into

Waters of the United States.

Sediment
Solid material, both mineral and organic, that settles to the bottom of channels, canals, percolation ponds, or behind dams.

Sediment Removal
The act of removing sediment deposited within a stream. Typically, sediment is removed when it reduces capacity. This is the sediment removal activity referred to most often in the Stream Maintenance Program, and included in the program-level impact analysis. There is a subset of sediment removal that is conducted for purposes of allowing appurtenant structures (stream gages, outfalls, diversion sills, flap gates, and tide gates) to continue functioning and to clear fish passage and access to fish ladders and weirs. This latter category of sediment removal is considered low impact, as described in Chapter 3 of the Stream Maintenance Program.

Sensitive Habitat
A catchall phrase for habitats which either support sensitive species (listed species, species proposed for listing, and species of special concern) or are designated as a sensitive natural community in local or regional plans, policies, regulations, or by the CDFG or the United States Fish and Wildlife Service.

Sensitive Species
A catchall phrase for listed (i.e., on a state or federal endangered species list) species, species proposed for listing, and species of special concern (other species that may be of concern to state or federal agencies).

Shaded Riverine Aquatic Habitat
The aquatic area occurring along the edge of a channel where the adjacent bank is composed of natural materials and supports riparian vegetation which overhangs or protrudes into the water and provides fish habitat.

Shear Stress
The force tending to cause deformation of a material by slippage along a plane or planes parallel to the imposed stress.

Significant Environmental Impact
A significant environmental impact is a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by a project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance (reference CEQA Guidelines, CCR Title 13 Chapter 3, Sections 15358 and 15382).

Soft Structures
A type of bank protection structure incorporating biological materials like seeds, plants, plant parts (e.g., root wads), or combination of vegetation and inert materials (e.g., brush mats/sills, wattles, fascines, or branch packing/layering).

Stakeholder
A stakeholder is an individual or organization who will be affected by or has an interest in the Stream Maintenance Program. Stakeholders include regulatory agency representatives, municipalities, and environmental and business groups.

Stream
For the purposes of the Stream Maintenance Program, "streams" are defined as the natural watercourses and modified channels and canals within the District's jurisdiction. In this Stream Maintenance Program, streams include both the waterway and its immediate geographical corridor, including riparian corridors.

Streambank Protection
See "Bank Protection."

Streambank Repair

See "Bank Repair."

Stream Maintenance Guidelines
See "Maintenance Guidelines."

Stream Maintenance Program
The Stream Maintenance Program will provide long-term guidance to the District to effectively implement routine stream maintenance projects in a cost-effective and environmentally-sensitive manner. The Stream Maintenance Program is to be codified in a process and policy document that can be adopted by the District and utilized in obtaining long-term permits from regulatory agencies. The Stream Maintenance Program includes specific measures, protocols, and monitoring and reporting requirements to ensure that routine stream maintenance projects are implemented in an effective, cost-sensitive, and environmentally-sensitive manner.

Stream Maintenance Program Work Area
The stream maintenance work area addressed by this Stream Maintenance Program includes streams and any adjacent property that the District owns or holds an easement for access and maintenance. The District does not provide maintenance on private property when no easement exists. Other than leveed creeks (which can require a wider maintenance easement), the maintenance work area is within approximately 20 feet of the top of bank when access is provided, and can be substantially less when access is not provided. The maintenance work area is typically less than the District's permitting jurisdiction, which is within 50 feet of the top of bank of the streams within the District's jurisdiction.

Stream Maintenance Project
See "Routine Stream Maintenance Project."

Streambed
The part of a stream over which a column of water moves.

Surfactants
A shorthand term for surface-active agent, which are chemicals that modify surfaces of two liquids or a liquid and a solid. Used to increase the retention and penetration of herbicides on and into plants.

Take (of a Listed Species)
To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a listed species or its habitat, or to attempt to engage in any such activity.

Turbidity
The pollution of water by dissolved or suspended solids. The cloudiness of water, caused by suspended sediment. Turbidity is measured by the degree to which light penetration is blocked because the water is muddy or cloudy.

Unavoidable Impact
An unavoidable impact would occur if specific economic, social, legal, technical, or other considerations make mitigation measures or alternatives for an identified impact of a project infeasible. To support its decision on a project for which an EIR was prepared, a lead agency must prepare written findings that either: (1) changes in the project have been base to avoid or substantially reduce the magnitude of a significant impact, (2) changes to the project are within another agency's jurisdiction and have been or should be adopted, (3) specific economic, social, legal, technical, or other considerations make mitigation measures or alternatives infeasible (reference CEQA Guidelines Section 15091).

Vegetation Management
Removal of vegetation in and adjacent to creeks to maintain the ability of channels to function as flood protection facilities. In addition, vegetation is removed to meet local fire code requirements and to reduce combustible weeds and grasses on property adjacent to the streams within the District's jurisdiction. The control of invasive nonnative vegetation is another purpose for which the District undertakes vegetation control. Vegetation management can be accomplished through mowing,

discing, hand clearing, or herbicide applications (depending on the environmental conditions of the site).

Vegetation Removal
See "Vegetation Management."

Waste Discharge Requirement
A legal mechanism of the state and Regional Water Quality Control Boards to regulate discharges of dredge or fill materials.

Waters of the United States
Briefly, Waters of the United States are tidal waters, all interstate waters including wetlands, and all other waters which could involve interstate or foreign commerce.

Watershed
A geographic area from which water is drained by a river and its tributaries to a common outlet. A ridge or drainage divide separates a watershed from adjacent watersheds.

Wetlands
Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

APPENDIX B

Maintenance Guidelines

APPENDIX C

Nesting Migratory Bird Procedure

APPENDIX D

Dryback/Fish Relocation Operation Guidelines

APPENDIX E

Programmatic Impact Assessment and Mitigation for Routine Bank Protection Activities

APPENDIX F

Bank Protection Locations

Revised: September 1999

Bank Repair 1986-1999

Watershed	Creek No.	Creek	Feet	
Lower Peninsula (NW Zone)	1010	Adobe	3,822	
	1012	Barron	200	
	1016	Hale	530	
	1017	Heney	25	
	1021	Matadero	415	
	1024	Permanente	10,829	
	1028	San Francisquito	3,035	
	1029	Stevens	1,980	
	1031	Summerhill	260	
	1039	Palo Alto Flood Basin	100	21,196
West Valley (NC Zone)	2010	Calabazas	5,557	
	2013	Junipero Serra	220	
	2014	Mistletoe	25	
	2017	Regnart	862	
	2018	Rodeo	690	
	2019	San Tomas	1,089	
	2021	Saratoga	14,014	
	2023	Smith	1,583	
	2026	Sunnyvale East	10,157	
	2027	Sobey	75	
	2027	Sunnyvale West	125	
	2030	Wildcat	1,631	

	2034	Guadalupe Slough	3,140	
	2036	Prospect	10	
	2037	El Camino Storm Drain	1,003	40,181
Guadalupe (Central Zone)	3010	Alamitos	1,225	
	3011	Canoas	2,207	
	3012	Calero	50	
	3013	Golf	1,972	
	3015	Guadalupe River	3,291	
	3020	Los Gatos	2,429	
	3023	Ross	2,531	
	3029	Randolf	2,910	16,615
Coyote (East Zone)	4012	North Babb	384	
	4013	South Babb	314	
	4015	Wrigley-Ford	100	
	4017	Berryessa	1,930	
	4018	Calera	36	
	4021	Coyote	1,416	
	4025	Los Coches	540	
	4026	Silver	4,250	
	4029	Miguelita	510	
	4031	Piedmont	290	
	4032	Upper Penitencia	575	
	4033	Lower Penitencia	1,150	
	4038	Upper Silver	190	
	4043	Quimby	15	
	4047	Thompson	85	
	4049	East Penitencia	60	11,845
Uvas/Llagas (South Zone)	5010	Llagas	1,515	
	5012	West Little Llagas	45	
	5017	Princevalle	110	
	5018	Uvas	1,302	
	5021	Corralitos	50	
	5031	West Branch Llagas	50	
	5037	East Little Llagas	12	
	5039	Lions	35	
	5041	New	50	
	5049	Bodfish	905	
	5060	Burchell	10	4,084
		TOTAL	93,921	93,921

APPENDIX G

Best Management Practices List

APPENDIX H

District Use Pesticide Literature Review

INDEX

Creeks in Santa Clara Valley Water District Maintenance Creek System

Creek	Name	Map Location
1010	Adobe	B1,B2,B3,A3
5029	Alamias	I8,I7,J8
3010	Alamitos	E5,F5
3017	Almendra	D5,C5
1037	Arastradero	A2,A3
4011	Arroyo Aguague	F2,F3,G3
5072	Babbs Canyon	H8,I8
3038	Barrett Canyon	E6
1012	Barron	B2
4017	Berryessa	E1,E2,F2
5049	Bodfish	H8,G8,G9
2012	Bonjetti	C4,B4,B5
2011	Booker	B4
5060	Burchell	H8
2010	Calabazas	D2,D3,C3,C4
4018	Calera	E1
3012	Calero	E5,F5

3011	Canoas	E4,E5,F5
5032	Center	H7,I7
5034	Church	H7,I7
4056	Cochran Ch	G6,H6
5021	Corralitos	H6,I6
4021	Coyote	D1,D2,E2,E3,E4,F4,F5,G5,G6,H6,I6
5014	Crew	I8,J8
4036	Cribari	F4,G4
4041	Crosley (Local)	E2
2033	Daves	D4,D5
2033	Daves	D4,D5
5035	Day	H8,H7
1034	Deer	B2,B3
5068	Dewitt	H6
5036	Dexter	I9,I8
2035	E.B. El Camino S.D.	C3
5037	East Little Llagas	H7
3024	East Ross	D5
4049	East Penitencia Ch	E2
5038	Edmundson	H7,G7
2037	El Camino S.D.	C3
4045	Evergreen	F4,G4
5064	Farman	I9,H9
4023	Fisher	F5,G5,G6
4048	Flint	F3,G3
5023	Foothill	H6
4044	Fowler	F3,G3
5026	Gavilan	I9,I8,H8,H9
3013	Golf	E5
3014	Greystone	E5
3015	Guadalupe River	C1,D1,D2,D3,E3,E4
2034	Guadalupe Slough	C1,C2,D2
2034	Guadalupe Slough	C1,C2,D2
3026	Guadalupe Creek	E4,E5,D5,E6
3050	Guadalupe River Bypass	C1,D1,D2,D3,E3,E4
1016	Hale	B2,B3
5050	Hayes	H7
1017	Heney	C3
3040	Herbert	E6

3041	Jacques Gulch	E6
5011	Jones	I8
2013	Junipero Serra Ch	C3
3042	Larabee Gulch	E6,F6
5039	Lions	H8,H7
5048	Little Arthur	H8,G8,G7,F7
5040	Live Oak	I8,I7
5010	Llagas	I9,I8,I7,H7,G7,G6,F6
3019	Lone Hill	D4,D5
3020	Los Gatos	E3,D3,D4,D5,C5,D6,E6
4010	Los Buellis	E2,F2
1011	Los Trancos	A2,A3
4025	Los Coches	E2,E140264026
4026	Lower Silver	E3,F3
5070	Lower Miller Slough	I8
4033	Lower Penitencia	D1,E2
1018	Loyola	B3
5051	Machado	G7
5013	Madrone Ch	H7,H6
1020	Magdalena	B3
5022	Maple	H6
1021	Matadero	B1,B2,A2
3035	Mcabee	E5
4029	Miguelita	E3,E2,F2
2014	Mistletoe	D4
1022	Montebello	B4,B3
5041	New	I7,H7
5054	North Morey Ch	H8
4012	North Babb	F3,F2
4042	Norwood	F3,G3
1026	Ohlone	B3
2015	Page Ditch	D4
5016	Pajaro River	H10,I10,I9,I8,J8,J9
1039	Palo Alto Flood Basin	B1
5042	Panther	I8,I7
5052	Paradise	G6
1024	Permanente	C1,B1,B2,B3
1023	Permanente Diversion	B3,C3
3025	Pheasant	D5

4031	Piedmont	E2
5017	Princevalle Drain	I8,H8
2036	Prospect	C4
1013	Purissima	B3
4043	Quimby	F3,G3
3029	Randol	E5
2017	Regnart	C3,C4
2018	Rodeo	C4
3023	Ross	E4,D4,D5
4019	Ruby	F3
5044	Rucker	I7
5033	San Martin	H7,I7
1028	San Francisquito	B1,A1,A2
5045	San Ysidro	I8,J8
2038	San Andreas	C4,C5
2019	San Tomas Aquino	D2,D3,D4,C4,C5
2039	Sanborn	E5,F5,F6,E6
3027	Santa Teresa	F5
2021	Saratoga	D3,C3,C4,B4
3032	Shannon	D5
3033	Short	D5
4037	Sierra	E2
5047	Skillet	I7
2023	Smith	D4
5063	Solis	G7
4013	South Babb	F3,G3
5046	South Corralitos	H6,I6
5053	South Morey Ch	H8
1038	Stanford Ch	B2
1029	Stevens	C1,C2,C3,B4,C4,B3,A3
1031	Summerhill Ch	B3
2027	Sunnyvale West Ch	C2
2026	Sunnyvale East Ch	C2,C3
2027	Sunnyvale West Ch	C2
1032	Swiss	B4
5025	Sycamore	G7
5024	Tennant	H7,H6
4047	Thompson	F3,F4,G4
4040	Tularcitos	E1

5071	Upper Miller Slough	H8,I8
4032	Upper Penitencia	E3,E2,F2,G2
4038	Upper Silver	F3,F4,G4
5018	Uvas-Carnadero	I9,I8,H8,H7,G7,F7,E7
2028	Vasona	C4
2028	Vasona	C4
3059	West Br. Randol	E5
1025	West Br. Permanente	B3
5012	West Little Llagas	H7,H6,G6
5031	West Br. Llagas	I8,H8,H7
2030	Wildcat	C4,C5
2030	Wildcat	C4,C5
4016	Willow Springs	G6
4046	Yerba Buena	F4,G4

FIGURES

Figure 1-1
Streams and Canals in District Jurisdiction

Figure 2-1
Projected Sediment Removal Work Areas

Figure 2-2
Projected Channel Vegetation Management Work Areas

Figure 2-3
Projected Upland Vegetation Management Work Areas

Figure 2-4
Historical Bank Protection Work Areas

Figure 5-1
Compensatory Mitigation Sites

RETURN TO TOP OF PAGE RETURN TO TABLE OF CONTENTS

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Santa Clara Valley Water District

TABLE OF CONTENTS

Appendix "H"

Santa Clara Valley Water District

District Use Pesticide Literature Review

March 27, 2001

Thomas Reid Associates

1.0 Methodology 8
- 1.1 Sources 8
- 1.2 Toxicity 10
- 1.3 Exposure Scenarios 13
- 1.4 Ground water contamination 16
- 1.6 References 18
- 1.6 Report Preparers 25

2.0 Herbicides 26
- 2.1 Glyphosate 26
  - 2.1.1 Technical information 26
    - 2.1.1.1 Use 26
    - 2.1.1.2 Chemistry 26

2.1.1.3 Mode of action 26
2.1.1.4 Products and formulation 26
2.1.1.5 Regulatory status 27
2.1.1.6 District use and application 27
2.1.2 Public health 27
2.1.2.1 Acute toxicity 27
2.1.2.2 Subchronic toxicity 28
2.1.2.3 Chronic toxicity 29
2.1.2.4 Carcinogenic effects 29
2.1.2.5 Mutagenic effects 29
2.1.2.6 Reproductive effects 29
2.1.2.7 Teratogenic effects 29
2.1.2.8 Organ toxicity and systemic effects 29
2.1.2.9 Fate in humans and animals 30
2.1.2.10 Occupational and residential exposure 30
2.1.2.11 Effects of inert ingredients and surfactant 30
2.1.2.12 Controversy over health effects 31
2.1.3 Environmental safety 34
2.1.3.1 Label limitation 34
2.1.3.2 Ecological effects 34
2.1.3.3 Environmental fate 35
2.1.3.4 Controversy over environmental effects 36
2.2 Oryzalin 38
2.2.1 Technical information 38
2.2.1.1 Use 38
2.2.1.2 Chemistry 38
2.2.1.3 Mode of action 38
2.2.1.4 Products and formulation 38
2.2.1.5 Regulatory status 38
2.2.1.6 District use and application 38
2.2.2 Public health 38
2.2.2.1 Acute toxicity 38
2.2.2.2 Subchronic toxicity 39
2.2.2.3 Chronic toxicity 39
2.2.2.4 Carcinogenic effects 39

2.2.2.5 Mutagenic effects 39
2.2.2.6 Reproductive effects 39
2.2.2.7 Teratogenic effects 39
2.2.2.8 Organ toxicity and systemic effects 39
2.2.2.9 Fate in humans and animals 40
2.2.2.10 Occupational and residential exposure 40
2.2.2.11 Effects of inert ingredients 40
2.2.2.12 Controversy over health effects 40
2.2.3 Environmental safety 40
2.2.3.1 Label limitation 40
2.2.3.2 Ecological effects 41
2.2.3.3 Environmental fate 41
2.2.3.4 Controversy over environmental effects 41
2.3 Chlorsulfuron 43
2.3.1 Technical information 43
2.3.1.1 Use 43
2.3.1.2 Chemistry 43
2.3.1.3 Mode of action 43
2.3.1.4 Products and formulation 43
2.3.1.5 Regulatory status 43
2.3.1.6 District use and application 43
2.3.2 Public health 43
2.3.2.1 Acute toxicity 43
2.3.2.2 Subchronic toxicity 44
2.3.2.3 Chronic toxicity 44
2.3.2.4 Carcinogenic effects 44
2.3.2.5 Mutagenic effects 44
2.3.2.6 Reproductive effects 44
2.3.2.7 Teratogenic effects 44
2.3.2.8 Organ toxicity and systemic effects 44
2.3.2.9 Fate in humans and animals 44
2.3.2.10 Occupational and residential exposure 44
2.3.2.11 Effects of inert ingredients 44
2.3.2.12 Controversy over health effects 44
2.3.3 Environmental safety 44

2.3.3.1 Label limitations 44
2.3.3.2 Ecological effects 45
2.3.3.3 Environmental fate 45
2.3.3.4 Controversy over environmental effects 45
2.4 Clopyralid 46
2.4.1 Technical information 46
2.4.1.1 Use 46
2.4.1.2 Chemistry 46
2.4.1.3 Mode of action 46
2.4.1.4 Products and formulation 46
2.4.1.5 Regulatory status 46
2.4.1.6 District use and application 46
2.4.2 Public health 46
2.4.2.1 Acute toxicity 46
2.4.2.2 Subchronic toxicity 47
2.4.2.3 Chronic toxicity 47
2.4.2.4 Carcinogenic effects 47
2.4.2.5 Mutagenic effects 47
2.4.2.6 Reproductive effects 47
2.4.2.7 Teratogenic effects 47
2.4.2.8 Organ toxicity and systemic effects 48
2.4.2.9 Fate in humans and animals 48
2.4.2.10 Occupational and residential exposure 48
2.4.2.11 Effects of inert ingredients 48
2.4.2.12 Controversy over health effects 48
2.4.3 Environmental Safety 48
2.4.3.1 Label limitation 48
2.4.3.2 Ecological effects 48
2.4.3.3 Environmental fate 49
2.3.3.4 Controversy over environmental effects 49
2.5 Pendimethalin 50
2.5.1 Technical information 50
2.5.1.1 Use 50
2.5.1.2 Chemistry 50
2.5.1.3 Mode of action 50

2.5.1.4 Products and formulation 50
2.5.1.5 Regulatory status 50
2.5.1.6 District use and application 50
2.5.2 Public health 50
2.5.2.1 Acute toxicity 50
2.5.2.2 Subchronic toxicity 50
2.5.2.3 Chronic toxicity 50
2.5.2.4 Carcinogenic effects 51
2.5.2.5 Mutagenic effects 51
2.5.2.6 Reproductive effects 51
2.5.2.7 Teratogenic effects 51
2.5.2.8 Organ toxicity and systemic effects 51
2.5.2.9 Fate in humans and animals 51
2.5.2.10 Occupational and residential exposure 51
2.5.2.11 Effects of inert ingredients 51
2.5.2.12 Controversy over health effects 52
2.5.3 Environmental safety 52
2.5.3.1 Label limitations 52
2.5.3.2 Ecological effects 52
2.5.3.3 Environmental fate 52
2.5.3.4 Controversy over environmental effects 53
2.6 Sulfometuron-methyl 54
2.6.1 Technical information 54
2.6.1.1 Use 54
2.6.1.2 Chemistry 54
2.6.1.3 Mode of action 54
2.6.1.4 Products and formulation 54
2.6.1.5 Regulatory status 54
2.6.1.6 District use and application 54
2.6.2 Public health 54
2.6.2.1 Acute toxicity 54
2.6.2.2 Subchronic toxicity 55
2.6.2.3 Chronic toxicity 55
2.6.2.4 Carcinogenic effects 55
2.6.2.5 Mutagenic effects 55

2.6.2.6 Reproductive effects 55
2.6.2.7 Teratogenic effects 55
2.6.2.8 Organ toxicity and systemic effects 55
2.6.2.9 Fate in humans and animals 56
2.6.2.10 Occupational and residential exposure 56
2.6.2.11 Effects of inert ingredients 56
2.6.2.12 Controversy over health effects 56
2.6.3 Environmental safety 56
2.6.3.1 Label limitation 56
2.6.3.2 Ecological effects 57
2.6.3.3 Environmental fate 57
2.6.3.4 Controversy over health effects 58
2.7 Triclopyr 59
2.7.1 Technical information 59
2.7.1.1 Use 59
2.7.1.2 Chemistry 59
2.7.1.3 Mode of action 59
2.7.1.4 Products and formulation 59
2.7.1.5 Regulatory status 59
2.7.1.6 District use and application 59
2.7.2 Public health 60
2.7.2.1 Acute toxicity 60
2.7.2.2 Subchronic toxicity 60
2.7.2.3 Chronic toxicity 61
2.7.2.4 Carcinogenic effects 61
2.7.2.5 Mutagenic effects 61
2.7.2.6 Reproductive effects 62
2.7.2.7 Teratogenic effects 62
2.7.2.8 Organ toxicity and systemic effects 62
2.7.2.9 Fate in humans and animals 63
2.7.2.10 Occupational and residential exposure 63
2.7.2.11 Effects of inert ingredients and surfactants 63
2.7.2.12 Controversy over health effects 64
2.7.3 Environmental safety 64
2.7.3.1 Label limitation 64

2.7.3.2 Ecological effects 64
2.7.3.3 Environmental fate 66
2.7.3.4 Controversy over environmental effects 67
2.8 Isoxaben 67
2.8.1 Technical information 67
2.81.1 Use 67
2.8.1.2 Chemistry 67
2.8.1.3 Mode of action 67
2.8.1.4 Products and formulation 67
2.8.1.5 Regulatory status 68
2.8.1.6 Typical application 68
2.8.2 Public health 68
2.8.2.1 Acute toxicity 68
2.8.2.2 Subchronic toxicity 68
2.8.2.3 Chronic toxicity 68
2.8.2.4 Carcinogenic effects 68
2.8.2.5 Mutagenic effects 69
2.8.2.6 Reproductive effects 69
2.8.2.7 Teratogenic effects 69
2.8.2.8 Organ toxicity and systemic effects 69
2.8.2.9 Fate in humans and animals 69
2.8.2.10 Occupational and residential exposure 69
2.8.2.11 Effects of inert ingredients 69
2.8.2.12 Controversy over health effects 69
2.8.3 Environmental safety 69
2.8.3.1 Label limitation 69
2.8.3.2 Ecological effects 70
2.8.3.3 Environmental fate 70
2.8.3.4 Controversy over environmental effects 70
3.0 Adjuvants 71
3.1 Butyl alcohol 71
3.1.1 Technical information 71
3.1.1.1 Use 71
3.1.1.2 Chemistry 71
3.1.1.3 Mode of action 71

3.1.1.4 Products and formulation 71
3.1.1.5 Regulatory status 71
3.1.1.6 District use and application 71
3.1.2 Public health 71
3.1.2.1 Acute toxicity 71
3.1.2.2 Subchronic toxicity 72
3.1.2.3 Chronic toxicity 72
3.1.2.4 Carcinogenic effects 72
3.1.2.5 Mutagenic effects 72
3.1.2.6 Reproductive effects 72
3.1.2.7 Teratogenic effects 72
3.1.2.8 Organ toxicity and systemic effects 72
3.1.2.9 Fate in humans and animals 72
3.1.2.10 Occupational and residential exposure 72
3.1.2.11 Effects of inert ingredients 72
3.1.2.12 Controversy over health effects 72
3.1.3 Environmental safety 72
3.1.3.1 Label limitations 72
3.1.3.2 Ecological effects 72
3.1.3.3 Environmental fate 73
3.1.3.4 Controversy over environmental effects 73
3.2 Polyethylene Monophenyl Ether 74
3.2.1 Technical information 74
3.2.1.1 Use 74
3.2.1.2 Chemistry 74
3.2.1.3 Mode of action 74
3.2.1.4 Products and formulation 74
3.2.1.5 Regulatory status 74
3.2.1.6 District use and application 74
3.2.2 Public health 74
3.2.2.1 Acute toxicity 74
3.2.2.2 Subchronic toxicity 74
3.2.2.3 Chronic toxicity 74
3.2.2.4 Carcinogenic effects 75
3.2.2.5 Mutagenic effects 75

3.2.2.6 Reproductive effects 75
3.2.2.7 Teratogenic effects 75
3.2.2.8 Organ toxicity and systemic effects 75
3.2.2.9 Fate in humans and animals 75
3.2.2.10 Occupational and residential exposure 75
3.2.2.11 Effects of inert ingredients 75
3.2.2.12 Controversy over health effects 75
3.2.3 Environmental safety 75
3.2.3.1 Label limitations 75
3.2.3.2 Ecological effects 75
3.2.3.3 Environmental fate 75
3.2.3.4 Controversy over environmental effects 76
4.0 Rodenticides 77
4.1 Chlorophacinone 77
4.1.1 Technical information 77
4.1.1.1 Use 77
4.1.1.2 Chemistry 77
4.1.1.3 Mode of action 77
4.1.1.4 Products and formulation 77
4.1.1.5 Regulatory status 77
4.1.1.6 District use and application 77
4.1.2 Public health 77
4.1.2.1 Acute toxicity 77
4.1.2.2 Subchronic toxicity 78
4.1.2.3 Chronic toxicity 78
4.1.2.4 Carcinogenic effects 78
4.1.2.5 Mutagenic effects 78
4.1.2.6 Reproductive effects 78
4.1.2.7 Teratogenic effects 78
4.1.2.8 Organ toxicity and systemic effects 79
4.1.2.9 Fate in humans and animals 79
4.1.2.10 Occupational and residential exposure 79
4.1.2.11 Effects of inert ingredients 79
4.1.2.12 Controversy over health effects 79
4.1.3 Environmental safety 79

4.1.3.1 Label limitation 79
4.1.3.2 Ecological effects 79
4.1.3.3 Environmental fate 80
4.1.3.4 Controversy over environmental effects 80
4.2 Zinc Phosphide 82
4.2.1 Technical information 82
4.2.1.1 Use 82
4.2.1.2 Chemistry 82
4.2.1.3 Mode of action 82
4.2.1.4 Products and formulation 82
4.2.1.5 Regulatory status 82
4.2.1.6 District use and application 82
4.2.2 Public health 82
4.2.2.1 Acute toxicity 82
4.2.2.2 Subchronic toxicity 83
4.2.2.3 Chronic toxicity 83
4.2.2.4 Carcinogenic effects 83
4.2.2.5 Mutagenic effects 83
4.2.2.6 Reproductive effects 83
4.2.2.7 Teratogenic effects 83
4.2.2.8 Organ toxicity and systemic effects 83
4.2.2.9 Fate in humans and animals 83
4.2.2.10 Occupational and residential exposure 83
4.2.2.11 Effects of inert ingredients 84
4.2.2.12 Controversy over health effects 84
4.2.3 Environmental safety 84
4.2.3.1 Label limitation 84
4.2.3.2 Ecological effects 84
4.2.3.3 Environmental fate 84
4.2.3.4 Controversy over environmental effects 85

1.0 Methodology

This Literature Review focuses on the pesticides used or considered for use by the Santa Clara Water District for routine maintenance including vegetation management on streams and canals and rodent

control on levees and canals.

Each pesticide is described in a similar format, although the amount of information for some products is much greater than for others and information was not found for all categories for some pesticides. The Review presents information on Use, Public Health and Environmental Safety as follows:

Use

- Chemistry
- Mode of action
- Products and formulation
- Regulatory status
- District use and application

Public Health

- Acute toxicity
- Subchronic toxicity
- Chronic toxicity
- Carcinogenic effects
- Mutagenic effects
- Reproductive effects
- Teratogenic effects
- Organ toxicity and systemic effects
- Fate in humans and animals
- Occupational and residential exposure
- Effects of inert ingredients
- Controversy over health effects

Environmental Safety

- Label limitation
- Ecological effects
- Environmental fate
- Controversy over environmental effects

1.1 Sources

This report compiles information from a wide range of sources: the product label, pesticide company

information, EPA assessments, EXTOXNET (a collaborative multi-university project with the Institute for Environmental Toxicology and funded by the United States Department of Agriculture (USDA) Extension National Agricultural Pesticide Impact Assessment Program), and public interest, anti-pesticide citizen and activist group web information and reports (See Table A). A particular effort was made to identify areas of controversy.

Table A. Major sources used to compile Pesticide Appendix.

Major sources	**Description**
Government and Government Affiliated	
California Department of Pesticide Regulation	The state agency charged with implementing and enforcing state law pertaining to pesticides. http://www.cdpr.ca.gov
EXTOXNET	EXTOXNET is a collaborative multi-university project with the Institute for Environmental Toxicology and funded by the USDA Extension National Agricultural Pesticide Impact Assessment Program.
National Toxicology Program (NTP)	The NTP was established in 1978 by the Secretary of Health and Human Services to coordinate toxicology research and testing activities within the Department, to provide information about potentially toxic chemicals to regulatory and research agencies and the public, and to strengthen the science base in toxicology. http://ntp-server.niehs.nih.gov/main_pages/about_NTP.html
US Environmental Protection Agency (EPA)	The federal agency charged with implementing and enforcing the complex of laws pertaining to pesticides, notably FIFRA.
World Health Organization (WHO)	WHO is a specialized agency of the United Nations with 191 Member States. WHO promotes technical cooperation for health among nations, carries out programs to control and eradicate disease and strives to improve the quality of human life. http://www.who.int
Public Interest	
California Public Interest Research Group (CalPIRG)	CalPIRG, is a statewide, environmental and consumer advocacy group that students started 23 years ago in order to tackle some of the most pressing issues of our time. Students work with experienced staff to educate the public, organize grassroots support, involve the media, and make sure decision-makers are listening to the public interest instead of special interests. http://spirit.dos.uci.edu/calpirg/main.htm
Californians for Alternatives to Toxics (CATs)	CATs is dedicated to preventing harm caused by the unwise use of toxic chemicals in the environment, particularly pesticides. To achieve this goal, CATs serves as a clearinghouse for information and strategic action. http://www.reninet.com/catz/
Natural Resources Defense Council (NRDC)	NRDC uses law, science, and the support of more than 400,000 members nationwide to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things. http://www.nrdc.org/
Northwest Coalition for Alternatives to Pesticides (NCAP)	The NCAP works to protect people and the environment by advancing healthy solutions to pest problems. http://www.pesticide.org/

Pesticide Watch	Pesticide Watch is dedicated to fighting dangerous pesticide use in California communities. http://www.pesticidewatch.org/
Physicians for Social Responsibility (PSR)	PSR forms a community of conscience committed to eliminating weapons of mass destruction, preserving a sustainable environment, addressing public health reform and reducing violence and its causes. http://www.labridge.com/PSR/
Rachel Carson Council (RCC)	RCC is a clearinghouse and library with information at both scientific and layperson levels on pesticide-related issues. RCC develops its knowledge from literature searches and conversations with experts. It then provides answers to the public and also produces various publications clarifying pesticide dangers and bringing alternative pest controls to the public's attention. http://members.aol.com/rccouncil/ourpage/index.htm
Industry	
Dow AgroSciences	Manufacturer of Gallery, Garlon 3A, Garlon 4, Surflan, and Transline herbicides.
DuPont	Manufacturer of Oust and Telar herbicides.
BASF Corporation	Manufacturer of Pendulum WDG herbicide.
Monsanto	Manufacturer of RoundUp and Aquamaster (replacement for Rodeo).

Registered Trademarks

Most of the herbicides are formulated and sold as products with registered trademark names.

Gallery, Garlon 3A, Garlon 4, Surflan, and Transline are registered trademarks of Dow AgroSciences.

Oust and Telar are registered trademarks of DuPont

Pendulum WDG is a registered trademark of BASF Corporation

RoundUp and Aquamaster are registered trademarks of Monsanto

Rodeo is a registered trademark of Dow AgroSciences; however, most of the references to Rodeo aquatic herbicide in this Literature Review pertain to the herbicide product when it was sold under that name by Monsanto.

1.2 Toxicity

Precautionary labeling includes a signal word, personal protective equipment requirements, hazard symbol, and statements of practical treatment. The label warning is normally determined by six types of acute toxicity studies and the composition of the product.

Acute toxicity refers to the immediate effects (0-7 days) of exposure to a pesticide. Highly acutely toxic pesticides can be lethal at very low doses. Narrative toxicity categories are based on the LD_{50}, the dose (in

milligrams of substance per kilogram of body weight) that kills 50% of the test animals in a standard assay, through either oral or dermal exposure routes. For inhalation exposures, the LC_{50} is used--the concentration in air in mg per liter that kills 50% of the test animals. See Table B for LD_{50}-narrative equivalents. <

The acute oral, acute dermal and acute inhalation studies are used to determine the LD_{50} of a product via the designated route of exposure. The primary eye irritation and primary skin irritation studies measure the severity of irritation or corrosivity caused by a product. The dermal sensitization study determines whether a product is capable of causing an allergic reaction. With the exception of the dermal sensitization study, each acute toxicity study is assigned a toxicity category as defined in the table below. All products falling into toxicity categories I-IV must bear a signal word and in some cases warning symbols (EPA 1998*d*).

Table B. LD_{50}-narrative equivalents

WHO Toxicity Classification		Rat LD_{50} (mg of chemical per kg of body weight)			
Class	Description	Solids (oral)	Liquids (oral)	Solids (dermal)	Liquids (dermal)
Ia	Extremely hazardous	< 5	< 20	<10	< 40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	200-2000	100-1000	400-4000
III	Slightly hazardous	>500	>2000	>1000	>4000
Table 5	Unlikely to present acute hazard in normal use	>2000	>3000	-----	-----
Table 6	Not classified: believed obsolete				
Table 7	Fumigants not classified by WHO				

Several systems are used for ranking the acute toxicity of pesticides. Active ingredients of pesticides are ranked by the World Health Organization (WHO). Formulated pesticide products (which often include inert ingredients) are given a toxicity rating by the U.S. EPA which is shown as a warning label on the pesticide product.

WHO Acute Hazard Rankings

The WHO bases its ratings on the lowest published rat oral LD_{50}, the lethal dose (in milligrams of substance per kilogram of body weight) that kills 50% of the test animals in a standard assay (See Table B). WHO gives a hazard ranking of Ia (Extremely Hazardous) to the most hazardous pesticide active ingredients. While the WHO ratings generally reflect acute toxicity, they also take into account other toxic effects such as reproductive and developmental toxicity. WHO does not evaluate the fumigants, a class of gaseous pesticides that are generally extremely hazardous, nor does it evaluate pesticides believed obsolete or discontinued, even though some of these "obsolete" pesticides are currently registered for use in the U.S.

U.S. EPA Acute Toxicity Rankings

Formulated pesticide products (which often include inert ingredients) are given an acute toxicity rating by the U.S. EPA which is reflected in the warning label on the pesticide container. The U.S. EPA gives a warning label of Category I to the most acutely toxic pesticide products and Category IV to the least acutely toxic pesticide products.

Table C. U.S. EPA Acute Toxicity Rankings

EPA Warning Label			Acute Toxicity to Rats				
Category	**PAN Narrative Rating**	**Warning Label**	**Oral LD_{50} (mg/kg)**	**Dermal LD_{50} (mg/kg)**	**Inhalation LC_{50} (mg/L)**	**Eye Effects**	**Skin Effects**
I	Highly toxic	Danger-Poison*	< 50	< 200	< 0.05	----	----
I	Highly toxic	Danger	< 50	< 200	< 0.05	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days.	Corrosive (tissue destruction into the dermis and/or scarring)
II	Moderately toxic	Warning	50 - 500	200 - 2,000	0.05 - 0.5	Corneal involvement or irritation clearing in 8-21 days	Severe irritation at 72 hours (severe erythema or edema)
III	Slightly toxic	Caution	500 - 5,000	2,000 - 5,000	0.5 - 2	Corneal involvement or irritation clearing in 7 days or less	Moderate irritation at 72 hours (moderate erythema)
IV	Practically nontoxic	None	› 5,000	› 5,000	> 2	Minimal effects clearing in less than 24 hours	Mild or slight irritation (no irritation or slight erythema)

*This signal word is used for acute systemic poisons.

The different toxicity categories are based on the LD_{50}, the lethal dose (in milligrams of substance per kilogram of body weight) that kills 50% of the test animals in a standard assay. For inhalation exposures, the LC_{50} is used---the concentration in air in mg per liter that kills 50% of the test animals.

Active ingredients can be similarly ranked for toxicity on the basis of LD_{50} values. Thus, warning labels for single-active-ingredient pesticide products containing technical grade active ingredients over 90% pure can serve as a reasonable proxy for the toxicity of the active ingredient.

U.S. EPA-OPP Carcinogen List

The U.S. EPA Office of Pesticide Programs maintains a List of Chemicals Evaluated for Carcinogenic Potential, which classifies pesticides by their role in causing cancer in humans and laboratory animals. The process by which chemicals are ranked involves first selecting the chemicals to evaluate, than bringing together a panel of scientists who evaluate the available data and make a decision about a cancer ranking based on the weight of the evidence. The data evaluated includes both epidemiological studies on humans exposed to the chemical in the course of their daily lives and studies on laboratory animals. Chemicals that have been studied extensively are more likely to have an accurate rating; however, this means that newer chemicals that have been on the market for less time may not have been studied sufficiently for scientists to conduct a complete evaluation. Every registered pesticide active ingredient must be categorized as to its carcinogenic potential. EPA uses the following categories in assessing evidence of carcinogenicity are: The absence of a chemical on any of the carcinogen lists does not necessarily mean it is not a carcinogen. It may mean that it has not yet been evaluated.

Category A	Known to cause cancer in humans. Generally based on epidemiological data showing sufficient evidence to support a causal association between exposure to the substance and cancer.
Category B	Known to cause cancer in animals but not yet definitively shown to cause cancer in humans. These chemicals are designated "probable human carcinogens." Category B is further split into pesticides for which some evidence exists that it causes cancer in humans (B1) and those for which evidence exists only in animals (B2).
Category C	Possible human carcinogens, where the data show limited evidence of carcinogenicity in the absence of human data.
Category D	This category is for chemicals for which the data are either incomplete or ambiguous and is labeled "cannot be determined." This category is appropriate when tumor effects or other key data are suggestive or conflicting or limited in quantity and are thus not adequate to convincingly demonstrate carcinogenic potential for humans. In general, further chemical-specific and generic research and testing are needed to be able to describe human carcinogenic potential.
Category E	Probably not carcinogenic, with no evidence of carcinogenicity in at least two adequate animal tests in different species in adequate epidemiologic and animal studies. This classification is based on available evidence and does not mean that the agent will not be a carcinogen under any circumstances.

(Table information from http://www.pesticideinfo.org/documentation/ref_toxicity.html#WHOHazardRanking)

1.3 Exposure Scenarios

Studies required for herbicide registration must increase dosage until effects occur, usually at levels much higher than would ever be present in normal use. Many of the toxic effects reported have only been observed in the lab. It is unlikely that the scenarios will exist to replicate the ill effects that occur during scientific study (e.g. force feeding, direct application of herbicide to trachea). Nearly all of the laboratory results reported are based on use of the pure pesticide or pesticide concentrate; as used by the District, the concentrate is diluted in water to approximately 1% to 5%, depending on product.

Nonetheless, credible paths of public exposure to these herbicides do exist and include herbicide drift, spill, over-spray and release. Exposure scenarios have been created in order to put the results of laboratory tests in context with real risk possibilities to the public. An exposure scenario is a hypothetical situation in which a subject could be exposed to a pesticide. The amount the subject is likely to be exposed to is determined from the District use of each pesticide product. Compare the exposure amount to the LD_{50} to determine the exposure risk from each scenario. For this risk assessment, several very conservative scenarios are developed. As discussed below, most of these scenarios should be regarded as extreme.

1. Herbivore. This is a maximum exposure scenario where a large application area is consumed by a small animal. The "hungry rat" weighs 0.5 kilograms (kg) and consumes all vegetation within a 10 meter square (m^2) (~108 square foot) pasture that has just been sprayed with an herbicide. The mass of green vegetation would be at least 2 kg (5 lbs), otherwise there would not have been enough foliage to adsorb the spray and spray would have runoff into the ground. The scenario assumes consumption over several days but is an extreme dose for a small animal. For a larger animal, such as a goat grazing the same area, the same quantity of chemical would be divided by a larger body weight resulting in a proportionally smaller dose.

2. Child. Many of the exposure scenarios for the general public involve a child (Syracuse 1996). The "exposed child" is an important test of herbicide effect because the relationships of surface area and consumption rates to body weight result in estimated doses for young children that are higher than those for adults. The EPA recommends that dermal exposure scenarios that involve children use the following set of assumption: the child is 2 to 3 years old, weight 11 kg, and has a total body surface area of 0.6 m^2 (24 lbs, 6 ft^2). The child is assumed to be naked, maximizing the surface area of the body in contact with the chemical (Syracuse 1996). The child is assumed to be completely covered and the actual dose would not include chemical in spray that was absorbed by clothing, dripped off, or was washed off.

3. Adult. The "soaked sunbather" scenario addresses the risk of herbicide drift. The 50 kg sunbather is assumed to be covered with the maximum amount of herbicide in an applied area of $2m^2$ (110 lbs, 20 ft^2). Again, it is assumed that all the herbicide in the $2m^2$ sprayed area is absorbed into the body. In fact, dermal absorption rates are fairly slow and the actual dose would not include chemical in spray that was absorbed by clothing, dripped off, or was washed off.

There is a relationship between the amount ingested or the surface area of body exposed and the subsequent risk. To calculate the exposure amount, the first step is to determine the District's application rate, based on District practice consistent with the product label. Table P-1, Application Rate for District Use Herbicides, lists the herbicide, the product name and the % of product which is active ingredient. The product is diluted with water for application. The application rate is the quantity of active ingredient applied to the land, expressed as pounds per acre and milligram per square meter. The concentration of active ingredient in the spray solution is expressed as grams per liter.

Although a few of the herbicides may be applied between two to four times per year, most are applied no more frequently than once per year. Therefore, we are concerned with potential acute, single exposures; subchronic and chronic exposure is likely to be extremely low for the public or their pets. Table P-2, Acute Toxicity and Exposure for District Use Herbicides, lists the LD_{50} for oral and dermal exposure and presents the respective doses for the exposure scenarios. It is clear that only the aggressive herbivore scenario has ingested doses approaching acutely toxic levels; the human exposure scenarios are always 100 fold or more below the toxic level.

Table P-1 shows the application rates used by the District for each pesticide. Table P-2 lists the LD50s and the potential exposure scenario level for each pesticide based on the District application rates.

Table P-1: Application Rate for District Use Herbicides

			Broadcast Application Rates for Active Ingredient			
Active Ingredient	Herbicide Product	% active ingredient	pounds/acre	mg/m^2	spray dilution %	solution g/L
isoxaben	Gallery	75	0.75	84.06		0.45-8.99
triclopyr	Garlon 3A	44.4	1.5	168.13		1.81-9.22
triclopyr	Garlon 4	61.6	1.0	112.19		1.198
sulfometuron methyl	Oust	75	0.23	26.27		0.70-1.87
pendimethalin	Pendulum	60	3.0	336.26		< 8.99
glyphosate	Rodeo	53.8	2.7	302.63		1.5
glyphosate	RoundUp Pro	41	2.5	240		2%
oryzalin	Surflan	40.4	4.0	448.34		-
chlorsulfuron	Telar	75	0.09	10.54	0.06%	0.056
clopyralid	Transline	40.9	0.25	28.02	0.075%	3.99
Target Pro Spreader Used with Aqua-master		surfactant			.5%	
Garlon					.25%	

R-11 surfactant Used with Aqua-master Garlon	surfactant		.5% .25%

Table P-2: Acute Toxicity and Exposure for District Use Herbicides

Active Ingredient	Herbicide Product	LD_{50} mg/kg		Exposure scenario mg/kg		
		Oral (rat)	Dermal (rabbit)	Herbivore 0.5 kg animal,10m^2 exposure	Child 11 kg person, 0.6m^2 exposure	Adult 50 kg person, 2m^2 exposure
isoxaben	Gallery	>10,000	>2000	1680	4.58	3.36
triclopyr	Garlon 3A	1847	>5000	**3360**	9.17	6.73
triclopyr	Garlon 4	1338	>2000	**2240**	6.12	4.49
sulfometuron methyl	Oust	>5000	>2000	525	1.43	1.05
pendimethalin	Pendulum	>5000	>2000	**6730**	18.3	13.5
glyphosate	Rodeo/ Aqua-master	>5000	>5000	**6050**	16.5	12.1
glyphosate	RoundUp Pro	5600	>5000	**5600**	15.3	11.2
oryzalin	Surflan	>10,000	>2000	8970	24.5	17.9
chlorsulfuron	Telar	5545	3400	211	0.57	0.42
clopyralid	Transline	>5000	>5000	560	1.53	1.12
Target Pro-spreader Used with Garlon and Aqua-master		>3500	-			
R-11 Surfactant used with Garlon and Aqua-master		790	3400-4200			

1.4 Ground water contamination

Ground water is the water found in spaces between soil particles and rocks, and within cracks of the

bedrock. Ground water, stored and moved through underground aquifers, is the largest single supply of fresh water available for use by humans. In the United States, up to 50% of the population depends on ground water for drinking. However, this water supply is susceptible to contamination by human activities on the land above.

The ability of pesticides to contaminate ground water is of important concern. The draft Ground Water Protection Regulations (1/03/01) defines two types of "ground water protection areas" (GWPA): "Leaching" GWPA where pesticide may be carried directly into the ground water by infiltrating water flow, and "runoff" GWPAs where pesticides may run off of the application site and affect ground water recharge elsewhere (California Code 2001).

The determination of a ground water protection area is based on factors, such as soil type, climate, and depth to the ground water, that are characteristic of areas where legally applied pesticides or their breakdown products have been detected and verified in ground water (California Code 2001).

"Leaching ground water protection areas" are areas of land listed as "Leaching Areas" in the Department of Pesticide Regulation document EH-99-xx entitled "Ground Water Protection January 3, 2001" (California Code 2001). In Santa Clara County, leaching areas are found along the Pajaro River, between US 101 and CA 25.

"Runoff ground water protection areas" are areas of land listed as "Runoff Areas" in the Department of

Pesticide Regulation document EH-99-xx entitled "Ground Water Protection Areas," where pesticide residues are carried in runoff water to more direct routes to ground water such as dry or drainage wells, poorly sealed production wells, or soil cracks, or to areas where leaching can occur (California Code 2001). None of these areas are subject to direct District application.

None of the pesticides proposed for use by the District have been found in ground water, however some share characteristics in common with known leachers and may become further restricted in their use. Four herbicides have been identified as suspected leachers pursuant to section 13145(d) of the Food and Agricultural Code: chlorsulfuron, isoxaben, oryzalin, sulfometuron-methyl. There are currently no additional restrictions on the use of these herbicides, however, the treatment of these herbicides as if they were known leachers if under review.

Pesticide levels in ground water show pronounced seasonal variability in agricultural areas, with maximum values often following spring applications. (http://water.wr.usgs.gov/pnsp/gw/)

1.5 Glossary of Terms and Abbreviations

- Active ingredient

acute effect Adverse effect on a human or animal which has severe symptoms developing rapidly and coming quickly to a crisis. Also see "chronic effect."

acute toxicity Acute effects resulting from a single dose of or exposure to a substance. Ordinarily used to denote effects in experimental animals.

contaminant A contaminant is an inadvertent waste products of chemical manufacture that cannot be removed from herbicide ingredients.

EPA U.S. Environmental Protection Agency

FIFRA Federal Insecticide, Fungicide, and Rodenticide Act

IOBC International Organization for Biological Control

LC_{50} Median Lethal Concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. It is usually expressed as the weight of substance per weight or volume of water, air or feed, e.g., mg/L, mg/kg or ppm.

LD_{50} Median Lethal Dose. A statistically derived single dose that can be expected to cause death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation). It is expressed as a weight of substance per unit weight of animal, e.g., mg/kg.

nonresidual Not having a continued lethal effect over a period of time.

nonselective Used to describe a herbicide that is generally toxic to plants without regard to species; toxicity may be a function of dosage, method of application, and the like.

perennial A plant that lasts for more than two growing seasons

persistent herbicide Herbicide that, when applied at the recommended rate, will harm susceptible crops planted in normal rotation after harvesting the treated crop, or that interfere with regrowth of native vegetation in noncrop sites for an extended period of time . *See also* residual herbicide.

postemergence Used to describe an herbicide that is applied after specified weeds have emerged from the soil.

preemergence Used to describe an herbicide that is applied to an area before specified weeds have emerged from the soil.

ppm Parts per million

residual herbicide Herbicide that persists in the soil and injures or kills germinating weed seedlings over a relatively short period of time. *See also* persistent herbicide.

restricted use

pesticide A pesticide that the EPA determines must be applied under the direct supervision of a qualified applicator. Such clarification for restricted use is based upon consideration of toxicity data, including acute toxicity, exposure, and intended use.

RfD The RfD is an estimate of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

SARA Title III Superfund Amendment and Reauthorization Act of 1986

surfactant Ingredient that aids or enhances the surface-modifying properties of a pesticide formulation (wetting agent, emulsifier, or spreader).

translocation Transfer of food or other materials such as herbicides from one plant part to another.

1.6 References

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2.0 Herbicides

2.1 Glyphosate

2.1.1 Technical information

2.1.1.1 Use

Glyphosate belongs to a group of compounds known as phosphono amino acids. It is a

nonselective, nonresidual, postemergence material, and is recognized for its effectiveness against perennial, deep-rooted, grass and broadleaf weeds, as well as woody brush problems in crop and noncrop areas. It is a translocated, foliar-applied herbicide and although it can be applied at any stage of plant growth or at any time of year, with most types of application equipment (Ware 2000), it can be more effectiveness on some plants can be increased by application during a specific season and growth stage.

2.1.1.2 Chemistry

Chemically glyphosate is an organophosphate although it lacks organophosphate esters and therefore does not significantly inhibit cholinesterase activity and affect the nervous system as do organophosphate insecticides (e.g., malathion and parathion) (EXTOXNET 1996*a*). Glyphosate does not contain chlorine. Glyphosate itself is a phosphono amino acid, but it is commonly used in salt form. In Aquamaster and RoundUp, it is in the form of the isopropylamine salt.

2.1.1.3 Mode of action

Glyphosate moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, but on most perennial brush species effects may not occur for 7 days or more. Visible effects include gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts (Label).

The mode of action appears to be the inhibition of the synthesis of aromatic amino acids, which results in the inhibition of nucleic acid metabolism and protein synthesis. Phosphono amino acid herbicides penetrate foliage rather slowly, thus rainfall shortly after application can reduce effectiveness (Ware 2000).

2.1.1.4 Products and formulation

Glyphosate is the active ingredient in two herbicides used by the District, Aquamaster® and Roundup® Pro. There are a variety of additional glyphosate-based products available, including Accord®, Credit®, Gallup®, Landmaster®, Polado®, Pondmaster®, Protocol®, Ranger®, Rodeo® and Touchdown®, and it is likely that in the future new formulations will be developed.

Aquamaster and Rodeo were developed in parallel by Monsanto Corporation. Both herbicides have the identical formulation and are currently labeled for the same uses. Recently, Monsanto has sold the trade name of "Rodeo" to Dow AgroSciences and in the future Rodeo will be labeled for a slightly different use. As a result, the District will be using the herbicide Aquamaster for its in channel vegetation control. All research studies and results that refer to or were done on Rodeo can be used in determining the health and

environmental safety impacts of Aquamaster.

The Roundup® Pro formulation is 41% isopropylamine salt of glyphosate, 14.5% surfactant (a phosphate ester neutralized polyethoxylated tallowamine blend (POEA)), and water. No additional surfactant is needed or recommended. It is a postemergent, systemic herbicide with no soil residual activity. It gives broad spectrum control of many annual weeds, perennial weeds, woody brush and trees. Roundup® Pro is not approved for application directly in water.

The formulation for Aquamaster® is 53.8% isopropylamine salt of glyphosate and 46.2% inert ingredients. It is water-soluble and mixes readily with water and a nonionic surfactant (the District uses R-11 (See section 13) or Pro Spreader (See section 14) to be applied as a foliar spray for the control or destruction of many herbaceous and woody plants. Aquamaster® is approved for application on "emerged weeds in all bodies of fresh and brackish water which may be flowing, non-flowing or transient" in non-crops areas.

2.1.1.5 Regulatory status

Glyphosate acid and its salts are moderately toxic compounds. Aquamaster is in EPA toxicity class III (EXTOXNET 1999*a*) and product labels must bear the signal word CAUTION. The recently formulated product, Roundup Pro is designated as a class III toxin and the label must state CAUTION. Roundup Pro is classified as an immediate hazard according to SARA Title III Rules criteria while Aquamaster is not (Monsanto 2000; 1999*d*). The surfactant in Roundup is listed as a hazardous chemical by OSHA (Monsanto 1999*d*). Glyphosate is a General Use Pesticide (GUP).

2.1.1.6 District use and application

The District times season of Roundup Pro and Aquamaster application to ensure best results with the least volume of product.

Roundup Pro is applied to control broadleaf weeds and grasses on top of bank areas between October and June. Annual weeds are controlled with a broadcast boom at the rate of 1½ quarts (qts) per acre. 2½ qts per acre will be spread with a broadcast boom to control for perennials. Both of these applications will occur once annually per site. As followup, 2% solution will be used as needed, up to 4 times annually, for spot applications with a hand gun. The 2½ quarts per acre application rate will result in a distribution of 2.5 lb/acre or 280 mg/m^2 of the active ingredient, glyphosate.

Aquamaster will be applied annually to control undesirable aquatic weeds, cattails, bulrush, and woody vegetation within the banks of a stream from July through mid October. Channel spraying will be done with spot applications using a hand gun with a 1½ percent solution.

Broadcast application will occur inside stream banks where there is existing toe to toe vegetation that requires control. The broadcast application method is rarely used since a hand gun will minimize potential drift, but when it is, the broadcast rate of application is four pints/acre (2.7 lb/acre or 302 mg/m^2 of glyphosate).

2.1.2 Public health

2.1.2.1 Acute toxicity

Acute studies are designed to assess the risk of single, one-time exposure to a product and require that doses be increased until the dose tested is lethal to 50% of the laboratory animals. This classifies the toxicity of a product based on the lethal dose (known as LD_{50}). Glyphosate is of relatively low oral and dermal acute toxicity. The EPA has placed it in Toxicity Category III for these effects (EPA 1993*a*). EXTOXNET states that the toxicities of glyphosate and the formulated product Roundup are nearly the same (1996*a*), however, the Northwest Coalition Against Pesticides (NCAP) says that "commercial glyphosate herbicides are more acutely toxic than glyphosate" (15 as cited by NCAP 1998*b*).

The following subcategories list the results of acute toxicity tests specifically done to measure the effects of each herbicide on eye, skin, oral and lung exposure. For some tests results are available on the impacts of not only the herbicide formulations Aquamaster and Roundup Pro, but glyphosate as well.

Eye - In a 24-hour exposure study, Rodeo was found to be non-irritating to the eyes of rabbits (Monsanto 2000). Roundup rubbed in a human eye caused eye and lid swelling, rapid heartbeat and elevated blood pressure (68 *as cited in* NCAP 1998*b*).

Skin - Rodeo is practically non-toxic and is in Toxicity Category III for dermal effects (EPA 1993*a*). The dermal LD_{50} for rabbits is > 5000 mg/kg (Monsanto 2000). It was also found to be practically nonirritating to the skin of rabbits with 24-hour exposure (Monsanto 2000). Glyphosate, in the form of isopropylamine salt, is practically nontoxic by skin exposure, with reported dermal LD_{50} >5000 mg/kg (EXTOXNET 1996*a*; Ware 2000; WHO 1994) and is classified as "slightly irritating to skin" (1998). It does not induce skin sensitization (WHO 1994) and skin patch tests done by Monsanto showed that Roundup Pro is no more irritating to human skin than baby shampoo and less irritating than dishwashing liquid (Monsanto 1999c). However, Roundup is a "moderate skin irritant" and recovery can take up to two weeks (Agriculture Canada 1991 as cited by NCAP 1998*b*). An incident of wiping the face after touching leaky spray equipment caused facial swelling (68 as cited by NCAP 1998*b*) and accidental drenching with horticultural Roundup caused eczema of the hands and arms lasting two months (68 as cited by NCAP 1998*b*).

Oral - Rodeo is practically non-toxic and is in Toxicity Category III for oral effects (EPA

1993*a*). The oral LD_{50} for rats is >5000 mg/kg (Monsanto 2000). Glyphosate is practically nontoxic by ingestion, with a reported acute oral LD_{50} of 5600 mg/kg in rats (Ware 2000; EXTOXNET 1996*a*) and greater than 10,000 mg/kg in mice, rabbits, and goats (EXTOXNET 1996*a*). This places glyphosate herbicides in Toxicity Category III (CAUTION). However studies indicate that "commercial glyphosate herbicides are more acutely toxic than glyphosate by itself" (15 as cited by NCAP 1998*b*; WHO 1994). "The amount of Roundup required to kill rats is about 1/3 the amount of glyphosate alone. Roundup is also more acutely toxic than POEA", the phosphate ester neutralized polyethoxylated tallowamine blend surfactant contained in the Roundup formulation (15 as cited by NCAP 1998*b*). Monsanto dismisses these studies since "such a large dose of concentrated Roundup could only be ingested intentionally" (Monsanto 1999c).

Inhalation - Rodeo was rated by FIFRA for inhalation effects and was found to be practically non-toxic and placed in FIFRA Category IV (Monsanto 2000). The LC_{50} for rats exposed for 4 hours is > 4.24 mg/l. The 4-hour rat inhalation LC_{50} for isopropylamine salt is 5-12 mg/L and indicates moderate toxicity (EXTOXNET 1996a). Glyphosate-containing products have been found to be more toxic via inhalation that orally (NCAP 1998*b*). In a study cited by NCAP, inhalation of Roundup by rats cause "signs of toxicity in all test groups," even at the lowest concentration tested (1998). These signs included gasping, congested eyes, reduced activity, and body weight loss (Agriculture Canada 1991, EPA 1982*b* as cited by NCAP 1998*b*). Lungs were red or blood-congested. The dose required to cause lung damage and mortality following pulmonary administration of two Roundup products and POEA (when forced into the trachea) was only1/10 the dose causing damage orally (15, 18 as cited by NCAP 1998*b*).

2.1.2.2 Subchronic toxicity

Studies with Rodeo - In a six month study, dogs fed Rodeo exhibited slight body weight changes (Monsanto 2000). Following repeated skin exposure over a three week period, Rodeo caused skin irritation only in rabbits (Monsanto 2000). No skin allergy was observed in guinea pigs following repeated skin exposure (Monsanto 2000).

Studies with glyphosate - Following repeated exposures (90 days) to glyphosate in their feed, decreased weight gains were noted at the highest test level in mice, while no treatment-related effects occurred in rats (Monsanto 1999*d*, 2000). Following repeated skin exposure over a three week period, glyphosate caused skin irritation only in rabbits (Monsanto 1999*d*, 2000). No skin allergy was observed in guinea pigs following repeated skin exposure (Monsanto 1999*d*, 2000). A feeding study with rats revealed blood and pancreatic effects (EPA 1993*a*). In mice, a similar study showed reduced body weight gains in both sexes at the highest dose levels (EPA 1993*a*). A dermal study with rabbits showed slight reddening and swelling of the skin, decreased food consumption in males and decreased enzyme production at the highest dose levels (EPA 1993*a*).

In studies done by the National Toxicology Program (NTP) with rats and mice and glyphosate, microscopic salivary gland lesions were found in all doses tested in rats (200-3000 mg/kg/day) and in all but the lowest dose tested in mice (1000-12000 mg/kg/day). A follow up study by NTP determined that the mechanism by which glyphosate caused these lesions involved the hormone adrenalin (74 *as cited by* NCAP 1998*b*). The study also found increases in two liver enzymes at all but the two lowest doses tested. Other effects found in at least two doses in this study were reduced weight gain in rats and mice; diarrhea in rats; and changes in kidney and liver weights in male rats and mice (74 *as cited by* NCAP 1998*b*). Another test found that blood levels of potassium and phosphorus in rats increased at all doses tested (60-1600 mg/kg/day) (4 *as cited by* NCAP 1998*b*). Monsanto does not agree with the NTP results or conclusions. Monsanto claims that the "listed effects were seen at doses many thousands of times higher than theoretical maximum human exposure" and complains that NCAP failed to properly acknowledge NTP's conclusion which states: "There was no evidence of genetic or reproductive toxicity of glyphosate" (74 *as cited by* Monsanto 1999c).

Glyphosate-containing products are more toxic than glyphosate in subchronic tests (NCAP 1998*b*). In a 7 day study with calves, 790 mg/kg/day of Roundup caused pneumonia and death of 1/3 of the animals tested. At lower doses decreased food intake and diarrhea were observed (2 *as cited by* NCAP 1998*b*).

2.1.2.3 Chronic toxicity

Studies of glyphosate lasting up to 2 years have been conducted with rats, dogs, mice, and rabbits, and with few exceptions, no effects were observed (EXTOXNET 1996a; EPA 1993*a*). For example, no toxic effects were observed in rats given doses as high as 400 mg/kg/day (EXTOXNET 1996a). A 2-year feeding of high glyphosate doses fed to mice resulted in reduced body weight gain and effects on liver tissues (Monsanto 2000). Reduced body weight gain and eye changes were observed at the high-dose level in one long-term 2 year rat feeding study, while no treatment-related effects occurred in a second study. No adverse effects were observed in feeding studies with dogs (Monsanto 2000). However, there are also studies that show glyphosate to be toxic. At all but the lowest dose tested, excessive cell division in the urinary bladder occurred in male mice and inflammation of the stomach lining occurred in both sexes of rats (2 *as cited by* NCAP 1998*b*).

The EPA has established a reference dose (RfD) of 0.1 mg/kg/day. The RfD is an estimate of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime (Halstead 1998). In practical terms, this means that a 50 kg adult (110 lbs) must drink 20 ounces of spray solution per day to be exposed at the EPA reference dos. It is unlikely that amounts at this level will be accidentally ingested on a regular basis.

2.1.2.4 Carcinogenic effects

There is controversy over the carcinogenic effects of glyphosate. See *Controversy over health effects*.

2.1.2.5 Mutagenic effects

There is controversy regarding the mutagenic effects of glyphosate products. See *Controversy over health effects.*

2.1.2.6 Reproductive effects

There is controversy regarding the reproductive effects of glyphosate products. See *Controversy over health effects.*

2.1.2.7 Teratogenic effects

In studies done by Williams and studies cited by EXTOXNET, glyphosate, AMPA, and POEA have not been found to be teratogenic or developmentally toxic (2000; 1996*a*). No birth defects were noted in rats and rabbits given glyphosate orally during pregnancy, even at amounts which produced adverse effects on the mothers (Monsanto 1999*d*; 2000). No developmental toxicity was observed in rabbit fetuses at the highest dose tested (350 mg/kg/day) (EXTOXNET 1996*a*). Rats fed doses up to 175 mg/kg/day on day 6 and 19 of pregnancy had offspring with no teratogenic effects, but other toxic effects were observed in both the mothers and the fetuses (EXTOXNET 1996*a*). No toxic effects to the fetuses occurred at 50 mg/kg/day. However, the EPA cites developmental toxicity studies using pregnant rats and rabbits in which glyphosate caused treatment-related effects in the high dose groups including diarrhea, decreased body weight gain, nasal discharge and death (1993).

2.1.2.8 Organ toxicity and systemic effects

Glyphosate causes some microscopic liver and kidney changes, but no observable differences in function or toxic effects, were seen after lifetime administration of glyphosate to test animals (EXTOXNET 1996*a*; Monsanto 2000). Other studies show glyphosate to be linked to toxicity in liver and blood and that it may affect the kidney and thymus (CAT 1999). There is concern that it decreases the levels of a detoxification enzyme in the liver and that glyphosate may affect adrenalin levels as well (CAT 1999).

When dogs were given intravenous injections of glyphosate, POEA, or Roundup so that blood concentrations approximated those found in humans who ingested glyphosate, it was found that glyphosate increased the ability of the heart muscle to contract. The output of the heart and the pressure in the arteries were reduced by POEA and Roundup caused cardiac

depression (19 as cited by NCAP 1998*b*).

There was no evidence of effects on the nervous system, including delayed effects in chickens (repeat oral doses) or cholinesterase inhibition in rats (single oral doses) (Monsanto 2000).

2.1.2.9 Fate in humans and animals

Neither glyphosate nor the metabolite aminomethyl phosphonic acid (AMPA) bioaccumulate in animal tissue. Glyphosate and AMPA are poorly absorbed from the digestive tract and are essentially excreted unmetabolized by mammals (Williams 2000; EXTOXNET 1996*a*). At 10 days after treatment, there were only minute amounts of glyphosate in the tissues of rats fed glyphosate for 3 weeks (EXTOXNET 1996*a*). Cows, chickens, and pigs fed small amounts of glyphosate had undetectable levels (< 0.05 ppm) in muscle tissue and fat (EXTOXNET 1996*a*). Levels in milk and eggs were also undetectable (< 0.025 ppm) (EXTOXNET 1996*a*). In a different study with rats, 97.5% of the administered glyphosate was excreted in urine and feces as the parent compound and less than 1% remained in tissues and organs, primarily in bone tissue (EPA 1993*a*). Another study with rats showed that very little glyphosate reaches bone marrow, that it is rapidly eliminated from bone marrow, and that it is even more rapidly eliminated from plasma (EPA 1993*a*).

Although AMPA has low acute toxicity (LD50 of 8300 mg/kg in rats), it is a cause of concern because it has been shown to cause a variety of toxicological problems (Agriculture Canada 1991 as cited by NCAP 1998*b*). In subchronic tests on rats, "AMPA caused an increase in the activity of an enzyme, lactic dehydrogenase, in both sexes; a decrease in liver weights in males at all doses tested; and excessive cell division in the lining of the urinary bladdery of both sexes" (Agriculture Canada 1991 as cited by NCAP 1998*b*).

2.1.2.10 Occupational and residential exposure

Exposure of agriculture and landscape maintenance workers to glyphosate is generally not expected to pose undue risks due to the compound's low acute toxicity, however, in California, glyphosate ranks high among pesticides causing illness or injury to workers (EPA 1993*a*). Between 1984 and 1990, glyphosate-containing herbicides were the third most commonly reported cause of pesticide illness among agricultural workers. Among landscape maintenance workers, they were the most commonly reported cause (Robinson 1994 as cited by NCAP 1998*b*). While most splashes during mixing and loading can cause incidents of eye and skin irritation, a survey of about 100 reports made in 1993, 1994, and 1995 found that over half of the incidents involved more serious effects including: burning of the eyes or skin, blurred vision, peeling of skin, nausea, headache, vomiting, diarrhea, chest pain, dizziness, numbness, burning of the genitals, and wheezing (Cal. EPA 1998 as cited by NCAP 1998*b*). A British study showed that workers who breathed dust from

Roundup treated flax experienced a decrease in lung function and an increase in coughing and breathlessness (104 as cited by NCAP 1998*b*).

A study of CALTRANS herbicide mixer/loader and applicators found that absorbed dosages of glyphosate (0.001 mg/kg/day) were well below EPA's RfD (Halstead 1998).

2.1.2.11 Effects of inert ingredients and surfactant

The surfactant in Roundup Pro is POEA. According to Pesticide Watch, POEA is significantly more toxic than glyphosate (2000) and many environmental and citizen groups are concerned about the potential dangers of this ingredient (Greenpeace, World Rainforest Movement, Natural Law Party of New Zealand). POEA causes eye burns, skin redness, swelling, and blistering, nausea, and diarrhea (23,45 as cited by NCAP 1998*b*). Glyphosate and POEA are 3 times more toxic when mixed together than either are when tested alone (CAT 1999). However, Monsanto contends that POEA is safe and that it is commonly used in detergents, shampoos, soaps and makeup (Monsanto 1999c).

Another Roundup "inert", isopropylamine is destructive to tissues of the mucous membranes and the upper respiratory tract, eyes and skin. "Inhalation may result in spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting"(Sigma 2001; CAT 1999; 65 as cited by NCAP 1998*b*)

Other concerns include the surfactant contaminant,1,4-dioxane and the transformation product N-nitrosoglyphosate (NNG). According to Monsanto 1,4-dioxane is a common solvent used in laboratories as well as in industrial applications, and it also naturally occurs in tomatoes, coffee and shrimp. 1,4-dioxane is found as a trace level constituent in virtually any product that contains an ethoxylated ingredient including cosmetics, household detergents, baby shampoo, and the surfactant in Roundup® herbicide. In the past, 1,4-dioxane could be found as a trace level constituent of the final product. In current formulations, Monsanto claims to have reduced the trace quantities of 1,4-dioxane to extremely low levels, which are difficult to detect (1999c). However 1,4-dioxane is a potent liver carcinogen (CAT 1999; Briggs 1992) and there is concern about its presence in Roundup at any level.

NNG is a suspect carcinogen and suspect mutagen (Briggs 1992). The potential for NNG to cause cancer is unknown (Information 1995). During an investigation by Monsanto into the composition of Roundup® herbicide, it was found that a trace amount of N-Nitrosoglyphosate (NNG) was present at levels below 0.1 ppm. Monsanto conducted a range of toxicology, environmental residue and metabolism studies, along with applicator exposure studies and concluded that:

1.NNG has not been shown to cause significant adverse health effects

2.The concentration of NNG in Roundup herbicide is extremely low

3.Exposure to the applicator under normal use conditions is non-detectable

4.Exposure to the general populace is virtually non-existent

5.Biodegradation and photodegradation are both rapid and essentially complete (Monsanto 1999*c*)

Based on these studies, Monsanto suggests that trace levels of NNG in Roundup herbicide do not present an unacceptable risk to man or the environment, that its formation in the environment following application of Roundup is most unlikely, and that this N-nitroso compound is not present in crop residues (Monsanto 1999*c*).

2.1.2.12 Controversy over health effects

*Carcinogenicity***:** Glyphosate did not produce tumors in any feeding studies (Monsanto 1999*d*, 2000; Williams 2000). Rats given oral doses of up to 400 mg/kg/day did not show any signs of cancer, nor did dogs given doses of up to 500 mg/kg/day or mice fed glyphosate at doses of up to 4500 mg/kg/day (EXTOXNET 1996*a*; EPA 1993*a*). However, a recent study of hairy cell leukemia (HCL), a form of the cancer non-Hodgkin's lymphoma, found that people who were occupationally exposed to glyphosate herbicides had a threefold higher risk of HCL (74a, Hardell and Eriksson 1999 *as cited by* NCAP 1998*b*).

Furthermore, NCAP is concerned about the following studies, done by or for the manufacturer, that found tumors and which were dismissed by the EPA as inconclusive. At a dose of 30 mg/kg/day, the highest dose tested, a 1981 study found an increase in testicular tumors in male rats as well as an increase in the frequency of a thyroid cancer in females (EPA 1982*a*, EPA 1983*a as cited by* NCAP 1998*b*). A second study (1983) showed an increasing trend in the frequency of a rare kidney tumor in male mice (EPA 1985 *as cited by* NCAP 1998*b*). Most recently (1990) a study found an increase in pancreas and liver tumors in male rats together with an increase of the same thyroid cancer found in the 1983 study but this time in females (NCAP 1998*b*). The EPA did not consider glyphosate to be the cause of any of these increases in tumor or cancer. Glyphosate was classified as Group E carcinogen (EPA 1993*a*). However, the EPA added that this classification "should not be interpreted as a definitive conclusion" (EPA 1991*c as cited by* NCAP 1998*b*). Nevertheless, the Rachel Carson Council rates glyphosate and its transformation products formaldehyde and N-nitrosoglyphosate suspect carcinogens (Briggs 1992). Glyphosate herbicides also contain the contaminant 1,4-dioxane which is a potent liver carcinogen (CAT 1999, Briggs 1992).

Mutagenic effects: Monsanto Company and the EPA have concluded that glyphosate has produced no genetic changes in a variety of mutagenicity and genotoxicity assays using animals and animal or bacterial cells (Monsanto 1999*d*, 2000; EXTOXNET 1996*a*; EPA 1993*a*). There was no convincing evidence for direct DNA damage in vitro or in vivo and it was concluded that Roundup and its components do not pose a risk for the production of heritable/somatic mutations in humans (Williams 2000). However, several studies in peer-review journals have shown the opposite, that both glyphosate and glyphosate-containing products are indeed mutagenic and that the formulated products are the more potent mutagens (81 *as cited by* NCAP 1998*b*).

In a study with fruit flies, Roundup increased the frequency of sex-linked, recessive lethal mutations (83 *as cited by* NCAP 1998*b*). In human lymphocytes, an increase in the frequency of sister chromatid exchanges was found following exposure to Roundup at both doses tested (0.1 mg/mL and .33 mg/mL) and with glyphosate at all but the lowest dose (Bolognesi 1997 *as cited by* NCAP 1998*b*).

Roundup was found to be weakly mutagenic at two concentrations in salmonella bacteria (85 *as cited by* NCAP 1998*b*). In onion rootcells, Roundup caused an increase in chromosome aberrations, also at two concentrations (85 *as cited by* NCAP 1998*b*). In mice injected with Roundup, the frequency of DNA mutations in the liver and kidney increased at all three doses tested (200, 400 and 600 mg/kg) (86 *as cited by* NCAP 1998*b*). In another study with mice, injections of glyphosate and Roundup cause an increase in the frequency of chromosome damage and DNA damage in the bone marrow, liver and the kidney (81 *as cited by* NCAP 1998*b*). Only a single concentration was tested in this study. The Rachel Carson Council considers glyphosate and its transformation products formaldehyde and N-nitrosoglyphosate suspect mutagens (Briggs 1992).

Reproductive effects: Laboratory studies show that glyphosate produces reproductive changes in test animals very rarely and then only at very high doses (over 150 mg/kg/day) (EXTOXNET 1996a). Glyphosate was fed continuously to rats at very high dose levels for 2 successive generations (Monsanto 1999*d*; 2000). Toxicity was reported in offspring from the high dose, a level which also produced adverse effects on the mothers (Monsanto 1999*d*; 2000). In a 3 generation study conducted at lower dosages, no effects were seen on the ability of male or female rats to reproduce (Monsanto 1999*d*; 2000). A reproductive toxicity study with rats showed kidney effects in the high dose male pups; another study showed digestive effects and decreased body weight gain (EPA 1993*a*). Studies by Williams found no effects on fertility or reproductive parameters in two multigeneration studies and found no adverse effects in reproductive tissues from animals treated with glyphosate, AMPA (the glyphosate metabolite aminomethyl phosphonic acid), or POEA (2000). It is therefore unlikely that the compound would produce reproductive effects in humans (EXTOXNET 1996a).

However, studies exist that have linked glyphosate use to reproductive problems in humans

and laboratory animals. A Canadian study found that fathers' use of glyphosate was associated with an increase in miscarriages and premature births in farm families (87 *as cited by* NCAP 1998*b*). In rats, glyphosate reduced sperm counts at the two highest doses tested (74 *as cited by* NCAP 1998*b*). In male rabbits, glyphosate at doses of 1/10 and 100 of the LD50 caused an increase in the frequency of abnormal and dead sperm (89 *as cited by* NCAP 1998*b*). In a study from Texas Tech University, researchers used cells taken from Leydig cell testicular rumors in mice, showed that exposure to Roundup (but not glyphosate alone) caused a decrease in the production of sex hormones. Roundup inhibited the expression of a protein that carries cholesterol to the site where sex hormones are made. Without the necessary amount of cholesterol, the testicle cells' production of sex hormones decreased about 90 percent (89*a as cited by* NCAP 1998*b*). A study with female rabbits, glyphosate caused a decrease in fetal weight in all treated groups (EPA 1980 as cited by NCAP 1998*b*).

O'Neill press release: O'Neill states that "most of the studies identifying RoundUp's true toxicity are recent, and certain areas of RoundUp's toxicity have yet to be thoroughly studied.... It is important to also look to anecdotal information about RoundUp's toxicity to humans in order to develop a full picture of the symptomology it causes" (2001). O'Neill provides anecdotal evidence of central nervous system damage after exposure to Roundup. She says that Monsanto's original neurotoxicity studies on RoundUp were ruled invalid by the EPA due to "extensive gaps in the raw data supporting study findings and conclusions and that there has been no requirement for a new study on the neurotoxicity of RoundUp.

O'Neill points out that some people are more vulnerable to pesticides than others and those that take certain medications are similarly at risk. Tagamet and other H-2 Blockers such as Axid and Pepcid, all available over the counter, increase the vulnerability of persons taking these drugs to pesticide poisoning. These drugs vie for the same detoxification pathways in the body as pesticides do, making people taking the drugs more susceptible to the effects of pesticide poisoning.

Estrogen can also be an important factor in the severity of the impact RoundUp has on people.

Iris Bell, M.D., Ph. D. of the University of Arizona Health Sciences Center is quoted:

"In the sensitization process, we know that female animals are more likely to sensitize than are male animals, and, in research that has been done, picking apart the hormonal factors that may contribute, they found that a higher ratio of estrogen to progesterone seems to make the female animal more vulnerable for sensitization. Testosterone appears to protect the male animal."

O'Neill is also concerned about RoundUp being a cholinesterase inhibitor. "Merely saying glyphosate is not a cholinesterase inhibitor, however, does not define whether RoundUp

itself in full formulation is a cholinesterase inhibitor, and there are no published studies that purport to answer this question" (O'Neill 2001).

O'Neill refers to the work of Hardell and Eriksson (1999) and states that the scientists have established "clear links" between glyphosate and non-Hodgkin's lymphoma. The cited paper itself, however, shows no statistically significant effect. O'Neill also provides contact information for the Department of Cell Biology and Biochemistry at Texas Tech University where a study was recently released in which "RoundUp has just been conclusively identified as an Endocrine Disruptor" (O'Neill 2001) (Lance P. Walsh, Chad McCormick, Clyde Martin, and Douglas M.Stocco1. Roundup Inhibits Steroidogenesis by Disrupting Steroidogenic Acute Regulatory (StAR) Protein Expression).

Disagreement between Monsanto and the Northwest Coalition for Alternatives to Pesticides: The Journal of Pesticide Reform (JPR) is a magazine produced by the Northwest Coalition for Alternatives to Pesticides (NCAP), an activist group based in Eugene, Oregon. The journal has published articles on a number of herbicide active ingredients, including glyphosate. Monsanto Company criticizes the magazine because it is not peer reviewed. But since JPR does not publish original research, this is an inappropriate criticism and does not apply. Virtually all of the studies cited in their factsheets are either from peer-reviewed journals, government documents, or publications from pesticide manufacturer.

On their website, Monsanto has published a thorough evaluation of the Journal's glyphosate reports done by an independent researcher. His report states: "As with any review of bad work, an unexpected amount of detail and time has been required to reread and re-analyze almost every publication and report referenced in the articles ... The faults in the (NCAP) presentations cannot be attributed to inadequate understanding. I believe these articles contain serious misrepresentations of both published research and official regulatory reviews ... Very general statements are made implying that glyphosate is severely toxic. There is no evidence in any quoted source that supports that idea ... It is difficult to avoid a conclusion that the purpose of these papers is political, not informative." (Monsanto 1999*c*)

There also exists a rift of distrust between citizen activist groups and Monsanto due to the substantiated instances of fraudulent laboratory studies and altered results in tests required for product registration (US Congress 1984, 95 as cited by NCAP 1998*b*; Pannozzo 1999). As recently as 1996, a suit was won against Monsanto for claiming the herbicide is non-toxic and biodegrades into naturally occurring elements (Attorney General 1996 as cited by NCAP 1998*b*). Such fraudulent advertising has left some consumers uneasy about what the real effects of the herbicide, especially since the product formulation is kept a secret and the identity of inert ingredients is unknown.

2.1.3 Environmental safety

2.1.3.1 Label limitation

Roundup Pro - Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. For non-crop use, there is no re-entry period once the spray solution has dried.

Rodeo - Do not contaminate water when disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation. The likelihood of plant injury resulting from drift is greatest when winds are gusty or in excess of 5 mph or when other conditions, including lesser wind velocities will allow spray drift to occur. No REI is given.

2.1.3.2 Ecological effects

Effects on birds: Roundup Pro is practically non-toxic to bobwhite quail and the mallard duck (Monsanto 1999*d*). Rodeo is practically nontoxic to bobwhite quail and mallard duck (Monsanto 2000). Glyphosate is slightly toxic to wild birds (EPA 1993*a*; EXTOXNET 1996*a*). The dietary LC50 in both mallards and bobwhite quail is > 4500 ppm (EXTOXNET 1996*a*).

Effects on aquatic organisms: Roundup Pro is moderately toxic to warmwater and coldwater fish (data on the rate at which moderate toxicity occurred was not found) and slightly to moderately toxic to *Daphnia magna* (Monsanto 1999*d*). Acute toxicities (LC_{50} s) of Roundup to fish range from 2 ppm to 55 ppm (2 as cited by NCAP 1998*b*). Part of this variability is due to age: young fish are more sensitive to Roundup than are older fish (144 as cited by NCAP 1998*b*). Roundup toxicity increases with increased water temperature. In both rainbow trout and bluegills, toxicity almost doubled between 7 and 17 C. Treatment of riparian areas with glyphosate and other herbicide products causes water temperatures to increase for several years following treatment because herbicides tend to kill shade-providing vegetation (NCAP 1998*b*). No data is available regarding algal toxicity for this product (Monsanto 1999*d*).

Rodeo is practically nontoxic to *D. magna* (48-hour EC_{50} is 930 mg/L), bluegill sunfish (96-hour LC_{50} >1000 mg/L), and rainbow trout (96-hour LC_{50} >1000 mg/L) (Monsanto 2000). Acute toxicities of Rodeo (with the surfactant X-77) vary from 120 to 290 ppm (149 as cited by NCAP).

Glyphosate acid is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates. The 96-hour LC_{50} is 120 mg/L in bluegill sunfish, 168 mg/L in harlequin, and 86 mg/L in rainbow trout (EXTOXNET 1996*a*). The 96-hour LC_{50} for other aquatic species include > 10 mg/L in Atlantic oysters, 934 mg/L in fiddler crab, and 281 mg/L in shrimp (EXTOXNET 1996*a*).. The 48-hour LC_{50} for glyphosate in *D. magna* is 780 mg/L

(EXTOXNET 1996*a*). Roundup and other glyphosate formulations may be more toxic to fish and aquatic species due to variations in toxicity between the salts and the parent acid or to surfactants used in the formulation (EXTOXNET 1996*a*; NCAP 1998*b*). In soft water there is little difference between the toxicities of glyphosate and Roundup (150 as cited by NCAP). Also for fish with an empty stomach, the toxicity of glyphosate (LC_{50} 2.9 ppm) is similar to that of Roundup (151 as cited by NCAP 1998*b*).

Sublethal effects of glyphosate occur at low concentrations. In rainbow trout and *Tilapia*, concentration of about ½ to 1/3 of the LC_{50} (respectively) caused erratic swimming (153, 154 as cited by NCAP). The trout also experienced labored breathing (153 as cited by NCAP). These effects may increase the risk of predation, as well as impacting feeding, migration and reproduction (154 as cited by NCAP). Less than 1% of the LC_{50} caused gill damage in carp and less than 2% caused changes in liver structure (155 as cited by NCAP). Glyphosate and its formulations have not been tested for chronic effects in aquatic animals (Information 1995).

Effects on other organisms: Rodeo is practically nontoxic to honeybees and earthworms. The 14-day LC_{50} for earthworms is 3750 mg/kg (Monsanto 2000). There is controversy over the effects glyphosate has on earthworms and beneficial insects. See *Controversy over health effects.* Glyphosate and the surfactant used in Roundup have no known effect on soil microorganisms (Information 1995). Exposure to freshly dried Roundup was sufficient to kill over 50% of the following populations of beneficial insects: parasitoid wasp, lacewing, and ladybug (138 as cited by NCAP 1998*b*). Glyphosate has not been tested for chronic effects in terrestrial animals (1995).

Bioconcentration and degradation: There is very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms (EXTOXNET 1996*a*).

2.1.3.3 Environmental fate

Contamination and breakdown in soil and groundwater: Glyphosate is moderately persistent in soil, with an estimated average half-life of 47 days (EXTOXNET 1996*a*). Reported field half-lives range from 1 to 174 days (EXTOXNET 1996*a*) and initial breakdown is faster than the subsequent degradation of what remains (120 as cited by NCAP 1998*b*). Persistence has been recorded for up to 3 years in Swedish forestry sites (125 as cited by NCAP 1998*b*). Glyphosate and the surfactant used in Roundup are both strongly adsorbed to most soils, even those with lower organic and clay content (EXTOXNET 1996*a*; Information 1995) and is not expected to move vertically below the six inch soil layer (EPA 1993*a*). Residues are expected to be immobile in soil (EPA 1993*a*), and therefore even though it is highly soluble in water, field and laboratory studies show it does not leach appreciably, and has low potential for runoff (except as adsorbed to colloidal matter) (EXTOXNET 1996*a*; Information 1995). One estimate indicated that less than 2%

of the applied chemical is lost to runoff (EXTOXNET 1996*a*).

However, NCAP points our that glyphosate's strong adsorption to soil is reversible (1998*b*). A study found that although glyphosate bound readily to four different soil types, desorbtion, when the glyphosate unbinds from soil particles, also occurred readily (128 as cited by NCAP 1998*b*). In one soil, 80% of the added glyphosate desorbed in a 2 hour period and the study concluded that "this herbicide can be extensively mobile in soil" (128 as cited by NCAP 1998*b*).

Microbes are primarily responsible for the breakdown of the product to AMPA, which is degraded to carbon dioxide (EPA 1993*a*). Glyphosate and AMPA are not likely to contaminate ground water due to their strong adsorptive characteristics. The main break-down product of the surfactant used in Roundup is carbon dioxide (Information 1995). Volatilization or photodegradation losses will be negligible (EXTOXNET 1996*a*).

Contamination and breakdown in water: Glyphosate does have the potential to contaminate surface waters due to its aquatic use patterns and through erosion, as it adsorbs to soil particles suspended in runoff (EPA 1993*a*) and has been found in both ground and surface waters (129; 130; 2; 131; 132;133;134; 135 as cited by NCAP 1998*b*; CATs 2001). Upon reaching surface water, glyphosate is not readily broken down by water or sunlight (EPA 1993*a*). In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms (EXTOXNET 1996*a*). The half-life of glyphosate in pond water ranges from 12 days to 10 weeks (EXTOXNET 1996*a*) and another study estimates 35 to 63 days (Information 1995). Glyphosate persists longer in pond sediments (half-life of 120 days and persistence for over a year) (4 as cited by NCAP 1998*b*). The surfactant half-life is from 3 to 4 weeks (Information 1995).

Contamination and breakdown in vegetation: Glyphosate may be translocated throughout the plant, including to the roots (EXTOXNET 1996*a*). It is extensively metabolized by some plants, while remaining intact in others (EXTOXNET 1996*a*). Major products released from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide, and water (Information 1995). Phosphorus pentoxide forms phosphoric acid in the presence of water. None of these compounds is known to be a health threat at the levels which would be found in a vegetation fire (Information 1995). Glyphosate is not easily evaporated or volatile (Information 1995). The impacts of glyphosate on nitrogen fixation is another area of controversy (Monsanto 1999*c*; NCAP 1998*b*). See below.

2.1.3.4 Controversy over environmental effects

Drift: Glyphosate moves readily within plants so that even unexposed parts of a plant are damaged. Therefore, damage caused by drift is likely to be more extensive and more persistent than with many other herbicides (106 as cited by NCAP 1998*b*). As much as 14-78% of glyphosate has been known to drift off-site as far as 1,300 feet downwind (Pesticide

Watch 2000; CATs 2001). This information may be referring to drift resulting from helicopter application as it seems very high for ground application. Ground application studies of 15 noncrop plants found seedling mortality for most of the species tested at 20 meters downwind when using a tractor-mounted spray (110 as cited by NCAP 1998*b*). A drift model predicted damage to native species at distances of 80 meters away from source (107 as cited by NCAP 1998*b*). Monsanto reported that drift damaged 25 acres of corn, and the Washington Department of Agriculture reported damage to 30 acres of onions from a ground application of a glyphosate herbicide (111, 112 as cited by NCAP 1998*b*). Monsanto denies that glyphosate drifts. They say that Glyphosate is non-volatile and will not move off site as a vapor (Monsanto 1999*c*). DAMAGE TO PERENNIAL PLANTS, NCAP 106

Earthworm toxicity: NCAP says that glyphosate is hazardous to earthworms (148 as cited by 1998*b*). NCAP says that tests using New Zealand's most common earthworm showed that glyphosate, in amounts as low as 1/20 of standard application rates, reduced its growth and slowed its development. Monsanto criticizes the study and says that this New Zealand laboratory study is the only one that has ever connected glyphosate with earthworm toxicity and that the results have not been duplicated. In addition, Monsanto says the study has been criticized by scientists because there was a low survival rate among earthworms in the control group (those that were not exposed to glyphosate). Monsanto claims that there is no other suggestion that glyphosate causes damage to earthworms and that other studies using doses of Roundup thousands of times higher than would be expected from actual use produced no mortality among earthworms. No adverse effect of any kind was seen at doses hundreds of times higher. The definitive work on earthworms ("Biology and Ecology of Earthworms" by Edwards and Bohlen, 1996, pp. 300-305) examines the effect of several agricultural products on earthworms. The authors rank products using a scale of zero (relatively non-toxic) to three (extremely toxic). Glyphosate is ranked zero. Furthermore, Roundup is a leading product in no-till agriculture, which protects soil from erosion. Earthworms thrive in no-till agriculture. (Monsanto 1999*c*)

Persistence allegations: Monsanto refutes NCAP's claim that glyphosate can be persistent(EPA 1993*b* as cited by NCAP 1998*b*) with: "The fact that minute traces can be detected sometime after application does not mean persistence. Glyphosate does not build up after repeated use and is biologically degraded over time by soil microbes into natural substances such as carbon dioxide" (Monsanto 1999*c*). Monsanto asserts that the typical half-life of glyphosate is about 25 days. NCAP ignores the rest of the data in the Monsanto half-life study, which was conducted at eight sites. In six of the eight sites, half of the glyphosate degraded in less than 25 days. At one site, half was gone in 1.7 days. (Monsanto 1999*c*)

Insect toxicity allegations: Monsanto refutes NCAP's assertion that Roundup kills beneficial insects (138 as cited by NCAP). In the International Organization for Biological Control (IOBC) study, 18 species of insects were confined to glass or sand surfaces totally covered with a number of pesticide products. Because of the relatively low mortality of insects confined to the Roundup covered surface, IOBC rated Roundup as harmless to 13 species,

slightly harmful to four and only moderately harmful to one. The authors of the study did not feel there was sufficient reason to conduct field studies, realizing that in the real world, insects could easily avoid sprayed surfaces. Several field studies have been conducted, however, showing no significant adverse effect on nematodes, springtails, mites and beetles. The one species most affected in the IOBC study, the carabid beetle, has been studied in other laboratory experiments, which have concluded that glyphosate is harmless to the beetle.

Nitrogen fixation allegations: Monsanto does not agree with NCAP that glyphosate reduces nitrogen fixation (NCAP 1998*b*). Monsanto asserts that many of the studies that NCAP cites actually state a conclusion opposite of what NCAP implies. For example, Martens and Bremner state: "The 28 herbicides studied (including glyphosate) are not likely to substantially affect nitrification." (CITE) Stratton wrote: "Glyphosate had no deleterious effect on nitrification in any soil tested at field rate concentrations. In sandy loam, nitrification was significantly stimulated at a glyphosate rate 50 times higher than field rates. The use of glyphosate in agriculture and forestry should have no toxic effects on nitrification in soil."(CITE) Tu stated: "There is little evidence to suggest that these pesticide treatments have any prolonged deleterious effect on the soil microbial activities." *(CITE)*

In response to the statement that "amounts as small as 2 parts per million (ppm) have had significant effects" (NCAP 1998*b*), Monsanto acknowledges that one study by Eberbach and Douglas did find an effect at 2 ppm. However it is not clear that the effect was on bacteria directly or on the plants they depend on for energy, which is more likely given the results of other research. In another cited study, the authors write: "(Data) suggest that at field application rates these herbicides would cause little damage to legume nodulation." Examination of all these studies illustrates how NCAP selectively scanned studies for any information that supported the group's agenda but ignored the overall conclusion of the paper. (Monsanto 1999*c*)

NCAP states that nitrification effects have been measured up to 120 days after treatment (167 as cited by 1998b). However, Monsanto contends that the author of this report reports that concentrations used for the testing are not likely in normal applications.

2.2 Oryzalin

2.2.1 Technical information

2.2.1.1 Use

Oryzalin belongs to a group of compounds known as dinitroanilines. These are some of the most heavily used compounds in agriculture, and are used almost exclusively as soil-incorporated, preemergence selective herbicides in many field crops. Oryzalin controls

annual grasses and broadleaf weeds in rice, cotton, soybeans, nonbearing fruit trees, nut trees, vineyards, and ornamentals. As preemergence herbicides, the dinitroanilines severely inhibit growth of seedling roots, resulting in plant stunting. (Ware 2000)

2.2.1.2 Chemistry

Oryzalin is a dinitroaniline compound. Its chemical name is 3,5-dinitro-N^4,N^4-dipropylsulfanilamide.

2.2.1.3 Mode of action

Oryzalin inhibits both the root and shoot growth of germinating weed seeds. The mode of action involves blocking cell division in the meristems through inhibiting the development of several enzymes and uncoupling oxidative phosphorylation (EXTOXNET 1996*b*; Ware 2000).

2.2.1.4 Products and formulation

Oryzalin is the active ingredient in Surflan®, a herbicide used by the Santa Clara Water District. There are a variety of additional oryzalin-based products available, including Dirimal, EL-119, Rycelan, Ryzelan, and Ryzelon, and it is likely that in the future new formulations will be developed. The formulation is 40.4% Oryzalin and 59.6% inert ingredients. Inert ingredients include propylene glycol and glycerin.

2.2.1.5 Regulatory status

Oryzalin is a General Use Pesticide and is in EPA toxicity class IV "slightly to practically nontoxic". Products containing oryzalin must bear the signal word CAUTION (EXTOXNET, 1996*b*) and oryzalin is listed on the EPA's Toxics Release Inventory. Surflan has been reviewed according to the EPA and has been determined to be: "an immediate health hazard" in the SARA (Superfund Amendment and Reauthorization Act of 1986) Hazard Category (Dow 1999*a*). It is also defined as a "Hazardous Chemical" by OSHA (Dow 1999*a*). The inert ingredients glycerin and propylene glycol are listed under State-Right-to-Know which is a compilation of all state hazard lists that herbicide product components could be on (Dow 1999*a*).

2.2.1.6 District use and application

Oryzalin is typically applied in noncropland areas and industrial sites at a rate of: 2 - 6 qt/acre or 1.5 - 4.5 fl oz/1000 sq ft).

The District uses Surflan to control terrestrial weeds on top of bank areas and in landscaped

areas once annually per site from October to February. Surflan is applied at a rate of 4 qts/acre/year in landscape areas with a gun, boom or back pack. This will result in the application of 4 lbs/acre or 448.34 mg/m^2 of the active ingredient, oryzalin.

On Right of Way areas, Surflan will be applied at a rate of 3 qts/acre/year with a gun, boom or backpack. This will result in the application of 3 lbs/acre or 336.26 mg/m^2 of oryzalin.

2.2.2 Public health

2.2.2.1 Acute toxicity

In studies using laboratory animals, oryzalin has been found to be practically non-toxic when taken orally and is in Toxicity Category IV for this effect. The oral LD_{50} for rats is >10,000 mg/kg (Ware 2000). Oryzalin is of moderate dermal and inhalation toxicity and causes slight eye irritation. It is categorized as Toxicity III for these effects (EPA 1994). Prolonged exposure may cause skin irritation. Prolonged or frequently repeated skin contact may cause an allergic skin reaction in some individuals, but a single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts (Dow 1999*a*). The dermal LD_{50} for rabbits is >2000 mg/kg (Ware 2000). No skin sensitization occurred in guinea pigs (EPA 1994). However, it is worth mentioning that oryzalin contains the contaminant DCB, which is a potent skin sensitizer (CAT 1999) so dermal effects may be an area of controversy.

Formulated oryzalin products, such as Surflan A.S., may show moderate toxicity by either the oral or inhalation routes, and may show skin and eye irritation and skin sensitization properties. In dogs and cats, large oral doses induce nausea and vomiting (EXTOXNET 1996*b*).

2.2.2.2 Subchronic toxicity

No data found.

2.2.2.3 Chronic toxicity

The reference dose (RfD) for chronic oral exposure was determined to be 0.12 mg of oryzalin/kg/day (EPA 1994*b*). Repeated ingestion of large oryzalin doses led to adverse changes in blood cell formation and caused bone marrow and liver effects in beagle dogs (EPA 1994; EXTOXNET 1996*b*). Oryzalin also caused the accumulation of an iron-containing pigment in the kidneys of rats (EPA 1994). Rats fed a dietary level of about 2.5 mg/kg/day for 2 years exhibited blood changes, increased liver and kidney weights, inhibition of growth , and decreased survival (EXTOXNET 1996*b*). In mice, oryzalin caused an increase in the weights of several organs (EPA 1994), and mice given dietary

doses of about 200mg/kg/day for 1 year exhibited decreased uterine and ovarian weights. Those exposed to 75 mg/kg/day showed no observable effects (EXTOXNET 1996*b*).

2.2.2.4 Carcinogenic effects

Oryzalin is a suspect carcinogen according to the Rachel Carson Council (Briggs 1992), however due to conflicting study results, the carcinogenicity of oryzalin is still undetermined. See Controversy over health effects.

2.2.2.5 Mutagenic effects

Oryzalin was not found to be mutagenic in several tests, including those on live rats and mice and on bacterial cell cultures (EXTOXNET 1996*b).*

2.2.2.6 Reproductive effects

Oryzalin appears unlikely to cause reproductive effects (EXTOXNET 1996*b*). There were no adverse effects on reproduction in a three-generation study of rats fed dietary concentrations of 12.5, 37.5 or 112.5 mg/kg/day, the highest dose tested (EXTOXNET 1996*b*). Fetotoxic effects appeared at 12.5 mg/kg/day (EXTOXNET 1996*b*).

Most components of the formulated product, Surflan A.S. did not interfere with reproduction (Dow 1999*a*). Reproductive effects that were observed in female animals are believed to be due to altered nutritional states resulting from extremely high doses of glycerin (an inert ingredient) in the diet. Similar effects have been seen in animals fed synthetic diets (Dow 1999*a*).

2.2.2.7 Teratogenic effects

It appears that oryzalin is unlikely to cause teratogenic effects (Dow 1999*a*, EXTOXNET 1996*b*). "There were no birth defects in the offspring of pregnant rats fed dietary concentrations as high as 112 mg/kg/day for three generations, nor in the offspring of pregnant rabbits given doses of 125 mg/kg/day, the highest dose tested" (EXTOXNET 1996*b*). "Other fetal effects occurred only at doses toxic to the mother" (Dow 1999*a*).

2.2.2.8 Organ toxicity and systemic effects

In animal tests, oryzalin has shown systemic effects on the thyroid, liver, and kidneys, as well as blood chemistry (EXTOXNET 1996*b;* CAT 1999). Due to its effects on blood and blood forming tissues, oryzalin may be especially dangerous for persons with inherited blood abnormalities or acquired blood diseases (CAT 1999). The inert ingredient, propylene glycol has been shown to cause liver, kidney, bladder, spleen or blood effects in animals

(Dow 1999*a*). Human signs and symptoms of propylene glycol poisoning may include central nervous system depression (headache, dizziness, drowsiness and incoordination) (Dow 1999*a*).

2.2.2.9 Fate in humans and animals

Oryzalin is moderately well-absorbed from the gastrointestinal tract, and rapidly metabolized and eliminated following absorption. When oryzalin was administered to male rats, 40% of the dose was excreted in the urine and 40% in the feces within 3 days. Similar results were obtained in tests with rabbits, a steer, and with Rhesus monkeys. (EXTOXNET 1996*b*). Bioconcentration potential for oryzalin is low (Dow 1999*a*).

2.2.2.10 Occupational and residential exposure

Pesticide handlers may be exposed to oryzalin during application. Based on tests conducted by the EPA, low pressure handwand application was found to have the highest exposure and risk potential (1994). Because the pesticide is a possible human carcinogen, coveralls and chemical resistant footwear is required for all uses of oryzalin except homeowner uses. For agriculture and ornamental crops, EPA requires a 24 restricted entry interval (REI). For non-crop use, there is no re-entry period once the spray solution has dried. When residential lawns are treated with oryzalin, there is a potential for continued, substantial contact with treated surfaces, especially among children. As of 1994, due to insufficient information, oryzalin products labeled for residential lawn and turf use were not eligible for reregistration (EPA 1994).

2.2.2.11 Effects of inert ingredients

Oryzalin contains the contaminant DCB, which is a potent skin sensitizer (CAT 1999). This conflicts with findings by the EPA that no skin sensitization occurred in guinea pigs (EPA 1994). The inert ingredient, propylene glycol has been shown to cause liver, kidney, bladder, spleen or blood effects in animals (Dow 1999*a*). Human signs and symptoms of propylene glycol poisoning may include central nervous system depression (headache, dizziness, drowsiness and incoordination) (Dow 1999*a*). Reproductive effects that were observed in female animals are believed to be due to altered nutritional states resulting from extremely high doses of glycerin (an inert ingredient) in the diet. Similar effects have been seen in animals fed synthetic diets (Dow 1999*a*).

2.2.2.12 Controversy over health effects

In the EPA's 1994 Reregistration Eligibility Decision (RED), oryzalin was said to be carcinogenic based on an increase in mammary gland tumors in female rats and skin and thyroid tumors in rats of both sexes and oryzalin was classified as a Group C carcinogen (a possible human carcinogen for which there is limited animal evidence) (EPA 1994).

However, the 1996(*b)* EXTOXNET states that since tumors occurred only in the rats, and not in mice fed doses up to 4 times of that fed the rats over the same period of time, it is not possible to assess the carcinogenicity of oryzalin. Furthermore, the Oryzalin Material Safety Data Sheet states that "thyroid follicular cell tumors observed in rats were considered a secondary response caused by mechanisms not relevant to humans. Benign skin and adnexal tumors observed in rats may also have been secondary to thyroid effects"(1999*a*). Therefore the carcinogenicity of oryzalin is yet undetermined. However, a contaminant of oryzalin, N-nitrosodiproplylamine (NDPA), is a recognized carcinogen (CAT 1999).

The studies stating that oryzalin has low dermal effects do not address the effects of the oryzalin contaminant 2,4 dinitrochlorobenzene (DCB), which is a potent skin sensitizer (CAT 1999).

2.2.3 Environmental safety

2.2.3.1 Label limitation

This pesticide is toxic to fish. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. For non-crop use, there is no re-entry period once the spray solution has dried.

2.2.3.2 Ecological effects

Effects on birds: Oryzalin is slightly toxic to practically non-toxic to birds and has an oral LD_{50} for bobwhite quail and mallard duck of >500 mg/kg (EXTOXNET 1996*b*). In chicken, the oral LD_{50} is 1000 mg/kg. The 5-day dietary LC_{50} values for quail and mallard are >5000 ppm (EXTOXNET 1996*b*). Single application rates of 4 pounds of active ingredient (ai) /acre or less (the District proposes an application rate of 4 lb ai/acre) do not pose chronic risks to avians and the EPA is requiring further studies to determine whether higher application rates pose a serious avian reproduction threat (EPA 1994*a*).

Effects on aquatic organisms: Oryzalin is highly toxic to fish and aquatic organisms on an acute basis (LC_{50}/EC_{50} is between 0.1 and 1 mg/L in most sensitive species (Dow 1999*a*). The 96-hour LC_{50} value for bluegill sunfish is 2.88 mg/L, 3.26 mg/L for rainbow trout, and >1.4 mg/L in goldfish fingerlings (EXTOXNET 1996*b*). A *Daphnia magna* life-cycle study is needed, due to the persistence of oryzalin in the aquatic environment, to determine the chronic risk to freshwater invertebrates (EPA 1994*a*, 1994*b*).

Effects on other organisms: Oryzalin is nontoxic to bees and has an oral LD_{50} of 11 /bee (EXTOXNET 1996*b*). It is practically non-toxic to small mammals on an oral, acute basis

(LD_{50} >10000 mg/kg) (EPA 1994*b*).

Bioconcentration and degradation: Bioconcentration potential for oryzalin is low (BCF is <100 or Log Pow <3) (Dow 1999*a*) and the compound does not accumulate significantly in fish (EPA 1994*b*). Oryzalin degradation is expected in the soil environment within days to weeks (Dow 1999*a*). However, the EPA counters that oryzalin biodegrades slowly with a half-life of approximately two months. Oryzalin is of low to moderate persistence in field studies and half-lives range from 20 to 128 days (EXTOXNET 1996*b*). A representative value for soil half-life is estimated to be 20 days (EXTOXNET 1996*b*).

2.2.3.3 Environmental fate

Contamination of and breakdown in soil and groundwater: Microbial degradation is mainly responsible for the breakdown of oryzalin in soils, but it may undergo photodecomposition near the soil surface (EXTOXNET 1996*b*). Oryzalin is not volatile under field conditions (EXTOXNET 1996*b*; EPA 1994*a*). Oryzalin is slightly soluble in water and it does not have a strong tendency to adsorb to soil particles (EXTOXNET 1996*b*). It is bound to a greater extent with increasing soil organic matter and clay content (EXTOXNET 1996*b*). In soils with low proportions of these, highwater tables and increased rainfall, oryzalin may be mobile, and thus present a risk of contamination to groundwater (EXTOXNET 1996*b*). Oryzalin has been identified as a potential groundwater contaminant pursuant to section 13145(d) of the Food and Agricultural Code (California Code 2001). The EPA warns that up to 20% of the oryzalin degradates may leach (EPA 1994*a*).

Contamination of and breakdown in water: In Florida, chemicals that are suspected to contaminate surface runoff were analyzed and sampled. Several roadside chemicals that are considered not to percolate to groundwater - such as glyphosate and oryzalin - were found to be very likely to wash away with rainwater and then pollute surface waters (CATs 2001)

No breakdown of oryzalin by hydrolysis was observed at pH 5, 7, and 9 (EXTOXNET 1996*b*). Based on its behavior in soil, breakdown by microbial processes is probably slow in the aquatic environment due to low levels of oxygen and low microbial activity (EXTOXNET 1996*b*; EPA 1994*b*). Photodegradation may be significant in the upper portions of the water column (EXTOXNET 1996*b*).

Contamination of and breakdown in vegetation: Oryzalin poses an acute risk to non-target plants due to runoff and spray drift (EPA 1994*a*). It is readily absorbed via the roots, and plant metabolism of oryzalin is minimal (EXTOXNET 1996*b*).

2.2.3.4 Controversy over environmental effects

There is some discrepancy over the biodegradation rate of oryzalin (EPA 1994*a*; Dow

1999*a*; EXTOXNET 1996*b*).

2.3 Chlorsulfuron

2.3.1 Technical information

2.3.1.1 Use

Chlorsulfuron is a member of the sulfonylurea family of herbicides and is used primarily for broadleaf control.

2.3.1.2 Chemistry

Chlorsulfuron: (2-chloro-N-[[4-Methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] benzenesulfonamide)

2.3.1.3 Mode of action

Telar DF is absorbed by both the roots and foliage of plants, rapidly inhibiting the growth of susceptible weeds. At a molecular level, sulfonylureas inhibit the activity of the enzyme, acetolactate synthase (ALS), that is involved in the production of three chemically-related amino acids (valine, leucine, and isoleucine) (NCAP 1993). Somehow the inhibition of the ALS enzyme halts cell division and results in plant death. Although animal cells do not contain ALS, it is possible that sulfonylureas do impact other enzyme systems in animals (NCAP 1993).

Two to three weeks after application to weeds, leaf growth slows, and the growing points turn reddish-purple. Within 4 to 6 weeks of application, leaf veins and leaves become discolored, and the growing point subsequently die (Label). The effectiveness of Telar is enhanced during warm, moist weather conditions since moisture carries the herbicide into roots. Cold, dry conditions delay the activity of Telar (Label). Telar requires the use of a nonionic surfactant containing at least 80% active ingredients (Label).

2.3.1.4 Products and formulation

Chlorsulfuron is the active ingredient in the herbicide Telar DF. Another product containing chlorsulfuron is called, Glean. Telar may be applied as a preemergence or postemergence treatment and is recommended for control of many annual, broadleaf weeds along roadsides and on noncrop industrial sites. Telar may not be applied in or on irrigation ditches or canals including their outer banks (Label), but may be applied along creeks (Frank Aulger, Dupont pers. comm. to Mark Wander, SCVWD). Product formulation is 75% Telar and 25% inert ingredients.

2.3.1.5 Regulatory status

Disclosure as a toxic chemical is required under the SARA Act. Label bears the signal word "CAUTION!"

2.3.1.6 District use and application

Telar DF is typically applied as a 0.06% solution at the rate of ¼ - 3 oz/acre. The district uses Telar DF to control broadleaf weeds on top of bank areas and outboard levee slopes. This use is consistent with labeling restrictions which prohibit application along canals. Spraying will occur once per year between October and February. The District will apply 2 ounces of Telar per acre using a spray gun, boom or backpack. This amounts to an application rate of 0.094 lb/acre (10.54 mg/m^2) of the active ingredient, chlorsulfuron.

2.3.2 Public health

2.3.2.1 Acute toxicity

In oral studies using laboratory rats, the formulated product, Telar DF, was found to have "very low toxicity"with an LD_{50} >5000 mg/kg in rats (DuPont 1998*b*). Skin absorption tests in rabbits show the herbicide to be slightly to moderately toxic with a dermal LD_{50} >2000 mg/kg (DuPont 1998*b*). Telar DF Herbicide may cause eye irritation with discomfort, tearing, or blurring of vision (DuPont 1998*b*). DuPont concludes that Telar DF is "not a skin irritant or a skin sensitizer, but is a moderate eye irritant in animals"(1998*b*).

Toxicity described in animals from a single oral dose of chlorsulfuron include "lung changes, weakness and other nonspecific effects" (DuPont 1998*b*). The oral LD_{50} for rats is 5545 mg/kg. Four hour inhalation studies in rats (>5.9 mg/L) show inhalation toxicity to be very low (DuPont 1998*b*). The dermal LD_{50} for rabbits is 3400 mg/kg.

2.3.2.2 Subchronic toxicity

Repeated oral dosing of chlorsulfuron caused decreased weight gain (EPA 1990), and hematological and clinical chemical changes" (DuPont 1998*b*). Repeated inhalation exposures to chlorsulfuron have the following effects in animals: decreased weight gain, reversible kidney and spleen effects, and bone marrow changes (DuPont 1998*b*).

2.3.2.3 Chronic toxicity

Long-term oral dosing of chlorsulfuron resulted in decreased body weight gain, and slight hematological changes (DuPont 1998*b*).

2.3.2.4 Carcinogenic effects

As of 1990, chlorsulfuron had not undergone a complete evaluation for carcinogenic potential (EPA 1990*b*). As of 1998, studies indicated that chlorsulfuron does not have carcinogenic effects (DuPont 1998*b*). None of the components present in this herbicide at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA, or ACGIH as a carcinogen (DuPont 1998*b*).

2.3.2.5 Mutagenic effects

Chlorsulfuron did not produce genetic or heritable genetic damage in bacterial or mammalian cell cultures (DuPont 1998*b*)

2.3.2.6 Reproductive effects

Animal testing indicates that chlorsulfuron does not have reproductive effects (DuPont 1998*b*). Developmental toxicity has been observed, but only at maternally toxic dose levels (DuPont 1998*b*). However, controversy exists and chorsulfuron is considered by some to be a reproductive and developmental toxin (Schettler 1998; Kaplan 1997).

2.3.2.7 Teratogenic effects

DuPont found developmental toxicity only at maternally toxic dose levels (1998*b*). However, controversy does exist and chorsulfuron is considered by some to be developmental toxin (Schettler 1998).

2.3.2.8 Organ toxicity and systemic effects

Kidney and spleen effects have been documented (DuPont 1998*b*).

2.3.2.9 Fate in humans and animals

No data.

2.3.2.10 Occupational and residential exposure

No data

2.3.2.11 Effects of inert ingredients

No data

2.3.2.12 Controversy over health effects

The Physicians for Social Responsibility (SF and LA chapters), CalPIRG, and the Natural Resources Defense Council consider chlorsulfuron to be a non-listed developmental and reproductive toxin (Kaplan 1997, Schettler 1998).

2.3.3 Environmental safety

2.3.3.1 Label limitations

Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Do not apply in or on irrigation ditches or canals including their outer banks. Drift potential increases at wind speeds of less than 3 mph or more than 10 mph. Avoid applications during fusty or windless conditions. Drift potential is high during a surface temperature inversion. Re-entry allowed when product is dry.

2.3.3.2 Ecological effects

Effects on birds: Acute and subchronic toxicities of Telar are practically nontoxic to mallard duck and bobwhite quail. The acute oral LD_{50} for mallard duck is >5000 mg/kg and >5000 mg/kg for bobwhite quail (DuPont 1998*b*).

Effects on aquatic organisms: Telar shows moderate to slight toxicity to bluegill sunfish (96-hour LC_{50}>300 ppm) and rainbow trout (96-hour LC_{50}>250 ppm) (DuPont 1996). Telar has a 48-hour LC_{50} of 370.9 ppm for the water flea (DuPont 1996). For chlorsulfuron, the 48 hour EC_{50} for oysters is 385 mg/L (DuPont 1998*b*).

Effects on other organisms: Telar is very low in toxicity to mammals, birds, and insects since they are able to rapidly metabolize and eliminate the chemicals' active ingredients from their systems (DuPont 1996). Telar does not bioaccumulate in warm- or cold-blooded animals (DuPont 1996). Telar is practically nontoxic to the honeybee. The contact LD_{50} is >25 ug/bee (DuPont 1996).

Bioconcentration and degradation: The most common breakdown processes of Telar DF are chemical hydrolysis and microbial degradation. Animals are able to rapidly metabolize and eliminate chlorsulfuron from their systems (DuPont 1996). Telar does not bioaccumulate in warm- or cold-blooded animals (DuPont 1996).

2.3.3.3 Environmental fate

Contamination of and breakdown in soil and groundwater: The most common breakdown processes of Telar DF are chemical hydrolysis and microbial degradation. Chlorsulfuron has been identified by the California Department of Food and Agriculture (CDFA) as a potential ground water contaminant pursuant to section 13145(d) of the Food and Agricultural Code (California Code 2001). Ground water is monitored for the presence of suspected leachers and no restrictions are placed upon the compound's use until it has been detected (Yates 1991).

Contamination of and breakdown in water: The aqueous solubility of Telar in a buffered solution is 587 ppm at pH 5 and 31,800 ppm at pH 7 (DuPont 1996). Solubility is lower when buffer is omitted.

Contamination of and breakdown in vegetation: Biotypes of certain weeds listed on the label are resistant to Telar DF and other herbicides with the same mode of action, even at exaggerated rates.

2.3.3.4 Controversy over environmental effects

Chlorsulfuron may leach into ground water.

2.4 Clopyralid

2.4.1 Technical information

2.4.1.1 Use

Clopyralid is recommended for selective, postemergence control of broadleaf weeds.

2.4.1.2 Chemistry

Clopyralid is in the group of carboxylic acid herbicides. 3,6-dichloro-2-pyridinecarboxylic acid, monoethanolamine salt

2.4.1.3 Mode of action

Carboxylic acid herbicides are hormone herbicides that translocate in both the phloem and xylem. Clopyralid is a synthetic plant growth hormone that mimics the naturally occurring plant hormone (auxin), indoleacetic acid (Ware 2000). Clopyralid disrupts plant growth by binding to molecules that are normally used as receptors for the natural growth hormones. Because clopyralid is more persistent in plant tissue than auxins, the binding causes abnormal growth leading to plant death in a few days or weeks (NCAP 1998*a*).

2.4.1.4 Products and formulation

Clopyralid is the active ingredient in Transline herbicide. The formulation for Transline is 40.9% clopyralid and 59.1% inert ingredients (Isopropyl alcohol-5% and Polyglycol 26-2). Other products containing clopyralid include Stinger, Confront, and Lontrel.

2.4.1.5 Regulatory status

Transline has been reviewed according to the EPA SARA "Hazard Categories" and has been determined to be both "an immediate health hazard" and "a delayed health hazard" (Dow 1999*b*). Isopropyl alcohol is subject to the reporting requirements of SARA Title III Section 313 as a hazard (Target 1997). Under the OSHA Hazard Communication Standard, and listed under State-Right-to-Know, isopropyl alcohol is defined as a "Hazardous Chemical" (Dow 1999*b*).

2.4.1.6 District use and application

Transline is typically applied as a 0.075% solution. In California, the maximum application rate for Transline is pint/acre per annual use season. For non-crop use in California, transline is applied at a rate of ¼ to pints per acre (equivalent to 0.09 to 0.25 lb a.i. per acre). A non-ionic surfactant, either R-11 or Pro-Spreader, is used in spray mixtures of 1 to 2 quarts per 100 gallons of spray mixture. Volumes of 20 gallons or more per acre should be sprayed for ground roadside and rights-of-way applications.

The district intends to use the Transline to control broadleaf weeds on levee slopes between December and March. They will apply 2/3 pint per acre annually with a gun boom or back pack. This translates to 0.25 lbs/acre or 28.02 mg/m^2 of the active ingredient, clopyralid.

2.4.2 Public health

2.4.2.1 Acute toxicity

Eyes - Exposure may cause "very slight transient corneal injury" and vapor may irritate eyes (Dow 1999*b*). NCAP cites studies that have found acute exposure to clopyralid to be severely irritating to eyes, with symptoms (opaque cornea, inflamed iris, redness, and discharge) lasting up to 21 days after exposure (EPA 1990*a* as cited by NCAP 1998*a*).

Skin - Prolonged exposure may cause moderate skin irritation (Dow 1999*b*). A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts (Dow 1999*b)*. The LD_{50} for skin absorption in rabbits is >5000 mg/kg according to Dow (1999*b*), but is >2000 mg/kg according to Ware (2000).

Ingestion - Single dose oral toxicity from the formulated product Transline is extremely low and no hazards are anticipated from swallowing small amounts incidental to normal handling operations (Dow 1999*b*). The oral LD_{50} of Transline for rats is >5000 mg/kg (Ware 2000; Dow 1999*b*). Clopyralid poisoning in rats included the following symptoms; watery eyes, diarrhea, and lethargy (EPA 1990*c*).

Inhalation - Excessive vapor concentrations of Transline can occur and could be hazardous on single exposure. Excessive exposure (400ppm) to isopropanol may cause eye, nose, and throat irritation. "Incoordination, confusion, hypertension, hypothermia, circulatory collapse, respiratory arrest and death may (occur) following longer duration of higher levels" (Dow 1999*b*). Isopropanol vapor exposure has also resulted in middle ear lining damage (Dow 1999*b*).

2.4.2.2 Subchronic toxicity

A three-month study found an increase in the size of cells in the liver in female mice at two of the four clopyralid doses tested. At the high dose, male mice showed similar effects and the liver weights were increased in both sexes. With dogs, a six-month study found increased liver weights in females, and urinary tract problems in males. Both effects were found at the highest dose tested (EPA 1997 as cited by NCAP 1998*a*). NCAP states that there are no publicly available studies of the subchronic effects of clopyralid-containing products (1998*a*).

2.4.2.3 Chronic toxicity

Chronic studies of clopyralid on laboratory animals have found effects on the stomach, liver, and body weight. "A two year study with rats found hyperplasia of the stomach lining at all but the lowest dose tested. A one year study with dogs found an increase in liver weights and a decrease in the number of red blood cells, also at all but the lowest dose tested. A two year study with mice found decreased weight of males at the highest dose tested" (EPA 1997 as cited by NCAP 1998*a*). NCAP states that there are no publicly available studies of the subchronic effects of clopyralid-containing products (1998*a*).

2.4.2.4 Carcinogenic effects

The components tested by Dow did not cause cancer in laboratory animals (Dow 1999*b*). The EPA has not yet evaluated the ability of clopyralid to cause cancer and the NCAP states that there are no publicly available studies of the carcinogenic potential for clopyralid (EPA 1998*e*, 19 *as cited by* NCAP 1998*a*).

2.4.2.5 Mutagenic effects

For the components tested, in-vitro and animal mutagenicity studies were negative (Dow 1999*b*).

2.4.2.6 Reproductive effects

According to Dow, clopyralid has been shown not to interfere with reproduction in animal studies for the components tested (Dow 1999*b*). However, NCAP cites an EPA review in which laboratory tests have demonstrated that exposure to clopyralid results in "substantial" toxicity to fetuses and birth defects (EPA 1991*b* as cited by NCAP 1998*a*). NCAP states that there are no publicly available studies of the reproductive effects of clopyralid-containing products (1998).

2.4.2.7 Teratogenic effects

Clopyralid causes birth defects in test animals, but there appears to be a discrepancy over the dosage at which these effects are seen. Dow states that birth defects appear "only at greatly exaggerated doses that were severely toxic to the mothers" and that no birth defects were observed in animals given clopyralid at doses several times greater than those expected during normal exposure (Dow 1999*b*). NCAP states, however, that in a test with rabbits, the EPA found clopyralid to cause a decrease in the weight of the fetuses at both the low and the high dose tested. It was also observed that "developmental toxicity in the form of skeletal abnormalities (delayed bone formation in the skull, pubic bone, and breast bone) was evident at all dose levels tested (EPA 1991*b* as cited by NCAP 1998*a*). At the highest dose tested, a "substantial increase was found in the number of fetuses with hydrocephaly," (the accumulation of excess fluid around the brain which results in a small brain and an enlarged skull) (EPA 1991*b* as cited by NCAP 1998*a*).

2.4.2.8 Organ toxicity and systemic effects

In animal studies, effects to the liver and kidney have been reported. Lethargy was observed in animals (Dow 1999*b*)

2.4.2.9 Fate in humans and animals

No data

2.4.2.10 Occupational and residential exposure

No data

2.4.2.11 Effects of inert ingredients

Dow states that the inert ingredient, isopropyl alcohol, has been reported to cause birth defects and fetal toxicity in rats at extremely high doses. At lower concentrations no effects on the fetus were found (Dow 1999*b*).

2.4.2.12 Controversy over health effects

Reproductive effects: There is controversy over whether or not clopyralid causes toxicity to fetuses (Dow 1999*b*; EPA 1991*b* as cited by NCAP 1998*a*)

Teratogenic effects: Both Dow and NCAP agree that clopyralid causes birth defects in test animals, but there appears to be a discrepancy over the dosage at which these effects are seen. Dow states that defects appear only at the highest doses (Dow 1999*b*). The EPA studies cited by NCAP found effects even at the low dosage treatments (17 as cited by NCAP)

2.4.3 Environmental Safety

2.4.3.1 Label limitation

Do not contaminate water when disposing of equipment wash waters. Do not contaminate water used for irrigation or domestic purposes. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. The re-entry is allowed when product is dried.

Clopyralid is a chemical which can travel through soil and under certain conditions contaminate groundwater which may be used for irrigation or drinking purposes. Users are advised not to apply clopyralid where soils have a rapid to very rapid permeability throughout the profile (such as loamy sand to sand) and the water table of an underlying aquifer is shallow, or to soils that would allow direct introduction into an aquifer. The maximum application rate of Transline is 2/3 pint/acre/year.

2.4.3.2 Ecological effects

Effects on birds: No data.

Effects on aquatic organisms: Based largely or completely on information for clopyralid, material is practically non-toxic to aquatic organisms on an acute basis ($LC_{50}/EC_{50}>100$ mg/L in most sensitive species) (Dow 1999*b*).

Effects on other organisms: Clopyralid is toxic to some insects. Between 30-80% of both a ladybug and of a pirate bug populations were killed by clopyralid, as were 25-50% of a population of lacewings (48 as cited by NCAP 1998*a*).

Bioconcentration and degradation: Based largely or completely on information for clopyralid, bioconcentration potential is low (BCF<100 or Log Pow<3) (Dow 1999*b*). Biodegradation under aerobic laboratory conditions is below detectable limits (Dow 1999*b*).

2.4.3.3 Environmental fate

Contamination of and breakdown in soil and groundwater: Clopyralid is "persistent" in soil and has a half-life of "up to 11 months" (EPA 1992 *as cited by* NCAP 1998*a*). Potential for mobility in soil is very high (K_{oc} between 0 and 50) (Dow 1999*b*). Clopyralid is a chemical with the ability to travel (seep or leach) through soil and under certain conditions contaminate groundwater (Label; EPA 1997*b* as cited by NCAP 1998*a*). Users are advised not to apply clopyralid where soils have a rapid to very rapid permeability throughout the profile (such as loamy sand to sand) and the water table of an underlying aquifer is shallow (Label). For clopyralid, the photolysis half-life in soil is >12 years (Dow 1999*b*). Under aerobic soil conditions, the half-life is 71 days (Dow 1999*b*).

Contamination of and breakdown in water: The amount of clopyralid used in the U.S. is small relative to other herbicides (0.1% of that of atrazine, the most commonly used). Yet the United States Geological Survey (USGS) has found clopyralid contamination in two of the twenty river basins it has sampled for pesticides (the Central Columbia Plateau, Washington and Idaho, and the Trinity River Basin in Texas) (38, 39 as cited by NCAP 1998*a*). For clopyralid, the photolysis half-life in water is 261 days (Dow 1999*b*).

Contamination of and breakdown in vegetation: Clopyralid is considered volatile by the EPA (EPA 1990*d as cited by* NCAP 1998*a*) and means that it can "evaporated from foliage and soil after application, move away from the application site, and adversely affect non-target broadleaf plants" (EPA 1990*d as cited by* NCAP 1998*a*). The EPA has calculated that volatilization of only 1% of applied clopyralid would be enough to damage non-target plants (EPA 1990*d as cited by* NCAP 1998*a*). For a sensitive crop, such as potatoes, that amount is even smaller.

The Transline product label warns: "Do not use plant residues, including hay or straw from treated areas, or manure from animals that have grazed or consumed forage from treated areas for composting or mulching where susceptible plants may be grown the following season." Compost and mulches made from clopyralid-treated plants contain residues that can be detected a year later. Clopyralid-damaged bean plants used as a soil amendment caused visible damage in subsequent bean plantings for three generations (35 as cited by NCAP 1998*a*). To promote herbicidal decomposition, the label advises that "plant residues should be evenly incorporated or burned. Breakdown of clopyralid in crop residues or manure is more rapid under warm, moist soil conditions and may be enhanced by supplemental irrigation."

Resistance: Resistance to clopyralid was documented in a yellow starthistle populations. The resistant plants require 14 times the amount of clopyralid necessary to kill plants that had not developed resistance (49 as cited by NCAP 1998*a*).

2.3.3.4 Controversy over environmental effects

No significant controversy appears to exist.

2.5 Pendimethalin

2.5.1 Technical information

2.5.1.1 Use

Pendimethalin is a dinitroaniline herbicide. These are almost exclusively used as soil-incorporated, preemergence selective herbicides which severely inhibit growth of seedling roots resulting in plant stunting (Ware 2000). Pendimethalin controls annual grass and certain broadleaf weeds and can also be preplanted in crops.

2.5.1.2 Chemistry

Pendimethalin is in the chemical family dinitroaniline. Its chemical name is N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine. The transformation product is N-nitrosopendimethalin.

2.5.1.3 Mode of action

Nitroanilines inhibit both root and shoot growth when absorbed by roots. Their mode of action includes inhibiting the development of several enzymes and uncoupling oxidative phosphorylation. (Ware 2000)

2.5.1.4 Products and formulation

Pendimethalin is the active ingredient in the product Pendulum WDG. Another formulation for this herbicide is called Prowl. The formulation for Pendulum is 60% pendimethalin and 40% inert ingredients.

2.5.1.5 Regulatory status

Pendulum is listed under SARA Title III Section 313 and on the EPA's Toxic Release Inventory. The formulation may contain more than 0.1% crystalline silica which the IARC

has classified as a Group 1 carcinogen.

2.5.1.6 District use and application

When used alone, Pendulum is applied as a 2.5% to 12% solution at the rate of 2.5 - 5 lbs per acre.

The district uses Pendulum to control terrestrial weeds on top of bank areas between October and February. They apply 5 pounds per acre annually with a gun, boom or backpack. This translates into 3 lb/acre or 336.26 mg/m^2 of the active ingredient, pendimethalin.

2.5.2 Public health

Information on the following studies cited by the World Health Organization was provided by the chemical company, American Cyanamid Co.

2.5.2.1 Acute toxicity

Pendimethalin is reported to be of low acute toxicity (WHO 1996). The oral LD_{50} for rats is >5000 mg/kg. The dermal LD_{50} is >2000 mg/kg. Pendimethalin is found to be moderately irritating and, based on tests with guinea pigs, is not a skin sensitizer. Inhalation tests were not conducted. Tests on rabbits has shown that pendimethalin is moderately irritating to the eye (BASF 2000).

2.5.2.2 Subchronic toxicity

Rats were fed pendimethalin concentrations of 0, 100, 500, or 5000 mg/kg for 13 consecutive weeks. Food intake and body weight gain were decreased only at the highest dose. Indications of hepatotoxicity were also observed at this dosage. Absolute and relative kidney weights increased in males at 5000 mg/kg, and absolute and relative uterus and ovary weights decreased in females at 500 mg/kg (WHO 1996).

2.5.2.3 Chronic toxicity

Mice were given a diet containing pendimethalin at 0, 100, 500, 2500 mg/kg for 18 months (dose doubled after 8 weeks), and rats were fed a diet containing 0, 100, 500, or 2500 mg/kg for 2 years (highest dose doubled after 6 weeks). At the highest doses, general toxic effects were observed both in the mouse (hyperglycaemia and increased thyroid and adrenal gland weights) and in the rat (increase in alkaline phosphatase levels, increased thyroid and kidney weights, hepatomegaly). Hyperglycaemia in the mouse and hepatotoxicity in the rat were present even at the lowest dose level of 100 mg/kg of diet (equivalent to 5 mg/kg of body

weight per day) (WHO 1996). In a 2 year rat study, a marked depression in body weight gain and statistically significant increase in benign thyroid proliferative lesions were observed at the highest dose tested (5000 ppm) (BASF 2000). There is concern that the long-term (chronic) toxicity in mammals is not truely known (Vaeth 2000).

2.5.2.4 Carcinogenic effects

Studies associated with the American Cyanamid Co. with mice and rats fed doses of pendimethalin up to 25000 mg/kg for up to 2 years, showed no evidence of carcinogenicity. However, WHO notes that "these studies had important methodological limitations, including limited number of animals subjected to histological examinations" (WHO 1996). The EPA has given pendimethalin an rating of C (possible human carcinogen) (BASF 2000) and the Rachel Carson Council lists it as a carcinogen (Briggs 1992).

The formulated product, Pendulum, contains clay which may contain more than 0.1% crystalline silica. BASF warns that "overexposure to crystalline silica results in silicosis, a lung disease characterized by coughing, difficult breathing, wheezing, scarring of the lungs, and repeated, non-specific chest illnesses" (BASF 2000). Crystalline silica has been classified in Group 1 (those agents with evidence of carcinogenicity to humans) by the International Academy for Research on Cancer (IARC) (BASF 2000).

2.5.2.5 Mutagenic effects

"Although genetic mutations were induced by pendimethalin with metabolic activation in *Salmonella typhimurium*, higher-purity technical material did not induce mutations in the same test system. Pendimethalin did not induce chromosomal aberrations, unscheduled DNA synthesis, or dominant lethal mutations" (WHO 1996).

2.5.2.6 Reproductive effects

Reproductive toxicity was not observed in a three-generation reproduction study in Long-Evans rats given dietary pendimethalin doses as high as 1000 mg/kg (WHO 1996).

2.5.2.7 Teratogenic effects

"Teratogenicity was not observed at the highest dose tested in rats (1000 mg/kg of body weight per day) or rabbits (60 mg/kg of body weight per day). In rats force fed pendimethalin on days 6-15 of gestation, embryotoxicity in the form of minor anomalies and reduced fetal weight was observed at 1000 mg/kg of body weight, and reduced ossification of the extremities was present at 250 and 500 mg/kg of body weight" (WHO 1996).

2.5.2.8 Organ toxicity and systemic effects

Effects in kidney, uterus, and ovary weights were found due to subchronic testing. Hyperglycaemia and increased thyroid and adrenal gland weights were found as a result of chronic studies.

2.5.2.9 Fate in humans and animals

Pendimethalin appears to be both poorly absorbed and rapidly excreted. "About 95% is excreted within 24 hours after oral administration, 75% being found in the feces and 20% in the urine" (WHO 1996). Maximum tissue concentrations were found in the liver and kidney (WHO 1996).

2.5.2.10 Occupational and residential exposure

No data

2.5.2.11 Effects of inert ingredients

The formulated product, Pendulum, contains clay which may contain more than 0.1% crystalline silica. BASF warns that "overexposure to crystalline silica results in silicosis, a lung disease characterized by coughing, difficult breathing, wheezing, scarring of the lungs, and repeated, non-specific chest illnesses" (BASF 2000). Crystalline silica has been classified in Group 1 (those agents with evidence of carcinogenicity to humans) by the International Academy for Research on Cancer (IARC) (BASF 2000).

2.5.2.12 Controversy over health effects

The only available health and safety information on pendimethalin was provided by the chemical manufacturer American Cyanamid Co. and may not provide a well rounded view of this compound's effects.

Pendimethalin lacks data required for national safety data sheets. However, even lacking this data, it is on to two federal regulatory lists as a suspected carcinogen and a suspected gastrointestinal or liver toxicant (Vaeth 2000). Pendimethalin is ranked more hazardous than most chemicals in two out of four ranking systems, and is ranked as one of the most hazardous compounds (in the worst ten- percent) to ecosystems and health (Vaeth 2000).

On December 31, 1999, the EPA passed a final rule to lower reporting thresholds for certain Persistent Bioaccumulative Toxic (PBT) chemicals and pendimethalin is included in this list (Vaeth 2000). Lowering these chemicals' releasable levels is based on their carcinogenicity, chronic human health effects and/or their significant adverse effects on the environment (Vaeth 2000).

2.5.3 Environmental safety

2.5.3.1 Label limitations

"This product is toxic to fish. DO NOT apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift and runoff from treated areas may be hazardous to aquatic organisms in adjacent aquatic sites. DO NOT contaminate water when disposing of equipment washwaters". Re-entry is allowed when product is dried.

2.5.3.2 Ecological effects

Effects on birds: No data.

Effects on aquatic organisms: Pendimethalin is very highly toxic to fish and crustaceans and very toxic to aquatic plants (BASF 2000; Vaeth 2000). However, Pendulum poses very little hazard to fish or non-target plants when used according to labeled directions (BASF 2000).

Effects on other organisms: A 3-year study which examined the toxicity of different pesticides on earthworms, found that pendimethalin is of low toxicity to earthworms (Townsend 1994).

Bioconcentration and degradation: Pendimethalin appears to be both poorly absorbed and rapidly excreted. Maximum tissue concentrations were found in the liver and kidney (WHO 1996).

2.5.3.3 Environmental fate

Breakdown in soil and groundwater: Pendimethalin is stable under both alkaline and acidic conditions (WHO 1996). It is a moderately persistent herbicide that can give rise to long-lasting metabolites, mainly by photodegradation (WHO 1996). Both pendimethalin and its metabolites bind tightly to soil particles and the leaching potential is negligible (WHO 1996). In North Dakota, there is concern about both Pendulum and pendimethalin and they are described as having "immediate leaching potential" (Nowatzki 2001). Half-life estimates in soil range from 30 to 90 days (WHO 1996). Pendimethalin has a low affinity for the water compartment (WHO 1996). However, under anaerobic conditions, more polar metabolites of greater mobility are formed, and these can potentially contaminate both groundwater and surface waters (WHO 1996).

Contamination of and breakdown in water: Pendimethalin was found at a concentration below 0.1/L in one of 76 drinking-water supplies examined in the Veneto Region in Italy (WHO 1996).

Breakdown in vegetation: Pendimethalin is toxic to plants (BASF 2000).

2.5.3.4 Controversy over environmental effects

The only available health and safety information on pendimethalin was provided by the chemical manufacturer American Cyanamid Co. and may not provide a well rounded view of this compound's effects. This is important to realize since pendimethalin is ranked more hazardous than most chemicals in two out of four ranking systems, and is ranked as one of the most hazardous compounds (in the worst ten- percent) to ecosystems and health (Vaeth 2000).

On December 31, 1999, the EPA passed a final rule to lower reporting thresholds for certain Persistent Bioaccumulative Toxic (PBT) chemicals and pendimethalin is included in this list (Vaeth 2000). Lowering these chemicals' releasable levels is based on their carcinogenicity, chronic human health effects and/or their significant adverse effects on the environment (Vaeth 2000).

2.6 Sulfometuron-methyl

2.6.1 Technical information

2.6.1.1 Use

Sulfometuron-methyl belongs to a large class of herbicides, the sulfonylureas, which has attracted attention because of its extraordinary potency with application rates often being less than one-fourth ounce (7 grams) per acre (NCAP 1993 Ware 2000). Sulfometuron-methyl is used only on noncrop areas for nonselective weed control as a broad spectrum pre- and postemergence herbicide.

2.6.1.2 Chemistry

The chemical name of sulfometuron-methyl is: methyl 2[[[[(4,6-dimethyl-2-pyrimidinyl)amino]-carbonyl]amino]sulfonyl]benzoate.

2.6.1.3 Mode of action

Sulfometuron-methyl inhibits growth by blocking cell division in the meristematic tissue (active growing regions of stem and root tips). At a molecular level, sulfonylureas inhibit the activity of the enzyme, acetolactate synthase (ALS), that is involved in the production of three chemically-related amino acids (valine, leucine, and isoleucine) (6 as cited by NCAP 1993). Somehow the inhibition of the ALS enzyme halts cell division and results in plant

death. Although animal cells do not contain ALS, it is possible that sulfonylureas do impact other enzyme systems in animals (6 as cited by NCAP 1993).

2.6.1.4 Products and formulation

Sulfometuron-methyl is the active ingredient in Oust, a DuPont product which is primarily used as a nonselective herbicide to kill weeds in noncrop situations. In California, over 80% of the Oust used is applied to right-of-ways (5 as cited by NCAP 1993). Since the herbicidal properties of sulfonylureas were first noticed in 1966, 375 patents have been granted for sulfonylurea herbicides (NCAP 1993) and it is likely that new sulfonylurea candidates will continue to be introduced from major U.S. and Japanese manufacturers (Ware 2000). Trade names for other sulfometuron-methyl products include Oust Weed Killer and DPX 5648. The formulation of Oust is 75% sulfometuron methyl and 25% inert ingredients.

2.6.1.5 Regulatory status

Sulfometuron-methyl is a General Use Pesticide and is a slightly toxic compound which must bear the signal word CAUTION. It is a Title III acute hazard.

2.6.1.6 District use and application

Oust is applied at the rate of 1 - 5 oz/acre depending on the plants to be controlled. Fifteen to forty gallons of water is used when applying Oust as a broadcast application, and between five and fifteen gallons when applying Oust from a helicopter.

The District is concerned with controlling terrestrial weeds on top of bank areas between October and February. Oust is applied annually at the rate of 5 ounces per acre with a gun, boom or backpack. This translates into an application rate of 0.234 lb/acre or 26.27 mg/m^2 of the active ingredient sulfometuron methyl.

2.6.2 Public health

2.6.2.1 Acute toxicity

Oral - Sulfometuron-methyl and Oust are acutely lethal to animals only in large amounts (NCAP 1993). For both the compound and the formulated product, an LD_{50} of greater than 5,000 mg/kg is required to kill rats (Ware 2000; DuPont 1996, 1998; EXTOXNET 1996*c*; 11 as cited by NCAP 1993). Assuming that humans are equally susceptible, ingestion of over 10 ounces of Oust would be needed to kill a 60 kg person (NCAP 1993). At lower oral doses of Oust, baldness and mottled, heavy lungs were observed (EPA. 1981*a* as cited by NCAP 1993).

Skin - The acute dermal toxicity of the compound is also low. The LD_{50} values for exposure through the skin ranges from >2000 mg/kg in female rabbits to >8000 mg/kg in male rabbits (EXTOXNET 1996*c*). Sulfometuron-methyl is neither a skin irritant nor a skin sensitizer (EXTOXNET 1996*c*, DuPont 1998). However, Oust is a slight to moderate skin irritant and exposed rabbits experienced "red, slightly to severely swollen" skin and sporadically lost weight (EPA. 1981*a as cited by* NCAP 1993, DuPont 1996,1998).

Eye - Sulfometuron has mild eye irritant properties in rabbits (EXTOXNET 1996*c*). Oust is a slight to mild eye irritant that causes reversible irritation (DuPont 1996). When applied to rabbits' eyes, Oust caused mild redness, swelling, and the corneas to become opaque (EPA. 1981*a as cited by* NCAP 1993).

Inhalation - The acute inhalation LC_{50} of sulfometuron methyl is above 5.3 mg/L in rats, indicating that it is slightly toxic by this route (EXTOXNET 1996*c*). With Oust, single inhalation exposure in rats caused "slight to moderate body weight loss, nasal and ocular discharge, and other nonspecific effects" (Dupont 1998).

2.6.2.2 Subchronic toxicity

In two studies conducted over 90 days, rats developed increased white-blood cell counts (leukocytes) and anemia only at the highest dose tested (375 mg/kg/day) (EXTOXNET 1996*c*). Dogs fed sulfometuron methyl for 3 months also developed elevated white blood cell counts and had increased numbers of lymphocytes (cells found in both the blood and lymph systems) (EPA 1983*b as cited by* NCAP 1993). Neutrophils, scavenger cells in the blood, were decreased in number (EPA 1983*b as cited by* NCAP 1993).

2.6.2.3 Chronic toxicity

A study in which dogs were fed 25 mg/kg/day for one year resulted in mild anemia, with a decrease in the numbers of red-blood cells and the amount of hemolglobin. (EXTOXNET 1996*c*; EPA 1983*b as cited by* NCAP 1993). The same study found that sulfometuron methyl exposure caused a significant increase in the weight of the liver, as well as some increase in kidney weights. In a 2 year study with rats, no effects were noted below 7.5 mg/kg/day (EXTOXNET 1996*c*).

2.6.2.4 Carcinogenic effects

According to DuPont and EXTOXNET, no carcinogenic effects have been detected in either rats or mice exposed to Oust or sulfometuron-methyl (1996; 1996*c*). However, there is disagreement on this point (NCAP 1993). See *Controversy over health effects*.

2.6.2.5 Mutagenic effects

Oust did not produce genetic damage in bacterial or mammalian cell cultures (DuPont 1996, 1998). Sulfometuron methyl was also found not to be mutagenic in a variety of assays conducted on Salmonella cells and Chinese hamster ovary cells, and therefore, EXTOXNET states that it is unlikely that the compound poses a mutagenic risk (EXTOXNET 1996*c*). However, there is evidence to the contrary and disagreement on this issue, see *Controversy over health effects*.

2.6.2.6 Reproductive effects

DuPont and EXTOXNET state that neither Oust nor sulfometuron methyl is likely to have reproductive effects (1996; 1996*c*), however NCAP cites evidence to the contrary (1993). See *Controversy over health effects*.

2.6.2.7 Teratogenic effects

No effects were observed in studies of rats and rabbits exposed to sulfometuron methyl doses of 300 mg/kg/day or resulting from "prolonged and excessive dietary exposure"of Oust (DuPont 1996; EXTOXNET 1996*c*). However there is again disagreement on this point and pregnant rabbits fed sulfometuron methyl experienced miscarriages and fetal resorptions (NCAP 1993).

2.6.2.8 Organ toxicity and systemic effects

As previously mentioned, increased liver and kidney weight may result from chronic exposure (EXTOXNET 1996*c*; EPA 1983*b as cited by* NCAP 1993). Increased white blood counts and decreased red blood counts has also been documented (EXTOXNET 1996*c*; EPA 1983*b as cited by* NCAP 1993). Damage to blood forming agents may also occur (EXTOXNET 1996*c*).

2.6.2.9 Fate in humans and animals

Sulfometuron-methyl does not tend to bioaccumulate. It is readily absorbed through the gastrointestinal tract and is rapidly broken down and removed from the organism (EXTOXNET 1996*c*). Half-lives of the compound in rats ranged from 28 to 40 hours (doses of 16 mg/kg and 3000 mg/kg, respectively). The compound did not accumulate in rats (EXTOXNET 1996*c*).

2.6.2.10 Occupational and residential exposure

No data.

2.6.2.11 Effects of inert ingredients

Since 25% of the formulation of Oust is called a "trade secret" by DuPont, there is no publicly available information on the inert ingredients. Much of EPA's hazard assessment of Oust is based on tests of sulfometuron methyl and not on the complete Oust formulation. The EPA is concerned about "the potential that the inerts [phrase deleted by EPA] or the *combination* of inerts and active ingredient together, when applied directly to water, might be considerably more toxic than the active ingredient alone" (EPA 1982*c as cited by* NCAP 1993).

2.6.2.12 Controversy over health effects

Carcinogenic and mutagenic effects: Two of the chemicals produced by the breakdown of sulfometuron methyl in goats, sulfonilamide and saccharin have been associated with cancer and genetic damage in laboratory tests. Sulfonilamide "causes mutations in the bacteria *Escherichia coli* and invasive lung tumors in rats (18, 19 *as cited by* NCAP 1993). Saccharin induces bladder cancer in rats and sister chromatid exchanges in Chinese hamster and human cells" (20, 21 as cited by NCAP 1993). In response to these allegations, DuPont says that sulfonilamide is not even a breakdown product of sulfometuron methyl and implies that NCAP has made an error. Saccharin is indeed a breakdown product, however the amount used to produce tumors in rats was at a "dose rate greater than 600 times its average rate of human consumption" (Cain 1994). The U.S. Food and Drug Administration regards risk resulting from such a dose as unrealistic and has allowed saccharin to remain on the market for daily use as an artificial sweetener (Cain 1994).

Reproductive effects: In a 90 day reproductive effects study in rats, no reproductive effects were observed at doses of 300 mg/kg/day. Another study in rats showed decreased fecundity and body weight at 300 mg/kg/day. Studies of rabbits showed no fetotoxic effects at 300 mg/kg/day, the highest dose tested. EXTOXNET states that reproductive effects due to sulfometuron-methyl are not likely (1996*c*). However, NCAP cites evidence to the contrary. A small, early study of sulfometuron methyl toxicity to male rats found that several rats developed problems with their testes when fed the compound for ten days (EPA 1981*b as cited by* NCAP 1993). A longer term study of male dogs found both testicular degeneration and testicular atrophy (EPA 1983*b as cited by* NCAP 1993). With females, a study found that pregnant rabbits fed sulfometuron methyl become anorexic, depressed and thin (EPA 1981*b as cited by* NCAP 1993). Exposed rabbits had "lower reproductive indices" than control rabbits, and their pregnancies ended with miscarriages and fetal resorptions (EPA 1981*b as cited by* NCAP 1993). In rabbits fed the highest sulfometuron methyl dose, all fetuses were resorbed (EPA 1981*b as cited by* NCAP 1993). Another study of rats found that mothers fed sulfometuron methyl ate less, gained less weight, and had babies that weighed less than did unexposed mothers (EPA 1981*b as cited by* NCAP 1993).

2.6.3 Environmental safety

2.6.3.1 Label limitation

Do not apply in or on irrigation dirches or canals including their outer banks. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of equipment washwaters. There is no restricted entry interval for non-crop use. Re-entry is allowed when product is dried. Because drift potential increases at wind speeds of less than 3 mph or more than 10 mph, avoid gusty or windless condition.

2.6.3.2 Ecological effects

Effects on birds: Sulfometuron-methyl is practically nontoxic to birds (DuPont 1996; EXTOXNET 1996*c*). The acute oral LD_{50} in mallards is >5000 mg/kg. An 8-day dietary study on mallards and bobwhite quail, also showed an acute dietary LC_{50} of >5000 for both species (DuPont 1996; EXTOXNET 1996*c*).

Effects on aquatic organisms: Sulfometuron-methyl is slightly toxic to freshwater fish. It's LC_{50} in rainbow trout and in bluegill sunfish is greater than12.5 mg/L (EXTOXNET 1996*c*). This conflicts with the Oust Material Safety Data Sheet which has the 96 hour LC50 for sulfometuron-methyl at 148 mg/L for rainbow trout and 150 mg/L for bluegill sunfish (1998*a*). While the compound may not present a significant threat to adult aquatic organisms, the embryo hatch state of fathead minnow may be at a particular risk from its presence (EXTOXNET 1996*c*). Fish kills have been associated with sulfometuron-methyl, but other causes of death have not been ruled out. Sulfometuron-methyl is practically nontoxic to the water flea (*Daphnia magna*) with a NOEC of 150 mg/L. (DuPont 1998*a*; EXTOXNET 1996*c*). Its LC_{50} is >150 mg/L for sulfometuron-methyl (DuPont 1998*a*). No bioaccumulation has been detected (EXTOXNET 1996*c*).

Effects on other organisms: Oust is very low in toxicity to mammals, birds, and insects since they are able to rapidly metabolize and eliminate the chemicals' active ingredients from their systems (DuPont 1996). Oust does not bioaccumulate in warm- or cold-blooded animals (DuPont 1996). Oust is practically nontoxic to the honeybee. The contact LD_{50} is >100 ug/bee (DuPont 1996).

Bioconcentration and degradation:

For sulfonylureas, the most common and significant breakdown processes are through the actions of microorganisms, by the chemical action of water (hydrolysis), and through the action of sunlight (photodegradation) (EXTOXNET 1996*a*). No bioaccumulation in fish has been detected (EXTOXNET 1996*c*).

2.6.3.3 Environmental fate

Contamination and breakdown in soil and groundwater: Sulfometuron-methyl is of low to moderate persistence in the soil environment. For sulfonylureas, the most common and significant breakdown processes are through the actions of microorganisms, by the chemical action of water (hydrolysis), and through the action of sunlight (photodegradation) (EXTOXNET 1996*a*). The rate of hydrolysis is increased by high soil temperature, low pH and the presence of moisture (Dupont 1996). Hydrolysis half-lives of Oust at 25C range from 14 days at pH 5 and >30 days at pH 7 and 9 (Dupont 1996). Sulfometuron-methyl half-lives range from 20-28 days (EXTOXNET 1996*c*). Sulfometuron-methyl does not bind strongly to soil and is slightly soluble in water, but is rapidly degraded and does not appear to pose a threat to groundwater (EXTOXNET 1996*c*). Field study data indicated a majority of the parent compound stays within the top 3 inches of soil (EXTOXNET 1996*c*). There is, however, controversy regarding sulfometuron-methyl's soil persistence, leaching and groundwater contamination potential. See *Controversy over health effects.*

Contamination and breakdown in water: The aqueous solubility of Oust in buffered solutions is 6.4 ppm at pH 5, and 244 ppm at pH 7 (DuPont 1998*a*). Solubility is lower when buffer is omitted. In well aerated acidic water, the compound is broken down quickly (EXTOXNET 1996*c*). Reported half-lives for sulfometuron-methyl in water vary from 1 to 3 days to 2 months or more (EXTOXNET 1996*c*). Photolysis is generally less important than hydrolysis in its breakdown. Under anaerobic conditions in water sediments, the compound had a half-life of several months (EXTOXNET 1996*c*).

Contamination and breakdown in vegetation: Because sulfometuron-methyl is toxic to a number of plants and is non-selective, the use Oust on non-crop lands, including rights of way and along ditch banks, may endanger both terrestrial and aquatic plant species (EXTOXNET 1996*c*). Oust has been known to "drift" into fields and moves easily in wind when the soil is dry and with water when the soil is wet (NCAP 1993). Such incidences have caused damage to agricultural crops with large dollar losses (Turner 1987, Creger 1992 *as cited by* NCAP 1993). A significant problem with detecting Oust drift is that "damage from sulfonylurea herbicides can occur at levels that cannot be detected in the affected crop" (EPA 1989 *as cited by* NCAP 1993). Consequently it is very difficult to assign blame to drifting sulfonylureas since damage is caused by undetectable residues (EPA 1989 *as cited by* NCAP 1993). Resistance to sulfonylureas has been documented in both microorganisms and plants. In California, perennial ryegrass developed resistance after six annual roadside applications of Oust (42 as cited by NCAP 1993). As use of Oust increases, both the numbers and the variety of resistant species are increasing (NCAP 1993).

2.6.3.4 Controversy over health effects

Since 25% of the formulation of Oust is called a "trade secret" by DuPont, there is no publicly available information on the inert ingredients. Much of EPA's hazard assessment of

Oust is based on tests of sulfometuron methyl and not on the complete Oust formulation. The EPA is concerned about "the potential that the inerts [phrase deleted by EPA] or the *combination* of inerts and active ingredient together, when applied directly to water, might be considerably more toxic than the active ingredient alone" (EPA 1982*c as cited by* NCAP 1993).

Contamination and breakdown in soil and groundwater: Sulfometuron-methyl has been identified as a potential groundwater contaminant pursuant to section 13145(d) of the Food and Agricultural Code (California Code 2001). Soils studies in Delaware, North Carolina, Oregon, Colorado, and Saskatchewan found that sulfometuron methyl persisted in each soil for a year and in the Colorado soil, 18% or the compound applied was still present after one year (28 as cited by NCAP 1993). Laboratory tests of leaching potential found that a 75-87% of the amount applied leached from the soil column (EPA 1981*c as cited by* NCAP 1993). Chemicals that leach readily also move through the soil easily and can potentially contaminate groundwater (NCAP 1993). NCAP stated that soil mobility measurements of sulfometuron methyl showed that it is more mobile than atrazine, the second most common herbicide contaminant of groundwater in the U.S. (EPA 1997b as cited by NCAP 1993). DuPont counters that such a statistic is "NOT" true (Cain 1994).

2.7 Triclopyr

2.7.1 Technical information

2.7.1.1 Use

Triclopyr is a carboxylic acid herbicide. This group of herbicides are ideal for control of perennial broadleaf weeds and brush, and have both soil and foliar activity.

2.7.1.2 Chemistry

Triclopyr is a pyridine compound and belongs to a group of compounds known as carboxylic acid herbicides. Its chemical name is [(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid. Triclopyr is commercially available mainly as a triclopyr triethylamine salt (TEA) or a triclopyr butoxyethyl ester (BEE) of the parent compound.

2.7.1.3 Mode of action

Carboxylic acid herbicides behave like synthetic auxins. They imitate the natural plant hormone, indoleacetic acid, and cause the growing tips of the plant to elongate, followed by distortion, withering, and death (Ware 2000 cited by NCAP 2000). Triclopyr is selective to broadleaf plants because grasses are able to rapidly transform triclopyr into compounds that do not have hormonal activity (NCAP 2000(11).

2.7.1.4 Products and formulation

Triclopyr is the active ingredient in two herbicides used by the District, Garlon 3A and Garlon 4. There are a variety of additional triclopyr-based products available, including Access, Crossbow, ET, Grandstand, Grazon, PathFinder, PathFinder II, Redeem, Rely, Remedy, and Turflon.

Garlon 3A is composed of 44.4% triclopyr triethylamine salt (TEA) and 55.6% inert ingredients. Garlon 4 herbicide is formulated with 61.6% triclopyr butoxyethyl ester (BEE) and 38.4% inert ingredients. Triclopyr TEA and BEE products are used as selective herbicides to control perennial broadleaf weeds and woody plants on a variety of areas including rights-of-ways, pasture and rangelands, forests, and turf. Triclopyr TEA was first registered in 1979 and Triclopyr BEE was registered in 1980. According to EPA estimates, use of triclopyr products in the U.S. totals almost 700,000 pounds per year (NCAP 2000).

2.7.1.5 Regulatory status

Triclopyr herbicides are classified as toxicity class III (slightly toxic and can cause eye irritation) and are listed on the EPA's Toxics Release Inventory. Product labels for Garlon 3A must bear the signal word DANGER. (Dow 1999*c*) Garlon 4 must be labeled with the signal word CAUTION. Both Garlon 3A and Garlon 4 have been reviewed according to the EPA "SARA Hazard Categories" and have been classified as "an immediate health hazard", "a delayed health hazard", and "a fire hazard" (Dow 1999*c*, 1999*d*). Both are also considered "hazardous chemicals" as defined by the OSHA Hazard Communication Standard (Dow 1999*c*,1999*d*).

2.7.1.6 District use and application

Garlon 3A is typically applied at the rate of 1 - 2 quarts per acre. For foliage treatment with ground equipment, Garlon 3A is mixed as a .5 to 1% solution. For broadcast treatment with ground equipment, Garlon 3A is mixed as a 3 to 10% solution.

Garlon 4 is typically applied at the rate of 1 quart per acre. For foliage treatment with ground equipment, Garlon 4 is mixed as a .25 - .75% solution. For broadcast treatment with ground equipment to control broadleaf weeds, Garlon 4 is mixed as a 20 to 40% solution.

The District uses the Garlon 3A and Garlon 4 herbicides to control woody brush and invasive broadleaf weeds on levee slopes and top of bank areas. The time of year for this application varies.

Garlon 3A is applied once annually at the rate of 2 quarts per acre gun, boom, or back pack.

This translates to an application rate of 1.5 lb/acre or 168.13 mg/m^2 of the active ingredient, triclopyr.

The District applies Garlon 4 at the rate of 1 quart per acre gun, boom or back pack (annually). This results in the application of 1.0 lb/acre or 112.09 mg/m^2 of triclopyr.

The surfactants Wilbur Ellis "R-11" and Target Specialty Products "Pro Spreader" are used with the Garlon herbicides at the concentration of ¼ %. See sections 13 and 14 for a review of these surfactants.

2.7.2 Public health

2.7.2.1 Acute toxicity

Eye - Garlon 3A (TEA) may cause severe irritation with corneal injury, which may result in permanent impairment of vision, even blindness (Dow 1999c). Amine vapors may cause swelling of the cornea resulting in blurred, smoky or halo vision (Dow 1999c). EPA classifies TEA in the agency's highest acute toxicity category for eye irritation (NCAP 2000). It is "corrosive" to eyes with damage lasting over three weeks (NCAP 2000). When tested on animals, dilutions of this material were less irritating to eyes than the undiluted product (Dow 1999c)**.** BEE, found in Garlon 4, may cause slight temporary eye irritation but is unlikely to result in corneal injury (Dow 1999d, EPA 1998*a*)**.**

Skin - Acute data indicate that both triclopyr TEA and BEE are slightly toxic by the dermal route (EPA 1998*a*, EXTOXNET 1996*d*). Prolonged or repeated exposure to Garlon herbicides may cause skin irritation, and Garlon 3A may result in a burn (Dow 1999c, 1999d). When tested on animals, dilutions of this material were less irritating to skin than the undiluted product (Dow 1999c). Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals (Dow 1999c, 1999d). Both the TEA and the BEE sensitize skin so that subsequent exposures cause greater allergic reaction than the first exposure (17, EPA 1998*f as cited by* NCAP 2000; EPA 1998*a*). However, with the dilute mix, no allergic skin reaction is expected (Dow 1999*c*, 1999*d*). The LD_{50} for skin absorption in rabbits is >5000 mg/kg for Garlon 3A (Dow 1999*c*) and >2000 mg/kg for Garlon 4 (Dow 1999*d*). For triclopyr, dermal absorption is calculated at <2% with rabbits and human volunteers. No adverse effects were seen at the highest dose tested of 1000 mg/kg/day in a 21-day dermal toxicity study in rabbits (EPA 1998*a*).

Inhalation - Available data indicate that both TEA and BEE are practically non-toxic by inhalation (Toxicity Category IV) (EPA 1998a). The LC_{50} was determined to be >2.6 mg/mL (EPA 1998a). A single and short inhalation exposure to Garlon 3A is not likely to cause adverse effects (Dow 1999c). Excessive inhalation exposure to Garlon 4 may cause

irritation to upper respiratory tract (nose and throat) (Dow 1999d; EXTOXNET 1996d). Garlon 4 contains kerosene. Signs and symptoms of excessive inhalation exposure to kerosene may be central nervous system effects (Dow 1999d).

Oral - Acute data indicate that both triclopyr TEA and BEE are slightly toxic by the oral route (EPA 1998*a*, EXTOXNET 1996*d*). Single dose oral toxicity of Garlon 3A is low. The oral LD_{50} was 2574 mg/kg for male rats and 1847 mg/kg for female rats. Ingestion may cause gastrointestinal irritation or ulceration (Dow 1999c). For Garlon 4, the oral LD_{50} for rats is 1581 mg/kg (males) and 1338 mg/kg (females) (Dow 1999d). If liquid enters the lungs, lung damage or even death may occur due to chemical pneumonia (Dow 1999d). Triclopyr has an oral LD_{50} of 713 mg/kg (Ware 2000; Syracuse 1996).

Other symptoms of short-term exposure to triclopyr include lethargy, incoordination, weakness, difficult breathing, and tremors. Anorexia and diarrhea have also been observed in animals exposed to triclopyr (U.S. Dept. of Justice 1998 *as cited by* NCAP 2000).

2.7.2.2 Subchronic toxicity

In a 3 month study of rats fed triclopyr doses of 20 mg/kg of body weight per day, triclopyr caused kidney damage (degeneration of tubules) (U.S. Dept. of Justice 1998 *as cited by* NCAP 2000). There are no publicly available subchronic toxicity studies of commercial triclopyr-containing products (NCAP 2000).

2.7.2.3 Chronic toxicity

Chronic effects include decreased liver and body weight and increased kidney weight. Rats fed doses of 25 mg/kg/day developed kidney damage more often than unexposed rats (EPA 1998*a*; 20 as cited in NCAP 2000). Conflicting studies cited by EXTOXNET state that rats fed up to 30 mg/kg/day experience no adverse effects (1996*d*). When the dosage was increased to 100 mg/kg/day, male rats experienced decreased liver and body weight and increased kidney weight (EXTOXNET 1996*d*). Monkeys fed smaller doses of triclopyr (20 mg/kg/day) showed no adverse effects (EXTOXNET 1996*d*). Dogs fed doses of 20 mg/kg/day gained less weight, had less hemoglobin and red blood cells in their blood, and had more microscopic liver damage than did unexposed dogs (20 as cited in NCAP 2000). However, adverse effects in dogs are apparent at even lower doses and NCAP is concerned about the studies that the EPA used to calculate the acceptable exposure to triclopyr. Originally, the EPA used a dog study which showed kidney effects at a tenfold lower dose (2.5 mg/kg/day) (21 as cited by NCAP 2000). This lower dose calculation was criticized by triclopyr's manufacturer because of studies conducted by the chemical company which showed that "triclopyr is more slowly excreted by dogs than other animals, and that the dog kidney is more susceptible than the kidney of other animals" (EPA 1982c, 23 as cited by NCAP 2000). As a result, EPA classified the kidney damage as "not a toxic response to the

test chemical, but a physiologic response of the dog" and omitted the results in its more recent evaluation of triclopyr (24 as cited by NCAP 2000). There are no publicly available chronic toxicity studies of commercial triclopyr-containing products (NCAP 2000).

2.7.2.4 Carcinogenic effects

According to Dow Chemical, triclopyr did not cause cancer in laboratory animal studies (1999*c*,1999*d*). Triclopyr's carcinogenicity has been studied in rats and mice fed oral doses of triclopyr at 3 to 30 mg/kg/day for 2 years (EPA 1996 *as cited by* NCAP 2000; EXTOXNET 1996*d*). These studies showed no carcinogenic response even though the mice had a high incidence of lymph cancer, both the female rat and mouse showed increases in mammary tumors, and triclopyr caused an increase in the frequency of adrenal tumors in male rats (EPA 1996 *as cited by* NCAP 2000; EPA 1998*a*; EXTOXNET 1996*d*). In EPA's evaluation of these studies, the agency called this carcinogenic response "marginal" and classified triclopyr as a Group D carcinogen, one that is "not classifiable as to human carcinogenicity," even though EPA's guidelines call for classifying pesticides as carcinogens if they case cancer in laboratory tests of more than one species (EPA 1981*c as cited by* NCAP 2000). The Rachel Carson Council lists triclopyr as a suspect carcinogen (Briggs 1992).

Dow warns that Garlon 3A contains ethanol, and studies have linked alcohol consumption with cancer (Dow 1999*c*). Garlon 4 contains kerosene and in a chronic animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation (Dow 1999*d*). No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation (EXTOXNET 1999*d*). There are no publicly available carcinogenicity studies of commercial triclopyr-containing products (NCAP 2000).

2.7.2.5 Mutagenic effects

Triclopyr is nonmutagenic in bacterial and cytogenetic assay systems (EXTOXNET 1996*d*). A mutagenicity study using rats was weakly positive, but a negative result was found in mice, the more sensitive species (EXTOXNET 1996*d*). Based on these data, EXTOXNET concludes that triclopyr is unlikely to be mutagenic (1996*d*).

However, a study of triclopyr's mutagenicity reviewed by the EPA during the re-registration process, showed a different result. It looked at triclopyr's ability to cause dominant lethal mutations in rat embryos. Dominant lethal mutations are mutations in sperm that cause the death of the embryo fertilized by the defective sperm. They are studied by counting the number of dead embryos in pregnant animals (NCAP 2000). In a study of female rats mated with males who had been dosed with triclopyr, the frequency of embryo loss increased at the middle and high doses (7 and 70 mg/kg) (25 as cited by NCAP 2000). In seven studies of

other kinds of genetic damage that were submitted by triclopyr's manufacturer in support of its registration as a pesticide, no mutagenicity was observed (25 as cited by NCAP 2000). The Rachel Carson Council lists triclopyr as a suspect mutagen (Briggs 1992).

There is concern that a breakdown product of triclopyr, TCP, may adversely impact nervous system in fetuses and disrupts the functions of mitochondria (79, 78,77 as cited by NCAP 2000). See discussion of TCP under *Organ toxicity and systemic effects.*

2.7.2.6 Reproductive effects

According to the Dow Agriculture chemical company, effects of triclopyr on reproduction have been seen only at doses that produced significant toxicity to the parent animals (Dow 1999*c*, 1999*d*). Studies cited by EXTOXNET, found that rabbits fed triclopyr on days 6 to 18 of gestation at doses of 25,50, and 100 mg/kg/day, produced no effects on maternal body weight, litter size, or fetal body weight and it was concluded that "triclopyr does not appear to cause reproductive toxicity" (EXTOXNET 1996*d*). However, more recent documentation states that pregnant rabbits fed TEA had fewer litters, fewer live fetuses, and more embryo loss than did unexposed rabbits (EPA 1998*a*; 28 as cited by NCAP 2000). Similarly, pregnant rabbits fed BEE had fewer live fetuses , more embryo loss, and offspring with more skeletal abnormalities than did unexposed rabbits (EPA 1998*a*; 28 as cited by NCAP 2000). These problems occurred at doses of 100 and 250 mg/kg/day (EPA 1998*a*; 28 as cited by NCAP 2000).

A similar discrepancy is found in studies using rats. EXTOXNET found that a three generation study of rats at doses of 3, 10, and 30 mg/kg/day for an 8 to 10-week period prior to breeding of each generation showed no impact of triclopyr on fertility rates (1996*d*). In a study using a higher dose, researchers found that rats fed approximately 100 mg/kg of triclopyr for 3 generations had offspring that weighed less and had more skeletal abnormalities than offspring from unexposed rats (Syracuse 1996).

Dow warns that ingestion of ethanol (an inert ingredient found in Garlon 3A) in large amounts has been shown to interfere with fertility in human males (1999*c*).

There is concern that a breakdown product of triclopyr, TCP, may disrupt the development and maturation of the nervous system in fetuses and that it accumulates in fetal brains (78,77 as cited by NCAP 2000). TCP is also toxic to chicken embryos (81 as cited by NCAP 2000). See discussion of TCP under *Organ toxicity and systemic effects.*

2.7.2.7 Teratogenic effects

Dow claims that for both Garlon 3A and 4, birth defects are unlikely, even at exposures which have an adverse effect on the mother (Dow 1999*c*, 1999*d*). Garlon 4, did not cause birth defects in animals and impacted the fetus only at doses which caused toxic effects to

the mother (1999*d*). Pregnant rats given moderate to high doses of 50, 100, and 200 mg/kg/day on days 6 to 15 of gestation had offspring with mild fetotoxicity, but no birth defects. There were no teratogenic effects in rabbits treated on days 6 to 18 of gestation at dose rates of 10 and 25 mg/kg/day. These data suggest that triclopyr is not teratogenic (EXTOXNET 1996*d*).

Dow warns that ethanol has been shown to cause birth defects and toxicity to the fetus in animal tests. It has also been shown to cause human fetotoxicity and/or birth defects with ingested during pregnancy (Dow 1999c). There is concern that a breakdown product of triclopyr, TCP, may disrupt the development and maturation of the nervous system in fetuses (77 NCAP 2000). See discussion of TCP under *Organ toxicity and systemic effects.*

2.7.2.8 Organ toxicity and systemic effects

As previously discussed, exposure to Garlon 3A or Garlon 4 may cause blood, liver or kidney effects (NCAP 2000; Dow 1999*c*, 1999*d*; EPA 1998*a*; EXTOXNET 1996*d*). Recent concern has been raised that pesticides may interfere with the development of the nervous system (NCAP 2000). 3,5,6-trichloro-2-pyridinol (TCP) is the most common breakdown product of triclopyr in mammals. TCP disrupts the development and maturation of the nervous system that occurs in fetuses, infants, and children (77 NCAP 2000). Exposure to concentrations of only 0.2 ppm are sufficient to inhibit neurons from undergoing normal growth (79 NCAP 2000). Concentrations equal to this level have been measured in the brains of fetal laboratory animals whose mothers were exposed to pesticides(77 NCAP 2000). In addition, when TCP concentrations in the brains of fetal laboratory animals were compared with those in their mothers' brains, the fetal concentrations were between two and four times greater than those in maternal brains, suggesting that TCP accumulates in fetal brains (78 NCAP 2000). TCP also disrupts the functions of mitochondria (converting food into energy usable by the cell) (79 NCAP 2000). At concentrations of 2 ppm, TCP reduced four measures of mitochondrial function by at least 30 percent (79 NCAP 2000).

2.7.2.9 Fate in humans and animals

Data indicate that triclopyr is rapidly eliminated via the urine as the unchanged parent compound. At higher oral doses, some triclopyr may be eliminated through the feces as the absorption capacity of the intestine is exceeded. Reported half-lives for elimination of triclopyr from mammals are 14 hours (dog) and <24 hours (monkeys). A human elimination half-life of approximately 5 hours has been suggested. Metabolites of triclopyr may include TCP (EXTOXNET 1996*d*) which has been suggested to accumulate in the fetal brain (79 NCAP 2000). See discussion of TCP under *Organ toxicity and systemic effects.*

2.7.2.10 Occupational and residential exposure

Although the EPA determined that there is a "reasonable certainty that no harm will result to infants and children or to the general population from aggregate exposure to triclopyr or TCP residues" (EPA 1998*a*), NCAP believes that TCP, may be especially hazardous to children (NCAP 2000). See discussion of TCP under *Organ toxicity and systemic effects.* Homeowner exposure to triclopyr is expected to be minimal due to the low dermal and inhalation toxicity and safer home application methods and active ingredient concentrations. No chronic occupational exposure are anticipated either (EPA 1998*a*).

2.7.2.11 Effects of inert ingredients and surfactants

Garlon 3A contains the following inert ingredients that are listed under the State Right to Know:

a) Triethylamine (N,N-diethylethanamine CAS # 000121-44-8) 3%. Triethylamine is damaging to eyes and can cause abnormal vision (EPA 1991*a)* and irreversible damage (NCAP 2000). It is extremely destructive to skin and the upper respiratory tract. Symptoms of exposure include coughing, wheezing, headache, and nausea (7,8 as cited by NCAP 2000).

b) Ethylenediamine Tetraacetic acid (ETDA) (CAS # 000060-00-4) 2.3% - Causes eye and skin irritation and is also irritating to mucus membranes and the upper respiratory tract (Sigma 2000). In laboratory tests with rats, it caused a variety of birth defects: cleft palate, eye defects, and abnormal skeletons (2, 3 as cited by NCAP 2000). ETDA may also be harmful by inhalation, ingestion, or skin absorption (Sigma 2000). To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated (Sigma 2000).

c) Ethanol (CAS # 000064-17-5. The toxicity of ethanol is extremely well characterized in humans, and the hazards of exposure include intoxication from acute exposure as well as liver cirrhosis and fetal alcohol syndrome. For chronic exposure, the alcohol content of Garlon 3A is not of toxicological significance because of the rapid breakdown of alcohol in the environment and the relatively high levels of alcohol required for chronic alcohol poisoning (Syracuse 1996). Similarly, the acute hazard of ethanol is extremely low. Each mL of Garlon 3A contains 0.01 mL of ethanol. In comparison, 15 mL of alcohol is contained in 1 oz of an alcoholic beverage containing 50% alcohol (100 proof) and is enough to cause mild intoxication in sensitive individuals. Therefore, 1,480 mL (~ 1.5 L) of Garlon 3A must be consumed in order to equal the amount of alcohol contained in 1 oz of an alcoholic beverage. 1.5 L of Garlon 3A contains 540,000 mg of triclopyr which, for a 70 kg man, would equal a dose of approximately 770 mg/kg. This dose is slightly higher than the LD_{50} for rats and could be a reasonable approximation of a lethal dose of triclopyr for humans (Syracuse 1996). Therefore, the exposure risk of ethanol is toxicologically insignificant compared to the amount of triclopyr in the Garlon 3A formulation (Syracuse

1996).

Garlon 4 contains the inert ingredient kerosene which causes severe eye irritation and is also irritating to the upper respiratory tract. Inhalation of kerosene causes fatigue, headache, dizziness, and incoordination. Other symptoms include euphoria, a burning sensation, disorientation, and drowsiness (4,5 as cited by NCAP 2000). The acute LD50 of kerosene for humans ranges from approximately 2000 - 12,000 mg/kg. In experimental mammals it is from 16,000 to 23,000 mg/kg. Compared to the LD50 of triclopyr in experimental mammals of LD50 300 - 500 mg/kg, the acute lethal potency of kerosene is approximately 50 times less than the acute lethal potency of triclopyr (Syracuse 1996). Given the relative potency of kerosene and given that the amount of kerosene in Garlon 4 is at least 2 times less than the amount of triclopyr, the acute effects associated with exposure to Garlon 4 are most likely attributable to triclopyr, not to kerosene (Syracuse 1996). Thus the levels of kerosene present in Garlon 4 are not toxicologically significant.

2.7.2.12 Controversy over health effects

There are several areas of controversy regarding the safety of triclopyr. See the following sections for details: chronic effects, reproductive effects, teratogenic effects, carcinogenic effects, mutagenic effects and occupational and residential exposure.

2.7.3 Environmental safety

2.7.3.1 Label limitation

The Garlon 3A label reads "Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters." It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands, flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. Do not apply to open water such as lakes, reservoirs, rivers, streams, creeks, salt water bays, or estuaries. There is no restriction for non-crop use. Re-entry is allowed when product has dried.

The Garlon 4 label states; "This pesticide is toxic to fish. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters." It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands, flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. Do not apply to open water such as lakes, reservoirs, rivers, streams, creeks, salt water bays, or estuaries. Agricultural REI is 12 hours; there is no restriction for non-crop use.

2.7.3.2 Ecological effects

Effects on birds: Triclopyr is slightly to practically nontoxic to birds (EXTOXNET 1996*d*; Syracuse 1996). The LD_{50} of the parent compound in the mallard duck is 1698 mg/kg, while the formulated compounds are of lower toxicity. The LC_{50} in bobwhite quail and Japanese quail fed triclopyr for 8 days are 2935 ppm and 3278 ppm, respectively (EXTOXNET 1996*d*). However, it has also been found that triclopyr decreases the survival of newly hatched nestlings. In tests with mallard ducks, ducklings hatched from eggs laid by mothers who were fed triclopyr (200 ppm) had a survival rate that was between 15 and 20% lower than that of ducklings from unexposed mothers (29, EPA 1981*d as cited by* NCAP 2000).

Effects on aquatic organisms: Garlon 3A is slightly toxic to aquatic organisms on an acute basis (LC_{50} between 10 and 100 mg/L) (Dow 1999*c*). A report done by Syracuse Labs concluded that at plausible levels of acute exposure in standing water and streams, (0.07-0.5 mg/L), Garlon 3A is not likely to have any effect on fish, aquatic invertebrates, and most algae (1996). NCAP warns that effects on fish behavior (loss of voluntary neuromuscular control and fish lying flaccid on the bottom with irregular and labored breathing) have been observed at concentrations one-half of the LC_{50} (31 as cited by 2000), but such levels may not be realistic risks if the herbicide is used appropriately.

Garlon 4 is more toxic than Garlon 3A by a factor of about 200. According to the manufacture's description, Garlon 4 is moderately toxic to fish on an acute basis (LC_{50} between 1 and 10 mg/L) (Dow 1999*d*). Garlon 4 could cause adverse effects on aquatic species at the upper range of estimated exposure levels, 0.07 - 0.5 mg/L, associated with an application rate of 1 lb/acre (Syracuse 1996), which is the rate at which the District applies the herbicide. These effects would probably consist of transient behavioral changes (Syracuse 1996). However, BEE has also been found to be "highly toxic" to rainbow trout, bluegill sunfish, coho salmon, and the tidewater silverside (31 as cited by NCAP 2000). In lake enclosures, half the tested rainbow trout died at concentrations of 0.45 and mortality reached 100% at concentrations of 0.69 ppm (33 as cited by NCAP 2000). Reduced growth occurred at even lower concentration, 0.25 ppm. Researchers also found reduced growth in young rainbow trout following application of BEE to a forest stream (33 as cited by NCAP 2000). The most sensitive life stage and species in laboratory tests is the yolk-sac fry of the coho salmon, with a LC_{50} of less than 0.5 ppm (31 as cited by NCAP 2000). BEE also affects fish behavior, and at concentrations of 0.6 ppm, has caused rainbow trout to experience rapid respiration, flared gills, and erratic disoriented swimming (32 as cited by NCAP 2000).

Available LC50 values suggest some invertebrate families (Ephemeroptera, Plecoptera, Trichoptera, Odonata) are much more resistant than fish to Garlon 4. Given this pattern, and the limited levels of exposure in streams, the dose response assessment for fish is used to encompass effects on invertebrates (Syracuse 1996).

Triclopyr has little if any potential to accumulate in aquatic organisms. The bioconcentration factor for triclopyr in whole bluegill sunfish is only 1.08 (EXTOXNET 1996*d*).

		Garlon 3A	Garlon 4
LC_{50} (mg/L)	Coho salmon	463	2.1
	chum salmon	267	1.7
	sockeye salmon	311	1.4
	rainbow trout	420	2.7
	chinook salmon	275	2.7
Growth inhibition EC_{50} (mg/L)	Green algae	45	13.3

(DOW 1999*c*, 1999*d*; Syracuse 1996)

Effects on other organisms: A 3-year study which examined the toxicity of different pesticides on earthworms, found that triclopyr in Garlon is of low toxicity to earthworms (Townsend 1994).

A study of three frog species exposed to doses of 0.6, 1.2, and 4.6 ppm found that low concentrations of triclopyr BEE inhibited their avoidance behavior. Instead of moving when touched or prodded, tadpoles exposed to between 1.2 and 4.6 ppm of triclopyr lost their avoidance response and either "twitched in place or were completely unresponsive" when prodded (Syracuse 1996; 35 as cited by NCAP 2000). Exposure to 1.2 and 4.6 ppm caused newly hatched tadpoles to die or to become immobile (Syracuse 1996) and researchers concluded that "such exposure may occur in a managed forest system" (35 as cited by NCAP 2000).

Oyster larvae are more susceptible to triclopyr than other estuarine or marine animals (NCAP 2000). In a test with embryos and larvae of the Eastern oyster, all individuals developed abnormally at a concentration of 87 ppm (38 as cited by NCAP 2000).

Triclopyr may have a negative effect on small mammals. Red-backed voles living on a spruce plantation in Canada were reduced in number by about 80% from untreated areas one year after the plantation was treated with the triclopyr herbicide, Release (39 as cited by NCAP 2000). However, the results of the Syracuse risk assessment for triclopyr concludes that there is little indication that dermal exposure or exposure from the consumption of contaminated water will lead to exposure levels that approach levels of concern. The consumption of contaminated vegetation immediately after herbicide application is the only scenario that may cause problems and although signs of serious effects are not likely to

occur at such exposure levels, kidney function could be impaired (Syracuse 1996).

Triclopyr has been shown to impact populations of beneficial insects and spiders by killing their host plants (EPA 1997b, 37 as cited by NCAP 2000). The triclopyr-containing herbicide Grazon was found to be toxic to a spider mite used as a biological control agent to reduce populations of gorse (37 as cited by NCAP 2000). Triclopyr is nontoxic to bees (EXTOXNET 1996*d*).

Bioconcentration and degradation: Bioconcentration potential for Garlon 3A is low (BCF <100 or Log Pow <3) (Dow 1999*c*). Biodegradation under aerobic static laboratory conditions is high (BOD20 or BOD28/ThOD >40%) (Dow 1999*c*). 20 day biochemical oxygen demand (BOD20) is 0.30 p/p. Theoretical oxygen demand (ThOD) is calculated to be 0.75 p/p (Dow 1999*c*).

For Garlon 4, bioconcentration is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5) (Dow 1999*d*). Biodegradation under aerobic static laboratory conditions is moderate (BOD20 or BOD28/ThOD between 10 and 40%) (Dow 1999*d*).

Triclopyr has little if any potential to accumulate in aquatic organisms. The bioconcentration factor for triclopyr in whole bluegill sunfish is only 1.08 (EXTOXNET 1996*d*).

2.7.3.3 Environmental fate

Contamination of and breakdown in soil and groundwater: Triclopyr is one of the lesser persistent herbicides in soil (Ware 2000). In soil and aquatic environments, the BEE and TEA formulations rapidly convert to the acid, which in turn is neutralized to a relatively nontoxic salt (EXTOXNET 1996*d*). The salt is effectively degraded by soil microorganisms and has a moderate persistence in soil environments. The half-life in soil ranges from 30-90 days (mean=46) depending on soil type and environmental conditions. In general, half-lives are longer on forestry sites than they are on agricultural sites (59 as cited by NCAP 2000). The half-life of one of the breakdown products (trichloropyridinol) in 15 soil types ranged from 8 to 279 days, with 12 of the tested soils having half-lives of less than 90 days (EXTOXNET 1996*d*). Longer half-lives may occur in cold or arid conditions. According to the EPA, triclopyr is "very mobile" in soil as its molecules are not strongly held by soil or sediment particles (63, 64 as cited by NCAP 2000). Triclopyr contamination has been found in wells in Virginia and Texas (65 as cited by NCAP 2000). The EPA believes that triclopyr TEA is more likely to leach into ground water than BEE (U.S. Dept. of Justice 1998 *as cited by* NCAP 2000).

TCP also poses a variety of environmental hazards: it is "very mobile" in a variety of soil types and is also often more persistent than triclopyr itself; it is toxic to soil bacteria. (59; 80 as cited by NCAP 2000).

Contamination of and breakdown in surface water: Rivers and streams can be contaminated from runoff, leaching from contaminated soil, from a direct spill, or unintentional contamination from aerial applications (61,69-72 as cited by NCAP 2000; Syracuse 1996). USGS studies have found that contamination of urban streams may be widespread (67, 68 as cited by NCAP). Triclopyr is not readily hydrolyzed at pH 5 to 9. For triclopyr, the major degradative process appears to be photolysis (Syracuse 1996; EXTOXNET 1996*d*). In either natural or sterile waters, the halftime of triclopyr acid under conditions simulating natural sunlight is relatively short: about 0.5 days in natural water and 1.3 days in sterile water (Syracuse 1996). Under conditions of darkness, the halftime in sterile water is approximately 3 months (Syracuse 1996). BEE is more likely to run off into surface water than TEA (U.S. Dept. of Justice 1998 *as cited by* NCAP 2000). Hydrolysis of TEA and BEE occurs rapidly. Reported half-lives for TEA in water are 2.8 to14.1 hours, depending on the season and depth of water (EXTOXNET 1996*d*). The BEE half-life ranges from 12.5 to 83.4 hours (EXTOXNET 1996*d*).

Impact on nontarget plants and breakdown in vegetation: Direct deposition, from unintentional direct spraying or from spray drift is a plausible hazard for most herbicides, including those concerning triclopyr. If plants are sprayed accidentally at the application rates uses by the District, plants, with the possible exception of grasses, are likely to be damaged. The extent and duration of the resulting damage will depend on the time of application and the plant species. With proper management and application procedures, such accidental applications can be minimized or eliminated. The extent of drift depends on specific application conditions such as wind speed, wind direction, topography, the distance from the ground at which the herbicide is applied and the droplet size of the herbicide spray. Spray drift could cause detectable damage to nontarget plants within approximately 30m downwind of spray zone (Syracuse 1996).

Triclopyr is readily translocated throughout a plant after being taken up by either roots or the foliage. Cowberries contained residues of 2.4 ppm at 6 days, 0.7 to 1.1 ppm at 30 to 36 days, and 0.2 to 0.3 ppm at 92 to 98 days after application (EXTOXNET 1996*d*). The estimated half-life in aboveground drying foliage as in a forest overstory is 2 to 3 months (EXTOXNET 1996*d*). Triclopyr has been found to have the following unintended effects on plants that are not the target of herbicide application: drift damage (45,46,47,48), genetic damage(49), inhibition of mycorrhizal fungi(50,51,53), reduction of nitrogen cycling(54), damage and reduction of mosses and lichens diversity (55,56) and stimulation of algae blooms (57 *as cited by* NCAP 2000).

2.7.3.4 Controversy over environmental effects

There is discrepancy regarding the persistence of triclopyr in soils. NCAP describes it as "somewhat persistent" and Ware states that triclopyr is one of the lesser persistent herbicides in soil (65 *as cited by* NCAP 2000; 2000).

2.8 Isoxaben

2.8.1 Technical information

2.81.1 Use

Isoxaben is an herbicide recommended for pre-emergent control of various broadleaf weeds in terrestrial noncrop areas.

2.8.1.2 Chemistry

Isoxaben is in the chemical family Benzamide. The chemical name for isoxaben is: N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxy-benzamide.

2.8.1.3 Mode of action

Gallery is rapidly absorbed by roots and translocated through the xylem to the shoots of germinating weeds by inhibiting cell wall biosynthesis. Seedlings gradually die before they ever break the soil surface. Gallery provides season-long control. Germination of some sensitive crop species may be reduced in the year following treatment.

2.8.1.4 Products and formulation

Isoxaben is the active ingredient in the herbicide Gallery. Gallery is a selective pre-emergence herbicide for control of certain broadleaf weeds in a variety of non-crop areas including ornamentals and turf. The formulation for Gallery is 75% isoxaben and 25% inert ingredients.

2.8.1.5 Regulatory status

Gallery has been reviewed according to the EPA "SARA Hazard Categories" and has been classified as "an immediate health hazard" and "a delayed health hazard" (Dow 2000). Gallery is defined by OSHA as a "Hazardous Chemical" (Dow 2000). Kaolin is an inert ingredient in the herbicide Gallery. Kaolin contains crystalline silica and both are listed under State Right-To Know (Dow 2000).

2.8.1.6 Typical application

Gallery 75 Dry Flowable may be applied at the rate of 0.66, 1.0, or 1.33 lbs/acre, depending on the type of weeds to be controlled.

The District is primarily concerned with controlling broadleaf weeds on top of bank areas

between October and February.

Gallery 75 DF is applied once annually at the rate of 1 pound per acre using a gun, boom or back pack. This results in the application rate of .75 lb/acre or 84.06 mg/m^2 of the active ingredient, isoxaben.

2.8.2 Public health

2.8.2.1 Acute toxicity

Isoxaben has an EPA acute rating of "slightly toxic" and the WHO acute hazard has been rated as "unlikely" (Orme 2000). Eye - Gallery may cause moderate eye irritation, which may be slow to heal, and slight transient corneal injury (Dow 2000). Isoxaben is an eye irritant (CAT 1999).

Skin - Prolonged or repeated exposure to the formulated product may cause slight skin irritation. A single prolonged exposure is not likely to result in Gallery being absorbed in harmful amounts (Dow 2000). The LD_{50} for skin absorption in rabbits is >5000 mg/kg (Dow 2000). For isoxaben, the LD_{50} is >2000 mg/kg (Ware 2000) and it has been reported to cause skin irritation (CAT 1999).

Oral - Single dose oral toxicity is extremely low and the oral LD_{50} of Gallery is >5000 mg/kg for rats (Dow 2000). For isoxaben, the LD_{50} is >10,000 (Ware 2000).

Inhalation - Single exposure to dust is not likely to be hazardous (Dow 2000). Isoxaben causes lung irritation (CAT 1999).

2.8.2.2 Subchronic toxicity

A three month oral study with rats resulted in elevated liver weights, liver hypertrophy, and the stimulation of liver enzyme induction at the 2 highest doses (0.14 and 1.25% isoxaben solutions) (Jones 1987). Dogs fed isoxaben doses of 0, 25, 110, and 500 mg/kg/day, experienced increases in mean and absolute liver weight at the highest dose (Jones 1987). A dermal subchronic study with rabbits dosed at 0 and 1055 mg isoxaben/kg/day yielded no significant results (Jones 1987).

2.8.2.3 Chronic toxicity

Mice fed isoxaben doses of 0, 100, 1000, and 1 2500 ppm for 2 years experienced an increase in hepatocellular adenomas, carcinomas, liver hyperplasia, and liver nodules at the highest dose (Jones 1987). Rats dosed with 0, 0.0125, 0.125, or 1.25% isoxaben for 2 years

showed effects primarily to the liver and kidney. Liver/brain weight and liver/body weight ratios were increased in dogs fed 1000 mg/kg/day for one year (Jones 1987).

2.8.2.4 Carcinogenic effects

An increase in non-malignant liver tumors was observed with isoxaben in one of two species tested (Dow 2000). Isoxaben is a potential cancer causing agent (CAT 1999; Briggs 1992) and is classified by the EPA as a class C carcinogen (Jones 1987). The formulated product contains crystalline silica which has been classified in Group 1 (those agents with evidence of carcinogenicity to humans) by the International Academy for Research on Cancer (IARC) and is listed as a carcinogen by OSHA (BASF 2000; Dow 2000).

2.8.2.5 Mutagenic effects

In-vitro and animal mutagenicity studies were negative (Dow 2000; Jones 1987).

2.8.2.6 Reproductive effects

Isoxaben is known to interfere with reproduction in animals (Dow 2000). Reproductive toxicity was demonstrated in rats at 12,500 ppm by significantly decreased numbers of viable offspring. Fetotoxicity was demonstrated at the same level by "decreases in numbers of viable fetuses per litter, increases in resorptions and postimplantation losses" (Jones 1987).

2.8.2.7 Teratogenic effects

Isoxaben caused birth defects in laboratory animals only at doses toxic to the mother (Dow 2000).

2.8.2.8 Organ toxicity and systemic effects

Both the formulated product and isoxaben have been shown to cause liver and kidney effects (Dow 2000; Jones 1987). Toxicity caused by isoxaben may affect liver enzyme level and liver size (CAT 1999). Repeated excessive exposure to crystalline silica may cause silicosis, a progressive and disabling disease of the lungs, and kidney effects (Dow 2000).

2.8.2.9 Fate in humans and animals

Fecal excretion appeared to by the major route of elimination in a study with rats fed 250 mg isoxaben/kg and followed to 24, 48, and 72 hours. After 72 hours, 90% of the dose was recovered unmetabolized in feces (Jones 1987). An estimated 20% was absorbed of which half was excreted in urine and half in feces. Urinary metabolites indicated that the major

transformations were oxidation, to produce an alcohol or a ketone, hydroxylation of the aromatic ring, and O-demethylation of the methoxy substituents (Jones 1987). Gastrointestinal absorption appears to be rate-limiting due to a decreasing ratio of urinary to fecal excretion with increasing dose (Jones 1987).

2.8.2.10 Occupational and residential exposure

No data available

2.8.2.11 Effects of inert ingredients

The inert ingredient kaolin contains crystalline silica. Repeated excessive exposure to crystalline silica may cause silicosis, a progressive and disabling disease of the lungs, and kidney effects (Dow 2000). Crystalline silica has also been classified in Group 1 (those agents with evidence of carcinogenicity to humans) by the International Academy for Research on Cancer (IARC) and is listed as a carcinogen by OSHA (BASF 2000; Dow 2000).

2.8.2.12 Controversy over health effects

No significant controversy was found.

2.8.3 Environmental safety

2.8.3.1 Label limitation

Do not contaminate water when disposing of equipment wash waters. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift may result in reduced germination or emergence of non-target plants adjacent to treated area (Label; Dow 2000). Re-entry is allowed when product is dried.

2.8.3.2 Ecological effects

Effects on birds: Subchronic and chronic exposures of bobwhites and mallards to isoxaben showed little, if any, toxicity in the studies supplied for the reregistration request (Shelgren 1992).

Effects on aquatic organisms: Subchronic and chronic tests were performed on bluegill, rainbow trout, daphnia magna, grass shrimp, sheepshead minnow, quahog clam, and fathead minnows. Only a few species showed signs of toxicity (Shelgren 1992). Rainbow trout

experiencing chronic isoxaben exposure to early life-stage fish showed temporary effects on fish length (Shelgren 1992). Chronically exposed *Daphnia magna* exhibited physical signs of toxicity at the highest dose, 1.01 mg/l, and showed a significant reduction in overall body length, and brood size over time (Shelgren 1992). LC_{50} values in acute studies with freshwater fish were all above 1 ppm (Shelgren 1992).

Effects on other organisms: A 3-year study which examined the toxicity of different pesticides on earthworms, found that Gallery is of low toxicity to earthworms (Townsend 1994). Isoxaben has been classified as "nontoxic" to adult worker honeybees (Shelgren 1992).

Bioconcentration and degradation: Radioactive isoxaben residues accumulated in bluegill sunfish with maximum bioconcentration factors of 14x in edible tissues (fillet), 134x in non-edible tissues (head and viscera), and 70x in whole fish, during 28 days of exposure (Dynamac 1987).

2.8.3.3 Environmental fate

Breakdown in soil and groundwater: Isoxaben half-life in soil (spring application) was 56 days for loam and clay soils and 34 days for sand/turf. Fall applications had half-lives of 146 days for sandy loam soils and 87 days for sand/turf (Shelgren 1992). Isoxaben has been identified as a potential groundwater contaminant pursuant to section 13145(d) of the Food and Agricultural Code (Orme 2000; California Code 2001).

Breakdown in water: In a study using the isoxaben formulated product, Snapshot TG (0.5% isoxaben), isoxaben runoff from a commercial nursery site and dissipation was studied (Wilson 1997). Approximately 10% of the applied isoxaben moved from the nursery site in irrigation runoff water. The remaining isoxaben, not detected in runoff water, was possibly bound to ground cover and ditch surfaces, or subjected to degradative reactions before movement could occur. Isoxaben concentration dissipated in the runoff collection pond indicating that isoxaben does not accumulate (Wilson 1997). Isoxaben half-life in water was 3.9 days in river water for a summer application and 65.3 days in pH 7 buffered water for a winter application. Isoxaben proved to be quite insoluble in water and under field conditions would precipitate out of the water column and become sorbed to soil, thus becoming unavailable to aquatic organisms (Shelgren 1992).

Breakdown in vegetation: No data available.

2.8.3.4 Controversy over environmental effects

No significant controversy was discovered.

3.0 Adjuvants

3.1 Butyl alcohol

3.1.1 Technical information

3.1.1.1 Use

Butyl alcohol is the active ingredient in R-11 Spreader-Activator. R-11 is used to increase the efficiency of various agricultural chemicals. It should be used where quick wetting and uniform coverage of an agricultural chemical is required. R-11 increases absorption and translocation and inhibits rust and corrosion.

3.1.1.2 Chemistry

The chemical name is 1-Butanol. The common name for R-11 is Butyl Alcohol Octyl Phenoxy Polyethoxy Ethanol

3.1.1.3 Mode of action

3.1.1.4 Products and formulation

R-11 is composed of 90% alkyl aryl polyethoxylates, compounded silicone, and linear alcohol and 10% inert constituents.

3.1.1.5 Regulatory status

Label states CAUTION. Butyl alcohol is subject to the reporting requirements of SARA Title III Section 313 as a hazard. n-Butyl alcohol can be found on severak state right to know lists including California**.**

3.1.1.6 District use and application

R-11 is used as a ½% concentration with Rodeo (Aquamaster).

R-11 is used as a ¼% concentration with Garlon 3A and Garlon 4.

3.1.2 Public health

3.1.2.1 Acute toxicity

Oral - Acute oral LD50 of butyl alcohol in rats is 790 mg/kg (Wilbur-Ellis 1997) and for rabbit, 3484 mg/kg (UCSD 1997). Butyl alcohol may cause gastrointestinal irritation with nausea, vomiting and diarrhea (UCSD 1997). May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure (UCSD 1997).

Inhalation - The four hour inhalation LC50 in rats is 8000 ppm (UCSD 1997). R-11 can cause respiratory irritation in high concentrations (Wilbur-Ellis 1997). Butyl alcohol inhaled in high concentrations, may cause central nervous system effects characterized by headache, dizziness, unconsciousness and coma. It causes respiratory tract irritation and may cause narcotic effects (UCSD 1997).

Skin - Acute dermal LD50 in rabbits for butyl alcohol is 4200 mg/kg (Wilbur-Ellis 1997)and another source lists it as 3400 mg/kg (USCD 1997). Can cause mild skin irritation, or dermatitis. Overexposure may lead to skin irritation, scaling, or dermatitis (Wilbur-Ellis 1997). Another source describes butyl alcohol as causing severe skin irritation (UCSD 1997). It may be absorbed through the skin in harmful amounts (UCSD 1997).

Eye - May be mildly irritating to the eyes (Wilbur-Ellis 1997). Overexposure may lead to eye irritation and corneal inflammation (Wilbur-Ellis 1997). Butyl alcohol causes severe eye irritation characterized by a burning sensation, redness, tearing, inglammation, and possible corneal injury (UCSD 1997).

3.1.2.2 Subchronic toxicity

No data available.

3.1.2.3 Chronic toxicity

No chronic effects of R-11 are known (Wilbur-Ellis 1997). Chronic inhalation and ingestion of butyl alcohol may cause effects similar to those of acute inhalation and ingestion. Prolonged or repeated skin contact may cause defatting and dermatitis. May cause fetal effects.

3.1.2.4 Carcinogenic effects

n-Butyl alcohol is not listed on any carcinogenicity lists (UCSD 1997).

3.1.2.5 Mutagenic effects

Mutagenicity tests with *Salmonella typhimurium* (McCann 19975 as cited by UCSD 1997), in vitro Chinese hamster ovary cells sister chromatid exchange (Ube 1997 as cited by UCSD 1997) and in vitro micronuclei test (Lasne 1984 as cited by UCSD 1997) were all negative.

3.1.2.6 Reproductive effects

With rats, an oral TDLO of 35295 butyl alcohol occurred during the 1-15 days of pregnancy. The 7 hour rat inhalation TCLO was 6000 ppm during days 1-19 of pregnancy (UCSD 1997).

3.1.2.7 Teratogenic effects

Butyl alcohol caused fetotoxicity (stunted fetus) at the rat inhalation exposure level of 6000 ppm over 7 hours (UCSD 1997).

3.1.2.8 Organ toxicity and systemic effects

Butyl alcohol causes respiratory tract irritation and may cause digestive tract irritation. Butyl alcohol targets the central nervous system and may cause central nervous system depression (UCSD 1997).

3.1.2.9 Fate in humans and animals

No data available.

3.1.2.10 Occupational and residential exposure

No data available.

3.1.2.11 Effects of inert ingredients

No data available.

3.1.2.12 Controversy over health effects

No controversy found.

3.1.3 Environmental safety

3.1.3.1 Label limitations

Do not contaminate water, food or feed by storage, disposal or cleaning of equipment.

3.1.3.2 Ecological effects

Effects on birds: No data available.

Effects on aquatic organisms: In freshwater, goldfish exposed for 24-hours died at 1000 ppm butyl alcohol. (UCSD 1997). The LC50 for fathead minnow of 1940 mg/L after one hour exposure (UCSD 1997). Aquatic plant toxicity occurs at the rate of 8500 ppm (UCSD 1997).

Effects on other organisms: No data available.

Bioconcentration and degradation: Bioconcentration potential is predicted to be low. Butyl alcohol reacts in air with hydroxyl radicals (half-life=2.3 days) (UCSD 1997).

3.1.3.3 Environmental fate

Breakdown in soil and groundwater: When released in soil, butyl alcohol is expected to biodegrade, leach into groundwater, or volatilize (UCSD 1997). Substance is moderately to highly mobile in soil (log octanol/water partition coefficient=0.88) (UCSD 1997).

Breakdown in water: When released into water, butyl alcohol is expected to biodegrade or volatilize (UCSD 1997).

Breakdown in vegetation: No data available.

3.1.3.4 Controversy over environmental effects

No controversy found.

3.2 Polyethylene Monophenyl Ether

3.2.1 Technical information

3.2.1.1 Use

Polyethylene Monophenyl Ether (PME) is the active ingredient in Pro-Spreader activator and is used to increase the effectiveness of various pesticides.

3.2.1.2 Chemistry

Information not found.

3.2.1.3 Mode of action

Information not found.

3.2.1.4 Products and formulation

PME makes up 80% of the Pro-Spreader activator formulation. Isopropyl alcohol make up 9% of the product.

3.2.1.5 Regulatory status

Label bears the signal word "Warning". Isopropyl alcohol is subject to the reporting requirements of SARA Title III Section 313 as a hazard (Target 1997). Under the OSHA Hazard Communication Standard, and listed under State-Right-to-Know, isopropyl alcohol is defined as a "Hazardous Chemical" (Dow 1999*b*).

3.2.1.6 District use and application

Pro-Spreader is used as a ½% concentration with Rodeo (Aquamaster).

Pro-Spreader is used as a ¼% concentration with Garlon 3A and Garlon 4.

3.2.2 Public health

3.2.2.1 Acute toxicity

Oral - The oral LD50 for rats is > 3500 mg/kg (Target 1997). PME causes irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea (Baker 2000).

Inhalation - Pro-Spreader Activator is not expected to have any inhalation effects under typical workplace ventilation conditions, but inhalation of aerosol mist may cause mild irritation of nasal mucous membranes (Target 1997). PME may cause irritation to the respiratory tract. Symptoms may include coughing and shortness of breath(Baker 2000; Janitorial 2001).

Dermal - Pro-Spreader Activator is a mild irritant, especially from prolonged exposure. It

causes redness, drying and cracking of skin (Target 1997). The active ingredient, PME is an irritant and causes redness, pain, and burns to skin, which may heal over time (Baker 2000; Janitorial 2001).

Eyes - Pro-Spreader Activator is a moderate irritant. Vapors or mist may cause redness and burning (Target 1997). The active ingredient, PME is an irritant and causes burns to eyes, which may heal over time (Janitorial 2001). Baker describes PME as causing irritation, redness and pain and states that non-ionic surfactant compounds generally cause mild eye irritation (2000).

3.2.2.2 Subchronic toxicity

No information was found.

3.2.2.3 Chronic toxicity

No chronic effects of Pro-Spreader are listed by the manufacturer (Target 1997) and no chronic exposure information was found for PME (Baker 2001). However, PME is listed as an endocrine disruptor on a safety website for janitors (Janitorial 2001).

3.2.2.4 Carcinogenic effects

Neither Pro-Spreader nor PME is listed as a carcinogen (Baker 2001; Target 1997).

3.2.2.5 Mutagenic effects

PME was apparently investigated as a mutagen (Baker 2000), but no information could be found. The inert ingredient, isopropyl alcohol has been reported to cause birth defects in rats at extremely high doses (Dow 1999*b*).

3.2.2.6 Reproductive effects

PME was apparently investigated as a reproductive effector (Baker 2000), but no information could be found. The inert ingredient, isopropyl alcohol has been reported to cause fetal toxicity in rats at extremely high doses (Dow 1999*b*).

3.2.2.7 Teratogenic effects

No information was found.

3.2.2.8 Organ toxicity and systemic effects

No information was found.

3.2.2.9 Fate in humans and animals

No information was found.

3.2.2.10 Occupational and residential exposure

No information was found.

3.2.2.11 Effects of inert ingredients

Dow states that the inert ingredient, isopropyl alcohol, has been reported to cause birth defects and fetal toxicity in rats at extremely high doses. At lower concentrations no effects on the fetus were found (Dow 1999*b*).

3.2.2.12 Controversy over health effects

No chronic effects of Pro-Spreader are listed by the manufacturer (Target 1997) and no chronic exposure information was found for PME (Baker 2000). However, PME is listed as an endocrine disruptor on a safety website for janitors (Janitorial 2001).

3.2.3 Environmental safety

3.2.3.1 Label limitations

No label available.

3.2.3.2 Ecological effects

Effects on birds: No information found (Baker 2000).

Effects on aquatic organisms: No information found (Baker 2000).

Effects on other organisms: No information found (Baker 2000).

Bioconcentration and degradation: No information found (Baker 2000).

3.2.3.3 Environmental fate

Breakdown in soil and groundwater: No information found (Baker 2000).

Breakdown in water: No information found (Baker 2000).

Breakdown in vegetation: No information found (Baker 2000).

3.2.3.4 Controversy over environmental effects

No controversy found.

4.0 Rodenticides

4.1 Chlorophacinone

4.1.1 Technical information

4.1.1.1 Use

Chlorophacinone is a vertebrate control agent used to control a variety of vertebrate pests, mainly rodents, but also jackrabbits (lagomorphs), and moles (insectivores). It is an anticoagulant and belongs the indandione class of anticoagulants. Chlorophacinone is currently registered for the control of rodents in and around buildings, households and domestic dwellings, uncultivated agricultural and non-agricultural areas, commercial transportation facilities; industrial areas, and food processing, handling, and storage areas and facilities. It was introduced in 1961 and does not induce bait shyness as do other rodenticides in its class.

4.1.1.2 Chemistry

Chlorophacinone 2-[(p-chlorophenyl)phenylacetyl)] 1,3-indandione

4.1.1.3 Mode of action

Chlorophacinone is an anticoagulant which uncouples oxidative phosphorylation. It requires only a single dose of bait or tracking powder containing 50 mg/kg, killing rats from the fifth day.

4.1.1.4 Products and formulation

Chlorophacinone is formulated as tracking powder, (0.2% a.i.) as loose-grain bait, paraffinized pellets, rat and mouse bait ready-to-use place packs, and paraffin blocks (EPA 1998*c*). Baits are mostly formulated as 0.005 % active ingredient, but some 0.01% active ingredient baits are registered (EPA 1998*c*).

The rodent bait used by the District is a treated grain that is 0.01% chlorophacinone and 99.99% inert ingredients.

4.1.1.5 Regulatory status

Both general use and restricted use chlorophacinone products are currently registered (EPA 1998*c*). The label bears the signal word CAUTION.

4.1.1.6 District use and application

Chlorophacinone baits are applied as frequently as needed only for commensal rats and mice; most field uses have a limited number of applications. Bait and bait packs are placed at 15 to 30 foot intervals for rats and 8 to 12 foot intervals for mice. The rate of application is 16 ounces of bait per 15 foot interval for controlling commensal rats and 2 ounces of bait per 8 foot interval for controlling housemice (EPA 1998*c*).

The rodent bait used by the District is for use against ground squirrels, deer mice and pocket gophers. The District is primarily concerned about ground squirrels whose burrows can lead to failure in levees along channels or canals. Bait must be eaten at several feedings on 5 or more successive days with no period longer than 48 hours between feedings. Bait is used from April through September**.** An average of approximately 287 pounds of bait was used each month from April to September 2000 (Uhl 2001).

4.1.2 Public health

4.1.2.1 Acute toxicity

Oral - In a laboratory study, rats were fed doses of chlorophacinone ranging from 2 mg/kg to 21 mg/kg. Mortality occurred at all dose levels in males and at all but the two lowest doses in females. Deaths, with symptoms consistent with internal hemorrhage or other evidence of anticoagulant activity, occurred on days 4-13 after exposure (EPA 1998*c*). The LD_{50} for both sexes was 6.26 mg/kg and chlorophacinone is categorized in oral Toxicity Category I (EPA 1998*c*).

Dermal - Chlorophacinone dissolved in acetone was applied to a shaven dermal area of male rabbits. Doses ranged from 0.25 to 0.75 mg/L. Animals were observed for 21 days after exposure and deaths occurred between days 5 and 19. Symptoms (which included bloody

nasal discharge) and necropsy findings (hemorrhage in the thoracic cavity and large interesting) were consistent with anticoagulant activity and there were mortalities at each dose level (EPA 1998*c*). There were no indications of skin irritation in any of the animals (EPA 1998*c*). The dermal LD_{50} is <200 mg/kg which classifies chlorophacinone in Toxicity Category I for dermal exposure (EPA 1998*c*). It is in Toxicity Category IV in terms of its dermal irritation potential (EPA 1998*c*). Technical chlorophacinone is not a dermal sensitizer as a result of exposure to non-lethal doses (EPA 1998*c*).

Inhalation - In rats, mortality accompanied by signs of anticoagulant activity occurred 3 to 8 days after exposure to varying doses of chlorophacinone (EPA 1998*c*). The inhalation LC_{50} for males is 7.00g/L and 12.0 g/L for females (EPA 1998*c*). Chlorophacinone is in Toxicity Category I based on the LC_{50} value of 9.3 g/L in both sexes (EPA 1998*c*).

Eye - An eye irritation study in rabbits showed no effects and chlorophacinone is in Toxicity Category IV in terms of eye irritation potential (EPA 1998*c*).

4.1.2.2 Subchronic toxicity

Groups of 10 rats/sex/dose were force fed doses of 0, 10, 20, or 40 g/L/day for 113 days (EPA 1998*c*). Additional groups were tested at 80 and 160 g/L/day, but all animals died between days 3 and 13. At 40 g/L/day deaths occurred in all males, between days 29 and 82, and 4 out of 10 females between days 69 and 111. Four out of 10 males (but 0/10 females) died at 20 g/L/day on days 105-111 (EPA 1998*c*). Males appear to be more sensitive than females in subchronic studies.

4.1.2.3 Chronic toxicity

Given the exclusively non-food uses of these chemicals, no chronic studies were required (EPA 1998*c*).

4.1.2.4 Carcinogenic effects

Given the exclusively non-food uses of these chemicals, no carcinogenicity studies were

required (EPA 1998*c*).

4.1.2.5 Mutagenic effects

Results of mutagenicity studies for chlorophacinone indicate the following:

- In *Salmonella typhimurium*, there were no indications of an increased number of revertants

at the histidine locus in any of the strains used (EPA 1998*c*).

- While different species were used such as Chinese hamsters and mice, in vivo testing results consistently showed no evidence of induced mutagenicity response to any strains at any non-activated or activated dose levels (EPA 1998*c*).

- Based on the results of in vitro testing, it can be concluded that doses up to and including those associated with cytotoxicity (50 µg/ml), did not induce a clastogenic response in human lymphocytes under the conditions of this assay either in the presence or absence of S9 (EPA 1998*c*).

4.1.2.6 Reproductive effects

In a developmental toxicity study using rats, treatment-related effects for development anomalies were noted at the lowest dose (12.5 µg/kg/day) and above as increased fetal and litter incidences of distended ureter (EPA 1998*c*). There were no indications of maternal toxicity at 50 µg/kg/day. High-dose (100 µg/kg/day) rats died or were sacrificed and necropsy findings were indicative of anticoagulant effects.

4.1.2.7 Teratogenic effects

In the same developmental toxicity study, there was an increased total incidence of fetuses with an enlarged lateral ventricle at the highest dose (100 µg/kg/day). At 50 µg/kg/day there was an increased incidence of extra rib on the lumbar vertebrae. At 25 µg/kg/day, malformations included increased fetal and litter incidences of bilateral hydroureter (EPA 1998*c*).

4.1.2.8 Organ toxicity and systemic effects

Chlorophacinone is a suspected cardiovascular or blood toxicant (EDS 2001).

4.1.2.9 Fate in humans and animals

Although it is reported that there is over 90% excretion in the two days following dosage, findings in a subchronic study indicate there is potential for bioaccumulation (EPA 1998*c*).

4.1.2.10 Occupational and residential exposure

EPA has determined that there is a potential exposure risk to applicators or other handlers during typical use-patterns associated with chlorophacinone. Specifically, EPA is concerned about

potential dermal and inhalation exposures to handlers during the mixing of concentrate into baits

and loading and application of chlorophacinone (EPA 1998*c*).

Because the vapor pressure of chlorophacinone is low (3.6 X 10 Torr), the potential for exposure resulting from inhalation of chlorophacinone vapors is not a significant concern despite a very low LC_{50} (0.007 mg/L). However, if fine particles become airborne during the handling of chlorophacinone baits, individuals may inhale these particles. Because these particles could

potentially be ingested, such exposure would contribute to the individual's risk resulting from

accidental ingestion/oral exposure (EPA 1998*c*).

EPA has determined that there is a potential for exposure to consumers and others following applications of chlorophacinone, particularly in residences. EPA has concerns about possible post-application exposures if (1) baits are not placed out of reach of children or are not placed in tamper-resistant bait stations, as specified in labeling; (2) baits are available to consumers in packages which are not tamper resistant and could be accessible to children prior to application; and (3) baits are brightly colored or packaged in a way in which they could be appealing to children or mistaken by children for food or candy. These factors, among others, can be expected to lead to numerous exposures among small children (EPA 1998*c*).

4.1.2.11 Effects of inert ingredients

Chlorophacinone is formulated with a grain, such as oats, and has no other inert ingredients.

4.1.2.12 Controversy over health effects

Most information regarding chlorophacinone is from the EPA's Reregistration Eligibility Decision on the Rodenticide cluster. Significant controversy has not been identified.

4.1.3 Environmental safety

4.1.3.1 Label limitation

This product is toxic to fish, birds, and other wildlife. Baits exposed to soil surfaces may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams, or ponds.

4.1.3.2 Ecological effects

Effects on birds: Chlorophacinone LD_{50}s range from 51 to 500 mg/kg and indicated that the chemical is moderately toxic to birds on an acute oral basis. Results of subacute dietary studies on bobwhite quail and mallard duck yield 5-day LC_{50}s of 56 and 172 ppm, respectively. LC50 levels in the range of 50 to 500 ppm indicate that chlorophacinone is highly toxic to birds on a subacute dietary basis (EPA 1998*c*).

Effects on aquatic organisms: 96-hour LC_{50} values for rainbow trout and bluegill sunfish are 450 and 710 ppb, respectively. Because the LC_{50}s falls in the range of 100 to 1000 ppb, chlorophacinone is considered highly toxic to freshwater fish on an acute basis (EPA 1998*c*). Chlorophacinone is also highly toxic to aquatic invertebrates with a 48-hour EC50 with *Daphnia magna* of 640 ppb (EPA 1998*c*).

Effects on other organisms: Laboratory rats have a LD_{50} of 6.2 mg/kg. This indicates that chlorophacinone is very highly toxic to small mammals on an acute oral basis (EPA 1998*c*). The saltmarsh harvest mouse (*Reithrodontomys raviventris*) is a Federally Endangered species that is known to occur in Santa Clara County and may occupy habitat within the Santa Clara Water District. The EPA has determined that this mouse is jeopardized by the use of chlorophacinone (EPA 1998*c*). Studies show that chlorophacinone baits meant for the California ground squirrel, pose a primary risk to some nontarget species, i.e., mice, woodrats, pocket gophers, mourning doves, and rabbits (EPA 1998*c*). Nontarget mammal mortality might be reduced if 0.005% a.i. bait is used rather than 0.01% a.i. bait (EPA 1998*c*). Primary risk to larger mammals is reduced for application requiring secure bait stations designed with openings only large enough to accommodate adults of the target species (EPA 1998*c*). Studies of secondary toxicity indicate that rodents poisoned with 0.01% chlorophacinone baits pose a secondary hazard to coyotes and presumably other mammalian carnivores and scavengers (EPA 1998*c*). Because the 0.01% bait caused secondary mortality in coyotes, the EPA has required a study using 0.005% a.i. bait.

To avoid take of federally protected saltmarsh harvest mouse from non-pellet grain bait, the California Department of Pesticide Regulation sets Use Limit Code 34 "Outdoor use near salt marshes is limited to sites that are separated by at least 10 yards of barren (or clean cultivated) ground from pickleweed habitat."

Bioconcentration and degradation: Chlorophacinone does not accumulate in fish at a significant level (K_{ow} = 94) (EPA 1998*c*). Results from aqueous photolysis, soil photolysis, and aerobic soil metabolism studies suggest that chlorophacinone degrades very rapidly to o-phthalic acid and p-chlorophenylphenyl acetic acid through the cleavage of the indandione ring (EPA 1998*c*). The carboxylic acid on the o-phthalic acid was further cleaved and transformed into carbon dioxide (EPA 1998*c*).

4.1.3.3 Environmental fate

Contamination of and breakdown in soil and groundwater: Chlorophacinone appears to be very immobile and readily degradable in the environment. It is moderately susceptible to photodegradation on soil (half-life of 4 days) and is moderately degradable in a sandy clay loam soil under aerobic conditions (half-lives of 21-45 days). Chlorophacinone is expected to be very immobile in four different soil types(sand, loam, sandy clay loam and clay; K_{ads}=341; K_{oc}=43,411) and volatilizes slowly from both water and soil (vapor pressure = $3.6x10^{-6}$mm HG; Henry's Law constant = $5.2x10^{-8}$ at m-m^3/mol) (EPA 1998*c*). In the field, chlorophacinone is expected to be bound very tightly with soil. Most of the chemical is expected to remain in the top soil layers, and it's potential to reach ground water is very low (EPA 1998*c*).

Contamination of and breakdown in water: Chlorophacinone has low water solubility (34 ppm at 25 degrees) and is very susceptible to direct photolysis in water (helf-life oof 37 minutes at pH 7) (EPA 1998*c*). Surface water contamination may occur in less-permeable areas and in areas near water bodies. Chlorophacinone is more likely to reach surface water through adsorption to eroding soil, as opposed to dissolution in runoff water (EPA 1998*c*). Due to its high adsorption coefficient, most chlorophacinone would be partitioned in the suspended and bottom sediments instead of in the water column (EPA 1998*c*). Chlorophacinone might drift into surface waters from its use as a spray in orchards. However this is unlikely due to the low height at which the rodenticide is applied (EPA 1998*c*).

Contamination of and breakdown in vegetation: Not applicable

4.1.3.4 Controversy over environmental effects

All information regarding chlorophacinone is from the EPA's Reregistration Eligibility Decision on the Rodenticide cluster. Significant controversy has not been identified.

4.2 Zinc Phosphide

4.2.1 Technical information

4.2.1.1 Use

Zinc Phosphide is an intense poison to mammals and birds and is used against rats, mice, ground squirrels, prairie dogs, and gophers. It has an unpleasant, garlic-like odor, which is evidently not offensive to rodents.

4.2.1.2 Chemistry

Zn_3P_2

4.2.1.3 Mode of action

Zinc phosphide use as a rodenticide has largely been replaced by anticoagulants. Zinc phosphide acts similar to yellow phosphorus which attacks the liver, kidney, and heart, resulting in rapid tissue disintegration; it also causes rats to attempt to vomit, a function that, uniquely, they cannot perform (Ware 2000).

4.2.1.4 Products and formulation

Currently 59 zinc phosphide products are registered with the EPA (EPA 1998*b*). Trade names for these products include Arrex, Commando, Denkarin Grains, Gaopha-Rid, Phosvin, Pollux, Ridall, Ratol, Rodenticide AG, Zinc-Tox and ZP (EXTOXNET 1996*e*). Zinc phosphide can be formulated as a grain based bait, as scrap bait, or as a paste. Rodenticide baits usually contain 0.5 to 2.07% zinc phosphide and pastes are made up of approximately 5 to 10% zinc phosphide (EXTOXNET 1996*e*).

4.2.1.5 Regulatory status

Zinc phosphide is a Restricted Use Pesticide (RUP) because of its hazard to non-target organisms and its acute oral toxicity. RUPs may be purchased and used only by certified applicators. Some formulations of this rodenticide are classified as highly toxic and require the signal word "DANGER - POISON" on the label. Others are either moderately toxic or only slightly toxic.

4.2.1.6 District use and application

The District has used fumigants in the past and may continue to do so.

4.2.2 Public health

4.2.2.1 Acute toxicity

Zinc phosphide is rated in Toxicity Category I for acute effects via the oral or inhalation route of exposure, Toxicity Category III for the dermal route, and Toxicity Category IV for eye irritation (EPA 1998*b*).

Oral - When ingested, zinc phosphide reacts with water and acid in the stomach and produces phosphine gas, which may account in a large part for observed toxicity. Symptoms of acute poisoning by ingestion include nausea, abdominal pain, tightness in chest,

excitement, agitation, and chills (EXTOXNET 1996*e*). Other symptoms include vomiting, diarrhea, cyanosis, rales, restlessness, and fever (EXTOXNET 1996*e*). The oral LD_{50} for rats is 45 mg/kg (Ware 2000) or 40 mg/kg (EXTOXNET 1996*e*). For sheep the oral LD_{50} ranges from 60 to 70 mg/kg (EXTOXNET 1996*e*).

There are documented cases of adult humans dying from massive oral doses of 4000 to 5000 mg (approx. 55-70 mg/kg), although others have survived acute exposure of as high as 25000 to 100000 mg (approx. 350 to 1400 mg/kg) if vomiting occurred early and exposure to phosphine was limited. The EPA has determined that a single swallow of zinc phosphide bait may be fatal to a young child (1998*b*).

Inhalation - The inhalation of zinc phosphide or phosphine gas may result in vomiting, diarrhea, cyanosis, rapid pulse, fever, and shock (EXTOXNET 1996*e*).

Skin and eyes - The compound is non-irritating to the skin and eyes (EXTOXNET 1996*e*).

4.2.2.2 Subchronic toxicity

No data available.

4.2.2.3 Chronic toxicity

Rats fed zinc phosphide over a wide range of doses experienced toxic effects. In a study conducted over 13 weeks, increased liver, brain, and kidney weights, and lesions on these organs, were noted in rats exposed to approximately 14 mg/kg/day (EXTOXNET 1996*e*). Body hair loss, reduction in body weight, and reduction of food intake were all noted at 3.5 mg/kg/day (EXTOXNET 1996*e*). There have been no observed symptoms of chronic poisoning due to zinc phosphide exposure in humans, however it has been suggested that chronic exposure to sublethal concentrations for extended periods of time may produce toxic symptoms (EXTOXNET 1996*e*).

4.2.2.4 Carcinogenic effects

Zinc phosphide has not been classified for carcinogenicity. However, since dietary exposure to zinc phosphide residues in foods is negligible, no cancer risk is expected for the general population (EPA 1998*b*). No data currently available (EXTOXNET 1996*e*).

4.2.2.5 Mutagenic effects

No data are currently available regarding the mutagenicity of zinc phosphide. However, its metabolite, phosphine, has shown a concentration-dependent increase in chromosomal aberrations in studies using human lymphocyte cultures (EXTOXNET 1996*e*). Thus the

mutagenicity of zinc phosphide is unclear.

4.2.2.6 Reproductive effects

No data currently available (EXTOXNET 1996*e*).

4.2.2.7 Teratogenic effects

No data currently available (EXTOXNET 1996*e*).

4.2.2.8 Organ toxicity and systemic effects

Damage to the kidneys, liver, and stomach have been noted in humans, but only at high acute doses of the rodenticide. Zinc phosphide reacts with water and stomach juices to release phosphine gas, which can enter the blood stream and adversely affect the lungs, liver, kidneys, heart, and central nervous system (EXTOXNET 1996*e*).

4.2.2.9 Fate in humans and animals

Small amounts of the rodenticide fed to experimental animals may have produced and80% absorption of zinc as well. In sufficient concentration, zinc may have an emetic effect (EXTOXNET 1996*e*). Hypophosphite may be excreted in the urine as a metabolite of zinc phosphide (EXTOXNET 1996*e*). Since zinc phospide is readily converted to phosphine, there is little tendency for the compound to concentrate in living tissue (EXTOXNET 1996*e*).

4.2.2.10 Occupational and residential exposure

The EPA is concerned about the inhalation exposure of occupational workers to the particulate fines or dust that may be generated from the mixing and loading of the dust concentrate or wettable-powder formulations and from applying the pellet and bait formulations.

In general, rodenticides that are used in and around the home are responsible for a high number of accidental exposures each year. Although few of the reported incidents are associated with zinc phosphide, the EPA is concerned about the continued risk of exposure to humans, especially children, from rodenticides used in residential settings as well as the cost and trauma associated with treating those who might have been accidentally exposed (EPA 1998*b*).

4.2.2.11 Effects of inert ingredients

No information was found

4.2.2.12 Controversy over health effects

Significant controversy has not been identified.

4.2.3 Environmental safety

4.2.3.1 Label limitation

This product is toxic to fish, birds, and other wildlife. Baits exposed to soil surfaces may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams, or ponds.

4.2.3.2 Ecological effects

Effects on birds: Zinc phosphide is highly acutely toxic to wild birds. The most sensitive birds are geese (LD_{50} of 7.5 mg/kg for the white-fronted goose) (EXTOXNET 1996*e*). Pheasant, mourning dove, quail, mallard duck, some passerines, and the horned lark are also very susceptible to this compound (EXTOXNET 1996*e*; EPA 1998*b*).

Effects on aquatic organisms: Zinc phosphide is highly toxic to freshwater fish. The fish species which have been evaluated include bluegill sunfish (LC_{50} of 0.8 mg/L) and rainbow trout (LC_{50} of 0.5 mg/L) (EXTOXNET 1996*e*). Carp were also found to be susceptible to zinc phosphide, especially in weakly acidic water (EXTOXNET 1996*e*).

Effects on other organisms: Zinc phosphide is toxic to non-target mammals when ingested directly. Nearly 60 studies have been conducted on the toxicity of this rodenticide to wild animals (EXTOXNET 1996*e*). Secondary toxicity to mammalian predators (animals eating other animals that were exposed to the compound) from zinc phosphide is rather low, primarily because the compound does not significantly accumulate in the muscles of target species (EXTOXNET 1996*e*). However, these predators or scavengers may become ill, listless, and regurgitate (EPA 1998*b*). Studies have focused on the following predators; coyote, fox, mink, weasel, and birds of prey. Some of the toxic effects to predators have been due to the ingestion of zinc phosphide that was in the digestive tract of the target organism (EXTOXNET 1996*e*). Under field conditions most of the toxic effects to non-target wildlife are due to direct exposures resulting from misuse or misapplication of this rodenticide (EXTOXNET 1996*e*).

To avoid take of federally protected saltmarsh harvest mouse from non-pellet grain bait, the California Department of Pesticide Regulation sets Use Limit Code 34 "Outdoor use near salt marshes is limited to sites that are separated by at least 10 yards of barren (or clean cultivated) ground from pickleweed habitat."

Bioconcentration and degradation: The major route of degradation of zinc phosphide is hydrolysis, which result in the formation of volatile phosphine and zinc ions (EPA 1998*b*). The rates of hydrolysis and volatilization of phosphine appear to be pH and soil moisture dependent with the hydrolysis rate increasing as the pH increases or decreases from neutrality (EPA 1998*b*).

4.2.3.3 Environmental fate

Breakdown in soil and groundwater: Zinc phosphide and its residues appear to be non-persistent under most environmental conditions and relatively immobile in laboratory and field data (EPA 1998*b*). When applied to dry soil, zinc phosphide may be moderately persistent (~40% of applied compound remaining at 30 days post-treatment) (EPA 1998*b*). Under average conditions, the toxic activity of zinc phosphide applied as a bait or a dust persists for approximately 2 weeks (EXTOXNET 1996*e*). Zinc phosphide and its degradation products appear to have a low potential for ground water or surface water contamination (EPA 1998*b*).

Breakdown in water: No residues are expected in either ground or surface water due to the pesticide's rapid degradation and limited usage (EPA 1998*b*). No data are currently available (EXTOXNET 1996*e*).

Breakdown in vegetation: No data are currently available (EXTOXNET 1996*e*).

4.2.3.4 Controversy over environmental effects

Significant controversy has not been identified.

RETURN TO TOP OF PAGE RETURN TO TABLE OF CONTENTS

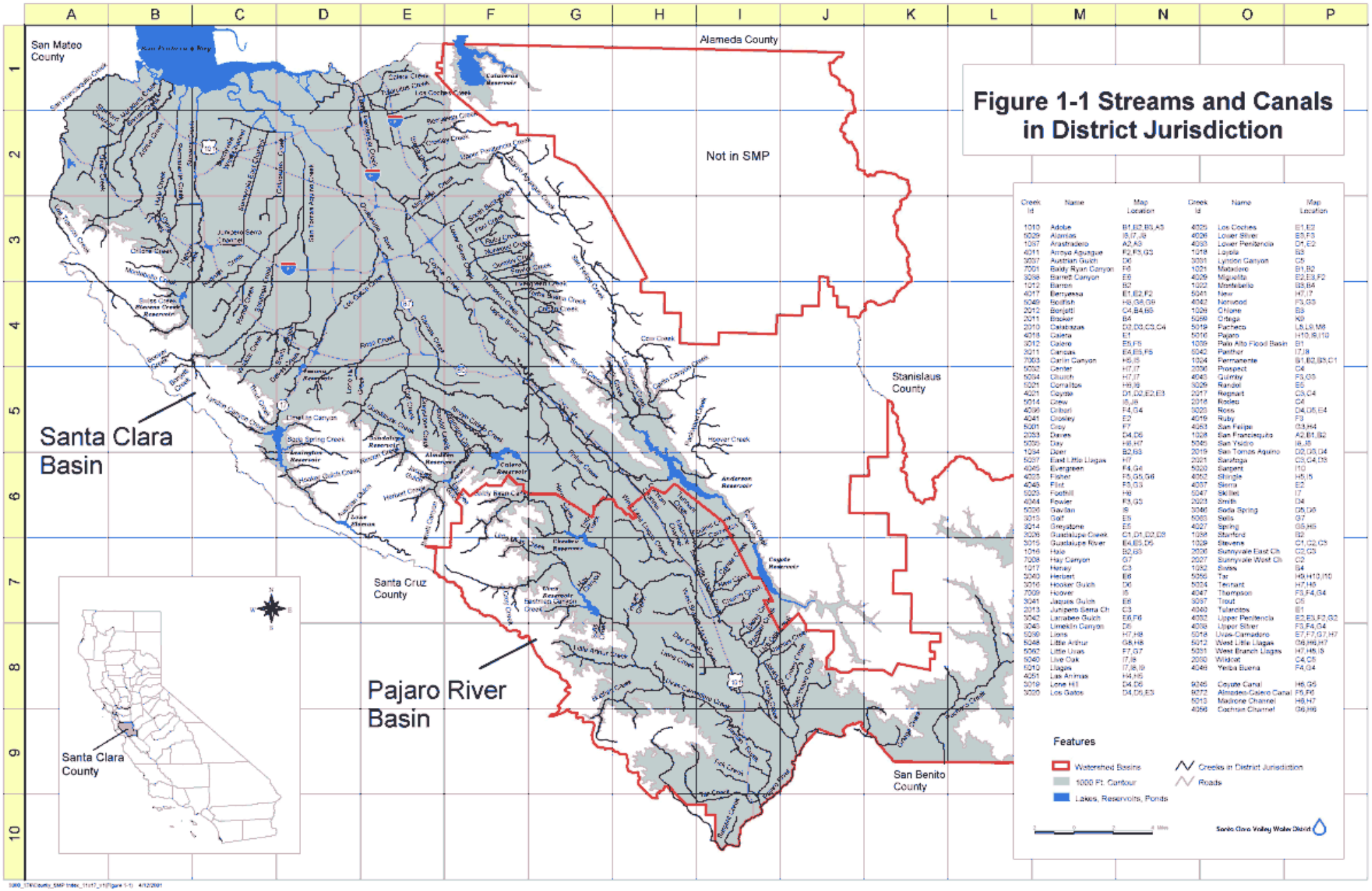


Figure 1-1 Streams and Canals in District Jurisdiction
San Mateo County
Alameda County
Not in SMP
Stanislaus County
Santa Clara Basin
Pajaro River Basin
Santa Cruz County
San Benito County
Santa Clara County
Features
Watershed Basins
1000 Ft. Contour
Lakes, Reservoirs, Ponds
Creeks in District Jurisdiction
Roads
Santa Clara Valley Water District

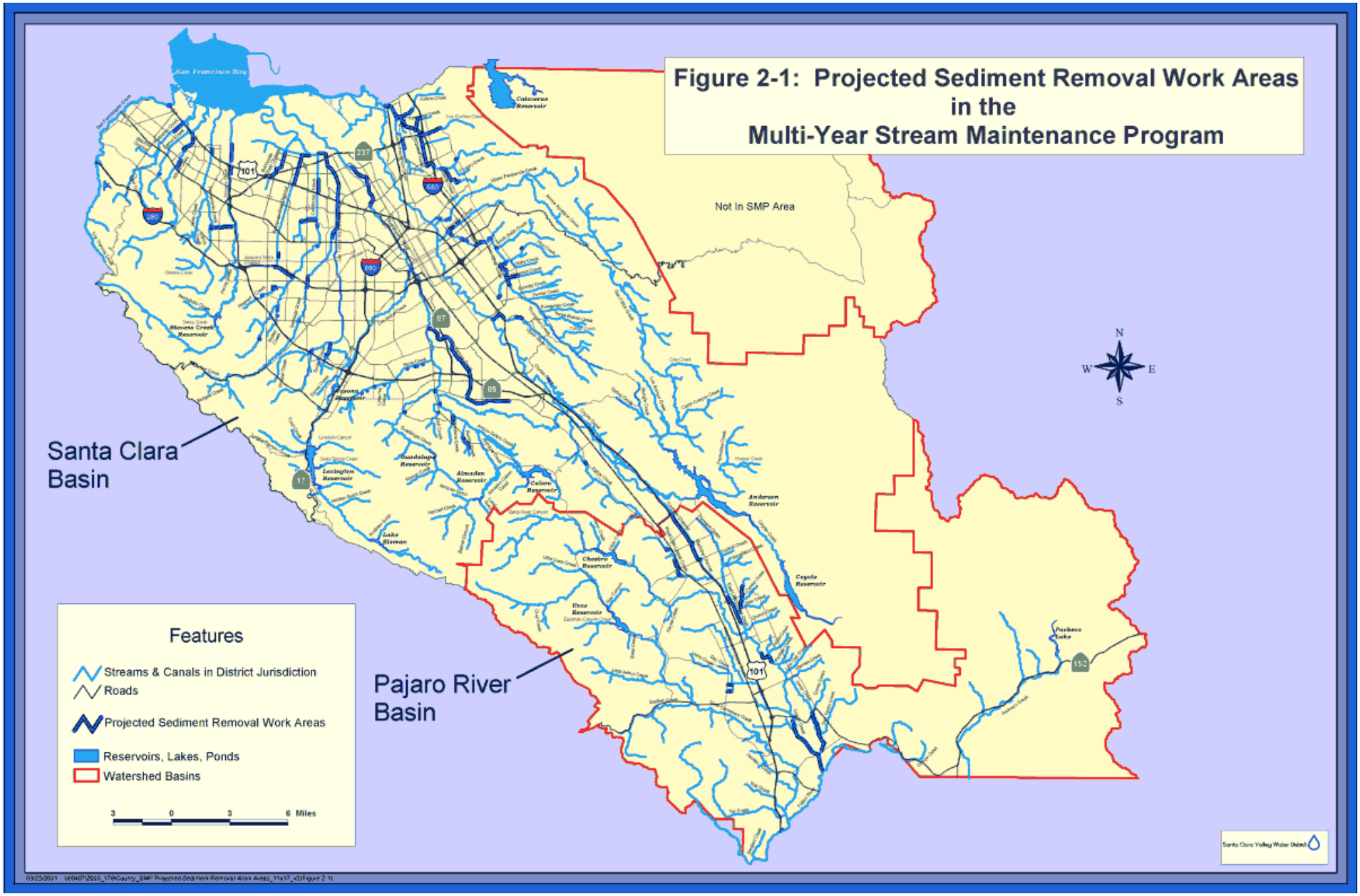


Figure 2-1: Projected Sediment Removal Work Areas in the Multi-Year Stream Maintenance Program
Not In SMP Area
Santa Clara Basin
Pajaro River Basin
Features
Streams & Canals in District Jurisdiction
Roads
Projected Sediment Removal Work Areas
Reservoirs, Lakes, Ponds
Watershed Basins
3 0 3 6 Miles
N
W
E
S
Calaveras Reservoir
Anderson Reservoir
Coyote Reservoir
Chesbro Reservoir
Uvas Reservoir
Lexington Reservoir
Almaden Reservoir
Guadalupe Reservoir
Calero Reservoir
Lake Elsman
Pacheco Lake
Santa Clara Valley Water District

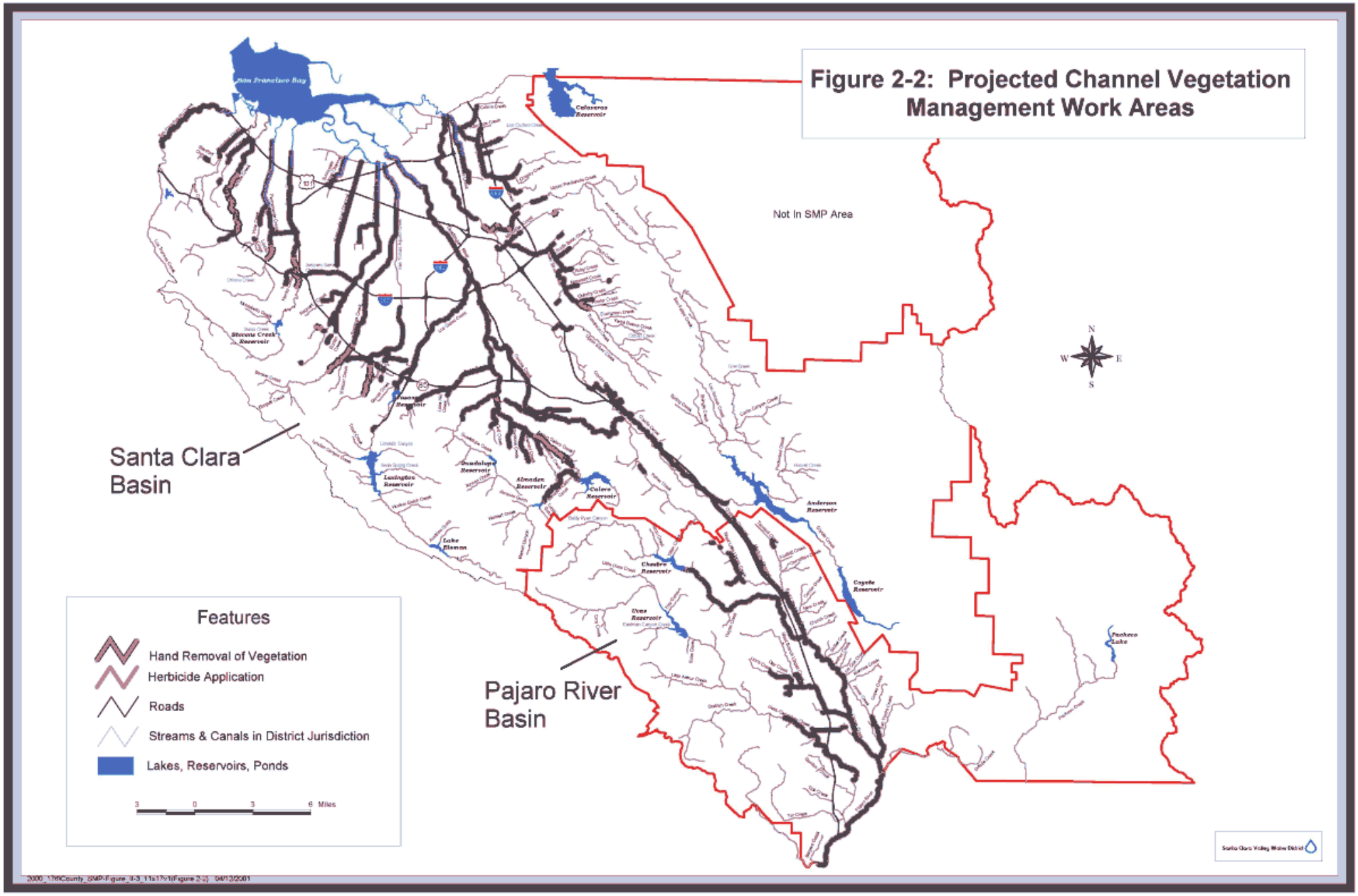


Figure 2-2: Projected Channel Vegetation Management Work Areas
Not In SMP Area
Santa Clara Basin
Pajaro River Basin
Features
Hand Removal of Vegetation
Herbicide Application
Roads
Streams & Canals in District Jurisdiction
Lakes, Reservoirs, Ponds
3 0 3 6 Miles
N
S
E
W

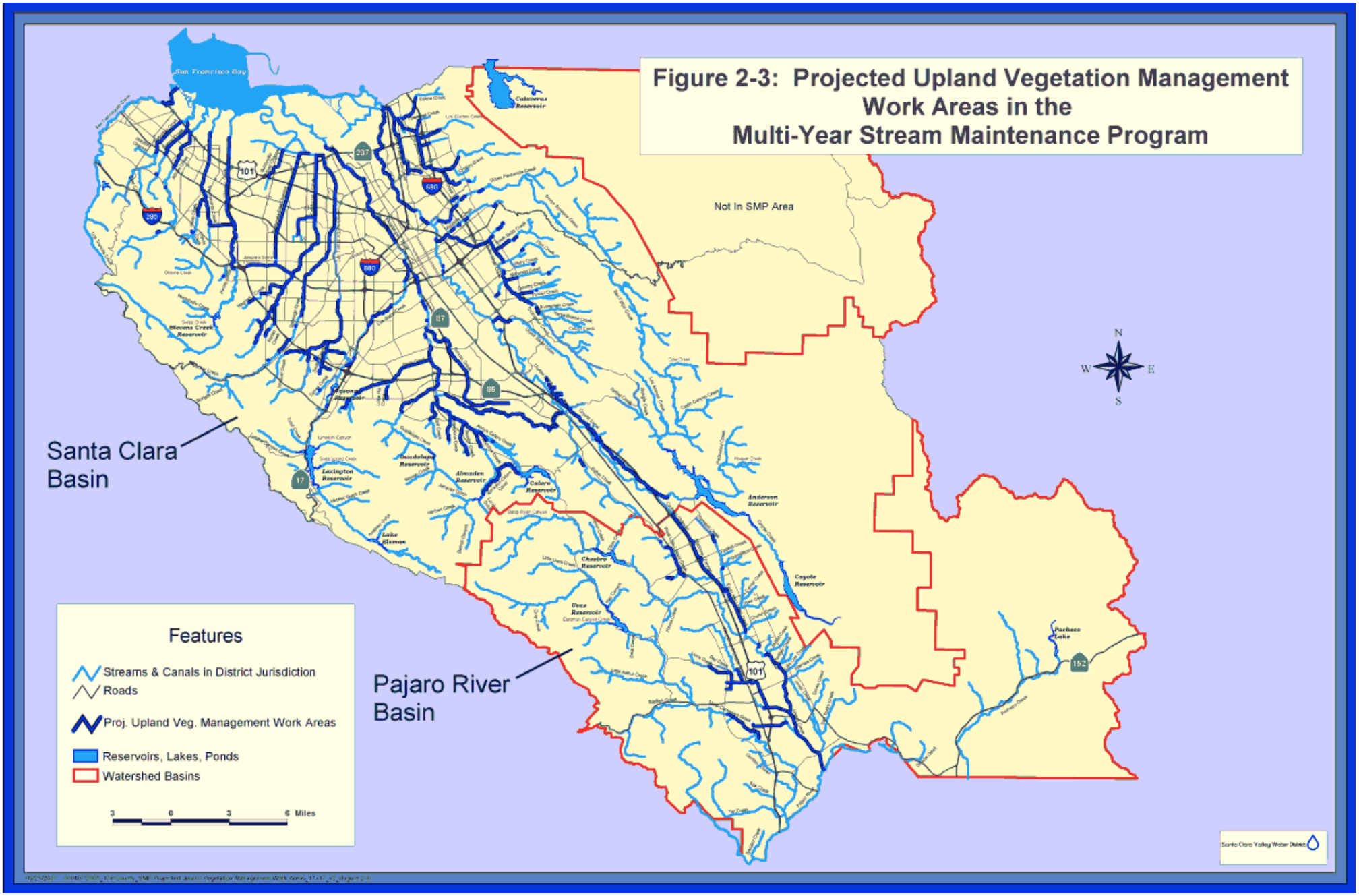


Figure 2-3: Projected Upland Vegetation Management Work Areas in the Multi-Year Stream Maintenance Program
Not In SMP Area
Santa Clara Basin
Pajaro River Basin
Features
Streams & Canals in District Jurisdiction
Roads
Proj. Upland Veg. Management Work Areas
Reservoirs, Lakes, Ponds
Watershed Basins
3 0 3 6 Miles
N
W
E
S
San Francisco Bay
Calaveras Reservoir
Anderson Reservoir
Coyote Reservoir
Lexington Reservoir
Almaden Reservoir
Calero Reservoir
Chesbro Reservoir
Uvas Reservoir
Pacheco Lake
Lake Elsman
Stevens Creek Reservoir
Santa Clara Valley Water District

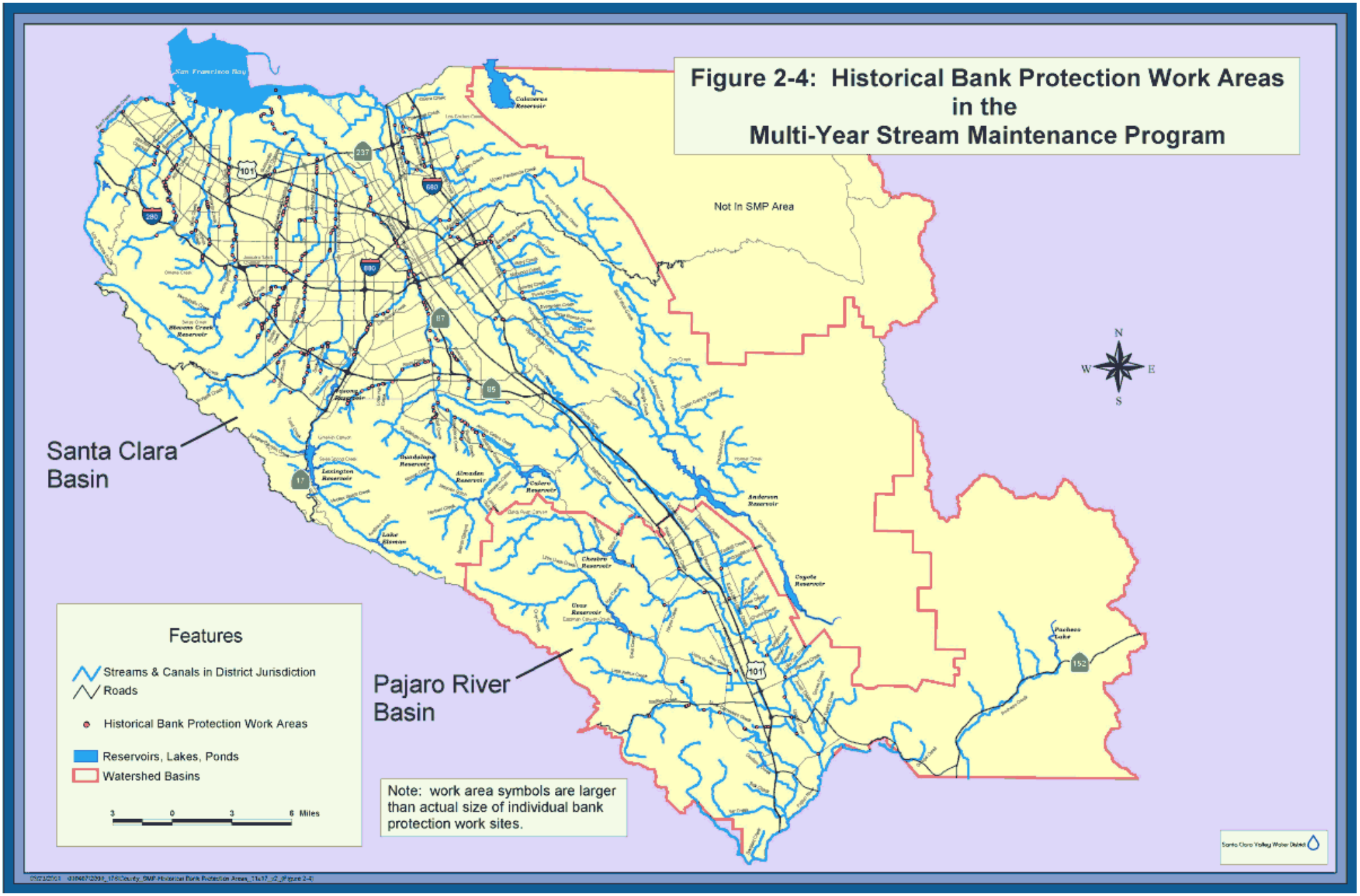


Figure 2-4: Historical Bank Protection Work Areas in the Multi-Year Stream Maintenance Program
Not In SMP Area
Santa Clara Basin
Pajaro River Basin
Features
Streams & Canals in District Jurisdiction
Roads
Historical Bank Protection Work Areas
Reservoirs, Lakes, Ponds
Watershed Basins
3 0 3 6 Miles
Note: work area symbols are larger than actual size of individual bank protection work sites.
N
S
E
W

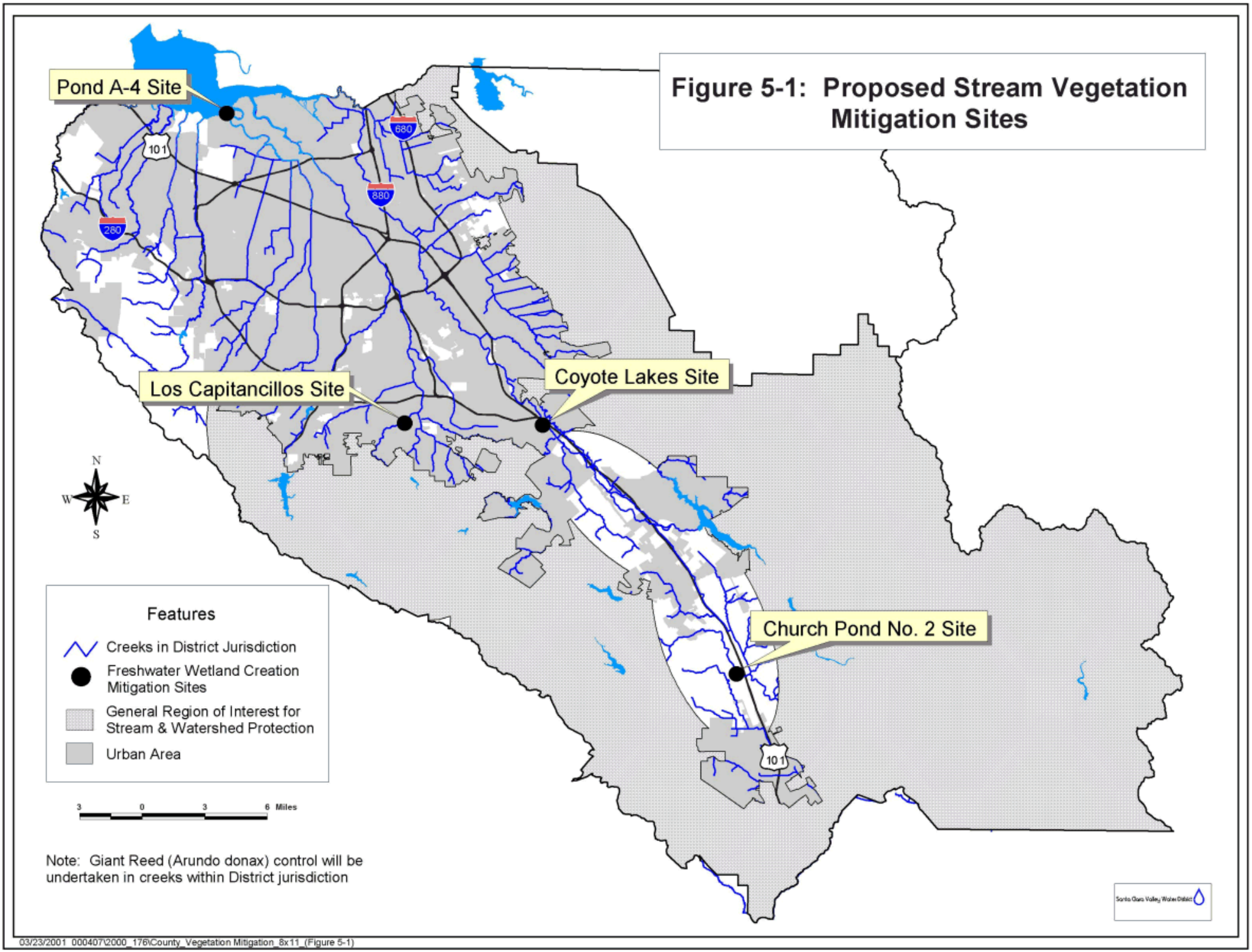
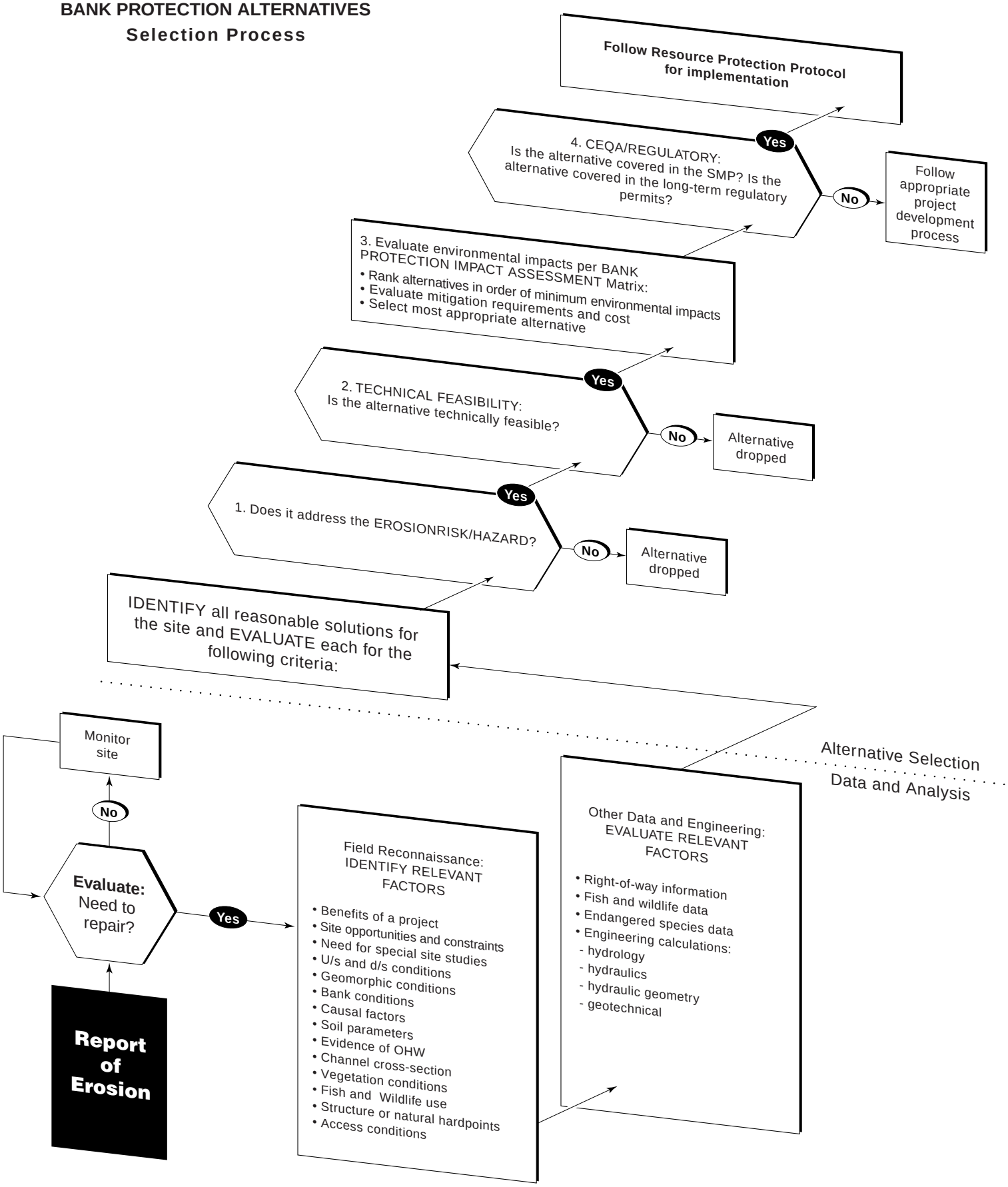


Figure 5-1: Proposed Stream Vegetation Mitigation Sites
Pond A-4 Site
Los Capitancillos Site
Coyote Lakes Site
Church Pond No. 2 Site
101
280
880
680
N
W
E
S
Features
Creeks in District Jurisdiction
Freshwater Wetland Creation Mitigation Sites
General Region of Interest for Stream & Watershed Protection
Urban Area
3 0 3 6 Miles
Note: Giant Reed (Arundo donax) control will be undertaken in creeks within District jurisdiction
03/23/2001 000407\2000_176\County_Vegetation Mitigation_8x11_(Figure 5-1)

Figure E-1

BANK PROTECTION ALTERNATIVES
Selection Process



APPENDIX 6A-3

SCVURPPP MULTI-YEAR RECEIVING WATER MONITORING PROGRAM

Santa Clara Valley *Urban Runoff* Pollution Prevention Program

PRELIMINARY DRAFT

Multi-Year Receiving Waters Monitoring Quality Assurance Project Plan (QAPP)

PLAN PREPARED BY:
Eisenberg, Olivieri and Associates (EOA, Inc.).

Refer correspondence to:

Chris Sommers
Monitoring Program Manager
1410 Jackson Street
Oakland, CA 94612

1.0 Approvals:

Program Manager, SCVURPPP

Signature: Adam Olivieri, _____ Date: _____

Monitoring Program Manager, SCVURPPP

Signature: Chris Sommers, _____ Date: _____

Project's Quality Assurance Officer, SCVURPPP

Signature: _____ Date: _____

2.0 TABLE OF CONTENTS

1.0 TITLE AND APPROVAL PAGE
2.0 TABLE OF CONTENTS 2
3.0 DISTRIBUTION LIST 4
4.0 PROGRAM ORGANIZATION 4
5.0 PROBLEM DEFINITION/BACKGROUND 8
6.0 PROJECT/TASK DESCRIPTION 10
7.0 DATA QUALITY OBJECTIVES 15
8.0 SPECIAL TRAINING REQUIREMENTS/SAFETY 17
9.0 DOCUMENTATION AND RECORDS 19
10.0 SAMPLING PROCESS DESIGN 20
11.0 SAMPLING METHODS 23
12.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS 27
13.0 ANALYTICAL METHODS REQUIREMENTS 29
14.0 QUALITY CONTROL REQUIREMENTS ..... **Error! Bookmark not defined.**
15.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE 40
16.0 INSTRUMENT CALIBRATION AND FREQUENCY 41
17.0 INSPECTION/ACCEPTANCE REQUIREMENTS 42
18.0 DATA ACQUISITION REQUIREMENTS 43
19.0 DATA MANAGEMENT 44
20.0 ASSESSMENT AND RESPONSE ACTIONS 45
21.0 REPORTS 46
22.0 DATA REVIEW, VALIDATION AND VERIFICATION 48
23.0 VALIDATION AND VERIFICATION METHODS 49
24.0 RECONCILIATION WITH DQO'S 50
25.0 REFERENCES 51

LIST OF TABLES

Table 1. Examples of screening-level indicators and investigative monitoring parameters, with associated beneficial uses. 10
Table 2. Indicators and associated parameters measured in the SCVURPPPP Receiving Waters Monitoring Plan. 12
Table 3. Typical schedule for annual monitoring activities that occur within each fiscal year.... 14

LIST OF FIGURES

Figure 1. Map of the SCVURPPP Jurisdictional Area. 5
Figure 2. Organization Structure of SCVURPPP Multi-year Plan. 6
Figure 3. SCVURPPP Monitoring and Assessment Process Flow Chart. 12
Figure 4. SCVURPPP Monitoring Locations in the Santa Clara Basin since FY 02-03. 13

APPENDICES

Appendix A. SCVURPPP 8-year monitoring plan for Santa Clara Basin Watersheds.
Appendix B. Data Quality Objectives and Data Acceptability Criteria Tables for Parameters Measured in the SCVURPPP Multi-Year Plan.
Appendix C. Procedures for collecting routine field measurements
Appendix D. Procedures for collecting water samples
Appendix E. Procedures for collecting and processing benthic macroinvertebrates and conducting physical habitat assessment.
Appendix F. Procedures for sampling fish community
Appendix G. Sample Handling and Custody Requirements
Appendix H. Methods, reporting limits and holding times for water chemistry analysis
Appendix I. List of equipment and supplies used for field sampling
Appendix J. Calibration and maintenance requirements for field measuring equipment
Appendix K. Health and safety guidelines
Appendix L. Quality control performance guidelines

3.0 DISTRIBUTION LIST

All project managers and coordinators will receive copies of this Quality Assurance Project Plan (QAPP) and any approved revisions of this plan. Once approved, this QAPP will be available to any interested party by requesting a copy from Chris Sommers at EOA, Inc. (see title page for address). The QAPP will also be posted on the SCVURPPP website (www.scvurppp.org).

4.0 PROGRAM ORGANIZATION

4.1 Program Background

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)

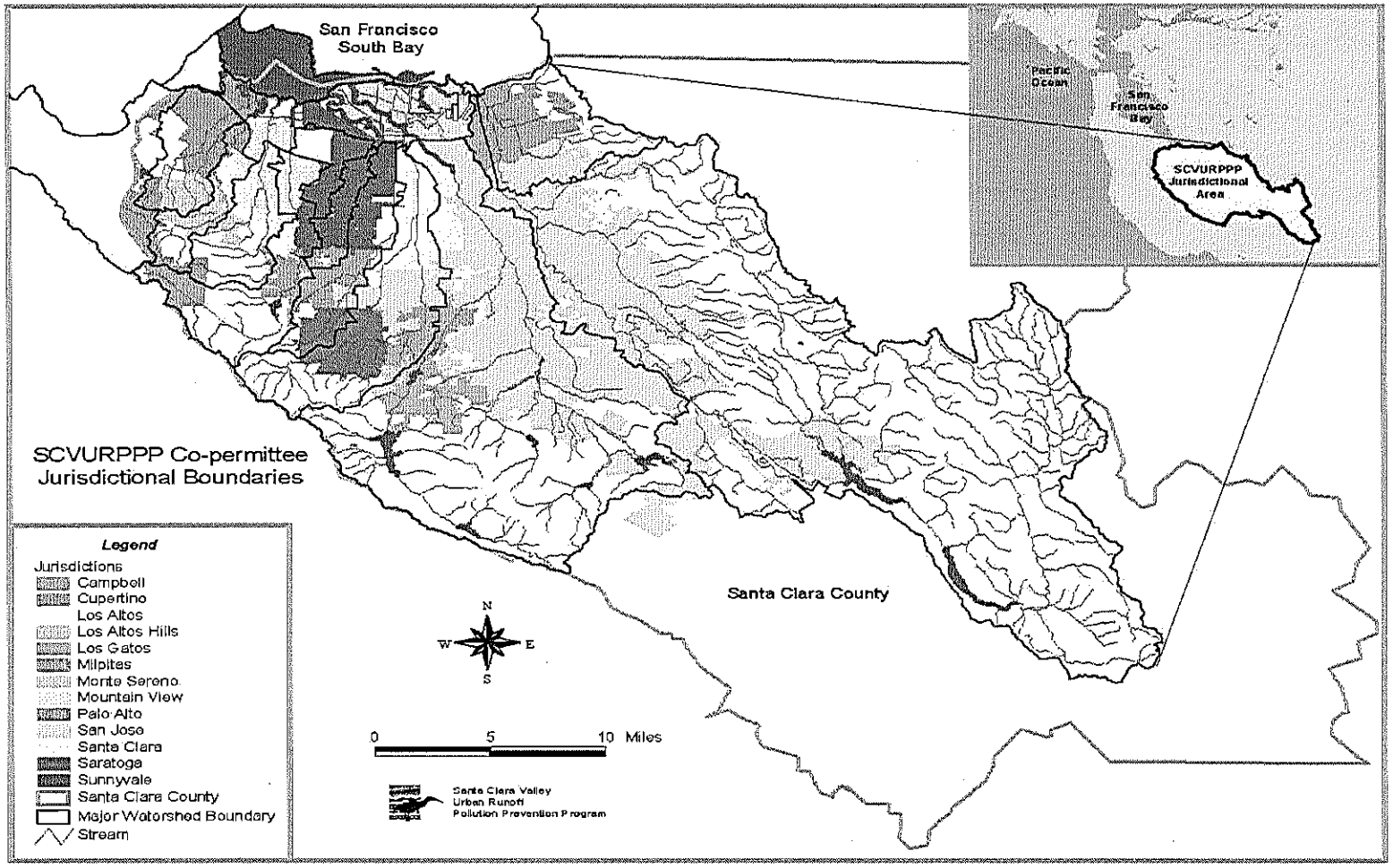
The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) is an association of thirteen cities and towns in Santa Clara Valley, the County of Santa Clara, and the Santa Clara Valley Water District ("Co-permittees") that share a common permit to discharge stormwater to South San Francisco Bay (Figure 1). The SCVURPPPP incorporates regulatory, monitoring and outreach measures aimed at reducing pollution in urban runoff to the "maximum extent practicable" to improve the water quality of South San Francisco Bay and the streams of Santa Clara Valley.

In June 1990, the SCVURPPPP received the first municipal stormwater permit in the nation from the San Francisco Bay Regional Water Quality Control Board (Regional Board or RWQCB). The permit was reissued in 1995 and 2001. On October 17, 2001, the Regional Board amended the permit to include expanded requirements for controlling pollutants from new and redevelopment activities. The SCVURPPPP 's third permit expires in February 2006.

The SCVURPPPP is organized, coordinated, and implemented in accordance with a Memorandum of Agreement (MOA) signed by the Co-permittees. The MOA details the responsibilities of each Co-permittee and a cost-sharing formula for joint expenditures. The SCVURPPPP 's Management Committee, consisting of one designated representative from each Co-permittee, meets on the third Thursday of each month to discuss and make decisions regarding Program business. The Management Committee retained EOA, Inc. to provide program management services. The Santa Clara Valley Water District (SCVWD) is the Program's fiscal

The Santa Clara Valley Urban Runoff Pollution Prevention Program- Urban Runoff Management Plan (URMP) consists of an area-wide plan and individual Co-permittee plans describing what the fifteen Co-permittees will do, acting individually and collectively as the SCVURPPPP, to reduce urban runoff pollution. The URMP describes the goals and objectives of the SCVURPPPP and its various elements, including monitoring and watershed management measures. The monitoring and assessment activities conducted by the SCVURPPP are identified in the Multi-Year Receiving Waters Monitoring Plan (Multi-year Plan).

Figure 1. Map of the SCVURPPP Jurisdictional Area.

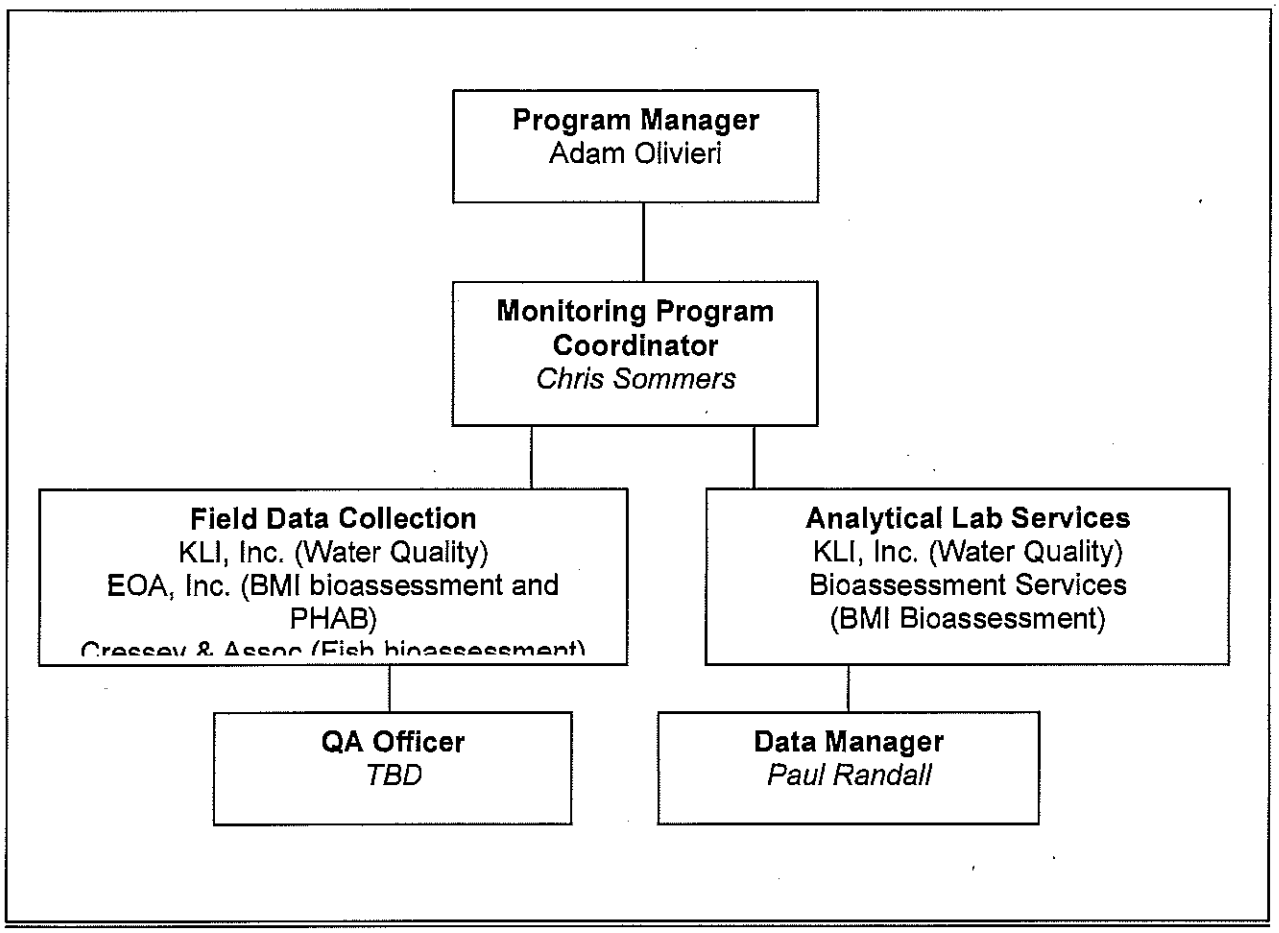


O:\eoa_data\sc_data\maps\SCVURPPP_juris_bndry

4.2 Project Organization

The monitoring and watershed assessment activities described in the Multi-Year Plan is managed, implemented and evaluated by the SCVURPPP. The current Project organizational structure is illustrated in Figure 2 and the roles and responsibilities of each participant are described below.

Figure 2. Organization Structure of SCVURPPP Multi-year Plan.



Program Manager
The Program Manager is responsible for the overall management and implementation of the SCVURPPP. Adam Olivieri, Principal Engineer with EOA, Inc. will serve in this capacity.

Monitoring Project Manager
Chris Sommers, EOA, Inc staff person currently manages the SCVURPPP Multi-Year Receiving Waters Monitoring and Assessment Program. Chris is currently responsible for coordinating monitoring activities for the Multi-Year Plan.

Field Data Collection Services
Kinnetic Laboratories Inc. staff currently conducts the water quality monitoring component of the Multi-Year Plan. EOA staff currently conducts the field data collection activities for the benthic

macroinvertebrate bioassessment component of the Multi-Year Plan. Cressey & Associated currently conducts the fish bioassessment component of the Multi-Year Plan.

Analytical Laboratory Services
Kinnetic Laboratories Inc. staff is coordinating all of the laboratory analyses for the water quality monitoring component of the Multi-Year Plan. KLI is currently contracts with ToxScan Inc. and BioVir Laboratories, Inc. for laboratory analytical services. EOA is coordinating the laboratory services for bioassessment studies. Bioassessment Services is currently conducting the laboratory processing of all benthic macro-invertebrates for the biological monitoring component of the Multi-Year Plan.

Data Manager
Paul Randall, EOA, Inc staff person, currently manages all of the data collected for the Multi-Year Plan.

QA Officer
TBD, EOA, Inc staff person, currently manages all of the data collected for the Multi-Year Plan.

5.0 PROBLEM DEFINITION/BACKGROUND

On February 21, 2001 the Santa Clara Valley Urban Runoff Pollution Prevention (SCVURPPP) was reissued a National Pollutant Discharge Elimination System (NPDES) permit (Permit) by the San Francisco Bay Regional Water Quality Control Board (Water Board) to discharge stormwater. Three provisions (C.7, C.9 and C.10) in the Permit contain environmental monitoring-related requirements. To meet these requirements the SCVURPPP submitted a Multi-Year Receiving Waters Monitoring Plan (Multi-Year Plan – Version 1.0) to the Water Board in 2002 that defined the SCVURPPP Watershed Monitoring and Assessment Program planned for implementation in Fiscal Years (FY) 2002-03 to 2009-10. The Monitoring and Assessment Program was designed to meet the following objectives listed in the Permit:

1. Characterization of representative drainage areas and storm water discharges, including land-use characteristics, pollutant concentrations, and mass loadings;
2. Assessment of existing or potential adverse impacts on beneficial uses caused by pollutants of concern in storm water discharges, including an evaluation of representative receiving waters;
3. Identification of potential sources of pollutants of concern found in storm water discharges; and,
4. Evaluation of effectiveness of representative storm water pollution prevention or control measures.

5.1 Multi-Year Receiving Waters Monitoring Plan

The Multi-Year Plan (Version 1.0) outlined the SCVURPPP's approach to monitoring, presented monitoring priorities and described accomplishments to-date. Furthermore, the 2002 Multi-Year Plan described the SCVURPPP's linkage to, and support for the Santa Clara Basin Watershed Management Initiative (WMI), a collaborative, stakeholder driven effort aimed at protecting and enhancing the watersheds in the Santa Clara Basin.
Following approval of the Multi-Year Plan, the SCVURPPP conducted screening level/baseline water quality monitoring in receiving water bodies in FY 02-03 and FY 03-04. In July 31, 2003, the SCVURPPP developed the *Assessment of Watershed Assessment Methods Technical Memorandum* (Technical Memo), which provides information necessary to improve SCVURPPP's monitoring and assessment program. Lessons learned from data collected during the first two years of implementing the Multi-Year Plan and recommendations presented in the Technical Memo provided the impetus to revise the Multi-Year Plan (Version 2.0).

Monitoring activities originally described in the Multi-Year Plan (Version 1.0) were generally aimed at developing and implementing programs/projects designed to assess programmatic and environmental effectiveness and practical, implementable indicators and protocols for assessing the beneficial uses of receiving water bodies, including local creeks and the San Francisco Bay estuary. The implementation of these indicators and protocols are a necessary step toward establishing a sound regulatory basis for locally based watershed management. The Multi-Year Plan (Version 2.0), submitted in March 1, 2004, continues to embrace this strategy and offers revisions that are intended to: 1) more fully integrate the monitoring activities identified in the Plan with the Program's need to conduct watershed assessments, and 2) allow for additional follow-up

monitoring activities that will help better identify sources of pollutants or causes of impacts to Beneficial Uses (Uses). Additionally, the revised Multi-Year Plan attempts to provide the SCVURPPP a formalized process for conducting future monitoring and assessment activities.

5.2 Monitoring and Assessment Program Goals

Environmental monitoring and watershed assessments are key components in the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). Environmental monitoring provides information needed to: (1) assist the RWQCB to characterize receiving water quality in urban watersheds consistent with the priorities of the Santa Clara Basin Watershed Management Initiative (SCBWMI) and the Program; (2) develop an understanding of baseline conditions in water bodies; (3) recognize the need for site-specific water quality investigations to address questions that might arise while conducting screening-level monitoring efforts; (4) allow for determining if control measures are having an intended effect; and, (5) conduct watershed assessments aimed at determining the condition of, and potential impacts to water bodies and Beneficial Uses (Uses). Prior to conducting environmental monitoring, data quality objectives and an understanding of how the data will be analyzed should be established. This understanding of the overall objectives of collecting the data typically allows for environmental monitoring that utilizes appropriate indicators and collects adequate quality and quantity of data needed to conduct an assessment of the watershed/subwatershed in question.

The following SCUVRPPP Monitoring and Assessment Program goals are intended to guide the programs monitoring and assessment activities.

1. Develop a better understanding of the chemical, biological, and physical characteristics of water bodies and watersheds relevant to the Program, which will help inform decisions about future management actions and help clarify and resolve storm water related issues within watersheds;
2. Assess baseline water quality conditions in representative watersheds within Program boundaries to evaluate storm water impacts and help solve creek drainage basin-specific water quality problems;
3. Assess whether specific pollutants of concern are found in storm water discharges and impact water quality in local water bodies and the San Francisco Bay;
4. Evaluate the effectiveness of existing storm water pollution prevention and control Best Management Practices (BMPs) and recommend improvements; and,
5. Evaluate overall Program effectiveness over time.

These goals and objectives are more fully described in the Multi-Year Plan (Version 2.0).

6.0 PROJECT/TASK DESCRIPTION

6.1 SCVURPPP's Monitoring and Assessment Approach

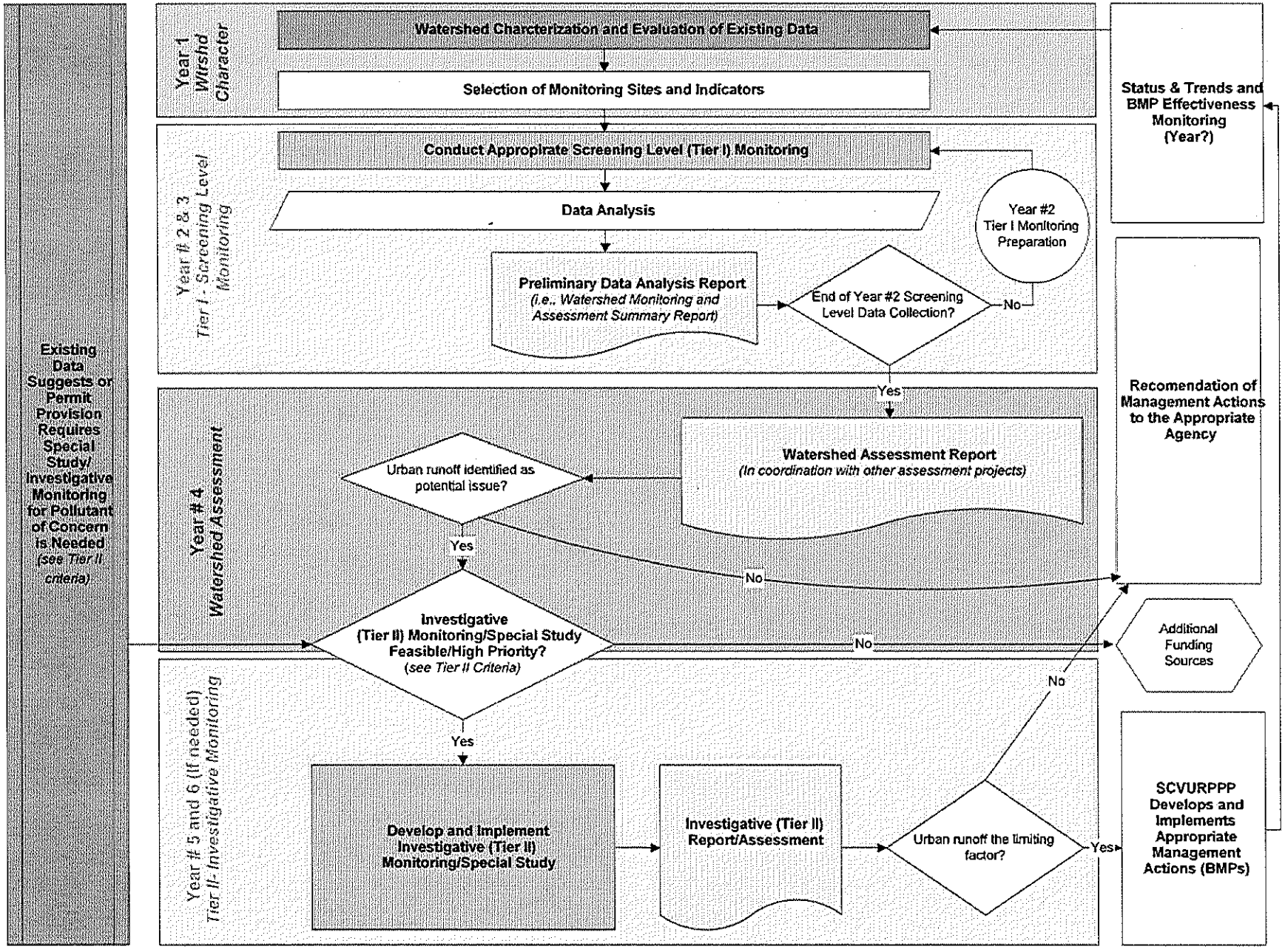
The SCVURPPP monitoring and assessment approach includes parameters that may be categorized into two tiers; screening-level monitoring and assessments (i.e. Tier I) and investigative monitoring (i.e., Tier II). Screening level monitoring and assessments include more general measurements made at various sampling locations, providing an initial characterization of the physical, chemical, and biological integrity of a particular watershed/waterbody. Investigative monitoring or studies include more detailed measurements typically taken in a more defined area (e.g., stream reach). Investigative monitoring is intended to address specific questions of impairment, such as: 1) what is the cause of the potential impairment, and 2) what is the potential source of the pollutant identified? Table 1 provides a few examples of screening-level indicators and investigative monitoring parameters.

A *Monitoring and Assessment Process Flow Chart* (Figure 3) illustrates the Program's "tiered" monitoring approach to environmental monitoring and the nexus between environmental monitoring and watershed assessment. This process is intended to provide the Program with a formalized structure for conducting monitoring and assessments under the Multi-Year Plan. This process utilizes the best available water quality and watershed-related information for each task, with the goal of collecting additional data needed to characterize, assess and protect/restore beneficial uses in receiving water bodies.

Table 1.0. Examples of screening-level indicators and investigative monitoring parameters, with associated beneficial uses.

Indicator/Parameter	Beneficial Uses
Screening-level Indicators	
General Water Quality	Aquatic Life Uses
Rapid Bioassessment	
Fisheries Assemblage Characterization	
Qualitative Physical Habitat Assessments	
Bacterial Indicators	Recreation Uses
Investigative Parameters	
Nutrients (NO3, NO2, NH4, PO4)	Aquatic Life Uses
Sediment (TSS, SSC, Geomorphic Analyses)	
Toxicity (3 species bioassays, TIEs)	
Metals (Cu, Ni, Cd, Hg, Cr, Pb, Se)	Aquatic Life and Recreation Uses
Pesticides (Organophosphates)	Aquatic Life Uses
Quantitative Physical Habitat Assessments	
Organics (PCBs, PAHs, Dioxins)	Aquatic Life and Recreation Uses

Figure 3. SCVURPPP Monitoring and Assessment Process Flow Chart.



6.2 Ecological Indicators

An ecological indicator is a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. An indicator may reflect biological, chemical and/or physical attributes of ecological condition, and may also be used to identify major ecosystem stress. The Program will collect two types of screening level indicators during the implementation of the Multi-Year Plan: (1) aquatic life use indicators (e.g., benthic macroinvertebrates and fish assemblages) and (2) water recreation use indicators (e.g., fecal and total coliforms, enterococcus and E. coli). Each type of indicator is further described below.

Aquatic Life Use Indicators - As a first step in conducting environmental monitoring, the Program intends to use screening level indicators that will aid in determining ecological condition and status of aquatic life uses in Santa Clara basin water bodies. In particular, the Program has selected Benthic macroinvertebrates (BMIs) and fish community assemblages as screening level indicators of aquatic life uses. Extensive guidance on development and use of BMIs and fish as indicators has been supported at the national and state levels, and a number of agencies and volunteer groups have begun to sample BMIs in Bay Area creeks using the California Stream Bioassessment Procedure developed by the California Department of Fish and Game. Additionally, screening level assessments of physical habitat will be conducted to aid in determining the physical/habitat condition or quality of a watershed and water body. Qualitative screening-level physical habitat assessments will be conducted synoptically with BMI and fish data collection efforts. Qualitative physical habitat assessments also include, general water quality measurements and substrate composition estimates taken during biological sampling.

Recreation Use Indicators - Microbiological water analysis is typically carried out to safeguard the health of a community by testing for possible fecal pollution, the source of microorganisms causing waterborne disease. Indicators of recreational use are microbiological organisms that coexist with pathogens in the fecal environment and are easier and less expensive to test for than pathogens. For these reasons, indicator organisms are often the focus of water analyses rather than pathogens. The most commonly employed indicator organisms are total coliform, fecal coliform, enterococcus, and E. coli. The Program intends to use these organisms as screening level indicators of beneficial uses related to recreation (i.e., REC-1 and REC-2). To ensure locations that have a high potential for recreational uses are sampled, Program staff will identify sampling sites within a given watershed during the watershed characterization stage of the watershed monitoring and assessment process. The selection of sampling site locations will be based upon where the highest potential for exposure and access to the creek appears to exist (e.g., parks adjacent to creeks and local swimming sites)

6.3 Monitoring Parameters

Table 2 shows the type of aquatic life and recreational use screening-level indicators and associated parameters measured by SCVURPPP for the Multi-year Plan. Specific monitoring parameters and associated data quality objectives for each parameter are listed in Section 7.0. Monitoring design is described in Section 10.0 and sampling methods are described in Section 11.0. The analytical methods are described in Section 13.0.

Table 2. Indicators and associated parameters measured in the SCVURPPPP Receiving Waters Monitoring Plan.

Indicator	Parameter Measured
Aquatic Life	
Physio-chemical	Water temperature, DO, pH, conductivity, stream velocity
Chemical	Total and dissolved metals
	Nutrients and anions
	Organophosphate pesticides
	Suspended sediment concentration
Aquatic Toxicity	3 species bioassays
Rapid Bioassessments	Benthic macroinvertebrates and fish community assemblage
Physical Habitat	Visual physical habitat assessment
Recreational Use	
Microorganisms	Total and fecal coliform, *enterococcus*

6.4 Project Timeline

SCVURPPP's proposed surface water monitoring program for an eight year period starting in FY 02-03 is provided in Appendix A. The table includes the following information: watershed location (prioritized based on WMI and SCVURPPP assessment priorities), data type (chemical, biological, and physical), FYs (8 years starting with FY02-03 through FY09-10), rationale, and lead agency. The information on data type utilizes a monitoring approach discussed above, and includes the following monitoring categories: screening level, investigative, and status and trends. Figure 4 shows SCVURPPP monitoring locations in Santa Clara Basin watersheds since FY 02-03.

Figure 4. SCVURPPP Monitoring Locations in the Santa Clara Basin since FY 02-03.

To be completed

A schedule of the specific monitoring activities conducted each year is shown in Table 3.

Table 3. Typical schedule for annual monitoring activities that occur within each fiscal year.

Activity	Time frame
Develop Annual Monitoring Plan and Characterization Memo	March (Year 1)
Field reconnaissance of monitoring sites	July (Year 2)
Water Quality Monitoring	Event 1: September – October (Year 2) Event 2: January – February (Year 2)
Bioassessment and Physical Habitat Assessment	Fish: September – October (Year 2) BMI and PHAB: April (Year 2)
Analysis of screening-level data	July - August (Year 3)
Reporting	Monitoring and Assessment Summary Report September (Year 3)

SCVURPPP provides specific monitoring information each year in the Annual Monitoring Plan, which is included in the SCVURPPP Annual Work Plan. The specific information includes: a summary description of existing and known information regarding waterbodies to be sampled during the year, site-specific lists of all planned monitoring site locations, with specific planned measurement parameters for monitoring at each site, as well as a summary of planned sampling frequencies for each site for the year.

SCVURPPP also develops Monitoring and Assessment Summary Report, which is submitted each year with the Annual Report. The Summary Report is intended to provide a preliminary analysis of data collected during the previous fiscal year.

7.0 DATA QUALITY OBJECTIVES

This section identifies data quality acceptance criteria (i.e., data quality objectives) related to the accuracy, precision, completeness, comparability, and representativeness of data collected through the SCVURPPP Multi-Year Plan. These data quality objectives were derived by reviewing the QAPPs and performance criteria developed by the State of California's *Surface Water Ambient Monitoring Program* (SWAMP) and the Department of Fish and Game's *California Stream Bioassessment Protocol* (CSBP); reviewing the specifications of the instruments and methods used for implementation of the Multi-Year Plan; and by considering the utility of the data.

As stated previously, the Multi-Year Plan was designed to meet the following objectives listed in the Permit:

1. Characterization of representative drainage areas and storm water discharges, including land-use characteristics, pollutant concentrations, and mass loadings;
2. Assessment of existing or potential adverse impacts on beneficial uses caused by pollutants of concern in storm water discharges, including an evaluation of representative receiving waters;
3. Identification of potential sources of pollutants of concern found in storm water discharges; and,
4. Evaluation of effectiveness of representative storm water pollution prevention or control measures.

Data quality objectives for water quality parameters measured in SCVURPPP Multi-Year Plan are provided in Appendix B (Tables B-1 and B-2). Information includes project detection limits, and objectives for precision and accuracy. Data acceptability criteria (DAC) tables for benthic macroinvertebrates (Table B-3), conventional constituents (Table B-4), metals (Table B-5), organophosphate pesticides (Table B-6), and toxicity testing (Tables B-7-B-9) are also provided in Appendix B. The DAC tables provide information on the QC sample objectives, QC sample frequencies, and resulting corrective actions for specific QC sample types and for each type of media.

Data acceptability criteria for bacterial indicators inserted here.

Standard Operating Procedures (SOP's) for Field Data Measurement Activities in SCVURPPP Multi-Year Plan are provided in Appendix C. Methods used for Water Sample Collection are provided in Appendix D. Field Sample Collection and Habitat Assessment SOP's, as well as Laboratory SOP's (taxonomy, sorting, counting, reporting, QA), for benthic macroinvertebrate bioassessment are detailed in Appendix E. Methods used to sample fish communities are provided in Appendix F.

The accuracy and precision of data are determined by particular actions of the analytical laboratory and field staff. The precision of data is a measure of the reproducibility of the measurement when an analysis is repeated. It is reported in Relative Percent Difference (RPD). The accuracy of an analysis is a measure of how much of the constituent actually present is determined. It is measured, where applicable, by adding a known amount of the constituent to a portion of the sample and determining how much of this spike is then measured. It is reported as Percent Recovery. The acceptable percent deviations and the acceptable percent recoveries are dependent on many factors including: analytical method used, laboratory used,

media of sample, and constituent being measured.

The completeness of data is basically a relationship of how much of the data is available for use compared to the total potential data before any conclusion is reached. Ideally, 100% of the data should be available. However, the possibility of data becoming unavailable due to laboratory error, insufficient sample volume, or samples broken in shipping must be expected. Also, unexpected situations may arise where field conditions do not allow for 100% data completeness. Therefore, 90% data completeness is required by SCVURPPP for data usage.

The comparability of data produced by and for SCVURPPP is predetermined by the commitment of its staff and contracted laboratories to use standardized methods, where possible, including EPA-approved analytical methods, or documented modifications thereof which provide equal or better results. These methods have specified units in which the results are to be reported. Measurements are made according to standard procedure, or documented modifications thereof which provide equal or better results, using common units such as Celsius, feet, feet/sec, mg/L, □g/L, mg/kg, etc. Analytical procedures are set by the USEPA approval list published in 40 CFR 136.

The representativeness of the data is mainly determined by selecting monitoring locations and sampling methods that adequately represent the true conditions of the sample site. Selecting sample locations and range of monitoring parameters (water, physical habitat and biota), and use of only approved/documented analytical methods, will determine that the measurement data represents the conditions at the monitoring site, to the maximum extent possible. The goal for meeting total representation of the site will be determined by the type of monitoring parameters, number of potential sampling points and frequency of sampling events, which are largely influenced by existing funding resources. Sampling schedules will be designed with respect to frequency, locations and methodology in order to maximize representativeness, where possible and applicable.

It is the responsibility of the program manager to verify that the data are representative while the analytical data's precision, accuracy, and comparability are mainly the responsibility of the laboratory supervisor. The program manager also has prime responsibility for determining that the 90% data completeness criteria are met or for justifying acceptance of a lesser percentage.

Laboratories performing the analysis of samples for this project have developed precision and accuracy limits for acceptability of data. For parameters and matrices which have USEPA established criteria, the limits are either equal to, or more stringent than, the established limit. These DQO's are used to evaluate the acceptability of each set of results. If the objectives are not passed for a particular analysis, the lab will immediately determine the cause of the discrepancy and resolve the problem.

8.0 SPECIAL TRAINING REQUIREMENTS/SAFETY

8.1 Recommended Training for Field Personnel

Proper training of field personnel represents a critical aspect of quality control. Field technicians are trained to conduct a wide variety of activities using standardized protocols to ensure comparability in data collection among crews and across geographic areas.

For training of SCVURPPP field staff, all sampling equipment (*e.g.,* field instruments and field data equipment, grabs, nets, etc.), and all pertinent sample collection protocols will be used extensively during "hands-on" training sessions (actual field sample collection trips). By the end of the sampling training, all crew members must demonstrate proficiency in all the required sampling activities, as certified by the Senior Scientist. SCVURPPP will document and maintain all training sessions completed by field personnel.

It is the responsibility of any and all SCVURPPP entities conducting field sample collection and field data measurements to develop and implement internal training and QA audit "checklists". Copies must be maintained in a central file by each SCVURPPP entity of all internal training and QA audit reports completed, as well as documentation of any deficiencies and corrective actions necessary to remedy such deficiencies. When requested, these records must be accessible to, or copies provided to, the SCVURPPP QA Program.

8.2 Safety Guidelines for Field Activities

Personnel conducting any field activities for SCVURPPP will be well-versed in standard safety procedures for such activities. It is the responsibility of the QA officer, or designee, of the particular participating SCVURPPP entity conducting field activities to ensure that safety training is mandatory for all field personnel, and that such training is documented in training certifications/records maintained and updated by all participating SCVURPPP field staff. Each SCVURPPP entity conducting field activities is responsible for preparing and maintaining a current Field Safety Manual (FSM) in compliance with the Occupational Safety and Health Administration (OSHA), or equivalent state or local regulations. The FSM will be readily available to field personnel, including all appropriate Material Safety Data Sheets (MSDS) information for chemicals that may need to be used while in the field. Proper procedures for safe storage, handling, shipping, transport, and disposal of chemicals and other materials will be followed at all times in the field; each chemical or field sample will be treated as a potential health hazard and good field safety practices will be implemented accordingly. A thorough description of recommended "Recommended Minimum Safety Guidelines for SCVURPPP Field Activities" is provided in **Appendix K** of this QAPP, which can serve as the FSM in most cases for entities in need of such a document.

8.3 Recommended Training and Proficiency Documentation for Laboratory Personnel

Minimum proficiency requirements that SCVURPPP analytical lab staff must meet shall be established and documented, and updated as necessary. Documentation of required expertise and on-going training for laboratory staff is required for all participating laboratory entities. Documentation of each analyst or technician must be provided regarding their proficiency to use analytical equipment and conduct analytical protocols, as well as being documented as being proficient in-house for conducting any general lab processes, such as glassware cleaning, sample preparation and processing, hazardous materials handling, storage, disposal, etc. All

lab staff must demonstrate proficiency in all the required laboratory activities that they conduct, as certified by the Laboratory QA Officer, or designee, as documented in training records developed and maintained for all SCVURPPP lab personnel.

8.4 Laboratory Health and Safety Requirements

All SCVURPPP laboratories shall be operated and maintained in a safe manner, and provide a working environment for staff that has as its top priority the implementation of any and all measures necessary for the highest level of protection of employee health and safety. Personnel in any laboratory performing analyses for SCVURPPP will be well-versed in good laboratory practices, including standard safety procedures. It is the responsibility of the particular participating laboratory QA Officer, laboratory manager and/or supervisor to ensure that safety training is mandatory for all laboratory personnel, and that such training is documented in training certifications/records maintained and updated for all participating SCVURPPP laboratory staff. Each laboratory is responsible for maintaining a current Laboratory Safety Manual (LSM) in compliance with Occupational Safety and Health Administration (OSHA), or equivalent state or local regulations. The LSM will be readily available to, and readily understood by, all laboratory personnel, including all appropriate Material Safety Data Sheets (MSDS) information. Proper procedures for safe storage, handling and disposal of chemicals will be followed at all times; each chemical will be treated as a potential health hazard and good laboratory practices will be implemented accordingly.

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
		1st	2nd	3rd	4th		
Coyote Creek	***Chemical***						
	Contaminants-Sediment[3]				S(10)	• Baseline: Metal concentrations were measured in sediment samples in Coyote Creek during dry season in 1999 at nine stream locations as part of SEIDP project. PCB and mercury concentrations in sediment were measured in selected catchments of Coyote Creek watershed during 2000-01 as part of Regional Project. Metal, PCBs and pyrethroids concentrations were measured by SCVURPPP during dry and spring season in FY 06-07 at eight sites. • FY 07-08: Conduct second year of screening level monitoring of metals, PCBs and pyrethroids at ten stream locations during spring season. TOC, percent solids and sediment grain size will be measured synoptically.	SCVURPPP
	General Water Quality[4]				S(20)	• Baseline: General water quality sampling was measured in Coyote Creek during summer season in 1999-2001 at eight stream locations. Continuous temperature monitoring conducted by SCVWD as part of FAHCE and Mid-Coyote Flood Control Projects. General water quality was measured using probes during sediment sampling (8 sites) and bioassessment sampling (10 sites) in FY 06-07. • FY 07-08: Conduct second year of screening level measurements of general water quality using probes during sediment sampling (ten sites) and bioassessment (ten sites). Continuous temperature monitoring will be conducted by SCVWD as part of Mid-Coyote Flood Control Project.	SCVURPPP/ SCVWD
	Biological						
	Toxicity-Sediment[5]				S(10)	• Baseline: Sediment toxicity testing was conducted in FY 06-07 by SCVURPPP during dry and spring season at six sites. • FY 07-08: Conduct second year of sediment toxicity testing at ten sites during spring season, synoptically with sediment chemistry sampling.	SCVURPPP
	Pathogen Indicator Organisms[6]	S (4)			S (4)	• Baseline: Bacterial indicators concentrations in water were measured at eight stream locations in Coyote Creek during summer season in 1999-2001 as part of Stream Augmentation Study. Bacterial indicator concentrations were measured by SCVURPPP during dry and spring season in FY 06-07 at four stream sites. • FY 07-08: Conduct second year of monitoring of bacterial indicators at four stream sites located in city and county parks during summer and spring season.	SCVURPPP

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
		1st	2nd	3rd	4th		
	Bioassessment – Macroinvertebrates[7]				S(10)	• Baseline: Benthic macroinvertebrate (BMI) bioassessments were conducted at eleven sites in Coyote Creek mainstem during 1997 as part of USGS study. BMI assessments were also conducted at nine sites during 1999 as part of SEIDP and six sites during 2000 as part of Stream Augmentation Study. BMI bioassessment is planned by SCVURPPP in spring season during FY 06-07 at 10 sites. • FY 07-08: Conduct second year of benthic macroinvertebrate bioassessment at ten sites synoptically with physical habitat assessment. BMI sampling will occur at all sediment sampling sites.	SCVURPPP
	Bioassessment – Fish					• Baseline: Existing fish survey data were collected within the Coyote mainstem in the following studies: 12 sites by Rob Leidy during 1995-97, 18 sites by SCVURPPP during 1999 and five sites by SCVWD during 2000. Downstream migrant trapping was also conducted by SCVWD during 1998-2000. • FY 07-08: Fish community sampling is planned during summer and fall season 2007 in the Coyote mainstem by SCVWD as part of Mid-Coyote Flood Control Project.	SCVWD
	Physical						
	Physical Habitat[8]				S(10)	• Baseline: Continuous aquatic habitat survey was conducted in 1999 as part of FAHCE Project by SCVWD. Habitat surveys were also conducted at 18 stream locations in Coyote mainstem in 1999 as part of SEIDP. Aquatic habitat surveys were conducted in Coyote mainstem during summer 2006 by SCVWD as part of Mid-Coyote Flood Control Project. • FY 07-08: Conduct second year visual physical habitat assessment, concurrent with macroinvertebrate sampling, at ten sites.	SCVURPPP
	Sediment Characterization[9]				S(10)	• Baseline: Substrate composition and embeddedness was visually estimated in Coyote mainstem in 1999 as part of FAHCE Project. Collection of surface/subsurface sediment samples was conducted in Coyote mainstem in summer 2006 by SCVWD as part of Mid-Coyote Flood Control Project. • FY 07-08: Substrate composition and embeddedness will be visually estimated, concurrent with habitat assessment, at ten sites in Coyote mainstem.	SCVURPPP/ SCVWD

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
		1st	2nd	3rd	4th		
	Channel Dynamics and Hydrology					• Baseline: Historical ecology study was conducted in the Coyote Creek watershed by SFEI in 2005-06. Longitudinal profiles, suspended and bedload sediment sampling and bankfull discharge measurements was measured during summer 2006 by the SCVWD as part of Mid-Coyote Flood Control Project. • FY 07-08: Sediment sampling to determine bed load and suspended sediment rating curves will be conducted by the SCVWD as part of Mid-Coyote Flood Control Project.	SCVWD
Upper Penitencia Creek	***Chemical***						
	Contaminants-Sediment				S (4)	• Baseline: Metals, organochlorine pesticide suite, PCB and PAH concentrations were measured in sediment samples collected at one stream location during summer season in FY 02-03. • FY 07-08: Conduct screening level monitoring of metals, PCBs and pyrethroids at four stream locations during spring season. TOC, percent solids and sediment grain size will be measured synoptically.	SCVURPPP
	General Water Quality				S(10)	• Baseline: Screening level measurements of general water quality was conducted by SCVURPPP in FY 02-03 synoptically with water chemistry (3 sites) and BMI bioassessment (6 sites). Continuous temperature monitoring conducted by SCVWD from 1999 to present. • FY 07-08: Conduct screening level measurements of general water quality using probes during sediment sampling (four sites) and bioassessment (six sites).	SCVURPPP
	Biological						
	Toxicity-Sediment				S (4)	• Baseline: No baseline data currently exists. • FY 07-08: Conduct testing of sediment toxicity at four sites during spring season, synoptically with sediment chemistry sampling.	SCVURPPP
	Pathogen Indicator Organisms	S (3)			S (3)	• Baseline: Screening level monitoring of bacterial indicators was conducted by SCVURPPP during three seasonal time periods in FY 02-03 at three sites. • FY 07-08: Conduct screening level monitoring of bacterial indicators during summer and spring season at three stream sites located in city and county parks.	SCVURPPP
	Bioassessment - Macroinvertebrates				S (6)	• Baseline: Benthic macroinvertebrate (BMI) bioassessments were conducted at seven sites during 1997 as part of USGS study. BMI bioassessments were conducted by SCVURPPP during April 2003 at six sites. • FY 07-08: Conduct benthic macroinvertebrate bioassessment at six sites synoptically with physical habitat assessment. BMI sampling will occur at all sediment sampling sites.	SCVURPPP

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
		1st	2nd	3rd	4th		
	Physical						
	Bioassessment – Fish					• Baseline: Existing fish survey data were collected in Upper Penitencia Creek by Stacy Li (2000) and Stillwater Sciences (2005). • FY 07-08: Fish community sampling is planned during summer and fall season 2007 in Upper Penitencia Creek by SCVWD as part of Mid-Coyote Flood Control Project.	SCVWD
	Physical Habitat				S (6)	• Baseline: Continuous aquatic habitat survey was conducted in 1999 as part of FAHCE Project by SCVWD. • FY 07-08: Conduct visual physical habitat assessment, concurrent with macroinvertebrate sampling, at six sites.	SCVURPPP
	Sediment Characterization				S (6)	• Baseline: Substrate composition and embeddedness was visually estimated in Coyote mainstem in 1999 as part of FAHCE Project. Collection of surface/subsurface sediment samples was conducted in 2005 as part of SCVWD geomorphic survey. • FY 07-08: Substrate composition and embeddedness will be visually estimated, concurrent with habitat assessment, at six sites.	SCVURPPP
	Channel Dynamics and Hydrology					• Baseline: Channel morphology and hydrology data collected by SCVWD as part of Upper Penitencia Creek Flood Control Project. • FY 07-08: Monitoring channel morphology and hydrology is not planned.	SCVURPPP
Lower Silver -Thompson Creek	***Chemical***						
	Contaminants-Sediment				S (4)	• Baseline: Metals, organochlorine pesticide, PCB and PAH concentrations were measured in sediment samples collected at one stream location during summer season in FY 02-03. • FY 07-08: Conduct screening level monitoring of metals, PCBs and pyrethroids at four stream locations during spring season. TOC, percent solids and sediment grain size will be measured synoptically.	SCVURPPP
	General Water Quality				S(10)	• Baseline: Screening level measurements of general water quality was conducted by SCVURPPP synoptically with water chemistry (3 sites) and BMI bioassessment (4 sites) in FY 02-03. • FY 07-08: Conduct screening level measurements of general water quality using probes during sediment sampling (four sites) and bioassessment (six sites).	SCVURPPP

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
	Biological						
	Toxicity-Sediment				S (4)	• Baseline: No baseline data currently exists. • FY 07-08: Conduct testing of sediment toxicity during spring season, synoptically with sediment chemistry sampling, at four sites.	SCVURPPP
	Pathogen Indicator Organisms	S (3)			S (3)	• Baseline: Screening level monitoring of bacterial indicators was conducted by SCVURPPP during three seasonal time periods in FY 02-03 at three sites. • FY 07-08: Conduct screening level monitoring of bacterial indicators located in city and county parks during summer and spring season at three stream sites.	SCVURPPP
	Bioassessment - Macroinvertebrates				S (6)	• Baseline: BMI bioassessments were conducted by SCVURPPP in Thompson Creek during April 2003 at four sites. • FY 07-08: Conduct benthic macroinvertebrate bioassessment at six sites synoptically with physical habitat assessment. BMI sampling will occur at all sediment sampling sites.	SCVURPPP
	Bioassessment – Fish					• Baseline: No existing baseline fish community data. • FY 07-08: Fish community sampling is planned during summer and fall season 2007 in Lower Silver Creek by SCVWD as part of Mid-Coyote Flood Control Project.	SCVWD
	Physical						
	Physical Habitat				S (6)	• Baseline: No baseline data exists. • FY 07-08: Conduct visual physical habitat assessment, concurrent with macroinvertebrate sampling, at six sites.	SCVURPPP
	Sediment Characterization				S (6)	• Baseline: No baseline data exists. • FY 07-08: Substrate composition and embeddedness will be visually estimated, concurrent with habitat assessment, at six sites.	SCVURPPP
	Channel Dynamics and Hydrology					• Baseline: Channel morphology and hydrology data collected by SCVWD as part of Lake Cunningham Flood Control Project. • FY 07-08: Monitoring channel morphology and hydrology is not planned.	SCVURPPP

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	Quarter in FY 07-08				Rationale	Lead Agency
Lower Penitencia Creek	***Chemical***						
	Contaminants-Sediment				S (5)	• Baseline: Metals, organochlorine pesticide, PCB and PAH concentrations were measured in sediment samples collected at one location in Lower Penitencia and one location in Berryessa Creek during summer season in FY 02-03. • FY 07-08: Conduct screening level monitoring of metals, PCBs and pyrethroids at five stream locations during spring season. TOC, percent solids and sediment grain size will be measured synoptically.	SCVURPPP
	General Water Quality				S(10)	• Baseline: Screening level measurements of general water quality was conducted by SCVURPPP synoptically with water chemistry (5 sites) in FY 02-03. • FY 07-08: Conduct screening level measurements of general water quality using probes during sediment sampling (five sites) and bioassessment (five sites).	SCVURPPP
	Biological						
	Toxicity-Sediment				S (5)	• Baseline: No baseline data currently exists. • FY 07-08: Conduct testing of sediment toxicity at five sites during spring season, synoptically with sediment chemistry sampling.	SCVURPPP
	Pathogen Indicator Organisms	S (1)			S (1)	• Baseline: Screening level monitoring of bacterial indicators was conducted by SCVURPPP at three sites during three seasonal time periods in FY 02-03. • FY 07-08: Conduct screening level monitoring of bacterial indicators located in city and county parks during summer and spring season at one stream site.	SCVURPPP
	Bioassessment - Macroinvertebrates				S (5)	• Baseline: BMI bioassessments were conducted at four sites in Thompson Creek during April 2003 by SCVURPPP. • FY 07-08: Conduct benthic macroinvertebrate bioassessment at five sites synoptically with physical habitat assessment. BMI sampling will occur at all sediment sampling sites.	SCVURPPP
	Physical						
	Physical Habitat				S (5)	• Baseline: No baseline data exists. • FY 07-08: Conduct visual physical habitat assessment, concurrent with macroinvertebrate sampling, at five sites.	SCVURPPP
	Sediment Characterization				S (5)	• Baseline: No baseline data exists. • FY 07-08: Substrate composition and embeddedness will be visually estimated, concurrent with habitat assessment, at five sites.	SCVURPPP
	Channel Dynamics and Hydrology					• Baseline: Channel morphology and hydrology data collected by SCVWD as part of Lower Penitencia and Berryessa Creek Flood Control Projects. • FY 07-08: Monitoring channel morphology and hydrology is not planned.	SCVURPPP

Attachment 4-1

Table 4-1. FY 07-08 SCVURPPP monitoring plan for Santa Clara Basin Watersheds[1].

1 Parameter types are listed with category of monitoring design, which include: (S) screening level, (I) investigative, and (T) status and trends. The number in parentheses represents the number of sampling locations for that sampling period. Sampling locations are described in separate table and figure attached to Plan.

2 Description of analyses conducted for each data type is described in the footnotes below. In some cases, partial analyses may be implemented for data types when existing data satisfies screening level target. Standard analytical methods are indicated in separate table attached to Plan; methods are intended to be congruent with SWAMP/RMAS methodology.

3 Sediment Chemistry: Total metals (Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se), Hg, PCBs and pyrethroids; sampling conducted during spring season.

4 General Water Quality: Temperature, dissolved oxygen, pH and specific conductance (multiparameter probe readings and/or continuous measurements); sampling conducted during spring season.

5 Sediment Toxicity: Sediment bioassays on *Hyella azteca*.

6 Pathogen Indicator Organisims: total and fecal coliform, *Enterococcus, and E. coli*; sampling conducted during dry and spring seasons.

7 Bioassessment - Macroinvertebrates: following CSBP methodology and conducted during the spring season.

8 Habitat survey physical habitat assessment using CSBP methodology.

9 Creek substrate sediment composition and embeddedness is qualitatively estimated by visual observation during bioassessment and habitat survey.

ATTACHMENT 4-1

Table 4-2. Sampling locations, frequency and data types for SCVURPPP's FY 07-08 monitoring plan.

Station Id	Station Name	Sediment Chemistry	Sediment Toxicity	General Water Quality	Pathogen Indicators	Benthic Macroinvertabrate Bioassessment	Physical Habitat Assessment
Coyote Creek							
COY-1	Coyote Creek at Montague Expressway	1	1	2		1	1
COY-2	Coyote Creek at Oakland Ave (North Coyote Park)	1	1	2		1	1
COY-3	Coyote Creek at Watson Park	1	1	2		1	1
COY-4	Coyote Creek at William Street (William City Park)	1	1	2	2	1	1
COY-5	Coyote Creek at Story Road (Kelley City Park)	1	1	2	2	1	1
COY-6	Coyote Creek at Yerba Buena (Hellyer County Park)	1	1	2	2	1	1
COY-7	Coyote Creek at Coyote Rd (Shady Oaks City Park)	1	1	2		1	1
COY-7.5	Coyote Creek at Forsum Rd (Metcalf Ponds)				2		
COY-8	Coyote Creek upstream Metcalf Rd (at powerstation)	1	1	2		1	1
COY-9	Coyote Creek above Osier Ponds (Model Airplane Park)	1	1	2		1	1
COY-10	Coyote Creek at Cochrane	1	1	2		1	1
UP-1	Upper Penitencia Creek at Flea Market	1	1	2		1	1

ATTACHMENT 4-1

Table 4-2. Sampling locations, frequency and data types for SCVURPPP's FY 07-08 monitoring plan.

Station Id	Station Name	Sediment Chemistry	Sediment Toxicity	General Water Quality	Pathogen Indicators	Benthic Macroinvertabrate Bioassessment	Physical Habitat Assessment
UP-2	Upper Penitencia Creek at Jackson Rd (Penitencia Creek Park)	1	1	2	2	1	1
UP-3	Upper Penitencia Creek at Kyle Street (Penitencia Creek Park)	1	1	2	2	1	1
UP-4	Upper Penitencia Creek at Talent Drive			1		1	1
UP-5	Upper Penitencia Creek at Alum Rock Park at Quail Hollow Bridge	1	1	2	2	1	1
UP-6	Upper Penitencia Creek at Alum Rock Park at Live Oak Bridge			1		1	1
LS-1	Lower Silver Creek at Wooster Ave	1	1	2		1	1
LS-1.5	Lower Silver Creek at McKee (Plata Arroyo Park)				2		
LS-1.75	Lower Silver Creek at San Antonio (Mayfair Park)	1	1	2	2	1	1
LS-2	Lower Silver Creek at Murtha Dr	1	1	2		1	1
T-1	Thompson Creek at Quimby	1	1	2		1	1
T-2	Thompson Creek at Villages Parkway			1		1	1
T-3	Thompson Creek at Meadowlands Lane			1		1	1
Lower Penitencia Creek							
LP-1	Lower Penitencia Creek at Corning Ave.	1	1	2		1	1

ATTACHMENT 4-1

Table 4-2. Sampling locations, frequency and data types for SCVURPPP's FY 07-08 monitoring plan.

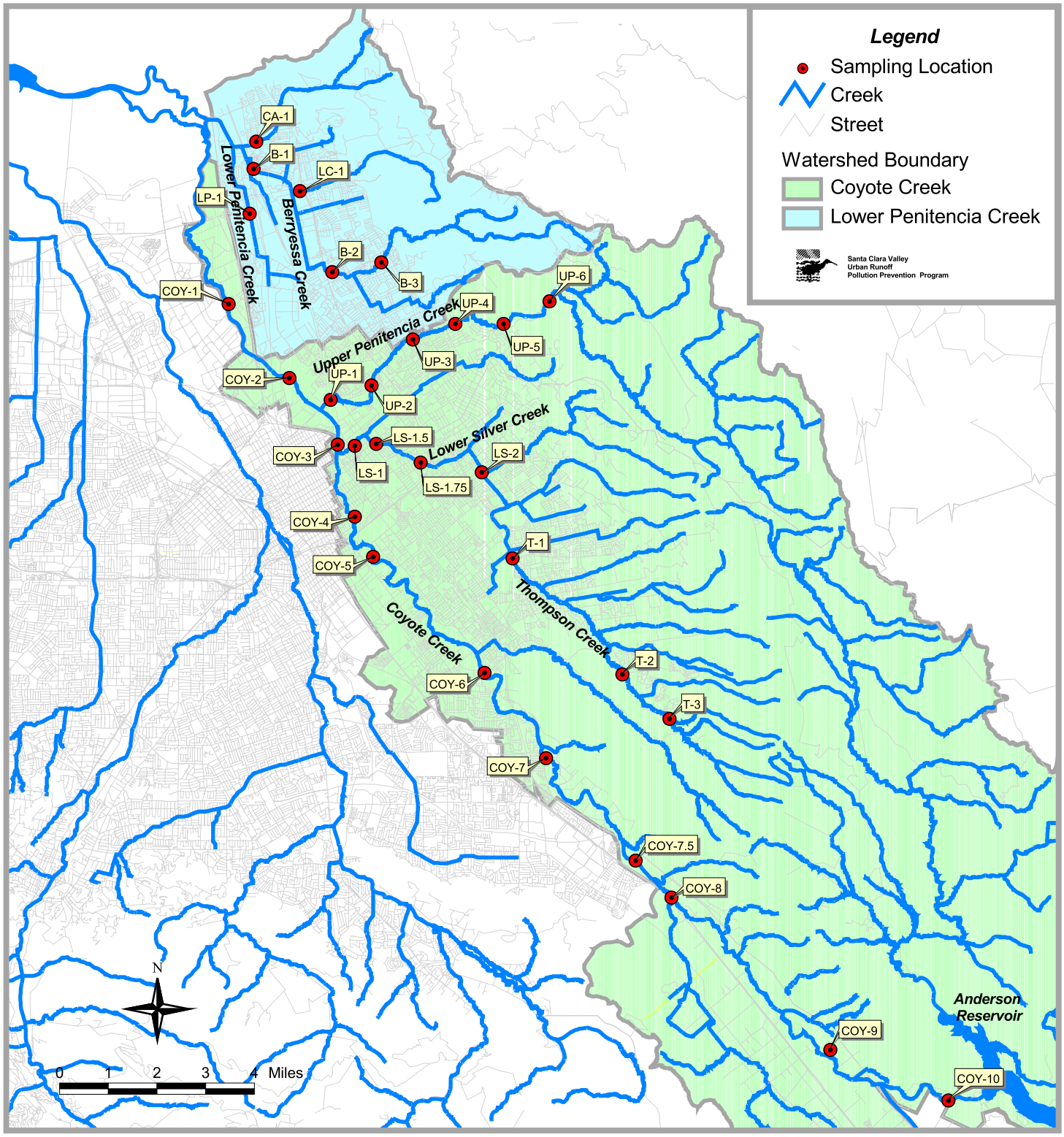
Station Id	Station Name	Sediment Chemistry	Sediment Toxicity	General Water Quality	Pathogen Indicators	Benthic Macroinvertabrate Bioassessment	Physical Habitat Assessment
B-1	Berryessa Creek at Milpitas Blvd	1	1	2		1	1
B-2	Berryessa Creek at Cropley Ave	1	1	2		1	1
B-3	Berryessa Creek at Messina Dr (Berryessa Creek Park)				2		
CA-1	Calera Creek at Milpitas Blvd	1	1	2		1	1
LC-1	Los Coches Creek along Los Coches Street	1	1	2		1	1
Total Number Samples		**23**	**23**	**50**	**20**	**27**	**27**

Sediment Chemistry: Total metals (Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se), Hg, PCBs and pyrethroids; sampling conducted during dry and spring seasons.
Sediment Toxicity: Sediment bioassays on *Hyella azteca*.
General Water Quality: Temperature, dissolved oxygen, pH and specific conductance (multiparameter probe readings and/or continuous measurements); sampling conducted during dry and wet seasons.
Pathogen Indicators: total and fecal coliform, Enterococcus, and E. coli; sampling conducted during dry and wet seasons.
Bioassessment - Macroinvertebrates: following CSBP methodology and conducted in the spring season.
Physical Habitat Assessment: survey physical habitat assessment using CSBP methodology.

Attachment 4-1

Table 4-3. Analytical methods used in SCVURPPP Multi-Year Monitoring Plan.

Description of data parameters	Analytical Methods
Sediment Chemistry	
Pyrethroid Pesticides (sediment)	EPA 8270C(SIM)
PCBs (sediment) - Congeners	EPA 8270C(m)
PBDEs (sediment)	EPA 8270C(m)
ICPMS metals suite (sediment) (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As)	EPA 6020
Total mercury (sediment)	EPA 245.7/1631M
Percent moisture (sediment)	EPA 160.3
TOC (sediment)	EPA 9060
Sediment grain size - full analysis (phi scale)	Plumb/PSEP
Bacterial Indicators	
Total coliform	SM 9221B&E
Fecal coliform	SM 9221B&E
E. coli	SM 9221B&E
Enterococcus	EPA 1600
Toxicity Testing	
Hyella azteca (10 day Survival & Growth)	EPA-600-R-99-064



Attachment 4-1 Figure 4-1. SCVURPPP FY 07-08 Sampling Site Locations in Coyote and Lower Penitencia Creek Watersheds.

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

MULTI-YEAR RECEIVING WATERS MONITORING PLAN

Prepared in Compliance with Permit Provisions C.7.a and b

(Appendix B contains detailed information on the environmental monitoring plan)

March 1, 2002

(Revised August 5, 2002)

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TABLE OF CONTENTS

PURPOSE …….. 1
Road Map …… 1
BACKGROUND …… 2
Development of the SCVURPPP's Approach to Monitoring …… 3
Annual Project Funding Process …….. 4
Priorities for Assisting the Watershed Management Initiative …… 5
Summary of Program Monitoring Priorities …….. 5
Accomplishments …… 6
MULTI-YEAR RECEIVING WATERS MONITORING PLAN …… 7
Comprehensive Monitoring Plan Timeline ……... 7
Programmatic Monitoring Indicators - Summary Matrix ……... 8
Environmental Monitoring Measures – Summary Matrix …….. 9
Continuous Improvement – Effectively Integrating Urban Runoff and Watershed Management …….. 10
Continuous Improvement Process ……..... 11
Stakeholder Involvement & Input …… 12

PURPOSE

The Multi-Year Receiving Waters Monitoring Plan (MY-RWMP) was prepared to fulfill the monitoring requirements of the NPDES permit contained in Provision C.7 and specifically Provision 7b of the SCVURPPP's Order adopted February 21, 2001by the Regional Board. That provision reads:

> **Multi-Year Receiving Waters Monitoring Plan.** In conjunction with the submissions required by Provision 9 the Dischargers shall submit by July 1, 2001, an interim draft of a Five-Year Receiving Waters Monitoring Plan, and, by March 1, 2002, a final Five-Year Receiving Waters Monitoring Plan acceptable to the Executive Officer, designed to comply with these Monitoring Program requirements. The Receiving Waters Monitoring Plan shall include provisions for monitoring South San Francisco Bay by participating in the San Francisco Estuary Regional Monitoring Program for Trace Substances or an acceptable alternative monitoring program. The Receiving Waters Monitoring Plan activities shall be coordinated with SCBWMI assessment activities.

MY-RWMP covers the entire spectrum of SCVURPPP monitoring activities, both programmatic and environmental. Readers specifically interested in the environmental monitoring activities (i.e., surface water monitoring activities) are referred to Appendix B. While MY-RWMP has been developed to meet the objectives of the NPDES permit, it also addresses the guidance contained in several RWQCB letters written to both the Program and members of the BASMAA monitoring committee.[1]

Road Map

The Multi-Year Receiving Waters Monitoring Plan (MY-RWMP)[2] contains four main elements:

1. <u>Comprehensive Timeline:</u> The timeline illustrates all existing commitments and priorities established by the Program, including ongoing activities meant to fulfill Regional Board Order Provisions related to C9 "Water Quality-Based

[1] RWQCB letter from Tom Mumley to BASMAA monitoring committee entitled *"Urabn Runoff Monitoring Needs/Recommendations"* dated February 2, 2001.
RWQCB letter from Loretta Barsamian to Adam Oliveiri entitled *"FY2002-2003 Syromwater Municipal NPDES Program Priorities"* dated December 7, 2001.
The water quality monitoring comments in the RWQCB from Bruce Wolfe to Beau Goldie entitled *"Pesticide-Related Components of 2000/01 Annual Report"* postmarked December 28, 2001.

[2] The Program, consistent with the NPDES permit, initiated work on the Multi-Year Receiving Waters Monitoring Plan (MY-RWMP) in January 2001. The first draft was released for review by the Monitoring Adhoc Group on January 15, 2001. Based on the review and response to comments a draft was formally submitted to the RWQCB on March 1, 2001 as part of the Program's FY01-02 Work plan. Comments were solicited from the WAS during April and May of 2001 and two additional Adhoc meetings were held on March 6 and April 19. A "Interim Draft" (fourth draft) was produced and submitted to the RWQCB on July 1, 2001, consistent with the NPDES permit. Minor revisions were made to the March darft and a final draft was submitted to the RWQCB on September 15, 2001 with the Program's FY00-01 Annual Report. Since the September submittal, three joint WAS and Monitoring Adhoc meetings were held on November 19, December 18 and January 24 (the last two included an EPA moderator/facilitator) to seek input from various stakeholders. In addition, a separate Co-permittee Adhoc meeting was held on December 16, 2001.

Requirements for Specific Pollutants of Concern" and C10 "Watershed Management" of the NPDES permit.

2. Summary matrix of Programmatic Monitoring Indicators (PMIs): The PMIs are used to gauge how well Performance Standards are being met and control measures are being implemented.

3. Summary matrix of Environmental Monitoring Measures (EMMs): The EMMs 1) assist the RWQCB characterize receiving water quality in urban watersheds consistent with the priorities of the Watershed Management Initiative and the Program[3], 2) identifies where and what type of status and trend type monitoring is appropriate, 3) recognizes the need for site-specific water quality investigations to address questions that might arise during the conduct of the routine monitoring efforts, and 4) allows for determining if control measures are having the intended effect.

4. Continuous Improvement: The continuous improvement element helps the SCVURPPP integrate urban runoff management and watershed management. It is based on the principles of adaptive management, thereby incorporating a systematic review of the monitoring results to improve future efforts and provides opportunities for stakeholder input into the continuous improvement process.

BACKGROUND

The word monitoring is applied to a wide range of activities; therefore, it is important that a monitoring program begins by defining the types of monitoring that will be employed to achieve its objectives. Nonpoint source programs, including urban runoff management programs, generally employ several types of monitoring depending on the type of observation that is desired. The types of monitoring employed by the SCVURPPP fall into five categories:[4]

1. Baseline monitoring: monitoring used to characterize existing water quality conditions, and to establish a database for planning or future comparisons. Where baseline monitoring is repeated at well-spaced time intervals, it can be used to indicate long term trends.

2. Assessment monitoring: observations made to estimate a particular parameter.

3. Implementation monitoring: monitoring used to assess whether an activity or activities were carried out as planned.

[3] The SCVURPPP's watershed assessment priorities are described in the Program's report entitled " Watershed Management and Urban Runoff Management Integration Report – Permit Provision C.10, June 29, 2001."

[4] These definitions were largely paraphrased from "*Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest" USEPA Region 10 1991 and EPA's Monitoring Guidelines. 1994, EPA National Guidance.*

4. Effectiveness monitoring: monitoring used to evaluate whether the specific activities accomplished the desired objective, such as the usefulness of a particular BMP or set of BMPs.

5. Project monitoring: monitoring used to assess the impact of a particular activity or project. This approach most often uses a combination of implementation and effectiveness monitoring to indicate the overall outcome of the project.

Of these five types of monitoring, typically only the first two are directly linked to water quality. However, many studies have shown that implementation and effectiveness monitoring are the most cost-effective approaches to reduce nonpoint source pollution because these types of monitoring provide immediate feedback on whether the activity or program is achieving the intended results. Monitoring types 3-5 form the basis for a 'continuous improvement process' that is central to the implementation principles of the Urban Runoff Program.

Development of the SCVURPPP's Approach to Monitoring

From its inception in 1990 through 1995, the Program's monitoring activities focused on establishing baseline information through sampling and analysis of runoff from various land uses and ambient waters. A summary of the products produced as part of the SCVURPPP's previous monitoring efforts is contained in the 1997 URMP. In addition to gathering baseline information, the Program's annual monitoring plans have also included assessments intended to enhance understanding of the sources and extent of urban runoff pollution, its effects, and methods for its control.

In August 1996[5] the Regional Water Quality Control Board (RWQCB) requested that the SCVURPPP redirect its monitoring resources and develop a new approach:

> Specific monitoring activities that should be considered within the strategy include characterization of drainage areas (watershed monitoring) including land use characteristics (general, such as open, residential, commercial, or industrial areas, or specific sources) and consideration of physical and biological, as well as chemical indicators to assess the drainage areas. We strongly encourage you to use community-based (volunteer) monitoring as an inexpensive and effective means to conduct this type of monitoring. The strategy should also establish a mechanism or process for effective use of special or pilot studies by your program or those conducted by other programs.

The SCVURPPP's Monitoring Plan implements the goals and objectives that were set by the Program's Management Committee in 1996. These goals and objectives were incorporated into the SCVURPPP's 1997 Urban Runoff Management Plan (URMP). In particular, the monitoring program implements Goals 2 and 3 (see highlighted text in box).

Since 1997 the Program's emphasis has been on integrating urban runoff and watershed management. This emphasis continues to be a major condition of the urban runoff permit. The results of this integration effort include the Program's and individual

[5] Loretta K. Barsamian, Executive Officer. August 30, 1996 letter to Frank Maitski.

Co-permittee assistance on managing various subgroups of the WMI, preparing the abridged and unabridged Watershed Characteristics Report, the conduct of various projects related at review of development policies and the completion of the national Stormwater Enivronmental Indicators Demonstration Project. A more detailed discussion of these efforts is contained the Program's Annual Reports (i.e., see FY 97-98, 98-99, 99-00, and 00-01).

Annual Project Funding Process

To achieve these goals, during its annual budgeting cycle, the Program identifies specific monitoring projects through the Program's continuous improvement process described in the 1997 Program URMP (Figure 1). As shown in the figure, projects are developed through:

- Evaluation of opportunities for improvement in Program (joint) activities. This evaluation is documented in the Program's annual performance review meeting and in the Program portion of the annual report.
- Co-permittee performance reviews. Specific items for improvement (by the Program or the Co-permittee) are identified during the annual review meetings and are documented in the summaries of these meetings.
- Participation in regional efforts (e.g. the BASMAA Regional Monitoring Strategy and the Regional Monitoring Program).
- Participation in the Santa Clara Basin Watershed Management Initiative (SCBWMI). As SCBWMI subgroups identify specific tasks related to creating the Watershed Management Plan, participating Program and Co-permittee staff consider whether the Program is the stakeholder that can most effectively implement these tasks. To determine which of these projects submitted by stakeholders from the SCBWMI receive funding, the Program uses a process described below under *Priorities for Assisting the Watershed Management Initiative.*

Regional Board staff and interested parties participate in the Program and Co-permittee performance review meetings and in the SCBWMI subgroups to provide input into the process for prioritizing and selecting projects.

1997 Urban Runoff Management Plan
Goals and Objectives

GOAL 1: Comply with Permit

- Effectively prohibit non-stormwater discharges (unless exempt or managed according to approved conditions)
- Reduce, to the maximum extent practicable, pollutants in stormwater runoff
- Comply with permit submittal requirements

GOAL 2: Determine Success

- Periodically evaluate the attainment of beneficial uses in selected waterways
- Evaluate changes in public awareness and behavior
- Evaluate effectiveness of specific control measures at pollution reduction.

GOAL 3: Adjust Activities to Meet Changes

- Define what constitutes success (how much is enough?) as it relates to programmatic and technical MEP
- Utilize what we learn to plan the next steps

GOAL 4: Achieve Acceptance of Urban Runoff Management Activities

- Effectively facilitate public input into Program planning process
- Integrate urban runoff goals at various intra-agency levels
- Develop and maintain a proactive relationship with regulatory authorities
- Publicize the efforts of the Co-permittees (Program)

GOAL 5: Integrate Urban Runoff Program Elements into other Programs

- Promulgate an understanding of the role of the urban runoff program
- Encourage other agencies to become involved in urban runoff issues
- Encourage action by the appropriate agencies

Priorities for Assisting the Watershed Management Initiative

The Program's Monitoring Ad-hoc Task Group (AHTG), composed of Co-permittee representatives, works with Program staff to review proposed projects and allocate available funds. Regional Board staff and interested parties attend the AHTG meetings. Figure 2, "Linking SCVURPPP and SCBWMI Goals," shows the four general areas of SCVURPPP support for the SCBWMI.

Summary of Program Monitoring Priorities

The Program's Monitoring AHTG uses the following monitoring priorities to determine which projects are funded for a given year:

1) New projects needed to implement the results, and achieve the goals, of current projects.
2) New projects that implement continuous improvement items identified through the annual review process.
3) Projects that support the Santa Clara Basin Watershed Management Initiative in one of the following ways:
   a) Investigate Beneficial Uses and Causes of Impairment (including field work)
   b) Review and Compile Environmental Data and Make it Accessible
   c) Develop Strategies for Controlling Impacts of Land Use on Beneficial Uses

d) Facilitate and Support WMI Subgroups (including coordination with other agencies)

4. Projects identified through participation in regional monitoring collaborative efforts, including the Regional Monitoring Program and BASMAA.

Each of these priorities is intended to fulfill specific provisions of the Program's 2001 NPDES permit and the 1997 URMP and to provide a strong basis for both program improvement and the next round of permit requirements. A more detailed summary, generally covering FYs 00-01 through 02-03, of how the SCVURPPP has addressed priority number 3 is contained in Appendix A. For additional information on this particular item, please see the Program's monitoring element contained the annual Work Plans.

Accomplishments

Complying with the Regional Board directive to redirect monitoring resources from a baseline monitoring approach, the Program has, since 1997, moved toward assessment of specific pollutants and conditions of designated beneficial uses. To improve the effectiveness of our special studies and those conducted by other programs, in 1996 and 1997, the SCVURPPP co-sponsored, and participated in, the Bay Area Stormwater Management Agencies Association's (BASMAA's) development of a BASMAA Regional Monitoring Strategy (BRMS). The SCVURPPP continues to coordinate its monitoring activities with other BASMAA member agencies.

In recent years, the Program has conducted substantial original research and investigations into the sources, fate, transport, and effects of urban runoff pollutants, the characteristics of Santa Clara Basin watersheds, the effects of urbanization on watersheds, and the effectiveness of various control measures. Beginning in 1993-1994, the SCVURPPP has funded efforts to assess the condition of beneficial uses of creeks within the Santa Clara Basin, including a pilot volunteer monitoring program for local creeks (Streamkeepers) and through the SCBWMI.

The SCVURPPP recently completed a two year research project entitled "The Stormwater Environmental Indicators Demonstration Project (SEIDP). The SEIDP is part of USEPA's Environmental Indicators/Measures of Success Project and is part of the third phase of EPA's project, which focuses on local demonstration projects and testing of the indicators. The Water Environment Research Foundation sponsored the SEIDP jointly with the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP).

The project objectives were to:

- Evaluate the usefulness of the Center for Watershed Protection's (CWP) Stormwater Indicator Methodology under semi-arid conditions.
- Evaluate the applicability of environmental indicators under semi-arid conditions in two different situations: at a watershed level that includes a variety of chemical, physical and biological indicators and in an industrial watershed that emphasizes programmatic indicators.
- Select, test, and refine protocols for monitoring environmental indicators in semi-arid conditions.

- Develop guidance on selection and use of environmental indicators, and disseminate guidance to other stormwater programs in California, Oregon and the west to assist in validation of environmental indicators throughout the west.

Consistent with these objectives, the CWP's stormwater indicator methodology was applied at two distinct geographic scales: the 310-square-mile watershed of Coyote Creek (which includes the eastern portion of the City of San Jose) and a 28-acre industrial catchment along Walsh Avenue in the City of Santa Clara. The semi-arid climate is typical of California's coast from the San Francisco Bay area southward.

In Coyote Creek, the baseline was a 1979-1981 EPA-sponsored study that sought to identify the effects of urban runoff on water quality, sediment, fish, macroinvertebrates, attached algae, and rooted aquatic vegetation. In addition, the SCVURPPP monitored stormwater constituents and toxicity in the creek 1987-1996. In 1999, the SEIDP sampled fish and the physical habitat at 18 locations in Coyote Creek, sampled surficial sediment at six locations, and sampled benthic macroinvertebrates at nine locations. The SEIPD analyzed flooding, changes to stream morphology, and sources of imperviousness in the surrounding watershed. Georeferenced reports of illegal dumping and known industrial and construction sites were also generated.

The Program, as part of the Annual Reports, updates a summary of memoranda and reports published as a result of their research and investigative efforts. The most recent update is contained in Table 4-2 of the 1999-2000 Program Annual Report.

Regional Board staff has been thoroughly involved in these projects through participation in the Program's Monitoring Ad-hoc Task Group, through SCBWMI subgroups, and through special review groups such as the Stormwater Environmental Indicators Demonstration Project Review Committee and other technical advisory groups facilitated by Program staff.

The Program has contributed to the Regional Monitoring Program for Trace Substances (RMP) since1993 and has contributed approximately $140,000 a year to the RMP over the past four years. In addition, the three South Bay municipal wastewater treatment plants (i.e., City of Palo Alto, City of Sunnyvale, and the San Jose-Santa Clara facility) annually contribute between $200,000 and $250,000 a year to the RMP. Thus, local communities (which are urban runoff Co-permittees) contribute approximately $340,000 to $390,0000 a year to a regional monitoring program (consistent with Permit Provision C.7b). The results of the RMP's research and investigations have been published by the San Francisco Estuary Institute.

MULTI-YEAR RECEIVING WATERS MONITORING PLAN

As described previously, there are four key components to the Multi-Year Receiving Waters Monitoring Plan (MY-RWMP). Each of these components are discussed in the following sections. The MY-RWMP seeks to extend and continue implementation of the Program's monitoring priorities. The MY-RWMP also details how projects previously planned within these priorities, plus some new projects, will seek to fulfill the provisions of the reissued NPDES permit.

Comprehensive Monitoring Plan Timeline

A comprehensive monitoring timeline is shown in the Table 1 and is organized by the Program's monitoring priorities (Column A). Table 1 includes all projects (i.e., programmatic and environmental monitoring) funded through the Program's monitoring budget. Column B shows references to specific provisions in either Order No. 95-180 and/or the new Order No. 01.024 (where applicable). Column C lists descriptive titles for each task; Column D references current projects (also listed in the FY99-00 & FY00-01 Program Annual Reports) that are implementing the tasks.

The preliminary summary has been grouped according to the Program's monitoring priorities that were previously discussed. These include the following categories:

1) New projects needed to implement the results, and achieve the goals, of current projects.
2) New projects that implement continuous improvement items identified through the annual review process.
3) Projects that support the Santa Clara Basin Watershed Management Initiative in one of the following ways:
   a) Investigate Beneficial Uses and Causes of Impairment (including field work)
   b) Review and Compile Environmental Data and Make it Accessible
   c) Develop Strategies for Controlling Impacts of Land Use on Beneficial Uses
   d) Facilitate and Support WMI Subgroups (including coordination with other agencies)
4) Projects identified through participation in regional monitoring collaborative efforts, including the Regional Monitoring Program and BASMAA.

Programmatic Monitoring Indicators - Summary Matrix

Based on the Program's experience in implementing the Performance Standards, monitoring projects and continuous improvement process, the Program believes that a key element of its strategy should focus on developing better programmatic indicators and on collecting and analyzing programmatic data. A summary matrix of the various ongoing and planned projects relative to how they address the four major components of the RWQCB's long-term monitoring goals is shown in Table 2. The purpose of this table is to give the reader a perspective on the various projects that the SCVURPPP has underway or planned. Additional detail on the expected schedule for conducting a particular project is contained in the comprehensive monitoring plan timeline, Table 1, previously discussed. Appendix A contains a brief summary and discussion of the projects underway to develop strategies for controlling impacst of land use on beneficial uses (Program Monitoring Goal 3c).

In general, specific details on the project scope, expected or completed products and overall due dates can be found in several other reports produced by the Program and are not reproduced in this report. Please see the following areas noted below for additional information:

- Project Scopes & Schedules: see the annual monitoring plan contained in the Annual Program Workplan[6]
- Completed Products: see Table 4-2 contained in the monitoring section of the Program's Annual Report
- Status Reports: distributed to Adhoc Monitoring Group and Management Committee at least on a quarterly basis. In addition, the Program discusses the status of various projects on an as needed basis at the BASMAA monitoring subcommittee meetings, special workshops, and various WMI subgroup meetings, in particular the Land Use Subgroup. The results of those presentations and discussions are contained in meeting notes that are distributed to the Management Committee and members of the specific workgroup.

Environmental Monitoring Measures – Summary Matrix

While continuing the programmatic approach to measuring compliance, the Program and Co-permittees are committed to monitoring and assessing their creeks and wetlands, and San Francisco Bay. A summary matrix of the various ongoing and planned projects relative to how they address the four major components of the RWQCB's long-term monitoring goals (i.e., status and trends monitoring, surveillance monitoring, management effectiveness monitoring, and monitoring to help set realistic standards) is shown in Table 3. The purpose of this table is to give the reader a perspective on the various projects that the SCVURPPP has underway or planned. Additional detail on the expected schedule for conducting a particular project is contained in the comprehensive monitoring plan timeline, Table 1, previously discussed.

In addition to the summary matrix shown in Table 3, a detailed set of tables and figures that identifies the SCVURPPP's proposed surface water monitoring program for the next eight years is contained in Appendix B. Appendix B is a standalone section that: 1) assists the RWQCB characterize receiving water quality in urban watersheds consistent with the priorities of the Watershed Management Initiative and the Program, 2) identifies where and what type of status and trend type monitoring is appropriate, 3) recognize sthe need for site-specific water quality investigations to address questions that might arise during the conduct of the routine monitoring efforts, and 4) allows for determining if control measures are having the intended effect.

Appendix B contains the following tables and figures:

- Table B-1Existing Monitoring Data for Coyote Creek Watershed: Table B-1 contains a description of parameters, sampling locations and number of sites, along with the agency and specific project where the data have been collected within the Coyote Watershed. The information is based on a summary of the information contained in the *"Santa Clara Basin Stream Studies Inventory, July 24, 2001"* prepared by the Program to assist the WMI, as well as more recent date from ongoing Program efforts (The Program will be producing a quick update of the SSI during the fall of

[6] Please note that for some projects a very detailed workplan is developed and reviewed and approved by the Adhoc Monitoring Work Group. For example, the SEIDP, Coyote Pilot Assessment, Policy project on tax incentives and compare and contrast all have detailed project scopes. These have been and will continue to be incorporated to the appropriate submittals to the RWQCB staff.

2002. That project is part of the WAS workplan and the Program's FY02-03 Annual Monitoring Plan).

- Figure B-1 Pilot Assessment and Monitoring Efforts (1997 to Present) Occurring in Watersheds of the Santa Clara Basin: Figure B-1 illustrates the spatial coverage of investigations as well as the type (i.e, benthic , macroinvertebrate, salmonid habitat, biological, sediment, and water quality) of investigations conducted over the past four years throughout the Santa Clara Basin.

- Figure B-2 Existing Chemical, Biological and Physical Data Collection Efforts in Coyote Creek Watershed: Figure B-2 illustrates, in greater detail the spatial coverage of data and type of data available specifically in the Coyote Watershed[7].

- Table B-2 Preliminary SCVURPPP 8-Year Monitoring Plan for the Santa Clara Basin (excluding the Coyote Watershed): Table B-2 contains the following information: watershed location (prioritized based on WMI and SCVURPPP assessment priorities), data type (chemical, biological, physical, and trash), FYs (8 years starting with FY02-03 through FY09-10), rationale, and lead agency. The information on data type utilizes a tiered monitoring approach discussed by the RWQCB staff in its RMAS memo (February 8, 2001 Draft Monitoring Design in Regional Board-lead Pilot Watersheds, Spring 2001) that includes the following monitoring categories: screening level, detailed investigation, and status and trends.

- Table B-3 provides a description of data parameters and analytical methods used in the SCVURPPP FY 02-03 and Multi-Year Waters Monitoring Plan.

The investigation of beneficial uses and causes of impairment will be greatly facilitated by implementation of the Regional Board's Regional Monitoring and Assessment Strategy (RMAS). The Program is committed to continuing its efforts to facilitate technical and stakeholder workgroups that will assist Regional Board staff to implement the RMAS.

With appropriate policy and guidance from the Regional Board, it should be possible to develop practical, implementable indicators (including physical and biological indicators) and protocols to assess beneficial uses in creeks, wetlands, and the Bay. These indicators and protocols are a necessary step toward establishing a sound regulatory basis for locally based watershed management.

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[7] The high priority assigned to the Coyote watershed is based on the fact that, relative other watersheds in the Santa Clara Basin (as well as others), the watershed has the least amount of developed land (and thus the least amount of imperviousness), has the least amount of development within riparian corridors, and has one of the highest areas for projected future development. In addition, a significant amount of available work is ongoing or recently completed which allows the Program to build upon. The high priority given to the Coyote Watershed is consistent with the WMI's assessment priorities described in Work Group D products entitled *"Combined Technical Memoranda #29, #30, #13 – Management Issues to be Considered in Watershed Selection; Process and Objective Criteria for Incorporating Management Issues into the Selection of Watersheds, and Watershed Suite Selection and Reevaluation , dated April 18, 2000."* In addition, the high priority assigned to the Coyote Watershed is further described in the SCVURPPP" report entitled *" Watershed Management and Urban Runoff Management Integration Report, C.10, June 29, 2001."*

Continuous Improvement – Effectively Integrating Urban Runoff and Watershed Management

The requirement to investigate, consider, and implement watershed management measures first appeared in the Program's 1995 NPDES permit and is also a requirement of the Program's current NPDES permit. As part of its application for the current permit, the Program developed a "Watersheds 2000 Vision" (December 1999) that outlines the principles and approaches that the Program and its Co-permittees will use to support better management of the Santa Clara Basin through the implementation of urban runoff control measures. The vision statement also defines the relationship between and the roles of the Program and the SCBWMI in this context.

The Program's approach for supporting watershed management and the SCBWMI is based on the following principles:

- The goal of the Program and its Co-permittees is to maintain water quality and protect the beneficial uses of the waterbodies in the Santa Clara Basin through the implementation of control measures to the maximum extent practicable.

- Successful watershed management must be a community-wide, stakeholder-driven effort that includes regulatory agencies, the business community, environmental advocates, and local government.

- The Co-permittees recognize it can be difficult to separate many urban runoff "issues" from the general impacts of urbanization resulting from the cumulative effects of land development.

- The Co-permittees understand that municipal agency activities have the potential to impact water quality and beneficial uses; conversely such activities can create opportunities to improve water quality and enhance aquatic resources.

Given those principles, the Co-permittees envision the roles of the Program and that of the SCBWMI as follows:

- The Program's activities pursuant to the NPDES permit assist Co-permittees and other local agencies to incorporate appropriate watershed management recommendations into their decision-making and specific watershed protection approaches into their day-to-day operations.

- The SCBWMI, as a stakeholder process, provides the tools to identify community goals and issues, and facilitates the development of common ground between stakeholders to recommend to policy-makers the actions needed to better manage watershed resources.

The Program seeks to create an avenue by which the SCBWMI's broad stakeholder goals and objectives can be incorporated into the daily operations of the Co-permittees. The Co-permittees will strive to apply their resources and powers to preserve and enhance the watershed. To do this most effectively, the Program and Co-permittees

need to translate SCBWMI stakeholder recommendations into specific actions that are reasonable, practical, and that can be incorporated into their missions and services. In addition, the Program will work with Regional Board staff to apply a regulatory strategy that allows Co-permittees to find ways to coordinate with other agencies within a specific watershed — to protect and enhance beneficial uses.

Continuous Improvement Process: An important feature of a mature Phase I municipal stormwater management program like the Santa Clara Valley Program is a process for continuous improvement. As shown in Figure 1 from the Program's 1997 URMP, continuous improvement is implemented through two feedback "loops." The loop on the left emphasizes programmatic measures to gage the performance of the Co-permittees and the overall Program (and includes participation in regional efforts such as the San Francisco Bay Regional Monitoring Program for Trace Substances). The loop on the right emphasizes watershed assessment and management conducted jointly with other stakeholders in the SCBWMI[8].

This two-pronged approach facilitates the Regional Board's responsibility for fairly measuring regulatory compliance while encouraging a watershed management approach. The continuous improvement process has been utilized by the Program over the past five years to successfully integrate programmatic monitoring indicators, which provide the best basis for measuring permit compliance, with watershed management measures (including environmental monitoring), which provides the best context for considering the effects of stormwater runoff on the environment and measures to improve the health of the watershed.

Stakeholder Involvement & Input: A significant factor in the success of the continuous improvement program is the active involvement and input from the various watershed stakeholders. Over the past 5 years, this involvement and input has principally come through the Program's and Co-permittees significant involvement in the Santa Clara Basin Watershed Management Initiative. For example, the Program's involvement involved a major role preparing both the abridged and unabridged versions of the Watershed Characteristics Report, the lead role in conducting the assessment of Coyote Watershed, a continuing leadership role in the Landuse Subgroup as well as the Bay Monitoring and Modeling and Regulatory Subgroups, and it's continued support of the Core Group efforts. As described below, a number of the Co-permittees have and continue to provide leadership and resources to the success of the WMI.

- The SCVWD's role managing the report preparation team, acting as co-chair of the watershed subgroup and providing significant staff leadership and resources to conduct the assessments in the Upper Penitencia, Guadalupe and San Francisquito watersheds.
- The City of San Jose staff chairing the Core Group, providing significant staff and technical resources to assist all subgroups including Co-chairing the BMM and WAS, and providing significant resources to conduct the assessments in the Upper Penitencia, Guadalupe and San Francisquito watersheds.

[8] The continuous improvement process concept was developed as part of the Program's 1997 Urban Runoff Management Plan to more effectively integrate urban runoff and watershed management.

- The City of Sunnyvale staff acting as the administrative chair of the Core Group, the Co-chair of the WAS, and providing significant technical resources in support of the BMM and WAS workplans.
- The City of Palo Alto staff acting as the finance chair for the Core Group and providing significant resources in support of the regulatory subgroup.

As the urban runoff program and WMI move forward towards completing ongoing assessments, initiating new assessments, identifying impediments to maintaining and improving water quality, and identifying actions to improve water quality the "continuous improvement" process and input from stakeholders will become even more important to shape the actions and priorities for the future. As illustrated in Figure 1, the most advantageous time to provide effective input to the Program and Co-permittees is through the review of the Annual Report. The Annual Report is submitted to the RWQCB on September 15 each year. Budget and Annual Workplan discussions for the next fiscal year are initiated in early November of each year. Thus, the most effective opportunity to provide input into the Program's budget and Workplan cycle is through timely review and comment on the Annual Report. To be useful, the review and comment needs to occur during the latter half of September and October of each year with comments available by the first of November.

While review of the Annual Report is the most effective means to influence future efforts, the Program and Co-permittees continued involvement in the WMI will also generate new ideas and avenues to improve the management of urban runoff and the effective and efficient integration[9] of urban runoff management into the overall management of the Santa Clara basin watersheds.

[9] See the Program's report entitled "Watershed Management and Urban Runoff Management Integration Report-Permit Provision C.10, June 29, 2001" for a further discussion.

APPENDIX A

SUMMARY OF CATEGORY #3
ENVIRONMENTAL MONITORING MEASURES

APPENDIX A

SUMMARY OF
CATEGORY #3 ENVIRONMENTAL MONITORING MEASURES

There are four key subcategories of projects in Category #3 projects that are directed at "supporting the SCBWMI." In particular, the specific field assessment and monitoring activities that the SCVURPPP is conducting individually and in conjunction with the SCBWMI are described under Subcategory 3(a) "Investigate Beneficial Uses and Causes of Impairment."

Subcategory 3(a): Investigate Beneficial Uses and Causes of Impairment
SCBWMI Support: The Program and Co-permittees have assisted the SCBWMI since it was initiated by the Regional Board and USEPA in 1996. The Program has consistently coordinated its watershed management activities (which were mandated in the 1995 permit) with the SCBWMI.

The SCBWMI stakeholders, including the Regional Board and the Program, have agreed on goals and objectives and on a phased process for developing a watershed management plan. The first of these phases was to characterize the overall status of watersheds within the Santa Clara Basin; this phase was essentially completed with publication, during 2000, of a Watershed Characteristics Report. As is discussed in detail in the Program's 1999-2000 Annual Report, the report was prepared almost entirely by Program staff, Program subcontractors, or contractors retained directly by Co-permittees.

Program and Co-permittee staff and contractors have also helped the SCBWMI to develop and adopt a "Framework for Conducting Watershed Assessments" which is currently being employed to conduct assessments in three representative watersheds: the watersheds of San Francisquito Creek, of the Guadalupe River, and of Upper Penitencia Creek.

Regional Monitoring and Assessment Strategy Assistance: During 1999 Regional Board staff, in coordination with the BASMAA Monitoring Committee, developed a Regional Monitoring and Assessment Strategy (RMAS) (Version 1.0, October 1, 1999). The purpose of the RMAS is to improve the technical content of the Regional Board's policies and regulatory actions. The specific regulatory focus of the RMAS relates to the Regional Board's obligation to complete biennial water quality assessments under the Clean Water Act's 305(b) and 303(d) requirements. The RMAS endorses several approaches to monitoring and assessment, including incorporation of bioassessment data and physical measurements in Regional Board decision making (supported by the 1997 USEPA 305(b) guidelines), coordination of consistent monitoring and assessment efforts and protocols both regionally and nationally, and enhancement of waterbody classification to help improve sampling design. The RMAS is being carried out in a phased approach, beginning with "pilot-scale implementation in selected watersheds", and establishing a rotating basin approach that will eventually result in "comprehensive assessment of surface and ground waters in the San Francisco Bay Region."

To assist Regional Board staff with the development of the RMAS, the Program

- organized and facilitated a technical panel, comprised of experts in macroinvertebrate and fish sampling, analysis of assemblages, and use of multimetric indices to assess water bodies; assessments of physical habitat to support fish and other aquatic life;

- applied fluvial geomorphology; use of metrics and statistical analysis;

- discussed the management of geographically referenced physical, chemical and biological data and information;

- discussed the use of scientific data and information in applying water-quality regulations; and

- facilitated discussions with stakeholders as part of meetings of the BASMAA Monitoring Committee.

The technical panel reached consensus to recommend initial use of a functional approach to assessing urban streams. By linking stream hydrogeomorphic functions to habitat functions and to beneficial uses the Regional Board will be better able to place ecological information into the regulatory context. The approach is summarized in the Coyote Pilot Assessment Workplan (previously submitted to the RWQCB)

The functional/pragmatic approach provides a common technical and regulatory perspective for three Regional Board Initiatives that were being developed during 2000:

1. The RMAS.
2. Sediment TMDLs and Regional Watershed Assessment.
3. Stream Protection Policy.

The Program will continue to assist Regional Board staff to improve the technical content of its 305(b) water quality assessments and 303(d) listings, with a focus on developing and refining the methodology for assessing urban streams. The Program is also willing to pull the expert panel together to further assist the Regional Board staff.

To test this approach, and to contribute to the SCBWMI's assessment of Santa Clara Basin watersheds, the Program is also implementing an Integrated Pilot Assessment in the Coyote Creek Watershed. The pilot assessment will facilitate continuous improvement of the SCBWMI's watershed assessment framework, integrate that methodology with that being used by the RMAS and other Regional Board initiatives, develop a list of appropriate initial management actions to preserve and enhance the Coyote watershed, and identify appropriate monitoring locations and provide baseline information for a long-term monitoring program for continued watershed assessment. Additional monitoring within the Coyote Watershed is specifically recognized within the proposed 8 year monitoring cycle (see Appendix B). The proposed additional efforts will be reviewed as part of Task 7 & 8 the Coyote Pilot Assessment Work Plan (see March 1, 2001 Work Plan, Attachment 4-3) which call for developing a long-term monitoring strategy by September 2002.

While expansion of the assessment and monitoring effort beyond the current pilot investigations in the Coyote Watershed are specifically recognized in the MY-RWMP, The intent is to constructively build the future years' monitoring and assessment efforts on the past years' work and lessons learned.

Pollutant-Specific Provisions C9: The recent emphasis on enforcement of long-standing Federal requirements that the states develop and implement TMDLs has led the Regional Board to request, and then require, assistance with estimating pollutant loads and with identifying control measures.

As described in the 1990 stormwater regulations, the intent of USEPA's mandate that stormwater pollution prevention programs incorporate a monitoring element was to help determine the effectiveness of these programs. Various studies, including the SEIDP, have demonstrated that pollutant loadings may not be the best indicator of the effectiveness of municipal stormwater programs. The Program's current Performance Standards provide for the control of urban runoff pollutants to the maximum extent practicable, and the Program's Continuous Improvement process provides for timely and orderly updates of the Performance Standards as new technology and information becomes available.

The Program has scoped and budgeted monitoring projects to comply with the new Permit's provisions that require the Program to assist Regional Board staff to prepare TMDLs. Many of these projects continue and expand on current efforts to assist the Regional Board.

Provisions C9a and b. Copper and Nickel Control Measures

The Metals Control Measures Plan, was first created in FY00-01 (SC27.05) to assist implementation of baseline activities contained in the Lower South San Francisco Bay Copper and Nickel Action Plans, to track and report activities, and to continue to work with the SCBWMI Bay Monitoring and Modeling (BMM) and Regulatory Subgroups regarding BMM Work Plan Updates. Descriptions of copper control program activities and nickel control program activities are included in the Copper and Nickel Action Plans approved by the SCBWMI and transmitted to the RWQCB as part of the Copper and Nickel TMDL Project. In addition, those baseline activities that are specifically related to the stormwater program are listed in Appendix B of the recently adopted NPDES permit. The Program's activities to support baseline activities was carried into FY 01-02 (see FY001-02 Workplan monitoring section project descriptions #9, 10 and 11) and is continued into the FY02-03 Workplan.

Provisions C9c and e. Mercury and PCB Control Measures

The Mercury Rising (FY00-01, Project SC27.06), was created to assist Regional Board staff with preparation of TMDLs and Implementation Plans to address potential effects of mercury and PCBs on beneficial uses of San Francisco Bay. The focus of the first phase of this project has been to respond to a May 2000 Regional Board letter request for information by leading a joint project, with other

Bay Area stormwater programs, to study mercury and PCBs in storm drain sediments.

The joint stormwater agencies project, which the Program contributes to through Project SC27.06, assesses the occurrence and distribution of PCBs, as well as that of mercury, in Bay Area storm drain sediments. The results of the first year of this project have been published. Based on the results of the technical review and discussions with the RWQCB staff and other stormwater programs through the BASMAA Monitoring Committee, the SCVURPPP's FY 01-02 projects scope is being defined (FY01-02 Workplan Project #12 & 14).

Program staff is currently working with the RWQCB staff and other storm water programs to complete the second year (FY01-02) of the project and developing the third year workplan (FY02-03). The three year investigation is being conducted consistent with Provisions 9ei,ii and iii requirements and guidance from the RWQCB staff. The scope for the third year investigations will be submitted to the RWQCB, consistent with the year two workplan, by July 1, 2002.

Provision 9c requires submission of a Mercury Plan by March 1, 2002. This document has been developed and is contained in Volume II of the FY 02-03 Work Plan.

Provision 9ei&ii requires submission of a workplan to characterize the representative distribution of dioxin-like compoundsand provide information to allow calcaulation of loadings by March 1, 2002. The workplan needs to be implemented by October 1, 2002. The workplan is contained in Volume II of the FY02-03 Workplan.

Provision 9eiv require submission of a plan and implementation schedule by March 1, 2002 that addresses actions to eliminat or reduce dischargesm of PCBs from urban runoff conveyance systems from controllable sources (if any). The plan is contained in Volume II of the FY02-02 Work Plan.

Provisions C9d. Pesticide Control Measures

Regional Pesticide Strategy Coordination and Implementation, provides for the Program to continue involvement with the BASMAA Pesticide Work Group and Urban Pesticide Committee to coordinate, evaluate, and report on storm water management plan actions outlined in the BASMAA Pesticide Strategy and in the Program's Pesticide Work Plan.

Provision C9d required the Program to submit, by July 1, 2001, a "pesticide toxicity control plan (Pesticide Plan) that addresses their own use of pesticides including diazinon, and, other lower priority pesticides no longer in use such as chlordane, dieldrin and DDT and the use of such pesticides by other sources within their jurisdictions. The Dischargers may address this requirement by building upon their prior submissions to the Regional Board. They may also coordinate with BASMAA, the Urban Pesticide Committee, and other agencies and organizations." It is the SCVURPPP's intent to collaboratively work with the RWQCB, it's staff, and other stormwater programs to develop enhancements to and continually improve the Program's Pesticide Management Plan.

Provision C 9f. Control Program for Sediment

Requirements in the new Order mandate a different approach to assessing the effects of urbanization and other land uses on the hydrogeomorphic and habitat functions of streams. In particular, Provision C9fi of the Order requires submittal of a plan and time schedule, by September 2001, to conduct an assessment of San Francisquito Creek that provides for:

1. Quantitative characterization of sediment and water inputs to the creek.
2. Relative roles of sediment associated with natural and anthropogenic land use discharges.
3. Sediment conveyance from headwaters to the Bay.
4. Development of a rapid sediment budget."

The SCVWD (onbehalf or the SCVURPPP) and MC STOPP submitted the plana nd time schedule as part of the FY00-01 Annual Report this past September 15, 2001.

Provision C9fii requires "an assessment of management practices that are currently being implemented to reduce excess sediment impairment in urban creeks, and implement any additional management practices to prevent or reduce excess sediment impairment in urban San Francisquito Creeks. Such management practices may include but are not limited to: management and/or removal of large woody debris and live vegetation from channels; streambank stabilization projects; road construction, operation, maintenance, and repairs to prevent road-related erosion; management of construction related sediment; and management of post-construction sediment from areas of new development or redevelopment." A plan and time schedule for implementation are required by March 1, 2002. The Santa Clara Valley Water District has taken the lead on these two provisions.

Provision C9fiii requires the Program to submit, by March 1, 2002, a report that identifies other creeks that may be impaired by excessive sediment production from erosion due to anthropogenic activities. This submittal is contained in Volume II of the FY02-03 Work Plan.
Provision C9fiii also requires submittal, by September 1, 2002, of a plan and schedule "to conduct a watershed analysis and management practice assessment in other creeks which may be impaired by excessive sediment production from erosion due to anthropogenic activities."

Watershed Management Provision C.10: Provision C10 requires submittal to the Regional Board by July 1, 2001, a report concerning the integration of watershed management activities into the Management Plan. The report shall, at a minimum:

a) Identify the watersheds that are relevant to each Discharger;
b) Identify key characteristics related to urban runoff in each watershed and program elements related to such characteristics; and
c) Provide a priority listing of watersheds to be assessed and a schedule for conducting such assessments in conjunction with the SCBWMI.

As previously described, the Program has consistently coordinated its watershed management activities (which were mandated in the 1995 permit) with the SCBWMI. The Program, as a stakeholder in the SCBWMI, has agreed with the Regional Board and numerous other Santa Clara Valley stakeholders on goals and objectives and on a phased process for developing a watershed management plan. That approach is contained in the SCBWMI "Watersheds Characteristics Report, May 2000[1]."

The above approach addresses the broader aspects of watershed management goals and activities and provides baseline information on the identification of Basin watersheds and characteristics. How these goals and activities are reflected and further integrated into the ongoing daily implementation of the stormwater performance standards by the Co-permittees should be further clarified. Consistent with the permit, the Program and the Co-permittees during FY 01-02 prepared a report on the integration of watershed activities into the Program URMP. (see FY 01-02 Project #6.) The report is entitled "Watershed Management and Urban Runoff Management Integration Report, Provision C.10, June 29, 2001." The recommendations from that report regarding the priorities for future assessment efforts has been incorporated into the proposed surface monitoring efforts described in Appendix B.

During FY01-02 the Program's support of Monitoring Priority 3a, Investigate Beneficial Uses and Causes of Impairment, included completion of a project for the SCBWMI Wetland Advisory Group's Baylands Assessment (FY00-01 Project SC27.13). Program staff l compiled additional baylands metadata for incorporation into the Santa Clara Basin Watershed Management Initiative (SCBWMI) Metadata Database (MDDB) and submitted the final report to the WAG on February 5, 2002.

Subcategory 3(b): Compile and Maintain Environmental Data and Make it Accessible.

To implement this priority, the Program will continue ongoing projects, including development and improvement of data libraries and project report libraries and their incorporation into the Program website. The SCVURPPP website has been completely updated and can be found at www.SCVURPPP.org. The Program's waterwatch website is located at www.waterwatch.org.

Subcategory 3(c): Develop Strategies for Controlling Impacts of Land Use on Beneficial Uses

To implement this priority, the Program supports the SCBWMI Land Use Subgroup (LUS). The Program's participation in the LUS is intended to fulfil a commitment in the 1997 URMP to "translate SCBWMI goals and objectives into model local-jurisdiction policies and procedures." The LUS includes stakeholders representing business interests, developers, environmental advocates, and Regional Board staff, as well as SCVURPPP Co-permittees. As documented in the LUS "Consensus Points" and in Chapter 4 of the SCBWMI Watershed Characteristics Report ("Land Use in the Basin"), the LUS has reviewed and discussed at length the potential effectiveness of various

[1] As is discussed in detail in the Program's 1999-2000 Annual Report, the Watershed Characteristics Report was prepared almost entirely by Co-permittee and Program staff, Program subcontractors, or contractors retained directly by Co-permittees.

approaches to controlling urban runoff pollutants and other effects of urbanization on streams. A specific approach to integrating municipal land use planning and watershed management is described in Section 4.1 of the Watershed Characteristics Report (unabridged). Continuation of the Program's support for the LUS is shown in the MY_RWMP.

In addition to administrative support and leadership for the LUS, the Program has also created additional projects to support the LUS' development of policies and watershed management measures. As shown below, two projects are underway which are intimately connected to the new development issues. These projects include:

Economic and Tax Incentives in Watershed Management, is intended to identify ways that Federal, state and local economic policies, including taxation, affect land use patterns and to explore ways that the Santa Clara Basin Watershed Management Initiative (SCBWMI) might be able to promote economic and tax policies that encourage more environmentally beneficial development decisions.

Compare and Contrast Development Policies, is intended to develop model municipal planning principles that would assist municipalities in developing effective policies, ordinances, or procedures to provide for long-term effective watershed protection and/or enhancement. In addition, the intent is to compare municipalities' existing policies, ordinances, or procedures against these model municipal planning principles to indicate areas where improvements can be made. The work provides for a re-examination of the previous work and additional research to be conducted in cooperation with Santa Clara Basin local and to build consensus within the WMI on the methods used in the comparison.

The Program encourages the RWQCB staff, as part of developing the revised permit language for new development, to integrate the results of the LUS' work to date, to continue RWQCB staff participation in the LUS, and to work with the Program and LUS to implement consensus recommendations reached within the LUS.

Category #4 – Regional Collaborative Efforts

As is mandated in the SCVURPPP's NPDES Permit, the Program pays over $140,000 annually to SFEI for expenditures on the Regional Monitoring Program for Trace Substances (RMP). In recent years the RMP has expanded its scope beyond periodic water-quality sampling into a broad range of special studies which are periodically reviewed by a steering committee and various technical advisory committees.

The Program, strictly from a volunteer perspective, has been working with the Regional Board staff and Executive Officer along with BASMAA and BACWA to develop a Memorandum of Understanding (MOU) to memorialize the understandings of the various parties regarding the development of Water Quality Attainment Strategies (WQASP) including Total Maximum Daily Loads (TMDLs) for the San Francisco Bay-Delta and its tributaries. The intent of the MOU is to outline the various parties desire to work collaboratively on the development and implementation of water quality attainment strategies including TMDLs. In order to facilitate these goals, the various parties are looking a mechanisms to develop work plans, schedules for implementing the work plans, funding sources and monitoring programs. The Program believes that this a key document that can be used to cost-effectively address water quality problems. The

Program is looking for this MOU to also provide some regulatory stability and certainty regarding the identification of resource needs over the next 5 years.

The Program has provided funds during FY01-02 from its contingency budget to assist with Year 0 of the WQASP. While the Program supports the concept of the WQASP, several questions remain to be addressed as part of the developing the WQASP project management plan. These questions include:

1. Various memos show estimated budgets varying from 7.5 million to 10.5 million. What are the WQASP plans for better defining and refining the estimates?

2. As the WQASP gets a better handle on the budget, questions regarding the overall timing of the program also should be discussed. What are the WQASP plans to review the reasonableness of the original proposed schedules given the availability of resources, technical practicalities, and regulatory realities?

3. The assumption has been that the POTW and Stormwater agencies will provide most of the resources. However, many of the POTWs and Stormwater agencies are one and the same and the proposed resources requirements are not insignificant. Thus, the costs to conduct the WQASP needs to be spread to more than the public. What are the WQASP plans to bring in other resources?

4. The RWQCB is a key player in the MOU and, as such, it was our understanding would also contribute resources to the budget. What are the RWQCB's plans for providing financial resources to the WQASP?

5. Stormwater Programs have been participating in funding various TMDL associated investigations over the past several years. Specifically, a significant amount of resources have already been expended on PCBs and mercury investigations throughout the San Francisco Bay Area. More efforts are also currently planned and will be shortly underway. This is not to mention the North Bay and South Bay copper and nickel efforts. How do agencies get credit for the work that has been completed, ongoing and will continue to go on outside of the WQASP but coordinated with the overall effort?

6. Public agencies have been providing resources to regional monitoring activities (Regional Monitoring Program) for a number of years and with WQASP are being asked to fund another regional activity. What are the WQASP plans to clearly define the linkages and overlaps between the RMP and WQASP programs and how these programs address all of the RWQCB's regional monitoring needs?

The Program has discussed these question with the Executive Board of BASMAA, has requested BASMAA to transmit them to the WQASP Executive Management Board, and has transmitted them directly to the EMB.

APPENDIX B

ENVIRONMENTAL MONITORING MEASURES

APPENDIX B

ENVIRONMENTAL MONITORING MEASURES

The Multi-Year Receiving Waters Monitoring Plan (MY-RWMP)[1] contains four main elements:

1. Comprehensive Timeline: The timeline illustrates all existing commitments and priorities established by the Program, including ongoing activities meant to fulfill Regional Board Order Provisions related to C9 "Water Quality-Based Requirements for Specific Pollutants of Concern" and C10 "Watershed Management" of the NPDES permit.

2. Summary matrix of Programmatic Monitoring Indicators (PMIs): The PMIs are used to gauge how well Performance Standards are being met and control measures are being implemented.

3. Summary matrix of Environmental Monitoring Measures (EMMs): The EMMs 1) assist the RWQCB characterize receiving water quality in urban watersheds consistent with the priorities of the Watershed Management Initiative and the Program[2], 2) identifies where and what type of status and trend type monitoring is appropriate, 3) recognizes the need for site-specific water quality investigations to address questions that might arise during the conduct of the routine monitoring efforts, and 4) allows for determining if control measures are having the intended effect.

4. Continuous Improvement: The continuous improvement element helps the SCVURPPP integrate urban runoff management and watershed management. It is based on the principles of adaptive management, thereby incorporating a systematic review of the monitoring results to improve future efforts and provides opportunities for stakeholder input into the continuous improvement process.

Environmental Monitoring Measures – Summary Matrix

While continuing the programmatic approach to measuring compliance, the Program and Co-permittees are committed to monitoring and assessing their creeks and wetlands,

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[1] The Program, consistent with the NPDES permit, initiated work on the Multi-Year Receiving Waters Monitoring Plan (MY-RWMP) in January 2001. The first draft was released for review by the Monitoring Adhoc Group on January 15, 2001. Based on the review and response to comments a draft was formally submitted to the RWQCB on March 1, 2001 as part of the Program's FY01-02 Work plan. Comments were solicited from the WAS during April and May of 2001 and two additional Adhoc meetings were held on March 6 and April 19. A "Interim Draft" (fourth draft) was produced and submitted to the RWQCB on July 1, 2001, consistent with the NPDES permit. Minor revisions were made to the March darft and a final draft was submitted to the RWQCB on September 15, 2001 with the Program's FY00-01 Annual Report. Since the September submittal, three joint WAS and Monitoring Adhoc meetings were held on November 19, December 18 and January 24 (the last two included an EPA moderator/facilitator) to seek input from various stakeholders. In addition, a separate Co-permittee Adhoc meeting was held on December 16, 2001.

[2] The SCVURPPP's watershed assessment priorities are described in the Program's report entitled " Watershed Management and Urban Runoff Management Integration Report – Permit Provision C.10, June 29, 2001."

and San Francisco Bay. A summary matrix of the various ongoing and planned projects relative to how they address the four major components of the RWQCB's long-term monitoring goals (i.e., status and trends monitoring, surveillance monitoring, management effectiveness monitoring, and monitoring to help set realistic standards) is shown in Table 3. The purpose of this table is to give the reader a perspective on the various projects that the SCVURPPP has underway or planned. Additional detail on the expected schedule for conducting a particular project is contained in the comprehensive monitoring plan timeline, Table 1, previously discussed.

In addition to the summary matrix shown in Table 3 of the main report, a detailed set of tables and figures that identifies the SCVURPPP's proposed surface water monitoring program for the next eight years is contained in this appendix (Appendix B). Appendix B is a standalone section that: 1) assists the RWQCB characterize receiving water quality in urban watersheds consistent with the priorities of the Watershed Management Initiative and the Program, 2) identifies where and what type of status and trend type monitoring is appropriate, 3) recognizes the need for site-specific water quality investigations to address questions that might arise during the conduct of the routine monitoring efforts, and 4) allows for determining if control measures are having the intended effect.

Included in this appendix (Appendix B) are the following tables and figures:

- Table B-1Existing Monitoring Data for Coyote Creek Watershed: Table B-1 contains a description of parameters, sampling locations and number of sites, along with the agency and specific project where the data have been collected within the Coyote Watershed. The information is based on a summary of the information contained in the *"Santa Clara Basin Stream Studies Inventory, July 24, 2001"* prepared by the Program to assist the WMI, as well as more recent date from ongoing Program efforts (The Program will be producing a quick update of the SSI during the fall of 2002. That project is part of the WAS workplan and the Program's FY02-03 Annual Monitoring Plan).

- Figure B-1 Pilot Assessment and Monitoring Efforts (1997 to Present) Occurring in Watersheds of the Santa Clara Basin: Figure B-1 illustrates the spatial coverage of investigations as well as the type (i.e, benthic , macroinvertebrate, salmonid habitat, biological, sediment, and water quality) of investigations conducted over the past four years throughout the Santa Clara Basin.

- Figure B-2 Existing Chemical, Biological and Physical Data Collection Efforts in Coyote Creek Watershed: Figure B-2 illustrates, in greater detail the spatial coverage of data and type of data available specifically in the Coyote Watershed[3].

[3] The high priority assigned to the Coyote watershed is based on the fact that, relative other watersheds in the Santa Clara Basin (as well as others), the watershed has the least amount of developed land (and thus the least amount of imperviousness), has the least amount of development within riparian corridors, and has one of the highest areas for projected future development. In addition, a significant amount of available work is ongoing or recently completed which allows the Program to build upon. The high priority given to the Coyote Watershed is consistent with the WMI's assessment priorities described in Work Group D products entitled *"Combined Technical Memoranda #29, #30, #13 – Management Issues to be Considered in*

- Table B-2 Preliminary SCVURPPP 8-Year Monitoring Plan for the Santa Clara Basin (excluding the Coyote Watershed): Table B-2 contains the following information: watershed location (prioritized based on WMI and SCVURPPP assessment priorities), data type (chemical, biological, physical, and trash), FYs (8 years starting with FY02-03 through FY09-10), rationale, and lead agency. The information on data type utilizes a tiered monitoring approach discussed by the RWQCB staff in its RMAS memo (February 8, 2001 Draft Monitoring Design in Regional Board-lead Pilot Watersheds, Spring 2001) that includes the following monitoring categories: screening level, detailed investigation, and status and trends[4].

- Table B-3 provides a description of data parameters and analytical methods used in the SCVURPPP FY 02-03 and Multi-Year Receiving Waters Monitoring Plan.

The investigation of beneficial uses and causes of impairment will be greatly facilitated by implementation of the Regional Board's Regional Monitoring and Assessment Strategy (RMAS). The Program is committed to continuing its efforts to facilitate technical and stakeholder workgroups that will assist Regional Board staff to implement the RMAS.

With appropriate policy and guidance from the Regional Board, it should be possible to develop practical, implementable indicators (including physical and biological indicators) and protocols to assess beneficial uses in creeks, wetlands, and the Bay. These indicators and protocols are a necessary step toward establishing a sound regulatory basis for locally based watershed management.

Watershed Selection; Process and Objective Criteria for Incorporating Management Issues into the Selection of Watersheds, and Watershed Suite Selection and Reevaluation , dated April 18, 2000." In addition, the high priority assigned to the Coyote Watershed is further described in the SCVURPPP" report entitled *" Watershed Management and Urban Runoff Management Integration Report, C.10, June 29, 2001."*

[4] Comments and guidance contained in the RWQCB's letter regarding Pesticide-Related components of the 2002/01 Annual Report indicate that water quality monitoring must include: 1) routine screening of representative creeks for aquatic toxicity (wet and dry periods), 2) monitoring for diazinon levels (wet and dry), and 3) monitoring for other pesticides with a substantial market share. MY-RWMP includes screening level toxicity testing in various locations based on the results of past work. MY-RWMP also allows for monitoring other pesticides consistent with permit Provision C.9i. Annual monitoring programs are developed based on previous years results. It is the SCVURPPP's intent to incorporate, as appropriate, monitoring based on the results of the Pesticide Plan use surveys.

Table B-1. Existing monitoring parameters, location, number of sites, sampling dates, associated projects and agencies for Coyote Creek Watershed.

Tier One - screening level monitoring

Data type	Parameters	# Sites/Subwatershed			Sampling Date	Project	Lead Agency
		Below Anderson Dam	Upper Penitencia Creek	Above Anderson Dam			
Chemical							
Field probe	Water temp, pH, conductivity, DO, turbidity	15		3	May - Sept 1999	SEIDP	SCVURPPP
Continuous monitoring	Water temp, pH, conductivity, DO	4		1	June - Sept 1999	SEIDP	SCVURPPP
Field probe	Water temp, pH, conductivity, DO, turbidity, alkalinity	9	1		May - Nov 2000	Streamflow Augmentation	San Jose
Continuous monitoring	Water temp, pH, conductivity, DO	3			May - Nov 2000	Streamflow Augmentation	San Jose
Continuous monitoring	Water temperature	6	1		May - Sept 2000	Streamflow Augmentation	San Jose
Continuous monitoring	Water temperature	42	5	1	1996-2001	FAHCE, others	SCVWD
Biological							
Rapid bioassessment	Benthic Macroinvertebrates	7		2	May - June 1999	SEIDP	SCVURPPP
Rapid bioassessment	Fish	15		3	May - Sept 1999	SEIDP	SCVURPPP
Bioassessment	Benthic Macroinvertebrates	9	7	2	May-97	Distribution and Abundance of Lotic Macroinvertebrates	USGS/ SCVURPPP
Bioassessment	Benthic Macroinvertebrates	15			Sep-98	Streamflow Augmentation	San Jose
Bioassessment	Fish	15			Oct-98	Streamflow Augmentation	San Jose

Data type	Parameters	# Sites/Subwatershed			Sampling Date	Project	Lead Agency
		Below Anderson Dam	Upper Penitencia Creek	Above Anderson Dam			
Bioassessment	Fish				1858 - 1999	Characterization Western Hamilton Stream Fisheries	The Nature Conservancy
Bioassessment	Microsatellite DNA		x	x	1997	Steelhead Genetic Study	SJSU
Physical							
Physical habitat	Salmonid Habitat Survey	15		3	Jul-99	SEIDP	SCVURPPP
Physical habitat	Salmonid Habitat Survey	4			Nov-98	Streamflow Augmentation	San Jose
Physical habitat	Salmonid Habitat Survey	x	x		1999	FAHCE	SCVWD
Physical habitat	Fish barriers	x	x		1999	FAHCE	SCVWD
Stream morphology	Rosgen classification	x	x		1999	FAHCE	SCVWD
Stream morphology	Stream classification	x	x	x	2002	Coyote Pilot Assessment	SCVURPPP
Stream morphology	Channel modification	x	x	x	1999	Waterways Management Model	SCVWD
Land use	Watershed Imperviousness	x	x	x	2000	SEIDP	SCVURPPP
Riparian Vegetation	Map of vegetation communities	x	x		1998	CCRS	SCVURPPP
Sediment	Volume of sediment removal	x	x		2001	Stream Maintenance Project	SCVURPPP
Other							
Photos - Physical Habitat	Channel location of fish sampling sites	15		3	May - Sept 1999	SEIDP	SCVURPPP
Trash	Illicit Discharge Inspection Records	x	x		Ongoing	Illicit Discharge Control Program	SCVURPPP
Flow	Stream gage measurement	x	x	x	Ongoing	Flow monitoring	SCVWD
Tier 2 - Detailed-level monitoring							
Chemical							
Field probe	Metals	9	1		May - Nov 2000	Streamflow Augmentation	San Jose

Data type	Parameters	# Sites/Subwatershed			Sampling Date	Project	Lead Agency
		Below Anderson Dam	Upper Penitencia Creek	Above Anderson Dam			
Field probe	Organophosphate Pesticides	2			Jul-00	Streamflow Augmentation	San Jose
Sediment sampling	Arsenic, cadmium, chromium, copper, lead, mercury	7		2	Jun-99	SEIDP	SCVURPPP
Sediment sampling	PCB, mercury	13		1	2000-2001	PCB/mercury study	SCVURPPP
Sediment sampling	Metals, Organics	9			Ongoing	Sediment Characterization - Stream Maintenance Program	SCVWD
Biological							
Field probe	Nutrients, pathogens	9	1		May - Nov 2000	Streamflow Augmentation	San Jose
Chronic toxicity bioassays	*Ceriodaphnia*	3			Jun-00	Streamflow Augmentation	San Jose
Physical							
Stream morphology	Channel cross sections, longitudinal profiles, bank erosion assessment		x		Mar-00	Alum Rock Park Riparian Management Plan	San Jose

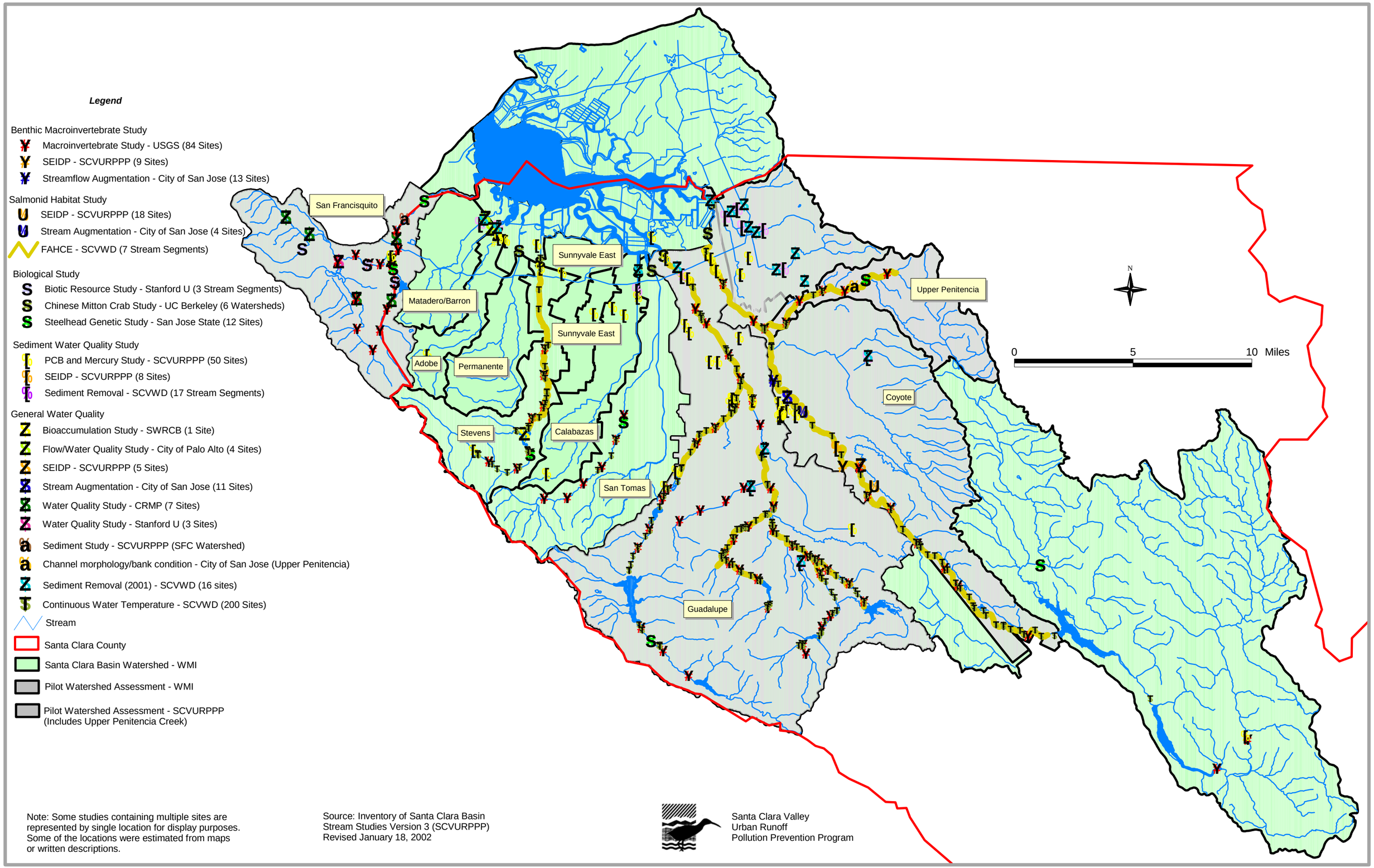

Figure B-1. Pilot Assessments and Monitoring Efforts (1997 to Present) Occurring in Watersheds of the Santa Clara Basin

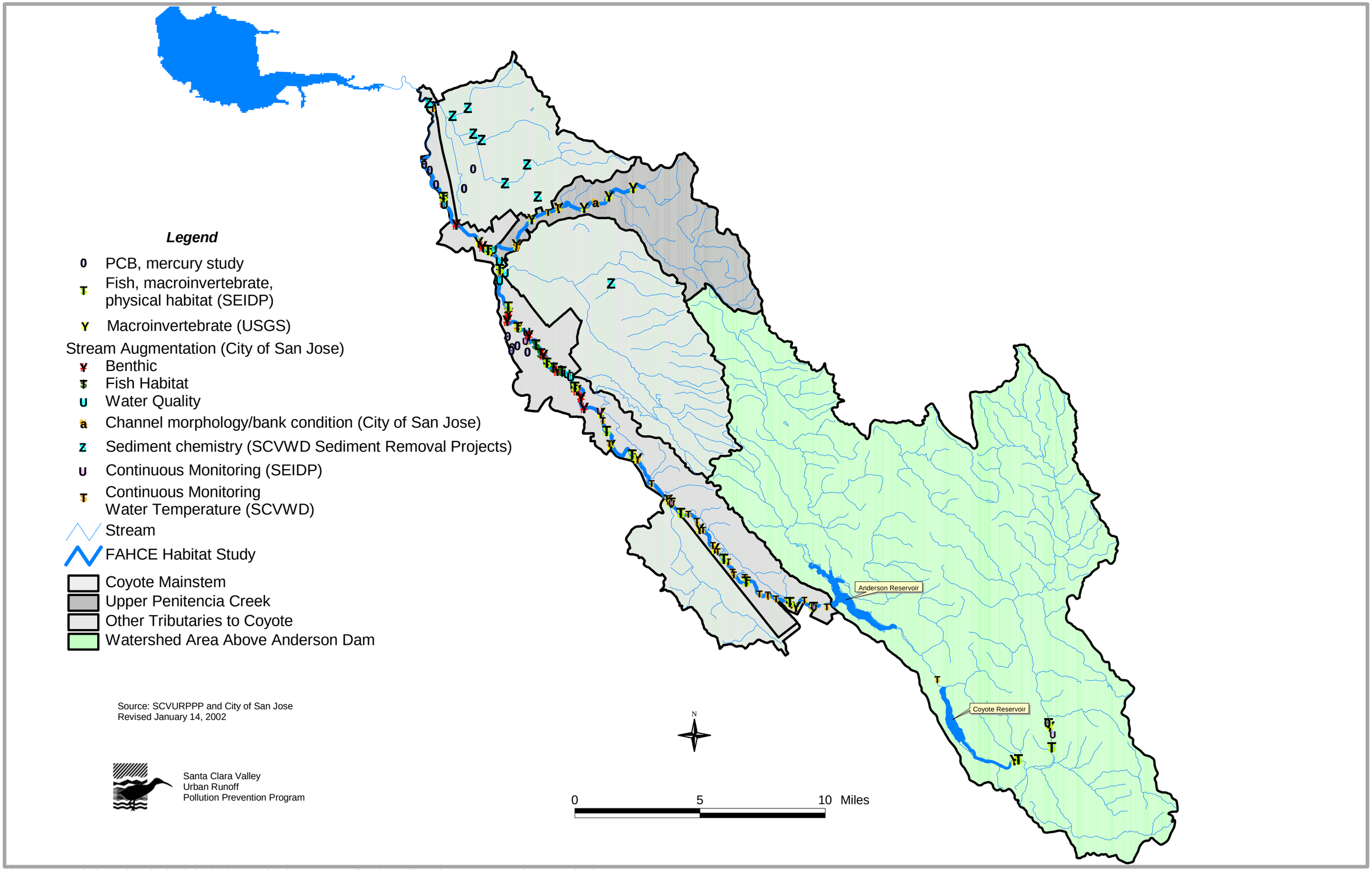

Figure B-2. Existing Chemical, Biological and Physical Data Collection Efforts in Coyote Creek Watershed.

Table B-2 (Revised 8/5/02). SCVURPPP 8-year monitoring plan for Santa Clara Basin Watersheds[1].

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
Coyote Creek (Only tribs sampled in FY 02-03)	***Chemical***										
	Contaminants - Water [3]	S(3)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Contaminants - Sediment[4]	S(1)				T(1)				See FY 02-03 Monitoring Plan	SCVURPPP
	General Water Quality[5]	S(5)				T(8)				See FY 02-03 Monitoring Plan	SCVURPPP
	Biological										
	Toxicity - Water Quality[6]	S(1)				T(4)				See FY 02-03 Monitoring Plan	SCVURPPP
	Conventional Water Chemistry[7]	S(4)				T(8)				See FY 02-03 Monitoring Plan	SCVURPPP
	Pathogens (Indicator Organisms) [8]	S(4)				T(8)				See FY 02-03 Monitoring Plan	SCVURPPP
	Bioassessment – Macroinvertebrates[9]	S(4)				T(12)				See FY 02-03 Monitoring Plan	SCVURPPP
	Bioassessment – Fish[10]					T(6)				See FY 02-03 Monitoring Plan	SCVURPPP
	Physical										
	Physical Habitat[11]	S(4)				T(12)				See FY 02-03 Monitoring Plan	SCVURPPP
	Sediment Characterization[12]	S(4)		I	I	T(12)				See FY 02-03 Monitoring Plan	SCVURPPP
	Channel Dynamics and Hydrology									See FY 02-03 Monitoring Plan	SCVURPPP
	Riparian Vegetation									See FY 02-03 Monitoring Plan	SCVURPPP
	Trash[13]	S(4)				T(4)				See FY 02-03 Monitoring Plan	SCVURPPP
Lower Penitencia Creek	***Chemical***										
	Contaminants - Water Quality	S(2)				T(2)				See FY 02-03 Monitoring Plan	SCVURPPP
	Contaminants - Sediment	S(1)				T(1)				See FY 02-03 Monitoring Plan	SCVURPPP
	General Water Quality	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Biological										
	Toxicity - Water Quality	S(2)				T(2)				See FY 02-03 Monitoring Plan	SCVURPPP
	Conventional Water Chemistry	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Pathogens (Indicator Organisms)	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Bioassessment - Macroinvertebrates	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Bioassessment - Fish									See FY 02-03 Monitoring Plan	SCVURPPP
	Physical										

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Physical Habitat	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Sediment Characterization	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
	Channel Dynamics and Hydrology									See FY 02-03 Monitoring Plan	SCVURPPP
	Riparian Vegetation									See FY 02-03 Monitoring Plan	SCVURPPP
	Trash	S(5)				T(5)				See FY 02-03 Monitoring Plan	SCVURPPP
Stevens Creek	***Chemical***										
	Contaminants - Water Quality				T(2)				T(2)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Contaminants - Sediment				T(1)				T(1)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	General Water Quality				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Biological										
	Toxicity - Water Quality				T(2)				T(2)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Conventional Water Chemistry				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Pathogens (Indicator Organisms)				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Bioassessment - Macroinvertebrates				T(8)				T(8)	Baseline data collected by USGS in 1997 and RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Bioassessment - Fish				T(4)				T(4)	Coordinate with SCVWD to obtain permits and/or develop approach to monitor status and trends of steelhead populations.	SCVWD/ SCVURPPP
	Physical										
	Physical Habitat				T(8)				T(8)	Salmonid habitat survey in 1999 by FAHCE; Visual habitat assessment by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Sediment Characterization		I		T(8)				T(8)	Identified as high priority for potential impairment from sediment in SCVURPPP sediment report. Conduct studies using methods developed in work associated with sediment workplan.	SCVURPPP
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
										Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
Permanente Creek	***Chemical***										
	Contaminants - Water Quality				T(2)				T(2)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Contaminants - Sediment				T(1)				T(1)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	General Water Quality				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Biological										
	Toxicity - Water Quality				T(2)				T(2)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Conventional Water Chemistry				T(2)				T(2)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Pathogens (Indicator Organisms)				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Bioassessment - Macroinvertebrates				T(7)				T(7)	Baseline data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
	Bioassessment - Fish				T(4)				T(4)	Coordinate with SCVWD to monitor status and trends of resident rainbow trout populations.	SCVWD/ SCVURPPP
	Physical										
	Physical Habitat				T(7)				T(7)	Baseline screening level data collected by RWQCB in 2002; repeat monitoring in future to determine status and trends. Conduct salmonid habitat survey in reaches that support trout.	SCVURPPP
	Sediment Characterization				T(7)				T(7)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	RWQCB/ SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	SCVURPPP
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash				T(3)				T(3)	Baseline screening level data collected by RWQCB in 2002; SCVURPPP will repeat monitoring in future to determine status and trends.	SCVURPPP
San Thomas Aquino	***Chemical***										
	Contaminants - Water Quality		S(3)				T(3)			Conduct screening level monitoring	SCVURPPP
	Contaminants - Sediment		S(1)				T(1)			Conduct screening level monitoring	SCVURPPP
	General Water Quality		S(7)				T(7)			Conduct screening level monitoring	SCVURPPP
	Biological										
	Toxicity - Water Quality		S(3)				T(3)			Conduct screening level monitoring	SCVURPPP
	Conventional Water Chemistry		S(7)				T(7)			Conduct screening level monitoring	SCVURPPP
	Pathogens (Indicator Organisms)		S(7)				T(7)			Conduct screening level monitoring	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Bioassessment - Macroinvertebrates		S(7)				T(7)			Baseline data from 1997 USGS study in Saratoga; conduct rapid bioassessment synoptically with chemical and physical parameters.	SCVURPPP
	Bioassessment - Fish		S(4)				T(4)			Coordinate with SCVWD to monitor status and trends of resident rainbow trout populations.	SCVURPPP
	Physical										
	Physical Habitat		S(7)				T(7)			Salmonid habitat survey data was identified as a data gap for Saratoga Cr in SCVURPPP sediment report; conduct salmonid habitat survey.	SCVURPPP
	Sediment Characterization		S(7)			I	T(7)			Conduct evaluation of sediment related impacts in Saratoga Cr in conjunction with SCVURPPP sediment assessment workplan.	SCVURPPP
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	SCVURPPP
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash		S(4)				T(4)			Conduct screening level monitoring	SCVURPPP
Matadero/ Barron	***Chemical***										
	Contaminants - Water Quality			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
Creeks	Contaminants - Sediment			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	General Water Quality			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Biological										
	Toxicity - Water Quality			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Conventional Water Chemistry			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Pathogens (Indicator Organisms)			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Macroinvertebrates			S(6)				T(6)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Fish									No data collection is currently planned	SCVURPPP
	Physical										
	Physical Habitat			S(6)				T(6)		Conduct screening level monitoring	SCVURPPP
	Sediment Characterization			S(6)				T(6)		Conduct screening level monitoring	SCVURPPP
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	SCVURPPP
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash			S(6)				T(6)		Conduct screening level monitoring	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
Adobe Creek	***Chemical***										
	Contaminants - Water Quality		S(2)				T(2)			Conduct screening level monitoring	SCVURPPP
	Contaminants - Sediment		S(1)				T(1)			Conduct screening level monitoring	SCVURPPP
	General Water Quality		S(3)				T(3)			Conduct screening level monitoring	SCVURPPP
	Biological										
	Toxicity - Water Quality		S(2)				T(2)			Conduct screening level monitoring	SCVURPPP
	Conventional Water Chemistry		S(3)				T(3)			Conduct screening level monitoring	SCVURPPP
	Pathogens (Indicator Organisms)		S(3)				T(3)			Conduct screening level monitoring	SCVURPPP
	Bioassessment - Macroinvertebrates		S(4)				T(4)			Conduct screening level monitoring	SCVURPPP
	Bioassessment - Fish									No data collection is currently planned	SCVURPPP
	Physical										
	Physical Habitat		S(4)				T(4)			Conduct screening level monitoring	SCVURPPP
	Sediment Characterization		S(4)				T(4)			Conduct screening level monitoring	SCVURPPP
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash		S(4)				T(4)			Conduct screening level monitoring	SCVURPPP
Calabazas Creek	***Chemical***										
	Contaminants – Water Quality			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	Contaminants - Sediment			S(1)				T(1)		Conduct screening level monitoring	SCVURPPP
	General Water Quality			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Biological										
	Toxicity - Water Quality			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	Conventional Water Chemistry			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Pathogens (Indicator Organisms)			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Macroinvertebrates			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Fish									No data collection is currently planned	SCVURPPP
	Physical										
	Physical Habitat			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Sediment Characterization			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
										Provision. The specific creeks in which to compile baseline data have not been selected at this time.	
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash			S(4)				T(4)		Conduct screening level monitoring	SCVURPPP
Sunnyvale Channel (East/West)	***Chemical***										
	Contaminants - Water Quality			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	Contaminants - Sediment			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	General Water Quality			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Biological										
	Toxicity - Water Quality			S(2)				T(2)		Conduct screening level monitoring	SCVURPPP
	Conventional Water Chemistry			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Pathogens (Indicator Organisms)			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Macroinvertebrates			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Bioassessment - Fish									No data collection is currently planned	SCVURPPP
	Physical										
	Physical Habitat			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP
	Sediment Characterization			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Channel Dynamics and Hydrology									Baseline information describing geomorphic and hydrologic characteristics of stream channels in the Santa Clara Basin will be compiled to assist in the development of the Hydrogeomorphic Management Plan, as required in the C.3 Provision. The specific creeks in which to compile baseline data have not been selected at this time.	SCVURPPP
	Riparian Vegetation									No data collection is currently planned	SCVURPPP
	Trash			S(3)				T(3)		Conduct screening level monitoring	SCVURPPP

Monitoring Activities in watersheds not currently considered in plan.

San Francisquito Creek										Detailed watershed assessment being conducted by stakeholder workgroup administered by the San Francisquito Creek Joint Powers Authority (JPA)	
Guadalupe River	***Chemical***										
	Contaminants - Water Quality	S 16	S 16	S 16	S 16	S 16	S 16	S 16	S 16	Four reaches. Monitoring is shown as quarterly; actual frequency will be in accordance with RWQCB requirements. Total Hg, Methylmercury, TSS.	SCVWD
	Contaminants - Sediment	S(4)	S(4)	S(4)	S(4)	S(4)	S(4)	S(4)	S(4)	Methylmercury concentrations in riverbed and suspended sediments.	SCVWD
	General Water Quality	S(9)	S(9)	S(9)	S(9)	S(9)	S(9)	S(9)	S(9)	Monitoring used to calibrate model to simulate stream temperature. Key variable for fish survival.	SCVWD

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency
	Biological										
	Toxicity - Water Quality										
	Conventional Water Chemistry										
	Pathogens (Indicator Organisms)										
	Bioassessment - Macroinvertebrates										
	Bioassessment - Fish	S 17	S 17	S 17	S 17	S 17	S 17	S 17	S 17	Adult migration & spawning; juvenile rearing and/or migration in 17 or more locations.	SCVWD
	Physical										
	Physical Habitat										
	Sediment Characterization										
	Channel Dynamics and Hydrology	S 14	S 14	S 14	S 14	S 14	S 14	S 14	S 14	Channel bottom stability in 14 transects	SCVWD
	Riparian Vegetation	S 23	S 23	S 23	S 23	S 23	S 23	S 23	S 23	Survival, health & vigor, non-native species cover, and/or tree basal area (18 plots)	SCVWD
	Trash										

1 Parameter types are listed with category of monitoring design, which include: (S) screening level, (I) detailed investigation, and (T) status and trends. The number in parentheses represents the number of sampling locations for that sampling period. Sampling locations are described in separate table and figure attached to Plan.

2 Description of analyses conducted for each data type is described in the footnotes below. In some cases, partial analyses may be implemented for data types when existing data satisfies screening level target. Standard analytical methods are indicated in separate table attached to Plan; methods are intended to be congruent with SWAMP/RMAS methodology. Adjustments will be made, if necessary, when SWAMP QAPP becomes available in September 2002.

3 Water Chemistry: Total and dissolved metals (Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se) and organophosphate pesticides; sampling conducted for three seasonal time periods.

4 Sediment chemistry: Metals (Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As), PCB, mercury, PAHs and organochlorine pesticides; sampling conducted in the dry season only. Sediment samples taken only at integrator sites.

5 General water quality: Temperature, dissolved oxygen, pH and specific conductance (multiparameter probe readings and/or continuous measurements); sampling conducted for three seasonal time periods.

6 Toxicity testing of water on three species: (1) Ceriodaphnia: 7 day survival and reproduction; (2) pimephales 7-day; and (3) selenastrum test; toxicity conducted at wet and dry season. Frequency of toxicity was reduced (RMAS/SWAMP conducts 3 samples/year at each site) to cut costs and to increase the number of sites.

7 Conventional water chemistry: Major anions: ortho-phosphate, nitrate, nitrite, chloride, sulfate; total phosphate, boron, TKN, TDS, SSC, ammonia, chlorophyll-a, alkalinity, hardness, TOC and DOC; sampling conducted for three seasonal time periods.

8 Indicator organisims: total and fecal coliform and *enterococcus*; sampling conducted for three seasonal time periods.

Watershed Area	Data Type[2]	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	Rationale	Lead Agency

9 Bioassessment: following CSBP methodology and conducted in the spring season.

10 Rapid bioassessment of fish communities will be done using methods established in the SEIDP or by other standardized methods utilized by the SCVWD or other Co-permittee agencies.

11 Habitat survey physical habitat assessment using CSBP methodology.

12 Sediment characterization includes collecting sediment grain size (full analysis) at sites sediment samples are collected. Suspended sediment concentrations (SSC) are collected with conventional water chemistry samples. Bedload sediment is estimated using pebble counts during bioassessment and habitat survey.

13 Trash assessment will be conducted at selected locations identified as hot spots in SCVURPPP report SCVURPPP will test and implement RWQCB assessment survey form and methods. Trash assessments will also occur at sites concurrent with bioassessment and visual habitat surveys to identify levels of trash at non-hot spot locations.

Table B-3. Analytical methods used in SCVURPPP FY 02-03 and Multiyear Monitoring Plan.

Description of data parameters	Analytical Methods
Pesticides (water) - Organophosphate suite	EPA 8141A
Pesticides (sediment) - Organochlorine suite	EPA 8081A
PCB congeners	EPA 8082
PAH congeners	EPA 8270
ICPMS metals suite (sediment) (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As--all costs)	EPA 6020
ICPMS metals suite (water)--unfiltered "total" (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se--all costs)	EPA 200.8
ICPMS metals suite (water)--filtered "dissolved" (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se--al costs)	EPA 200.8
Mercury (sediment)	EPA 245.7/1631M
Major anions nutrient scan: ortho-phosphate, nitrate, nitrite, chloride, sulfate	EPA 365.2, EPA 300
Total Phosphate	EPA 365.2
Boron	EPA 200.8
TKN	EPA 351.3
TDS	EPA 160.1
Suspended Sediment Concentration (SSC)	ASTM D3977-97
Ammonia	EPA 350.3
Chlorophyll-a	SM 10200H/EPA 445.0
Alkalinity	EPA 310.1
Hardness	EPA 130.2
TOC	EPA 415.1
DOC	EPA 415.1
Sediment grain size - full analysis (phi scale)	Plumb/PSEP
Total coliform	SM 9221B
Fecal coliform	SM 9221B
enterococcus	SM 9230B
Ceriodaphnia 7-day Survival & Reproduction	EPA 1002.0 (WET)
Pimephales (fathead minnow) 7 - day	EPA 1000.0 (WET)
Selenastrum (algae) test	EPA 1003.0 (WET)

(WET) Whole Effluent Toxicity: Guidelines Establishing Test Procedures for the Analysis of Pollutants (October 16, 1995)

TABLE 1
Interim Draft
5-year Monitoring Plan

A Program Monitoring Priorities	B Permit Provision	C Task	D In progress 00-01 (New FY01-02)	3/1/01	7/1/01	9/1/01	3/1/02	7/1/02	9/1/02	3/1/03	7/1/03	9/1/03	3/1/04	9/1/04	3/1/05	9/1/05
Category #2 - Continuous Improvement																
	C(6)a.i.	Continuous Improvement of ICID	Completed		d	Description of Procedures for Enhanced ICID Reporting										
		Continuous Improvement of ICID	SC34.02			Development and Testing of Program-wide ICID Reporting System						Implementation of Program-wide ICID Reporting System				
	C(5)a.1.	Continuous Improvement of IND	Completed			Description of Procedures for Enhanced IND Reporting										
		Continuous Improvement of IND	SC34.01			Development and Testing of Program-wide Inspection Reporting &Tracking System						Implementation of Program-wide Inspection Reporting &Tracking System				

TABLE 1
Interim Draft
5-year Monitoring Plan

A Program Monitoring Priorities	B Permit Provision	C Task	D In progress 00-01 (New FY01-02)	3/1/01	7/1/01	9/1/01	3/1/02	7/1/02	9/1/02	3/1/03	7/1/03	9/1/03	3/1/04	9/1/04	3/1/05	9/1/05
	C2	Pilot Liter "HotSpots"	Project SC27.01						Draft June Final Sept.Technical Report							
	C2	Storm Drain Inlet Retrofit Design Development	Project SC27.02						Technical Report							
	C2	Trash Work Plan	FY02-03							WorkPlan						
Category #3- Support SCBWMI																
3a - Investigate BU s and Causes of Impairment																
	C10	Support for SCBWMI Watershed Assessment Subgroup Workplan	FY02-03 (WAS task 7.7, Task 7.6, Task 11.2, and Task 11.3)													
	C9/10	Policy and Guidance for 305(b) Assessments and 303(d) Listings	Project SC22.59				Contribution s to 305(b) Report									
	C9/10	Integrated Assessment of Coyote Creek	SC27.11 -				Interim Status Report		Final Report							

TABLE 1
Interim Draft
5-year Monitoring Plan

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	C(9)fi.	San Francisquito Creek Watershed Analysis	To be prepared by SCVWD	→		Plan and Schedule										
	C(9)fii.	San Francisquito Creek Management Practices	To be prepared by SCVWD	→	→	→	Plan and Schedule									
	C7/9	San Francisquito Creek Baseline Streamflow	Completed													
	C(9)fiii	Identify other creeks potentially impaired by sediment	FY01-02		→	→	Report									
	C(9)fiii.	Other Creeks - Watershed Analysis and Management Practice Assessment	FY02-03			→	→	→	Plan and Schedule							
	C(9)fiii.	Analysis of Other Creeks								Analysis of Other Creeks		→ Tentative	→	→	→	→

TABLE 1
Interim Draft
5-year Monitoring Plan

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	C(10)I,ii,iii	Integration of Watershed Management into URMP	Completed	→	Report with priority listing & schedule for assess-ments											
	C(10)iii	Summary Assessments of Each Watershed			→	Not Defined	→	→	→	→	→	→	→	→	→	→
	C7/10	Targeted Assessment and Monitoring of Water-Quality and Biological Indicators in Coyote Creek							→ Findings from Assessment	→	→	→	→	→	→	→
	C7/10	Support for Baylands Assessment	Completed	→	→	→ Draft	Final (Feb. 02)									
	C10	Review Assessments Strategies/Approaches								Define Project Scope and Funding						
3b - Review and Compile Environmental Data and Make it Accessible	**C2-10**	Compile, Maintain and Share Watershed Data	SC34.13	→	→	→	→	→	→	→	→	→	→	→	→	→

TABLE 1
Interim Draft
5-year Monitoring Plan

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3c - Develop Strategies for Controlling Impacts of Land Use on Beneficial Uses	**C7/10**	Support SCBWMI Land Use Subgroup	Project SC34.14													
	C7/10	Opportunities for Land Use Policies to Protect Beneficial Uses	Project SC20.06													
	C7/10	Economic and Tax Incentives in Watershed Management	Project SC22.65													

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Interim Draft
5-year Monitoring Plan

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Category # 4- Regional Collaborative Efforts																
	C(7)b	Participation in Regional Monitoring Program	Projects SC27.10 - Assist RMP Redesign	→	→	→	→	→	→	→	→	→	→	→	→	→
	C(7)	Annual Contribution to RMP	Program Budget Line Item	→	→	→	→	→	→	→	→	→	→	→	→	→
Pollutant-Specific Provisions																
	C(9)a	Control Program for Copper	Metals Control (SC34.04)	→	→	Annual Report on Baseline Activities	→	→	Annual Report on Baseline Activities	→	→	→	→	→	→	→
	C(9)b	Control Program for Nickel	(SC34.05)	→	→	Annual Report on Baseline Activities	→	→	Annual Report on Baseline Activities	→	→	→	→	→	→	→
	C(9)c	Mercury Control Program	Completed	→	→	→	Mercury Plan									
	C(9)diii	Regional Pesticide Strategy Coordination & Implementation	SC34.07	→	Updated Plan		Updated Plan									

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Interim Draft
5-year Monitoring Plan

A Program Monitoring Priorities	B Permit Provision	C Task	D In progress 00-01 (New FY01-02)	3/1/01	7/1/01	9/1/01	3/1/02	7/1/02	9/1/02	3/1/03	7/1/03	9/1/03	3/1/04	9/1/04	3/1/05	9/1/05
	C(9)ei&ii	Characterize PCBs	SC34.08(participation in Joint SW Agencies Project)First Year Completed	Submit draft Year One Report	Submit Final First Year Report		Submit draft Year One Report	Submit Final First Year Report								
	C(9)eiii	Identify PCB Control Measures; Schedule Implementation	Completed		Plan (Due June 1, 2001)											
	C(9)eiii	Begin PCB Control Impl.	SC34.09				Plan									
	C(9)eiv	Implement PCB Actions					Plan		(Begin Impl. July 1, 2002)							
	C(9)eiii	Identify Dioxin Control Measures; Schedule Implementation	SC34.09				Plan									
	C(9)eiii	Begin Dioxin-like PCBs Control Impl.							Begin (Oct. 1, 2002)							
	C(9)eiv	Implement Dioxin-like PCBs Actions								Plan	(Begin Implementation)					

Table 2
Summary of Ongoing and Planned SCVURPPP Programmatic Monitoring Activities

SCVURPPP Monitoring Categories	Status and Trends[1]	Surveillance (targeted – source ID)	Evaluate Management Effectiveness	Realistic Standards	Status (Expected FY)
Assessment					
Assess the Assessments	No	No	Planned	No	Planned 02-03
Implementation					
Copper/Nickel Baseline Actions[2]	Yes	Yes	Yes	Yes	Ongoing[3]
Pesticide Strategy	Yes	Yes	Yes	Yes	Ongoing
LUS – subgroup support	No	No	Yes	Yes	Ongoing
LUS • Economic and Tax Incentives • Compare and Contrast develop. policies	No	No	Yes	Yes	Ongoing Draft FY01-02 Final FY01-02 Draft FY01-02 Fianl 02-03

[1] Notes: Status and Trend monitoring involves 1) collection and analysis of existing and/or new data (chemical, physical, biological) to characterize baseline conditions, and 2) periodic collection of new data for comparison against baseline conditions and analysis of trends.
Surveillance monitoring involves targeted monitoring of known or suspected sources of pollutants of concern.
Management Effectiveness monitoring involves designing specific receiving water and/or programmatic monitoring programs to evaluate BMPs and/or the implementation and effectiveness of overall stormwater program activities.
Realistic Standards monitoring involves specifically designing monitoring and data analysis programs to establish reasonable standards (narrative and/or numeric).
[2] Multi-year implementation program for Copper and Nickel Action Plan.
[3] Review of the results of the Baseline Actions is conducted via the BMM subgroup twice per year. The results of the first review were completed and submitted to the RWQCB on November 9, 2001 (see separate submittal).

SCVURPPP Monitoring Categories	Status and Trends[1]	Surveillance (targeted – source ID)	Evaluate Management Effectiveness	Realistic Standards	Status (Expected FY)
• Stormwaters role in congestion management					Draft FY01-02 Final FY01-02
Effectiveness					
Storm drain inlet retrofit assessment	No	No	Planned	Planned	Planned 01-02
Industrial Outreach (FWP to IND 2)	Planned	Planned	Planned	Planned	Planned 02-03

SCVURPPP Monitoring Categories	Status and Trends[1]	Surveillance (targeted – source ID)	Evaluate Management Effectiveness	Realistic Standards	Status (Expected FY)
Pilot Investigation re. Trash "hot spots"	Planned	Planned	Planned	Planned	Ongoing FY 01-02 Workplan 02-03
Project					
Stream Inventory	No	No	Yes	No	Two updates Completed Quick Update Planned FY02-03 Complete Update Planned F03-04
Baylands Inventory	No	No	Yes	No	Draft Completed Final to be completed FY001-02
Program Data Management & ICID/IND enhanced reporting	No	Yes	Yes	Yes	Ongoing
Draft Multi-Year Plan	Planned	Planned	Planned	Planned	Various Drafts Completed FY00-01 and Interim Draft Completed July1, 2001 Final Completed March 1, 2002

Table 3
Summary of Ongoing and Planned SCVURPPP Receiving Water Monitoring & Watershed Assessment Activities

SCVURPPP Monitoring Categories	Description	Status and Trends Monitoring[1]	Surveillance Monitoring (targeted – source ID)	Management Effectiveness Monitoring	Realistic Standards Monitoring	Activity Status
Baseline						
PCB[2]	Three year project. Characterization of deposited sediments in urban storm drains for industrial, residential, commercial , open and mixed land uses. First year sampling included 21 sites for SCVURPPP. Year two includes 20 sampling sites and a "hot spot" case study for four different drainages (i.e., Leo Ave., Burke St., Auzerais and Sunol St., and West Holm St., this includes 9 separate stations).	Yes	Yes	Yes	Yes	Ongoing
Hg[3]	First year study included sampling at 21 sites for total and mythel mercury. Second year includes sampling at the sites noted above for Total only.	Yes	Yes	Yes	Yes	Ongoing
Copper/Nickel[4]	Monthly monitoring of ten receiving water stations located in the Lower South San Francisco Bay.	Yes	No	Yes	Yes	Ongoing
Chlorinated Pesticides[5]	Preliminary sampling at 20 sites as part of year two of the PCB/Hg investigation.	Yes	Yes	Yes	Yes	Ongoing

[1] Notes: Status and Trend monitoring involves 1) collection and analysis of existing and/or new data (chemical, physical, biological) to characterize baseline conditions, and 2) periodic collection of new data for comparison against baseline conditions and analysis of trends (the tier 1 and 2 concepts contained in the RMAS are considered as part of this type of monitoring). Surveillance monitoring involves targeted monitoring of known or suspected sources of pollutants of concern (includes the collection of information to allow the RWEQCB to develop preliminary loading estimates within the technical constraints of conducting such estimates). Management Effectiveness monitoring involves designing specific receiving water and/or programmatic monitoring programs to evaluate BMPs and/or the implementation and effectiveness of overall stormwater program activities. Realistic Standards monitoring involves specifically designing monitoring and data analysis programs to establish reasonable standards (narrative and/or numeric).
[2] Joint Bay area stormwater program managed by the SCVURPPP to assist RWQCB with TMDL effort. Third year effort to consider sediment as a drainage basin monitoring tool.
[3] Joint Bay area stormwater program managed by the SCVURPPP to assist RWQCB with TMDL effort.
[4] Multi-year Joint POTW and stormwater monitoring effort in Lower South San Francisco Bay managed by the City of San Jose
[5] Initiated some preliminary chlorinated pesticide monitoring as part of the Joint Bay Area stormwater PCB and Hg program. Results will be use to define second year of effort.

Table 3, continued
Summary of Ongoing and Planned SCVURPPP Receiving Water Monitoring & Watershed Assessment Activities

SCVURPPP Monitoring Categories	Description	Status and Trends Monitoring[1]	Surveillance Monitoring (targeted – source ID)	Management Effectiveness Monitoring	Realistic Standards Monitoring	Activity Status
Sediment – San Francisquito	Work plan developed by the SCVWD in conjunction with the San Mateo STOPPP to conduct a watershed analysis that provides for: 1) quantitative characterization of sediment and water inputs to the creek, 2) relative roles of sediment associated with natural and anthropogenic land use discharges, 3) sediment conveyance from headwaters to the Bay, and development of a rapid sediment budget.	Planned	Planned	Planned	Planned	Planned 02-03
Sediment - other	Project aimed at 1) identifying urban streams that may be impaired by excessive sediment production from erosion due to anthropogenic activities, and 2) developing a plan and time schedule to conduct watershed analysis and management practices.	Planned	Planned	Planned	Planned	Planned 02-03
Regional Monitoring Program	The RMP is a regional collaborative monitoring effort. The Regional Monitoring Program for Trace Substances (RMP) monitors contaminant concentrations in water, sediments, and fish and shellfish tissue in San Francisco Bay and Delta, together known as the San Francisco Estuary. The RMP is designed to obtain data describing the concentration of toxic trace elements and organic contaminants. Ultimately, the goal of the RMP is to provide information on how contaminant concentrations in the Estuary are responding to pollution prevention and reduction measures and thus if the financial resources devoted to these efforts are improving water quality. Funding is provided by the three South Bay POTWs (who are Co-permittees to urban runoff program) and the SCVURPPP on behalf of all 15 Co-permittees.	Yes	No	Yes	Yes	Ongoing

Table 3, continued
Summary of Ongoing and Planned SCVURPPP Receiving Water Monitoring & Watershed Assessment Activities

SCVURPPP Monitoring Categories	Description	Status and Trends Monitoring[1]	Surveillance Monitoring (targeted – source ID)	Management Effectiveness Monitoring	Realistic Standards Monitoring	Activity Status
Water Quality Attainment Strategies Program (WQASP)[6]	The San Francisco Bay Area Water Quality Attainment Strategies Program is a joint Bay Area Clean Water Agencies (BACWA), Bay Area Stormwater Management Agencies Association (BASMAA), and SFRWQCB program established under an MOU to guide and assist the development of TMDLs and other water quality attainment strategies for the SF BAY-Delta and its tributaries. The three South Bay POTWs, as members of BACWA) and the SCVURPPP as a member of BASMAA will be providing resources to this effort over the next five plus years.	Planned	Planned	Planned	Planned	Planned 02-03 (Year 0 funded requested in FY01-02 not originally in budget-will address with contingency)
Follow-up monitoring to fill high priority assessment data gaps (Screening-Level Receiving Water Monitoring)	Annually develop and conduct a screening level assessment of the physical, chemical (water and/or sediment), and biological parameters at stations for a selected reach of an urban stream. For each of the next five Fiscal years, starting in FY 02-03, a screening level assessment will be conducted. Urban stream reaches will be selected to 1) assist fill high priority data gaps identified as part of the WMI watershed assessments and SCVURPPP Coyote Assessment, and 2) collect preliminary water quality data on prioritized list of watersheds listed in the Integration Report.	Planned	Planned	Planned	Planned	Planned 02-03

[6] While the SCVURPPP supports the overall goals of the WQASP efforts it has requested that BASMAA forward to the Executive Management Board the following questions: The SCVURPPP understands that an overall plan is under preparation as part of FY year zero (FY 01-02) and that it is the intent to address the above questions as part of the plan. The SCVURPPP has separately requested that the EMB give careful consideration to these questions. The SCVURPPP's review of the plan and the responses to these questions will be a key consideration for future funding requests.

Table 3, continued
Summary of Ongoing and Planned SCVURPPP Receiving Water Monitoring & Watershed Assessment Activities

SCVURPPP Monitoring Categories	Description	Status and Trends Monitoring[1]	Surveillance Monitoring (targeted – source ID)	Management Effectiveness Monitoring	Realistic Standards Monitoring	Activity Status
Long-term Monitoring in Coyote Watershed	Implement the long-term monitoring plan developed as part of the Pilot Coyote Integrated Assessment. Integrate the monitoring plan with the City of San Jose monitoring program.	Planned	Planned	No	Planned	Planned 03-4
Coyote Creek Water Quality Monitoring[7]	The City of San Jose has, for the past two years, collected baseline water quality data in Coyote Creek. On a monthly basis between May and November, water quality monitoring is conducted at 8 stations in Coyote Creek and two stations in tributaries (i.e, Upper Penitencia and San Miguelita Creeks). Fifty-five water quality parameters (includes temperature, nutrients, pathogens, metals, anions, and general water quality parameters) are measured from garb samples during each sampling event, but not at each station. (The sampling stations are located between the Montague Expressway to just south of the Capitol Expressway.) The CSJ has included additional investigations for low DO as shown in Appendix B and have committed to annual monitoring for screening and/or investigation type studies in the future based on the results of each years monitoring.	Yes	No	Yes	No	Ongoing
Assessment						
WMI – Assessments (San Francisquito Creek, Guadalupe River, Upper Penitencia)	Three ongoing watershed assessments by the WMI following the WMI's "Framework for Conducting Watershed Assessments." The assessments are based on available data.	Planned	No	Planned	Planned	Ongoing

[7] Coyote creek water quality monitoring is part of stream flow augmentation project funded by the City of San Jose and managed by the City's Stormwater Program.

Table 3, continued
Summary of Ongoing and Planned SCVURPPP Receiving Water Monitoring & Watershed Assessment Activities

SCVURPPP Monitoring Categories	Description	Status and Trends Monitoring[1]	Surveillance Monitoring (targeted – source ID)	Management Effectiveness Monitoring	Realistic Standards Monitoring	Activity Status
Coyote Creek Pilot Assessment	Develop and test, on a pilot scale, an integrated watershed assessment approach. The assessment is based on the linkage of stream hydrogeomorphic functions (movement of water and sediment) to habitat functions and how the functions support aquatic life beneficial uses. The project includes conducting: a stream classification , assessment of physical conditions affecting biological resources, evaluating potential near-term management actions, prioritizing critical reaches, and developing a long-term monitoring program (see above for implementation of receiving water monitoring).	Planned	No	Planned	Planned	Ongoing

APPENDIX 6A-4

SCVURPPP URBAN RUNOFF MANAGEMENT PLAN, MS4 PERMIT AND SUPPORTING DOCS

ACKNOWLEDGEMENTS

The Santa Clara Valley Urban Runoff Program's (Program) Urban Runoff Management Plan (URMP) was developed by the Program Manager under the direction of the Management Committee.

MANAGEMENT COMMITTEE

Dave Chesterman (Chair)	Randolph Shipes (Vice Chair)
Santa Clara Valley Water District	San Jose
Lavenia Millar, Cupertino	Lorrie Gervin, Budget & Executive Committee Chair, Sunnyvale
Larry Lind, Los Altos	Cheri Donnelly, West Valley Cities
Richard Chen, Los Altos Hills	Lynn Penoyer, Campbell
Darryl Wong, Milpitas	John Curtis, Los Gatos
Eric Anderson, Mountain View	Brian Loventhal, Monte Sereno
Joe Teresi, Palo Alto	John Cherbone, Saratoga
Rick Mauck, Santa Clara	Steve Homan, Santa Clara County

Note: The 2004 Urban Runoff Management Plan was revised on February 24, 2005 to only reflect changes to the Industrial/Commercial Discharger Control Program and Illicit Connection/Illegal Dumping Elimination Activities Performance Standards provided within Appendix A: Model Performance Standards.

ACRONYMS

ABAG	Association of Bay Area Governments
AHTG	Ad Hoc Task Group
BAAQMD	Bay Area Air Quality Management District
BACWA	Bay Area Clean Water Agencies
BASMAA	Bay Area Storm Water Management Agencies Association
BMM	Bay Monitoring and Modeling
BMP	Best Management Practice
BPP	Brake Pad Partnership
CAP	Copper Action Plan
CEP	Clean Estuary Partnership
CCMP	Comprehensive Conservation and Management Plan
CEQA	California Environmental Quality Act
CMA	Congestion Management Agency
CUPA	Certified Unified Program Agency
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization Amendments
EOA	Eisenberg, Olivieri, & Associates
EPA	Environmental Protection Agency
HMP	Hydromodification Management Plan
ICID	Illicit Connection/Illegal Dumping

IND	Industrial and Commercial Discharge
IPM	Integrated Pest Management
KLI	Kinetic Laboratories Incorporated
MCMP	Metals Control Measures Plan
MEP	Maximum Extent Practicable
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MTC	Metropolitan Transportation Commission
NAP	Nickel Action Plan
NDC	New Development and Construction
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
O&M	Operation & Maintenance
PAA	Public Agency Activities
PCB	Polychlorinated Biphenyls
PCDF	Polychlorinated dibenzofurans
PCDD	Polychlorinated dibenzo-p-dioxins
PIP	Public Information and Participation
POC	Pollutant of Concern
POTW	Publicly Owned Treatment Works

QA/QC	Quality Assurance/Quality Control
RMAS	Regional Monitoring and Assessment Strategy
RMP	Regional Monitoring Program
RWQCB	Regional Water Quality Control Board
SCBWMI	Santa Clara Basin Watershed Management Initiative
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SCVWD	Santa Clara Valley Water District
SFEI	San Francisco Estuary Institute
SIC	Standard Industrial Classification
SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TATG	Trash Ad Hoc Task Group
TMDL	Total Maximum Daily Load
URMP	Urban Runoff Management Plan
USEPA	United States Environmental Protection Agency
WEO	Watershed Education and Outreach
WLA	Waste Load Allocation
WMI	Watershed Management Initiative (same as SCBWMI, above)

WUPPP	Water Utility Pollution Prevention Plan
WWC	Watershed Watch Campaign

TABLE OF CONTENTS

CHAPTER ONE: OVERVIEW **8**

CHAPTER TWO: ABOUT THE PROGRAM **11**

2 A THE SANTA CLARA BASIN AND ITS COMMUNITIES 11
2 B HISTORY OF THE SCVURPPP 15
2 C POLLUTION PREVENTION AND REGULATORY COMPLIANCE 18
2 D POLLUTION PREVENTION AND WATERSHED MANAGEMENT 20
2 E DESCRIPTION OF RELATED PROGRAMS 21

CHAPTER THREE: PROGRAM GOALS AND ORGANIZATION **27**

3 A DURATION OF THE URBAN RUNOFF MANAGEMENT PLAN 27
3 B MISSION STATEMENT 28
3 C GOALS AND OBJECTIVES 29
3 D HOW THE PROGRAM IS ORGANIZED 31
3 E PERFORMANCE STANDARDS 33
3 F REPORTING 35
3 G WORK PLANS 36
3 H EVALUATION AND CONTINUOUS IMPROVEMENT 37
3 I EXEMPTED AND CONDITIONALLY EXEMPTED DISCHARGES 40

CHAPTER FOUR: SUMMARY OF ACTIVITIES **41**

4 A PROGRAM FEATURES 41
4 B ILLICIT CONNECTIONS AND ILLEGAL DUMPING ELIMINATION 44
4 C INDUSTRIAL/COMMERCIAL DISCHARGER CONTROL 47
4 D PUBLIC INFORMATION AND PARTICIPATION 52
4 E PUBLIC AGENCY ACTIVITIES 63
4 F NEW & REDEVELOPMENT AND CONSTRUCTION 70
4 G HYDROMODIFICATION MANAGEMENT PLAN 77
4 H MONITORING 80
4 I SUMMARY 99

TABLES

TABLE 1: EXISTING LAND USE IN SANTA CLARA VALLEY COMMUNITIES

TABLE 2: TYPICAL ANNUAL CYCLE FOR CONTINUOUS IMPROVEMENT 39

TABLE 3: PROGRAM GOALS, OBJECTIVES AND ELEMENTS.....43

TABLE 4: TARGETED OUTREACH.....59

TABLE 5: OUTREACH ACTIVITIES RELATED TO CONTROL OF SPECIFIC POLLUTANTS.....60

FIGURES

FIGURE 1: MAJOR WATERSHEDS IN SCVURPPP JURISDICTIONAL AREA

FIGURE 2: CONTINUOUS IMPROVEMENT

APPENDICES TO THIS VOLUME

APPENDIX A MODEL PERFORMANCE STANDARDS

APPENDIX B REGULATORY BACKGROUND

APPENDIX C STATUS AND SCHEDULE:

- TABLES C1-C12 - CO-PERMITTEE WORK PLANS, BMPS AND SOPS
- TABLE C13 - SUMMARY OF CO-PERMITTEE STORMWATER PROGRAM ORGANIZATION

APPENDIX D RELATED PROGRAM DOCUMENTS AND PLANS

ACCOMPANYING VOLUMES

CHAPTER 5: CITY OF CUPERTINO URMP

CHAPTER 6: CITY OF LOS ALTOS URMP

CHAPTER 7: CITY OF LOS ALTOS HILLS URMP

CHAPTER 8: CITY OF MOUNTAIN VIEW URMP

CHAPTER 9: CITY OF MILPITAS URMP

CHAPTER 10: CITY OF PALO ALTO URMP

CHAPTER 11: CITY OF SAN JOSE URMP

CHAPTER 12: CITY OF SANTA CLARA URMP

CHAPTER 13: CITY OF SUNNYVALE URMP

CHAPTER 14: WEST VALLEY COMMUNITIES

CHAPTER 15: SANTA CLARA COUNTY

CHAPTER 16: SANTA CLARA VALLEY WATER DISTRICT

Overview Chapter One

This Urban Runoff Management Plan (URMP)[1] details what the Santa Clara Valley Urban Runoff Pollution Prevention Program[2] (SCVURPPP or Program) is doing to reduce urban runoff pollution in the Santa Clara Valley watershed.

Fifteen agencies — *Co-permittees* under a stormwater discharge permit issued by the Regional Water Quality Control Board — comprise the Program. Each agency implements urban runoff pollution controls within its own jurisdiction. A *Management Committee* coordinates joint efforts among the Co-permittees. By pursuing agency-specific activities, and contributing to joint activities, each Co-permittee endeavors to protect water quality in local creeks and South San Francisco Bay, and complies with a myriad of regulatory requirements that govern urban runoff pollution control programs.

Chapter 2 provides the geographical and regulatory context for Program activities. It begins with a description of the characteristics of the Santa Clara Valley drainage basin, followed by a brief history of the Program. Chapter 2 continues with a discussion of the Program's overall approach to controlling pollutant sources and the Program's relationship to other pollution-prevention efforts. The Program's participation in Santa Clara Basin Watershed Management Initiative (SCBWMI) is described in some detail, followed by more brief notes on the Program's work with other public agencies and with private entities.

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[1] The URMP complies with NPDES Permit CAS029718 (Order No. 01-024 as amended by Order 01-119).

[2] As stated in the Bylaws, the co-permittees — when collectively implementing area-wide activities that benefit all co-permittees — are referred to as the "Program".

Chapter 3 describes the fundamental ideas around which the Program is organized, and which drive the relationship between the Program and its participating agencies. These ideas are embodied in the Program's Mission Statement, Goals and Objectives. This is followed by a summary of the roles played by the Co-permittees, Management Committee and Program staff in implementing the Program. Chapter 3 also describes how the Program applies Performance Standards to achieve consistency, accountability and continuous improvement in the Program and every jurisdiction within the Santa Clara Valley Basin.

Chapter 4 summarizes the common features of each Co-permittees' local urban runoff pollution prevention program, as represented in the Program-wide model Performance Standards. The Performance Standards apply to each element of the Program: Illicit Discharge and Illegal Dumping Elimination (ICID), Industrial and Commercial Discharge Controls (IND), Public Information and Participation (PIP), Public Agency Activities (PAA), and New & Redevelopment and Construction (NDC).

Chapter 4 also describes activities, coordinated through the Management Committee that the Co-permittees pursue jointly. These include specific things the Program and Co-permittees are doing to support other entities' efforts to reduce, to the maximum extent practicable (MEP), urban runoff pollution — and protect and enhance beneficial uses.

Chapters 5 through 16 consist of individual Urban Runoff Management Plans for Cupertino, Los Altos, Los Altos Hills, Milpitas, Mountain View, Palo Alto, San Jose, Santa Clara, and Sunnyvale; the West Valley communities of Campbell, Los Gatos, Monte Sereno and Saratoga (combined in Chapter 14); Santa Clara County, and the Santa Clara Valley Water District.

Each of these Co-permittees may choose to adopt any or all of the model Performance Standards, or adapt them to suit local conditions. The adaptations accommodate differing local conditions and are documented in Chapters 5-16. The local plans also describe how each Co-permittee organizes and carries out its local program.

About the Santa Clara Valley Urban Runoff Pollution Prevention Program

Chapter Two

2A THE SANTA CLARA BASIN AND ITS COMMUNITIES

Physical Setting. Santa Clara County encompasses more than 1,300 square miles in the southern portion of the San Francisco Bay Area, making it the second largest of the nine Bay Area counties. The County is geomorphologically diverse and includes the Santa Clara Valley, the Santa Cruz Mountains, the mountains of the Diablo Range, and the Baylands.

The northern portion of the county is occupied by a broad, northward draining valley located between the Santa Cruz Mountains, to the west, and the Diablo Range to the east. This basin, the Santa Clara Valley, is highly urbanized and contains 13 of the county's 15 cities and towns (Figure 1). This portion of the County constitutes the area covered by the Santa Clara Valley Urban Runoff Pollution Prevention Program. The Santa Clara Basin has warm, dry summers and receives 15 to 20 inches average rainfall between October and April each year.

Creeks and streams that originate in the Santa Cruz Mountains and the Diablo Range drain through the Santa Clara Basin into South San Francisco Bay. Thirteen major watersheds are within the Program's jurisdictional areas (Figure 1). They include the Coyote Creek watershed on the east side of the

valley, the Guadalupe River watershed, which drains the south-central portion of the valley, and a series of small, relatively urbanized watersheds that drain the west side of the valley. Surface runoff generated from various land uses in all the hydrologic subbasins discharges into watercourses, which in turn flow into South San Francisco Bay (below the Dumbarton Bridge).

Population and Job Growth. In 2000, Santa Clara County ranked fourth in the state in terms of population and employment. According to the California Department of Finance 2000 Census Report, the population of the county is about 1.68 million. Of this total, about 1.51 million or 90 percent are residents of the thirteen communities in the Program Area. Most of the population in the unincorporated county is concentrated in areas around these urban communities. Therefore an estimated 95 to 96 percent of the county's total population is within the Program Area. According to the Association of Bay Area Governments' (ABAG's) *Projections 2002*, the population in the county will grow to about 2.06 million by 2025.

San Jose, with approximately 894,950 residents, is by far the most populous city. San Jose has 53 percent of the total county population, followed by Sunnyvale, with about 8 percent of the total county population, and Santa Clara, with 6 percent of total county population. San Jose is expected to retain a similar share of the county population in 2015. The smallest communities in the valley are the City of Monte Sereno and the Town of Los Altos Hills.

The Santa Clara County economy is dynamic. Up until the mid 1950s, the county was predominantly rural with an agricultural-based economy. Since then, the valley has been transformed into a vast metropolitan area with an economy dominated by high technology firms. Through these decades, the valley has continued to attract fast-growth industries, which have led to both job and population growth within the county and in adjacent counties. The end of the 1990s saw tremendous growth in Santa Clara County as the Silicon Valley became the embodiment of a "New Economy" driven by efficiencies from computers, communications and the use of the internet. During the 1990s, the county added 201,400 jobs. Job growth continues in some sectors throughout 2000, even as the news media reported the demise of dot-com

companies. In many ways, companies that provided the services and materials for internet companies eventually accounted for most of the job losses. Currently, companies that make equipment and provide business services, not the pure internet companies, are causing a shift in the county's economic fortunes.

Santa Clara County will see limited job growth in the first ten years of the forecast period (2000-2025). Service jobs will account for approximately 38 percent of new jobs in the county during the next ten years. Between 2000 and 2025, the county is expected to add 303,500 new jobs.

Land Use. The Santa Clara Valley is characterized by flat fertile lands and was once an important agricultural area. Since the mid 1950s however, housing developments, businesses, industrial parks, shopping centers, and freeways have replaced agricultural lands. This development was triggered by the emergence of the electronics industry. Stanford University in Palo Alto spawned the earliest firms engaged in electronics and further supported the growth by building the Stanford Industrial Park. As available land in Palo Alto became scarce, the electronics and semiconductor industry moved south into Mountain View and Sunnyvale, then into Santa Clara and Cupertino. By the 1970s, industries were concentrated in the northern portion of the valley, with housing extending into the southern part of the county. Very-low-density, affluent residential areas developed in the western foothill communities.

Table 1 presents estimated percentages of land within the Program communities devoted to different land uses. As this table shows, some communities, such as Los Altos, Los Gatos, Saratoga, and Monte Sereno, are almost entirely residential with little or no industrial areas and very limited commercial areas. Other communities are more diverse. The cities of Mountain View, Santa Clara, and Milpitas have 15 to 20 percent of their land in industrial use.

Most communities are built out, and the availability of land for development is limited. With the exception of San Jose, Milpitas, and unincorporated County, valley communities generally have less than 8 percent of their land vacant or under agricultural use that could be converted to urban uses. Land

prices and scarcity of vacant land will likely spur intensification of existing land uses, such as increased residential density through infill and redevelopment. ABAG notes that Santa Clara County has a large inventory of commercial and industrial sites that will not be fully absorbed over the next 20 years and could be made available for housing.

Industrial Base. High technology firms, engaged in the electronics, aerospace, and semi-conductor industries, dominate the industrial economy of the valley. Other major industries include printing and publishing, industrial machinery and equipment, auto repair, trucking, and warehousing. Most of the electronics industry is concentrated in the cities of Santa Clara, Sunnyvale, Mountain View, Palo Alto, and Milpitas. The City of San Jose has a more diverse industrial base.

Jurisdiction over Drainage Systems. Within the valley, drainage systems are of diverse physical types, and have diverse ownership and maintenance responsibility. Drainage facilities consist of gutters, swales, ditches, culverts, storm drain inlets, catch basins, storm drain lines, pump stations, and detention basins. In most cases, these facilities are owned and maintained by the municipality in which the facility is located. The natural drainages and flood control channels, some detention basins, and groundwater recharge basins are maintained and operated by the Santa Clara Valley Water District. Multiple agencies have jurisdiction and responsibility for management and maintenance of drainage facilities within the Program's thirteen major watershed areas. In addition, upland portions of some of these subwatersheds have non-urban land uses (agricultural, ranching, and open space) and are outside the Program Area. Runoff from these non-urban areas drains through the urban portion of the valley on its way to South San Francisco Bay.

2B HISTORY OF THE SCVURPPP

1986 Basin Plan and Initial Memorandum of Understanding. The Program was originally organized in response to the 1986 Regional Water Quality Control Plan for the San Francisco Bay Region (Basin Plan).[3] The 15 agencies prepared a plan[4] to characterize urban non-point sources and to identify and evaluate existing and additional controls. The 15 agencies then signed a Memorandum of Understanding to jointly contribute to a series of monitoring and BMP studies leading to a control plan.[5]

1990 Stormwater Permit and Storm Water Management Plan (SWMP). These materials became the basis for an NPDES permit application. In June 1990 the Program received an early NPDES municipal stormwater permit.[6] Permit provisions recognized that the Program had already accomplished significant work, which the California Regional Water Quality Control Board for the San Francisco Bay Region (Regional Board or RWQCB) considered equivalent to specific municipal stormwater permitting requirements promulgated by EPA in October of that year.

1990 Memorandum of Agreement. The Program is organized, coordinated, and implemented based upon a mutual Memorandum of Agreement (MOA) signed by the 15 participating public agencies in 1990. The MOA defines roles and responsibilities of all Co-permittees, a cost-sharing formula for joint expenditures and the role of the SCVWD as managing agency of the Program. The Management Committee, which includes representatives from the 15 Co-permittees, provides overall direction to the Program. The SCVWD chairs the Management Committee and employs a Program Manager and staff to implement, manage, and coordinate joint activities. The Program's Management Committee established subcommittees, composed of

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[3] California Regional Water Quality Control Board for the San Francisco Bay Region (1986). *Water Quality Control Plan for the San Francisco Bay Region.* (Basin Plan). The reference in this section is to the 1986 version of the Basin Plan. The Regional Board approved the most recent Basin Plan on June 21, 1995.

[4] CH2MHill and EOA, Inc. (1987). *Nonpoint Source Evaluation Action Plan.*

[5] Woodward-Clyde Consultants (1990). *Loads Assessment Results and Implementation Program,* (3 volumes).

[6] Permit No. CA 0029718, Order No. 90-094

Program and Co-permittee staff, to assist in coordination of Co-permittee implementation efforts, including annual reporting and evaluation.

1993 Copper Waste Load Allocation[7] (WLA) and Copper Reduction Dialogue. In June 1993 the Regional Board adopted a WLA, which included an annual reduction of 950 pounds of copper to be accomplished jointly by the three South Bay wastewater dischargers (Publicly Owned Treatment Works, or POTWs) and the Program. In response, the Program and POTWs included regulatory, environmental, and commercial interest groups in a Copper Reduction Dialogue. In March 1994, the four entities signed a Memorandum of Agreement specifying actions to be completed. The actions are reviewed in the Program's 1997 Metals Control Measures Plan, and appropriate items incorporated into the URMP. The State Water Resources Control Board (SWRCB) has since remanded the WLA back to the Regional Board for review.

1995 Permit Reissuance. As part of the 5-year NPDES permit cycle, the Program developed and submitted a second SWMP to the Regional Board on June 30, 1995. The Regional Board approved the SWMP and issued the second NPDES storm water permit[8] on August 23, 1995. The SWMP included metals control measures. The permit called for the Program to develop watershed-based measures.

1997 Storm Water Management Plan Revision. The 1995 Permit called for the Program to develop a set of Performance Standards during 1995-1996. The permit defined Performance Standards as "the level of implementation necessary to demonstrate the control of pollutants in storm water to the maximum extent practicable." The Performance Standards were incorporated in the revised plan and submitted to the Regional Board on September 1, 1997. The Regional Board approved the URMP and performance standards in two separate letters (July 10, 1998 and December 14, 1998). In addition, an updated URMP, including updates to several Performance Standards only,

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[7] A Waste Load Allocation is the portion of a receiving waters' assimilative capacity that is allocated to one of its existing or future point sources of pollution (40 CFR 130.2(g)).

[8] NPDES Permit No. CAS029718, Order 95-180.

was submitted to the Regional Board as part of the permit renewal application in December 1999. The Permit also calls for the submittal of an Annual Work Plan and Annual Monitoring Plan[9] on March 1 of each year and an Annual Fiscal Year Report, which may include recommendations for improvements or revisions to the plan, to be submitted on September 15 of each year.

In September 1997, the Management Committee (consistent with the SCVURPPP MOA/Bylaws) retained EOA, Inc. to provide Program management services. The SCVWD is the Program's fiscal agent and contracts with the Program Manager.

Memorandum of Understanding (MOA) and SCVURPPP Bylaws. The Co-permittees submitted an updated Memorandum of Agreement (MOA) and SCVURPPP Bylaws as part of the December 21, 1999 permit re-application package. Co-permittees are individually responsible for implementing the permit within their respective jurisdictions. The Co-permittees make use of the Program to pool resources and complete joint activities.

The Management Committee renamed the Santa Clara Valley Nonpoint Source Pollution Control Program to the Santa Clara Valley Urban Runoff Pollution Prevention Program. The new name is more descriptive of the Program's purpose, and better defines the Program's focus. Consistent with this renaming, this plan is titled an Urban Runoff Management Plan (URMP) instead of a Storm Water Management Plan.

2001 Permit Reissuance.

On February 21, 2001, the Regional Board adopted the Program's third NPDES permit (NPDES Permit No. CAS029718, Order No. 01-024 as amended by Order No. 01-119). The permit required the Co-permittees to

[9] Consistent with Provision C.7.b and C.9 of its Permit, the Program developed and submitted to the RWQCB (on March 1, 2002), a Multi-Year Receiving Waters Monitoring Plan (Multi-Year Plan) that identifies Program monitoring activities in Santa Clara Basin Watersheds over an eight-year period. The Program received a request from Regional Board staff on June 5, 2002 to revise the March 1, 2002 Multi-Year Plan. On August 5, 2002, the Program submitted an updated Multi-Year Plan. Each year (March 1), the Program submits an Annual Monitoring Plan that is consistent with the Multi-year Plan.

continue to implement existing performance standards and contained a number of new requirements including: addressing the post-construction and some construction phase impacts of new and redevelopment; hydromodification management plan; enhanced reporting requirements for industrial/commercial discharger control and illicit connection and illegal dumping elimination activities; a Multi-Year monitoring program; and control programs for pollutants of concern that have the reasonable potential to cause or contribute to exceedances of water quality standards/receiving water limitations. Specific control programs cover the following pollutants of concern: copper, nickel, mercury, legacy pesticides, PCBs, dioxin-like compounds and sediments. The Program was also required to continue to implement the 2000 Copper and Nickel Action Plans.

2C THE PROGRAM'S APPROACH TO POLLUTION PREVENTION AND REGULATORY COMPLIANCE

Santa Clara Valley municipalities were among the first in California, and nationally, to begin implementing control measures for urban runoff pollution prevention. The technical knowledge, regulatory mechanisms, and institutional division of responsibility needed to control urban runoff pollution are still maturing.

The Co-permittees' pollution control strategies have been developed in the context of Federal regulations, state regulations, regional management plans, regulatory staff guidance, and the requirements of the Program's NPDES permit.[10]

Ultimately, each "non-point" pollutant source is related to some specific natural condition or human activity. The general solution to "nonpoint" pollution is to find each of a multitude of small "point" sources — and then to reduce them to the maximum extent practicable.

[10] A brief summary of these regulatory and management programs is contained in Appendix B.

The Program encourages reduction of all sources of pollutants that may enter storm drains. These sources may be divided into three categories:

1. Urban sources that are within the authority and ability of municipal government to address

2. Urban sources that are beyond the regulatory authority of municipal government or that municipal government does not have the ability to address

3. Non-urban sources, which are beyond the regulatory authority of municipal government

Each Co-permittee has developed a comprehensive URMP to reduce sources in the first category to the maximum extent practicable. The Co-permittee Urban Runoff Management Plans incorporate Performance Standards that, where necessary, refine the model Performance Standard to suit local conditions. The Co-permittee URMPs contain local strategies for urban runoff control; including tailored Performance Standards, work plans to implement Performance Standards, and Best Management Practices and Standard Operating Procedures that detail how control measures will be carried out day-to-day. The Co-permittee URMPs comprise Chapters 5-16. The common features of the Co-permittee URMPs are detailed in Chapter 4.

For sources in the second category, the Program participates in, and contributes to, joint efforts with other entities, including regulatory agencies, public benefit corporations, universities, and citizens' groups. These entities take the lead on addressing particular sources because they are regional, statewide or national in scope, because they have different skills or expertise, or because they have appropriate regulatory authority.

For the third category, non-urban sources, the Program continues to build, and actively participate in, the Santa Clara Basin Watershed Management Initiative (SCBWMI).

2D POLLUTION PREVENTION AND WATERSHED MANAGEMENT

Watershed Management — managing activities and natural processes of a watershed in a practical manner that maximizes the benefits and minimizes the adverse impacts on the environment for the benefit of the community and recognizes the quality of life and diversity — defines a new approach to the Regional Board's watershed and Bay protection efforts. The Regional Board has specified the Santa Clara Basin as one of two watersheds initially targeted for this approach.

The first Storm Water Management Plan (June 1995) contained five Watershed Management Measures, beginning with institutional arrangements and leading, after some years of planned effort, to area-wide watershed management. Since that time the Program has helped forge a new approach that brings in stakeholders at the beginning of the planning process.

The Santa Clara Basin Watershed Management Initiative (SCBWMI) is organized into three distinct phases: (1) Initiating Phase, (2) Planning Phase, and (3) Operating or Implementing Phase. In April 1996, Regional Board staff commenced the Initiating Phase. The Board staff, with the assistance of several Co-permittees, gathered together various interested parties (stakeholders) in the watershed to determine their interest in watershed management and their vision of how to begin planning watershed use and protection. In June 1996, an ad hoc committee composed of representatives from various stakeholder groups met to discuss these issues. This group later came to be called the Core Group and now meets monthly. The Core Group developed a mission statement, and a Process subgroup formalized the planning structure, planning process, and a timeline. In November 1996, the SCBWMI moved into an 18- to 24-month planning phase.

Coincident with this planning phase, the Program committed specific resources, in addition to resources committed by individual Co-permittees, to assist the SCBWMI with:

- Modeling loading, fate and transport of pollutants, to support development of a copper and nickel Total Maximum Daily Load (TMDL) in the Lower South Bay.

- Assessments of impairment of beneficial uses in the sloughs and tributary creeks of the Lower South Bay.

SCVURPPP's Program Manager participates in the SCBWMI's Core Group. Co-permittee staff, and Program staff and consultants, will continue to participate in various SCBWMI workgroups. By helping to create the SCBWMI, the Co-permittees have effectively implemented the watershed tasks in the 1995 SWMP, the 1997 URMP, and the 2001 Watershed and Urban Runoff Integration report.[11] The Program believes that a viable watershed management plan for the Santa Clara basin will require stakeholder involvement and area-wide planning. Accordingly, the Program's ongoing watershed planning is coordinated through participation in the SCBWMI. As the SCBWMI has developed, it has begun to lay the groundwork for adaptive management within the Santa Clara Basin watersheds. The SCVURPPP will continue to focus on preventing pollution from urban sources by pursuing activities within the purview of the Co-permittees. (See Figure 2)

The Management Committee, as part of the annual evaluation and continuous improvement cycle, reviews the resources that the Program and Co-permittees contribute to the SCBWMI and recommends actions (including budget) to assist the SCBWMI in the coming year.

2E DESCRIPTION OF RELATED PROGRAMS

In addition to participating in the SCBWMI, the Program works with other entities — including regulatory agencies, trade associations and nonprofit groups — to pursue urban runoff pollution prevention. Some examples follow.

[11] Consistent with Provision C.10 of the NPDES permit, SCVURPPP developed a report entitled "Watershed Management and Urban Runoff Management Integration Report, June 29, 2001." The report contains an analysis of how watershed management and urban runoff are currently integrated along with recommendations on the prioritization of watersheds for future investigations/assessments. .

SF Bay Regional Monitoring Program (RMP). Point and urban runoff dischargers including the SCVURPPP fund this monitoring program. The program is administered by the San Francisco Estuary Institute and includes water column, sediment, and biological monitoring at stations throughout the San Francisco Bay, including the lower South Bay. The program conducts special studies such as a pilot watershed-monitoring element in Coyote Creek. The SCVURPPP may supplement RMP funds, from time to time, to encourage special studies that are of interest to the Program.

Bay Area Stormwater Management Agencies Association (BASMAA). BASMAA is a consortium of San Francisco Bay region municipal stormwater programs. Representatives of the seven contributing programs comprise the association's Board, which oversees the work of three committees:

- Monitoring
- New Development
- Operational Permits

BASMAA's New Development Committee has focused on providing tools municipalities can use to incorporate measures to mitigate the urban runoff impacts of new development and construction. The New Development Committee has also overseen preparation of *Start at the Source*[12][13], a site planning/design guidance manual and other products, and provided coordination with Regional Board staff. Regional public outreach and advertising is also conducted through BASMAA. In addition, BASMAA continues to successfully develop a single voice for Bay Area urban runoff programs. The SCVURPPP Program Manager has (for the past five years) and continues to serve as Vice Chair of BASMAA.

POTW Pretreatment Programs. The three POTWs in the Santa Clara Basin inspect many facilities that discharge to sanitary sewers. The

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[12] Tom Richman & Associates (1997). *Start at the Source: Residential Site Planning and Design Guidance Manual for Stormwater Quality Protection.* Bay Area Stormwater Management Agencies Association.

[13] Tom Richman & Associates (1999). *Start at the Source: Design Guidance Manual for Stormwater Quality Protection.* Bay Area Stormwater Management Agencies Association.

inspections insure compliance with the industry's discharge permit and Federal pretreatment regulations. These inspection programs are closely coordinated with the control of industrial sources of urban runoff pollutants. All facilities that are inspected for compliance with sanitary sewer discharge regulations are also inspected for compliance with requirements to implement urban runoff pollution prevention Best Management Practices (BMPs).

Vehicle Emissions and Congestion Management Programs. The Santa Clara Transportation Authority is responsible for developing and implementing a Congestion Management Program that is intended to reduce traffic congestion through various measures, including public education, provision of high-occupancy-vehicle lanes, employer carpooling incentives, and encouraging use of public transit. Similarly, the Bay Area Clean Air Plan, jointly developed by the Bay Area Air Quality Management District (BAAQMD), the Metropolitan Transportation Commission (MTC), and ABAG, aims to improve air quality through controls on emissions from stationary sources and motor vehicles, and through transportation system improvement measures. The emission reduction programs benefit urban runoff quality because particulate metals and other pollutants emitted by automobiles settle on urban surfaces and are later washed into urban runoff.

Hazardous Waste Recycling and Disposal Programs. Most cities in Santa Clara County participate in the Countywide Household Hazardous Waste Collection Program, which is administered by the County Health Department. A guidebook describing these activities was developed jointly by the County Hazardous Waste Program and the SCVURPPP in 1991. The elements of the program differ from jurisdiction to jurisdiction, but typically include household hazardous waste drop-off locations, curbside pickup, and community recycling centers. These programs recycle batteries, fluorescent lamps, automotive fluids, household cleaners, paints, and garden chemicals generated by households and some small businesses.

Certified Unified Program Agency (CUPA) Program. Senate Bill 1082 of 1993 (Health and Safety Code Chapter 6.11) requires California EPA to establish a "unified hazardous waste and hazardous materials management" regulatory program (Unified Program) by January 1, 1996. The Unified

Program is intended to consolidate, coordinate and make consistent the administrative requirements, permits, inspection, enforcement and fees for state-mandated regulation of:

- Hazardous waste generators and onsite treatment of hazardous wastes
- Spill prevention control and countermeasure plans for above-ground storage tanks
- Underground storage tanks
- Hazardous material release response plans and inventory
- Risk management and prevention

Clean Estuary Partnership. The Clean Estuary Partnership (CEP) is a cooperative partnership (voluntary) that facilitates efforts to improve water quality in San Francisco Bay by providing financial and staff support for technical analysis and stakeholder outreach activities. The official CEP partners are:

1. San Francisco Bay Regional Water Quality Control Board (RWQCB);
2. Bay Area Stormwater Management Agencies Association (BASMAA); and
3. Bay Area Clean Water Agencies (BACWA).

The recent trend toward lengthy and costly legal challenges of regulatory decisions convinced stakeholders to pursue a more collaborative approach. In September 2001, the Regional Board, BACWA and BASMAA signed a memorandum of understanding (MOU) to establish the CEP. The intention was to provide a forum and process for industry, the environmental community and various research and planning initiatives to work together to:

4. Summarize the existing scientific evidence for pollutant impacts;
5. Develop conceptual models that explain the source of the problems and are consistent with available scientific data and theory;

6. Coordinate peer review of key scientific/technical documents; and

7. Identify feasible long-term strategies for addressing pollution problems.

The effort is designed to result in greater consensus regarding the technical foundation for regulatory action, and reduce the likelihood of controversy and litigation when the regulations are adopted in the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan). SCVURPPP has been actively involved from the inception of the CEP and annually contributes resources (both funding and staff in-kind support) to the effort. While SCVURPPP supports the overall goals and mission of the CEP, there is a need to been refine the operational relationship between the RMP and the CEP to more efficiently and cost-effectively utilize the limited public agency resources that support these two programs.

Water Resources Protection Collaborative. The Water Resources Protection Collaborative (Collaborative) includes representatives from the SCVWD, the County of Santa Clara, each municipality within the County, the Regional Water Quality Control Board, and representatives of property owners, the environmental community and business/development interests. It was initiated in December, 2002 in order to address land use issues near streams in response to SCVWD's proposal to modify Ordinance 83-2. The Collaborative's Mission is to review and assess the current state of water resources protection measures in Santa Clara County; and to propose appropriate management strategies and institutional arrangements to implement these strategies.

The Co-permittees, typically higher level staff from Planning and Public Works Departments, have participated in the Collaborative meetings since December 2002. The Program itself is not a member, but participates as needed in technical work groups and reviews products for consistency with Program goals and objectives and permit requirements. The Collaborative's goal to better implement watershed management strategies within the County supports the mission of the Program to assist in protecting beneficial uses of

streams by reducing pollutants of concern from adjacent land uses to the maximum extent practicable.

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

CONDITIONALLY EXEMPTED DISCHARGES: Classification and Control Measures

February 17, 2011

Document History:
Original developed by AHTG and Program staff. Draft report provided to Management Committee and Regional Board staff on October 1998 for review.
Revised draft provided for review on May 5, 1999.
Approved by the Management Committee on June 15, 2000
Submitted to the Regional Water Board on August 29, 2000
Report updated by Program staff to reflect MRP requirements and provided to the Water Utility AHTG and Executive Committee for review on January 5, 2011.
Approved by the Management Committee on February 17, 2011.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 BACKGROUND 1

3.0 PREVIOUS DOCUMENTS AND REPORTS 2

4.0 CONTROL MEASURES FOR CONDITIONALLY EXEMPTED DISCHARGES 3

4.1 Control Measures for:
Pumped groundwater from Non-Drinking Water Aquifers (b.i.(1)) 4

4.2 Control Measures for:
Uncontaminated Pumped Groundwater (b.i.(2)) 5
Foundation Drains (b.i.(2)) 5
Water from Crawl Space Pumps (b.i.(2)) 5
Footing Drains (b.i.(2)) 5

4.3 Control Measures for:
Air Conditioning Condensate (b.ii) 6

4.4 Control Measures for:
Irrigation Water (b.vi) 7
Landscape Irrigation (b.vi) 7
Lawn or Garden Watering (b.vi) 7

4.5 Control Measures for:
Planned Discharges from Potable Water Systems (b.iii.(1)) 8
Unplanned Discharges from Potable Water Systems (b.iii.(2)) 8

4.6 Control Measures for:
Emergency Discharges from Potable Water Systems (b.iii.(3)) 8

4.7 Control Measures for:
Individual Residential Car Washing (b.iv) 8

4.8 Control Measures for:
Swimming Pool Discharges (b.v) 9
Hot Tub Discharges (b.v) 9
Spa Discharges (b.v) 9
Fountain Water Discharges (b.v) 9

5.0 PROCEDURES FOR IMPLEMENTATION OF CONTROL MEASURES 10

6.0 DISCHARGE NOTIFICATION AND REPORTING PROCEDURES 10

6.1 Reporting Measures for:
Pumped groundwater from Non-Drinking Water Aquifers (b.i.(1)) 10

6.2 Reporting Measures for:
Uncontaminated Pumped Groundwater (b.i.(2)) 10
Foundation Drains (b.i.(2)) 10
Water from Crawl Space Pumps (b.i.(2)) 10
Footing Drains (b.i.(2)) 10

6.3 Reporting Measures for:
Air Conditioning Condensate (b.ii) 10

6.4 Reporting Measures for:
Irrigation Water (b.vi) 10
Landscape Irrigation (b.vi) 10
Lawn or Garden Watering (b.vi) 10

6.5 Reporting Measures for:
Planned Discharges from Potable Water Systems (b.iii.(1)) 11
Unplanned Discharges from Potable Water Systems (b.iii.(2)) 11

6.6 Reporting Measures for:
Emergency Discharges from Potable Water Systems (b.iii.(3)) 11

6.7 Reporting Measures for:
Individual Residential Car Washing (b.iv) 11
6.8 Reporting Measures for Discharge Type:
Swimming Pool Discharges (b.v) 11
Hot Tub Discharges (b.v) 11
Spa Discharges (b.v) 11
Fountain Water Discharges (b.v) 11
7.0 MONITORING / RECORD MANAGEMENT PROCEDURES..... 11

List of Tables

Table 1. Summary of Control Measures for Conditionally Exempted Discharges.....12

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Revised draft provided for review on May 5, 1999.
Approved by the Management Committee on June 15, 2000
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APPENDIX 6A-5

RWQCB RAPID TRASH ASSESSMENT METHODOLOGY

SWAMP
Surface Water Ambient Monitoring Program

Final Technical Report	2007

A Rapid Trash Assessment Method Applied to Waters of the San Francisco Bay Region: Trash Measurement in Streams

April 2007

Water Boards

www.waterboards.ca.gov/swamp

Table of Contents

Introduction 1
Trash and Water Quality Standards 1
Assessment Method Development 3
Water Quality Impacts of Trash 4
Sources and Fate of Trash 6
Methods 6
Monitoring Design Considerations 6
SWAMP Trash Monitoring Design 7
Site Definition 7
Trash Data Collection 8
Scoring 9
Quality Assurance 11
Results and Discussion 11
Regional Conditions 11
Trash Deposition Rates 16
Wet Season Deposition 16
Dry Season Deposition 17
Case Studies- High Trash Deposition Rates 21
1. Booker T. Anderson Park, Baxter Creek 21
2. Dow Wetlands, Kirker Creek 22
3. Washington and McDowell, Washington Creek (Petaluma River) 23
4. Moss Rock, Stevens Creek 24
Case Studies – Low Trash Deposition Rates 24
1. Dimond Park, Sausal Creek 24
2. Joaquin Miller Park, Palo Seco Creek (Sausal Creek) 25
Longitudinal Trends Within Watersheds 26
1. San Mateo Creek Watershed 26
2. Petaluma River Watershed 27
3. Baxter Creek Watershed 29
4. Sausal Creek Watershed 29
Conclusions and Recommendations 31
Acknowledgements 33
References 35

Appendix A – Rapid Trash Assessment, Version 8
Appendix B – Rapid Trash Assessment Method Evaluation, October 2002
Appendix C – Raw RTA Trash Assessment Data
Appendix D – Field Visit and Trash Collection Health and Safety SOPs

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Cover Photo of Peralta Creek at Cesar Chavez Park, Oakland, CA, by Anne Senter

Introduction

Trash is a term used in water quality control, synonymous with litter, debris, rubbish and refuse. Trash is a regulated water pollutant that has many characteristics of concern to water quality. It accumulates in streams, rivers, bays, and ocean beaches throughout the San Francisco Bay Region of California, particularly in urban areas. Trash in streams can impair beneficial uses such as human health and aesthetic enjoyment (REC-2) and aquatic life. Trash in urban waterways of coastal areas can become "marine debris," known to harm fish and wildlife and cause adverse economic impacts (Moore and Allen, 2000). Absent numeric guidelines or standard assessment methodologies, assessing trash levels and prioritizing water bodies for trash management remains a challenge for the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board).

This report documents a pilot effort conducted by the Surface Water Ambient Monitoring Program (SWAMP) to systematically assess trash levels in streams, which are sources of marine debris to the San Francisco Bay and Pacific Ocean. SWAMP staff developed a Rapid Trash Assessment (RTA) protocol for examining the amount and types of trash present in stream channels, the effects of trash on beneficial uses, and potential sources of trash.

The goals of this report are to (1) describe a rapid trash assessment protocol and (2) provide a regional assessment of trash deposition in fresh waters of the San Francisco Bay Region. The objectives are to document (1) dry and wet weather trash deposition rates, (2) longitudinal variability within watersheds, and (3) variability across watersheds in urban settings. The Introduction of the report includes a discussion of the water quality impacts of trash and relevant water quality standards, and describes the impetus for the study. The Methods section describes the RTA methodology, sampling design considerations, and QA issues. In the Results and Discussion sections we present data on site scores, trash abundance, and types of trash, followed by a discussion of likely sources of trash and potential management measures. Results from year-round surveys of 26 sites around the San Francisco Bay Region are presented and discussed (Figure 1). Sites with the highest trash deposition rates in dry and wet weather conditions are presented as case studies in a discussion of sources of trash pollution and potential management actions.

Trash and Water Quality Standards

Water quality standards consist of (1) designated beneficial uses for specific water bodies, (2) water quality objectives (narrative and/or numeric) to protect beneficial uses, and (3) the State's Antidegradation Policy, which mandates the maintenance of high quality waters, preventing degradation to the minimally acceptable standard. Water quality standards for the San Francisco Bay Region are contained in the San Francisco Bay Region Water Quality Control Plan (Basin Plan).

Trash adversely affects numerous beneficial uses of waters, particularly recreation and aquatic habitat. Not all litter and debris delivered to streams are of equal concern with

regards to water quality. Besides the obvious negative aesthetic effects, most of the harm of trash in surface waters is imparted to wildlife in the form of entanglement or ingestion (Laist and Liffmann, 2000; McCauley and Bjorndahl, 1999). Some elements of trash exhibit significant threats to human health, such as discarded medical waste, human or

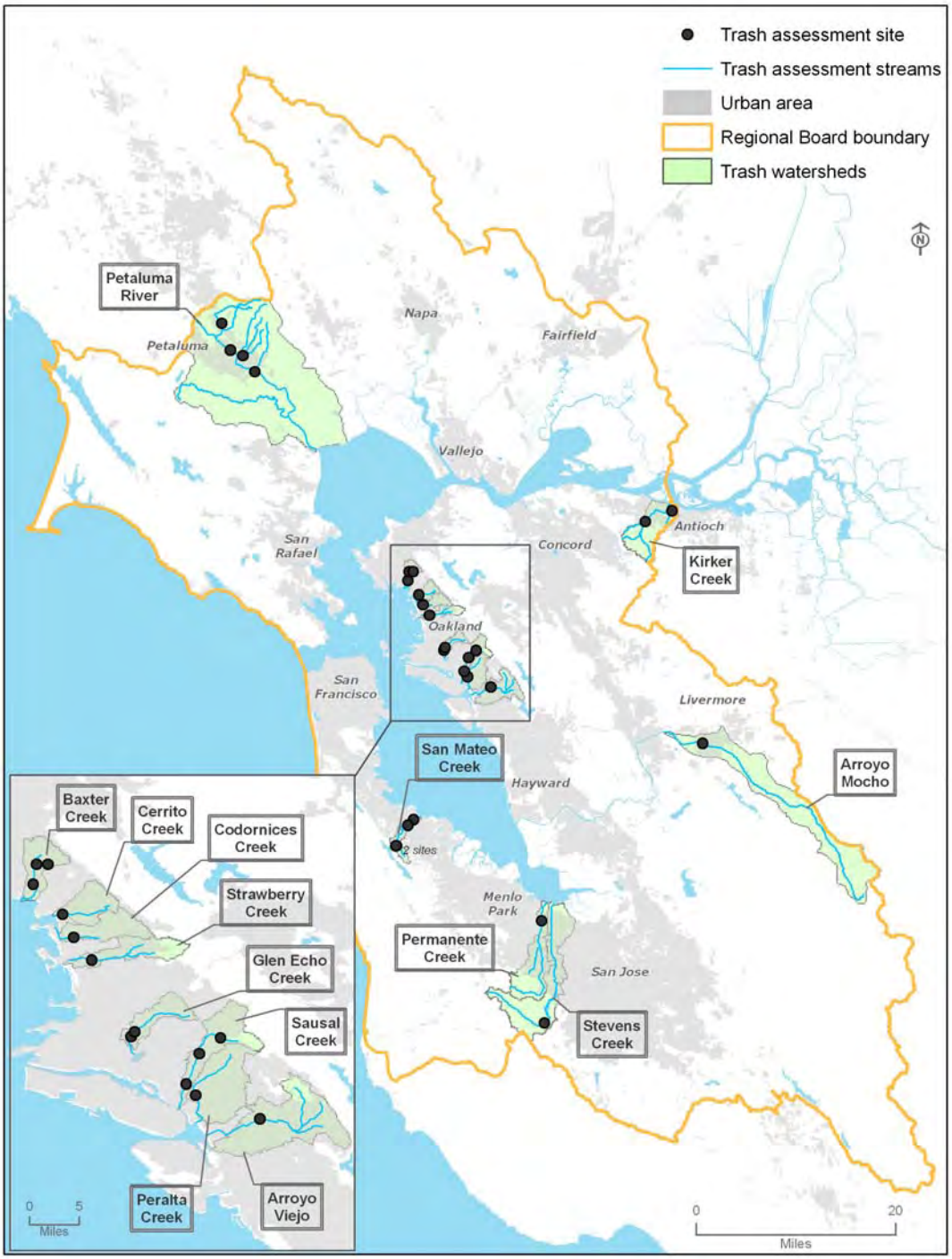

Figure 1 – Map of Trash Assessment Sites, San Francisco Bay Region SWAMP Program, 2003-2005

pet waste, and broken glass (Sheavly, 2004). Also, some household and industrial wastes may contain toxic substances of concern to human health and wildlife, such as batteries, pesticide containers, and fluorescent light bulbs that contain mercury. Large trash items such as discarded appliances can present physical barriers to natural stream flow, causing physical impacts such as bank erosion. From a management perspective, the persistent accumulation of trash in a water body is of particular concern, and signifies a priority for prevention of trash discharges. Also of concern are trash "hotspots" where illegal dumping, littering, and/or accumulation of trash occur.

The narrative water quality objectives applicable to trash are:

- Floating Material (*Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses*),
- Settleable Material (*Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses*), and
- Suspended Material (*Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses*).

The Basin Plan prohibits discharge of rubbish and refuse to waters of the state (Table 4-1, Discharge Prohibitions, No. 7). This prohibition was adopted by the Water Board in the 1975 Basin Plan, primarily to protect recreational uses such as boating.

Several water bodies in California are listed under Section 303(d) of the Clean Water Act (CWA) as impaired by trash, which means they are not meeting water quality standards. The 303(d) List includes Lake Merritt of Oakland as impaired by trash. In 2001, the Los Angeles Regional Water Board began adopting Total Maximum Daily Loads (TMDLs) for trash in its jurisdictional area, which established numeric targets of zero trash items in waterbodies including the Los Angeles River. The San Francisco Bay Regional Water Board keeps an informal "watch" list for impaired water bodies, and has placed trash in all urban creeks, lakes and shorelines on this list. As part of this action in November 2001, the Water Board identified the need for better information on trash assessment in order to discern which water bodies should be included on the 303(d) Impaired Water Bodies List.

Assessment Method Development

Recognizing the need for assessment procedures to support 303(d) listing decisions, the staff of the Water Board developed, refined, and implemented a rapid trash assessment method from 2002 through 2005 as part of its Surface Water Ambient Monitoring Program (SWAMP) (Water Board, 2004, Appendix A). The method was refined through field experience and by conferring with representatives from local government and nonprofit groups. The method generates site-specific scores on a scale from 0 to 120, with higher scores indicating cleaner sites. The method also documents the number of pieces of trash per one hundred feet of stream or shoreline, and the rate of return of trash under different hydrologic conditions. This data can be used to identify problem areas

where trash accumulates during dry weather due to littering or dumping and in wet weather due to accumulation from upstream sources, and to assess the effectiveness of targeted management measures.

Trash assessment includes a visual survey of the water body (e.g., streambed and banks) and adjacent areas from which trash elements can be carried to the water body by wind, water, or gravity. The delineation of these adjacent areas is site-specific and requires some judgment and documentation. The rapid trash assessment worksheet is designed to represent the range of effects that trash has on the physical, biological, and chemical integrity of water bodies, in accordance with the goals of the CWA and the California Water Code. The worksheet also provides a record for evaluation of the management of trash discharges, by documenting sites that receive direct discharges (i.e., dumping or littering) and those that accumulate trash from upstream locations. The specific items on the tally sheet were determined based on common items retrieved during numerous pilot surveys.

There is a need to systematically measure trash levels in Bay Area and California water bodies to establish baseline conditions, and evaluate the success of educational, institutional, operational and structural efforts to control trash. In some systems that behave as trash "catchments," such as Lake Merritt, tons of trash removed may be an appropriate indicator to measure over time to gauge success, as long as it is measured consistently. The Water Board staff developed the rapid trash assessment method to provide such a systematic approach for non-catchment systems such as streams and shorelines, where "tons of trash removed" may not provide an accurate tracking mechanism. Trash weight can be a misleading indicator, since the trash of most concern to beneficial uses is small, buoyant and persistent (U.S. EPA, 2001).

Water Quality Impacts of Trash

For aquatic life, buoyant (floatable) elements tend to be more harmful than settleable elements, due to their ability to be transported throughout the water body and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent, even though they are not biodegradable, because wave action and rusting can cause them to break into smaller pieces that are less sharp and harmful. Natural rubber and cloth can degrade but not as quickly as paper (U.S. EPA, 2002). Smaller elements such as plastic resin pellets (a by-product of plastic manufacturing) and cigarette butts are often more harmful to aquatic life than larger elements, since they can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life such as sea turtles, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation. Floating debris that is not trapped and removed will eventually end up on the beaches or in the ocean, repelling visitors and residents from the beaches and degrading coastal and open ocean waters.

Trash in water bodies can threaten the health of people who use them for wading or swimming. Of particular concern are the bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can then expose a person's bloodstream to microbes in the stream's water that may cause illness. Also, some trash items such as containers or tires can pond water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile virus.

Leaf litter is considered trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive levels due to human influence can cause nutrient imbalance and oxygen depletion in streams, to the detriment of the aquatic ecosystem. Other biodegradable trash, such as food waste, also exerts a demand on dissolved oxygen, but aquatic life is unlikely to be adversely affected unless the dumping of food waste is substantial and persistent at a given location.

Wildlife impacts due to trash occur in creeks, lakes, estuaries, and ultimately the ocean. The two primary problems that trash poses to wildlife are entanglement and ingestion, with entanglement the more common documented effect (Laist and Liffmann, 2000). Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of floatable debris. Many of the species most vulnerable to the problems of floatable debris are endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds that can lead to infections or loss of limbs; it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, or in difficulty in moving, finding food, or escaping predators (U.S. EPA, 2001).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (e.g., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (U.S. EPA, 2001).

Common settled debris includes glass, cigarettes, rubber, construction debris and more. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination. Larger settleable items such as automobiles, shopping carts, and furniture can redirect stream flow and destabilize the channel.

In conclusion, trash in water bodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration, thus the trash assessment methodology was designed to reflect a range of trash impacts to aquatic life, public health, and aesthetic enjoyment.

Sources and Fate of Trash

Movement and fate of trash in the landscape and waterways varies based on its size, buoyancy, and degradability. Small, buoyant and persistent trash items such as plastic or synthetic rubber may travel from land all the way to mid-ocean locations, whereas other trash items may have a more transient or localized presence in waters.

The primary sources of trash to waters of the state are urban runoff in nearshore areas such as creeks and San Francisco Bay, and fishing boats in offshore areas (Moore and Allen, 2000). In most of the region, storm drainage in urban areas had been designed to move water as quickly as possible to surface waters. One unfortunate by-product of this design is that medium to heavy rain events move trash that is deposited on streets and other impervious surfaces directly to waters of the state, unless it is screened out by coarse metal grates in urban gutters.

Surveys of the ocean floor of the Southern California Bight for trash and natural debris concluded that land-based trash sources contributed the most to the ocean bottom trash levels near the shoreline, but the trash on the outer continental shelf was dominated by discarded fishing gear and incidental waste from recreational and commercial fishing boats (Moore and Allen, 2000).

Surveys of the North Pacific central gyre for floating plastics and plankton suggest that the amount of plastic material in the ocean is increasing over time (Day and Shaw, 1987). Plastic degrades slowly in the ocean (Andrady, 1990; U.S. EPA, 1992). The eddy effects of the gyre probably serve to retain plastics, whereas plastics may wash up on shore in greater numbers in other areas. This is based on the observation that a large fraction of the materials in the central gyre study appeared to be remnants of offshore fishing-related activity and shipping traffic. The survey indicated that the mass of plastics is about six times that of plankton, but the abundance of plankton is still about five times that of plastic pieces (Moore et al., 2001).

Methods

In order to generate consistent and comparable results, the methods of site definition, data collection, scoring, and overall monitoring program design are discussed in this section.

Monitoring Design Considerations

The rapid trash assessment method can be used for a number of purposes, such as ambient monitoring, evaluation of management actions, determination of trash accumulation rates, or comparing sites with and without public access. In this report, the data collected is used for all of these purposes. Ambient monitoring provides information

on the spatial and temporal patterns of trash dynamics. Additionally, the ambient sampling design should document the effects of episodes that affect trash levels such as storms or community cleanup events. Pre- and post-project assessments can assist in evaluating the effectiveness of management practices ranging from public outreach to structural controls, or to document the effects of public access on trash levels in waterbodies (e.g., upstream/downstream). Such evaluations should consider trash levels over time and under different seasonal conditions. Revisiting sites where trash was collected during previous assessments enables the determination of accumulation rates. Alternatively, if a monitoring objective is to characterize trash conditions over time in a stream, it may be more appropriate to revisit different nearby reaches or not pick up trash if the same site is revisited. Ultimately, the monitoring design strongly affects the usefulness of any rapid trash assessment information.

SWAMP Trash Monitoring Design

In accordance with the goal of this report, sites were selected to represent the range of conditions found in the tributaries to San Francisco Bay, from rural residential areas in the foothills to dense, urbanized areas in the plains. All sites were near or within city limits, representing areas of public access (e.g., parks) or at the bottom of watersheds.

The SWAMP program rotates water quality monitoring through 46 planning watersheds in the San Francisco Bay Region, as budget allows. Trash assessments were conducted at sites where water quality was monitored in the SWAMP program from 2003 to 2005. The 26 sites assessed using the rapid trash assessment methodology are located in five of the nine Bay Area counties (see Figure 1). Two of the 26 sites were surveyed only once, due to dangerous field conditions and extremely high trash levels, while other sites were surveyed three to five times over a year in order to calculate deposition rates of trash during dry and wet weather conditions. Surveys sometimes integrated both dry and wet conditions, but these assessments were classified as “wet weather” due to the observed overwhelming effect of wet weather conditions on trash deposition. Of the 26 sites, 13 were located at the bottom of the watershed (BOTW), representing areas just upstream of the San Francisco Bay intertidal zone. The remainder of the sites were located further upstream, allowing for longitudinal analyses of trash deposition in the San Mateo Creek, Baxter Creek (Richmond), Petaluma River, and Sausal Creek (Oakland) watersheds. This report presents results and discussion for a total of 93 individual site surveys.

Site Definition

Defining site-specific characteristics facilitates the comparison of trash assessments conducted at the same site at different times of the year. Upon arrival at a designated monitoring site, a team of two people or more defined or verified a 100-foot section of the stream or shoreline to analyze, associated with a SWAMP water quality sampling location or station. When a site was first established, the 100-foot distance was accurately measured. The length was measured not as a straight line, but as 100 feet of the actual stream or shore length, including sinuous curves. Where possible, the starting and ending points of the survey were easily identified landmarks, such as an oak tree or

boulder, and noted on the worksheet ("Upper/Lower Boundaries of Reach"), or documented using a global positioning system (GPS), so that future assessments could be made at the same location. The team conferred and documented the upper boundary of the banks to be surveyed, based on evaluation of whether trash could be carried to the water body by wind or water (e.g., an upper terrace in the stream bank). At each site, the team documented the location of the high water line based on site-specific physical indicators, such as a debris line found in the riparian vegetation along the stream channel. If the high water line could not be determined, bank full height was documented in the field sheets, noting that the high water line could not be determined. Trash located below the high water line can be expected to move into the streambed or be swept downstream during the next significant rain event.

Trash Data Collection

The trash assessment protocol involves picking up and tallying all of the trash items found within the defined boundaries of a site. When repeated several times throughout a year, this procedure allows for the assessment of temporal changes in impairment, usage patterns, and trash deposition rates under wet and dry weather conditions. Surveys, including trash collection, note taking, and scoring, typically took one to two hours, depending on how trash-impacted the site was and the number of people on the survey crew. The first time a site was assessed the process generally took longer than on subsequent visits.

There are numerous potential human health hazards, such as puncture hazards and pathogens, that could affect field technicians performing trash assessments. We suggest that other entities using the RTA protocol consult the SWAMP program's health and safety standard operating procedures (SOPs) for general field work and trash assessments (Appendix 1) prior to beginning field work.

All surveys are initiated at the downstream end of the selected reach so that trash is not obscured after disturbing the streambed. Tasks are divided according to the number of team members. For a team with two members, both persons, equipped with gloves and garbage bags, pick up trash. A trash grabber, metal kitchen tongs, or a similar tool can also be used to help pick up trash. One team member begins walking along the bank at the edge of the stream or shore, looking for trash on the bank up to the upper bank boundary, above and below the high water line. This person picks up trash and tallies the items on the trash assessment worksheet as either above or below the high water line. The other person walks along the streambed and up and down the opposite bank, picking up and calling out trash items found in the water body and on the opposite bank, both above and below the high water line, for the tally person to mark down appropriately on the trash assessment sheet. A three-member team has one designated note-taker and two trash collectors.

To make sure that trash items are not missed from the survey, team members look under bushes, logs, and vegetation to see if trash has accumulated underneath. The ground and substrate is closely inspected to ensure that small items such as cigarette butts and pieces

of broken glass or Styrofoam are picked up and counted. Special attention was paid to items that can affect human health such as diapers, fecal matter, and medical needles; these items can strongly affect the total score. The person tallying the trash indicates on the worksheet whether the trash was found above the high water line on the bank, or below the high water line either on the bank or in the stream (i.e., tally dots or circles (•) for above high water line, tally lines (|) for below). If it is evident that items have been littered, dumped, or accumulated via downstream transport, notes are made in the designated rows near the bottom of the tally sheet - this helps when assigning scores.

Clumps of leaf litter and yard waste from trash bags should be treated as trash in the water quality assessment, and not confused with natural inputs of leaves to streams. If there is a question in the field, check the type of leaf to confirm that it comes from a nearby riparian tree. In some instances, leaf litter may be trash if it originates from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs.

When considering the water quality effects of trash while conducting a trash assessment, remember to evaluate individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife. Utilize the narratives in the worksheet, refer to the technical notes and trash parameter descriptions in the text as needed, and select your scores after careful consideration of actual conditions.

Once the team is finished collecting trash, the recorder indicates in the margins of the tally sheet the total number of items in each category found above and below the waterline. All worksheets are completed before leaving the site, while everything is still fresh in the memory. The team discusses each scoring parameter (described below under "Scoring") and agrees on a score for each of the condition categories, The team also discusses and records hypotheses of potential sources of trash, such as neighboring or upstream land uses.

Scoring

The rapid trash assessment includes six condition categories that capture the breadth of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the second two parameters estimate actual threat to water quality, and the last two parameters represent how trash enters the water body at a site, either through on-site activities or downstream accumulation.

Within each trash parameter, narrative language is provided to assist with choosing a condition category. The worksheet provides a range of numbers within a given category, allowing for a range of conditions encountered in the field. For instance, trash located in the water results in lower scores than trash above the high water line. Not all specific trash conditions mentioned in the narratives need to be present to fit into a specific condition category (e.g., "site frequently used by people"), nor do the narratives describe all possible conditions. Scores of "0" should be reserved for the most extreme conditions. Once team members assigned the scores for the six categories in the field, the final scores were summed and specific notes about the site included at the end of the

sheet. Each site was assessed three or four times in a given year, during different seasons, to characterize the variability and persistence of trash occurrence for water quality assessment purposes.

The scoring categories include:

1. *Level of Trash*. This assessment parameter is intended to reflect a qualitative "first impression" of the site, after observing the entire length of the reach. Sites scoring in the "poor" range are those where trash is one of the first things noticeable about the water body. No trash should be obviously visible at sites that score in the "optimal" range.

2. *Actual Number of Trash Items Found*. Based on the tally of trash along the 100-foot stream reach, total the number of items both above and below the high water line, and choose a score within the appropriate condition category based on the number of tallied items. Where more than 100 items have been tallied, assign the following scores: 5: 101-200 items; 4: 201-300 items; 3: 301-400 items; 2: 401-500 items; 1: 501-600 items; 0: over 600 items. Use similar guidelines to assign scores in other condition categories. Sometimes items are broken into many pieces. Fragments with higher threat to aquatic life such as plastics should be individually counted, while paper and broken glass, with lower threat and/or mobility, should be counted based on the parent item(s). Broken glass that is scattered, with no recognizable original shape, should be counted individually. The judgment of whether to count all fragments or just one item also depends on the potential exposure to downstream fish and wildlife, and waders and swimmers at a given site. Concrete is trash when it is dumped, but not when it is placed. Consider tallying only those items that would be removed in a restoration or cleanup effort.

3. *Threat to Aquatic Life*. As indicated in the technical notes, below, certain characteristics of trash make it more harmful to aquatic life. If trash items are persistent in the environment, buoyant (floatable), and relatively small, they can be transported long distances and be mistaken by wildlife as food items. Larger items can cause entanglement. Some discarded debris may contain toxic substances. All of these factors are considered in the narrative descriptions in this assessment parameter.

4. *Threat to Human Health*. This category is concerned with items that are dangerous to people who wade or swim in the water, and with pollutants that could accumulate in fish in the downstream environment, such as mercury. The worst conditions have the potential for presence of dangerous bacteria or viruses, such as with medical waste, diapers, and human or pet waste.

5. *Illegal Dumping and Littering*. This assessment category relates to direct placement of trash items at a site, with "poor" conditions assigned to sites that

appear to be dumping or littering locations based on adjacent land use practices or site accessibility.

6. *Accumulation of Trash*. Trash that accumulates from upstream locations is distinguished from dumped trash by indications of age and transport. Faded colors, silt marks, trash wrapped around roots, and signs of decay suggest downstream transport, indicating that the local drainage system facilitates conveyance of trash to water bodies.

Quality Assurance

To address concerns about observer bias and differences in interpretation of narrative language, SWAMP and Alameda County stormwater staff performed a methods repeatability study in July 2002. Three teams of two members assessed and scored the same two sites in a blind comparison. A summary of the study is included as Appendix B, Rapid Trash Assessment Method Evaluation.

Results and Discussion

There are two major mechanisms responsible for trash in streams of the San Francisco Bay Region: ***direct littering or dumping***, and ***downstream transport and accumulation***. Littering and dumping were usually documented in dry weather conditions between sampling events, while downstream transport and accumulation of trash occurred extensively at the bottom of watersheds in wet weather conditions between sampling events. Results confirmed that these two phenomena occur at remarkable rates of deposition and levels of trash per 100-feet of stream in every watershed studied. In this section, the sites with the highest dry and wet weather deposition rates are described, sources of trash are identified, and potential management measures are discussed. In addition, two public access sites with high RTA scores and relatively low trash deposition rates are discussed to identify management efforts that appear to be working to keep trash out of the streams.

Regional Conditions

The 93 site visits conducted by Water Board staff and students over three years and multiple seasons confirmed that high levels of trash are present throughout urban streams in the San Francisco Bay Region. On average, across all sites and seasons, 288 pieces of trash were collected per 100 foot reach of stream, equaling 2.88 pieces per linear foot of stream (Figure 2). Over 50% of this total, or 1.56 pieces per linear foot of stream, was composed of plastic items. Glass (19%) and biodegradable items (10%) were also commonly found. Most sites contained less than 500 pieces of trash, while several sites contained many more pieces, up to a maximum of 1133 pieces, or 11.33 pieces per linear foot of stream (Figure 3). Overall, 72% of all trash items were found below the high-water line, while 28% of items were found above the high-water line. Certain types of

items were found almost exclusively below the high-water line, including toxic items (87%), construction debris (87%), and glass (82%). Forty-two percent of biodegradable items were found above the high water line, indicative of the frequency with which paper is transported by wind into stream channels. The average total Rapid Trash Assessment (RTA) score was 47, with a range from 8 to 112 (out of a possible 120) (Figure 4). Lower RTA scores reflect higher levels of trash. A high RTA score, overall or in a specific category, represents more desirable, less trashed conditions. Total RTA scores were strongly related to the number of plastic pieces found at sites (Figure 5).

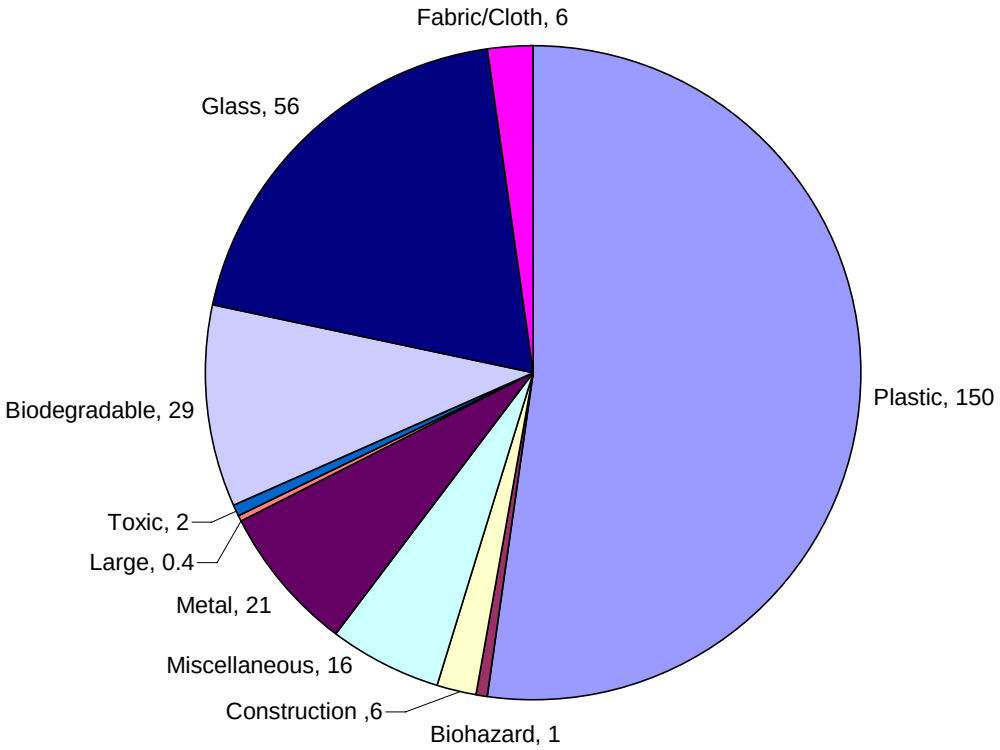

Figure 2: Average number of pieces of trash, by category, per 100 foot reach for all sites and all seasons.

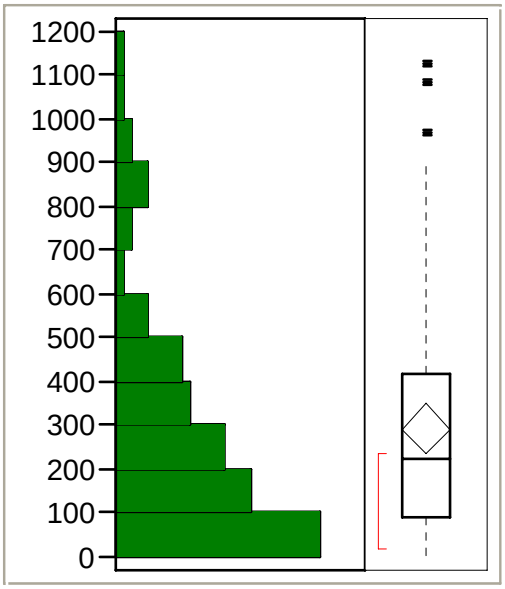

Figure 3: Frequency histogram of the number of pieces of trash found per 100 foot reach (site). A total of 93 site visits were conducted. The diamond indicates the mean and the standard error about the mean. The box indicates the median and the 25th and 75th percentiles, while the whiskers indicate the 5th and 95th percentiles.

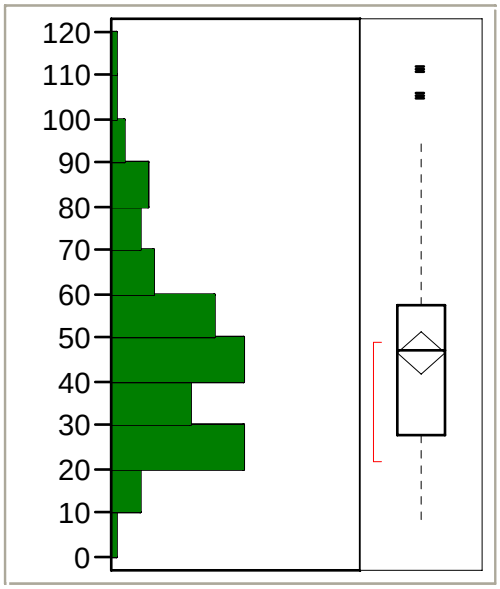

Figure 4: Frequency histogram of total RTA trash scores for each site visit. A total of 93 site visits were conducted. Symbols are the same as in Figure 3.

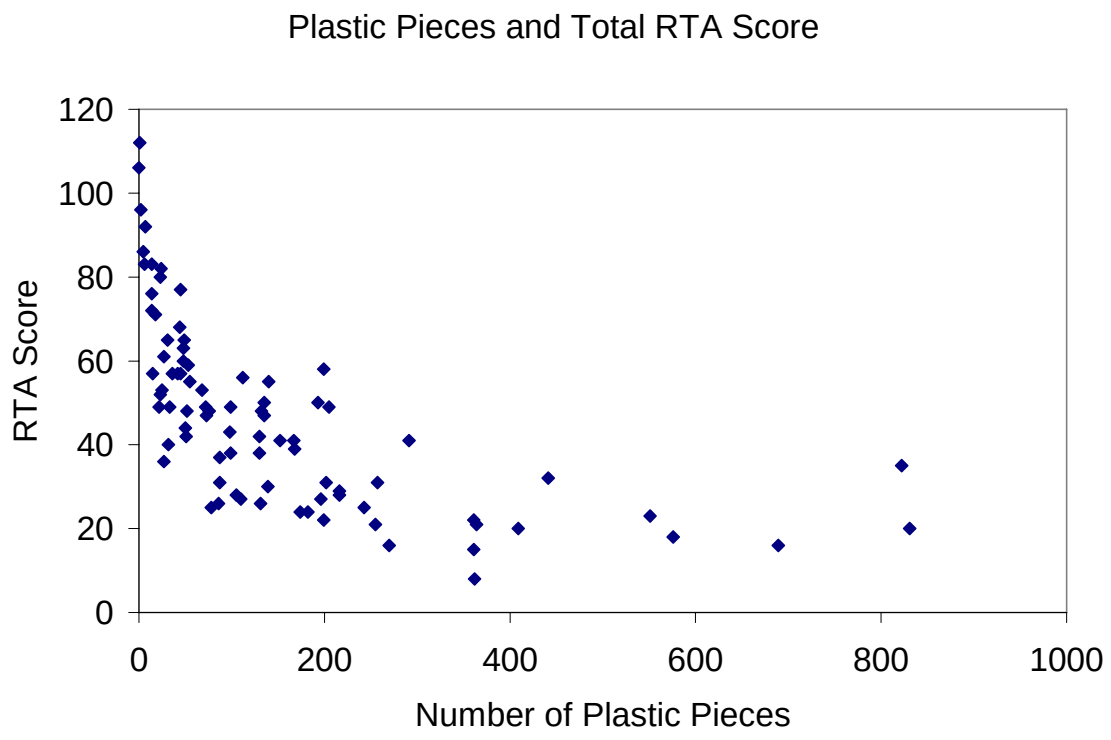

Figure 5: Total RTA score relative to the total number of plastic pieces collected.

The 26 sites surveyed did not include the worst-case conditions of trash in the region (e.g. Figure 6), where obstructions can cause buildup of floating trash in wet weather conditions. The most trash pieces per 100 feet of stream documented in this report was 1,133 pieces at Baxter Creek at Booker Park in Richmond. For comparison, trash stored behind obstructions may exceed 10,000 pieces per 100 feet (Figure 6). Other problem sites not surveyed include homeless encampments, although some of the sites were downstream of such major sources of trash.

There were significant differences in amounts and types of trash found at sites located at the bottom of watersheds and sites located in parks with high public access. Bottom-of-the-watershed (BOTW) sites (Table 2) received very low upstream accumulation scores (average score 3.3) relative to sites located higher in the watershed (average score 8.5). Conversely, littering was more important at sites with high public access (average score 3.9) than at sites without high public access (average score 5.4). Many more pieces of plastic were found below the high water line at BOTW sites (average 192) than at non-BOTW sites (average 52). Glass, however, was much more common at public access sites (average 92) than at non-public access sites (average 14). Overall, BOTW sites tended to most adversely affected by trash, in terms of highest total number of pieces (average 398) and lowest total RTA scores (average 35).

Condition category scores within the total RTA score reflected differences in trash deposition between both (1) wet and dry seasons and (2) BOTW and sites further

upstream. Bottom of the watershed (BOTW) sites generally scored lower than sites further upstream in the watershed in nearly all trash condition category scores, with the exception of dumping and littering (Figure 7). Qualitative scores were much lower at BOTW sites than upstream sites, indicating the "first impression" of BOTW sites is consistently more negative with respect to trash.

Accumulation scores were also much lower at BOTW sites than upstream sites, but wet season scores are much lower for both site locations than dry season scores, reflecting the seasonality of trash accumulation. At BOTW sites, the dry season scores for accumulation were markedly lower than the wet season accumulation scores for upstream sites, shown at the far right of Figure 7. As noted above, at BOTW sites the trash is dominated by plastics. Plastics continue to be delivered to the bottom of watersheds and into the San Francisco Bay during the dry season. Trash can be delivered to streams, the topographic low points in watersheds, by wind and dry season urban runoff (e.g., over-irrigation), and these data suggest it is a significant source. Trash control efforts in the Los Angeles region associated with TMDL implementation tend to focus on runoff events to capture the largest volume of trash, but the observations documented in this report show that dry season delivery of trash is likely significant.

Figure 6: Photo of the trash buildup behind a fallen tree immediately downstream of the Julian Street bridge, Coyote Creek, San Jose, CA, January 27, 2004. Photo by Friends of Coyote Creek.

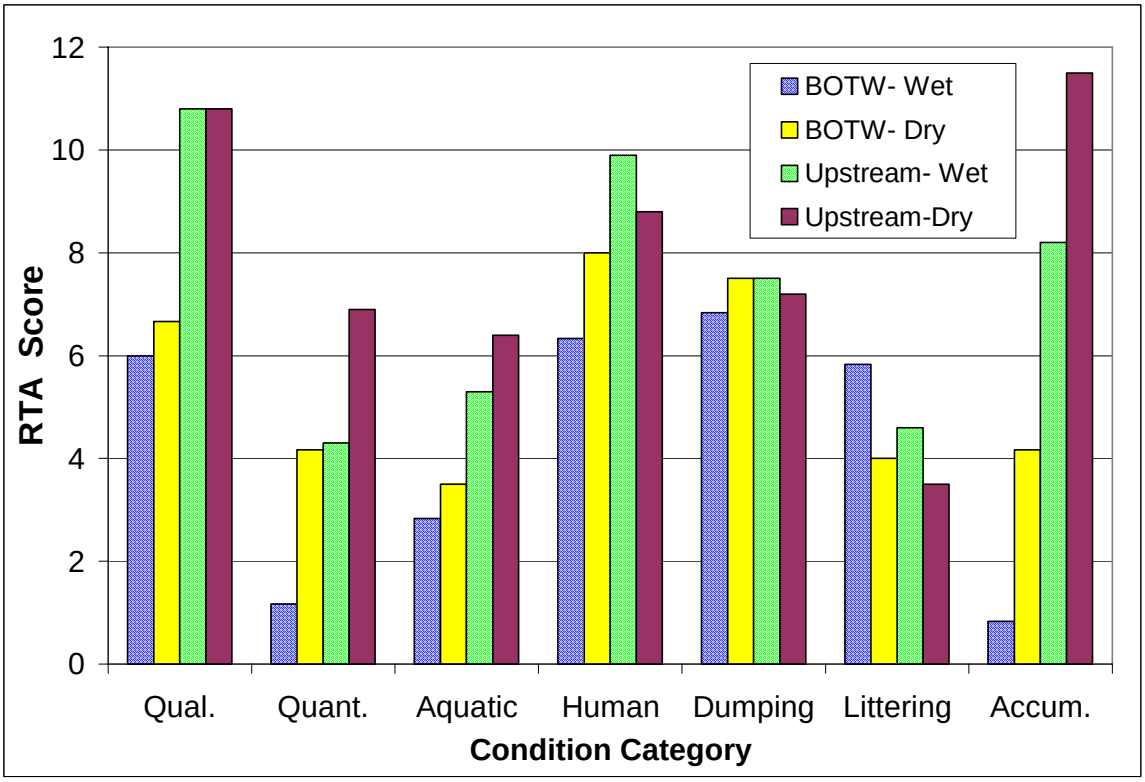

Figure 7: Average condition category scores from a subset of sites that were sampled during revisits that bracketed both and wet and dry seasons. Data are presented for both wet and dry season surveys from 6 BOTW sites and 10 upstream sites. Maximum RTA scores for all condition categories is 20, except littering and dumping which is 10.

Trash Deposition Rates

The monitoring design provided the opportunity to estimate trash deposition rates because trash was removed from 100-foot survey reaches during the initial site visit. Trash collected in the landmarked reach during subsequent surveys was assumed to have been deposited since the previous survey. Excluding initial site visits, the were a total of 67 site revisits (2-4 per site). A rate of deposition (pieces per reach per day) was calculated for all sites for wet and dry weather conditions, and ranked from highest to lowest (Table 1). Overall, the average trash deposition rate was 2.16 pieces of trash per 100-foot reach per day. Sites with high and low deposition rates are discussed in more detail below.

Wet Season Deposition

Very high trash deposition rates were generally associated with wet weather (Table 1), particularly at BOTW sites (listed in Table 2). Following the wet season, BOTW sites had a higher number of plastic pieces, indicating that this type of trash is more transportable in runoff events. The average number of plastic pieces found below the water line at BOTW sites, in all weather conditions, was 192 pieces per 100 feet. The

average number of plastic pieces found below the water line at non-BOTW sites was 57 pieces per 100 feet. Deposition rates also reflect the importance of upstream accumulation versus littering and dumping. The highest deposition rates tended to occur at sites that received low accumulation scores, indicating that most trash was deposited at these sites via accumulation from upstream transport (Figure 8). Based on condition category scores, littering and dumping was believed to be the dominant process resulting in trash deposition at only a few sites during the wet season.

Dry Season Deposition

Deposition rates were usually lower in the dry season than the wet season, generally below 1 piece of trash per day (Table 1, Figure 8). Several sites on small urban creeks in or near public parks, however, had some of the highest measured deposition rates in this study during the dry season (Figure 9). The high dry season deposition in these streams is most often associated with localized littering and dumping during the summer months (July-August), although some sites also receive some trash from upstream accumulation during this time period. Management priorities at these sites should focus on encouraging the proper disposal of trash in and around the stream.

TABLE 1

SAN FRANCISCO BAY REGION TRASH ASSESSMENT STUDY
SITES RANKED BY TRASH DEPOSITION RATE

Date	Rank	Location	Creek	City	Season (dry, wet)	Days between surveys	Trash Deposition Rate (pieces/100 ft.-day)
8/23/2005	1	Booker T. Anderson Park	Baxter Cr.	Richmond	d	76	8.66
11/19/2004	2	Booker T. Anderson Park	Baxter Cr.	Richmond	w	130	7.47
12/10/2004	3	Oak Glen Park	Glen Echo Cr.	Oakland	w	100	7.17
8/23/2005	4	Baxter Cr. below San Pablo Av.	Baxter Cr.	Richmond	d	76	6.36
12/10/2004	5	Strawberry Creek Park	Strawberry Cr.	Berkeley	w	114	5.61
11/7/2003	6	Washington @ McDowell	Washington Cr.	Petaluma	d	108	5.19
2/6/2004	7	Schollenberger Park	Petaluma R.	Petaluma	w	91	5.14
11/5/2004	8	Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito	d	116	5.03
8/23/2005	9	Lower Sausal Cr.	Sausal Cr.	Oakland	d	67	4.96
6/10/2005	10	Oak Glen Park	Glen Echo Cr.	Oakland	w	182	4.53
2/20/2004	11	Buchanan Park	Kirker Cr.	Pittsburg	w	210	4.30
1/27/2004	12	Washington @ McDowell	Washington Cr.	Petaluma	w	81	4.17
2/20/2004	13	Dow Wetlands	Kirker Cr.	Pittsburg	w	210	4.17
7/12/2004	14	Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito	d	108	4.11
2/13/2004	15	Gateway Park	San Mateo Cr.	San Mateo	w	116	4.10
12/3/2004	16	Lower Sausal Cr.	Sausal Cr.	Oakland	w	109	3.83
7/12/2004	17	Lower Codornices Cr.	Codornices Cr.	Albany	d	122	3.40
6/8/2005	18	Booker T. Anderson Park	Baxter Cr.	Richmond	w	201	2.92
11/7/2003	19	Schollenberger Park	Petaluma R.	Petaluma	d	108	2.90
7/12/2004	20	Booker T. Anderson Park	Baxter Cr.	Richmond	d	115	2.77
7/25/2003	21	Buchanan Park	Kirker Cr.	Pittsburg	d	128	2.71
3/12/2004	22	Lower Codornices Cr.	Codornices Cr.	Albany	w	300	2.70
11/5/2004	23	Lower Codornices Cr.	Codornices Cr.	Albany	d	116	2.47
12/10/2004	24	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	w	100	2.41
8/23/2005	25	Oak Glen Park	Glen Echo Cr.	Oakland	d	74	2.01
1/27/2004	26	Petaluma Factory Outlets	Petaluma R.	Petaluma	w	81	1.96
3/14/2004	27	Lower Permanente Cr.	Permanente Cr.	Mountain View	w	135	1.85
7/22/2003	28	Washington @ McDowell	Washington Cr.	Petaluma	d	124	1.85
8/23/2005	29	Canyon Trail Park	Baxter Cr.	El Cerrito	d	76	1.68
7/29/2003	30	Lower Permanente Cr.	Permanente Cr.	Mountain View	d	124	1.68
2/13/2004	31	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	w	116	1.58
6/8/2005	32	Baxter Cr. below San Pablo Av.	Baxter Cr.	Richmond	w	208	1.52
6/10/2005	33	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	w	182	1.43
6/17/2005	34	Lower Sausal Cr.	Sausal Cr.	Oakland	w	196	1.42
7/29/2003	35	Moss Rock	Stevens Cr.	Cupertino	d	124	1.38
8/23/2005	36	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	d	74	1.30
10/31/2003	37	Lower Permanente Cr.	Permanente Cr.	Mountain View	d	94	1.14
2/13/2004	38	Arroyo Court Park	San Mateo Cr.	San Mateo	w	116	1.11
6/8/2005	39	Canyon Trail Park	Baxter Cr.	El Cerrito	w	208	1.11
7/22/2003	40	Schollenberger Park	Petaluma R.	Petaluma	d	124	1.07
10/31/2003	41	Moss Rock	Stevens Cr.	Cupertino	d	94	1.03
8/20/2004	42	Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore	d	119	0.99
10/20/2003	43	Gateway Park	San Mateo Cr.	San Mateo	d	89	0.94
3/14/2004	44	Moss Rock	Stevens Cr.	Cupertino	w	135	0.93
10/7/2004	45	Gateway Park	San Mateo Cr.	San Mateo	w	237	0.86
11/7/2003	46	Petaluma Factory Outlets	Petaluma R.	Petaluma	d	108	0.85
8/23/2005	47	Dimond Park	Sausal Cr.	Oakland	d	67	0.84
7/23/2003	48	Gateway Park	San Mateo Cr.	San Mateo	d	124	0.79
12/3/2004	49	Dimond Park	Sausal Cr.	Oakland	w	109	0.72
8/18/2004	50	Strawberry Creek Park	Strawberry Cr.	Berkeley	d	159	0.70
1/27/2004	51	Penngrove Park	Lichau Cr.	Petaluma	w	81	0.64
2/13/2004	52	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	w	116	0.53
6/10/2005	53	Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore	w	294	0.53
7/23/2003	54	Arroyo Court Park	San Mateo Cr.	San Mateo	d	124	0.51
7/23/2003	55	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	d	124	0.51
7/25/2003	56	Dow Wetlands	Kirker Cr.	Pittsburg	d	128	0.45
11/7/2003	57	Penngrove Park	Lichau Cr.	Petaluma	d	108	0.37
10/20/2003	58	Arroyo Court Park	San Mateo Cr.	San Mateo	d	89	0.31
10/20/2003	59	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	d	89	0.29
7/23/2003	60	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	d	124	0.25
6/17/2005	61	Dimond Park	Sausal Cr.	Oakland	w	196	0.17
7/22/2003	62	Penngrove Park	Lichau Cr.	Petaluma	d	124	0.15
7/22/2003	63	Petaluma Factory Outlets	Petaluma R.	Petaluma	d	124	0.14
10/20/2003	64	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	d	89	0.13
8/23/2005	65	Joaquin Miller Park	Palo Seco Cr.	Oakland	d	67	0.04
12/3/2004	66	Joaquin Miller Park	Palo Seco Cr.	Oakland	d	109	0.04
6/17/2005	67	Joaquin Miller Park	Palo Seco Cr.	Oakland	w	196	0.03

TABLE 2

BOTTOM OF THE WATERSHED (BOTW)
TRASH MEASUREMENT LOCATIONS

Location	Water Body	City
Booker T. Anderson Park	Baxter Cr.	Richmond
Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito
Lower Codornices Cr.	Codornices Cr.	Albany
Strawberry Creek Park	Strawberry Cr.	Berkeley
Lower Glen Echo Cr.	Glen Echo Cr.	Oakland
Lower Sausal Cr.	Sausal Cr.	Oakland
Cesar Chavez Park	Peralta Cr.	Oakland
Arroyo Viejo Rec. Center	Arroyo Viejo	Oakland
Schollenberger Park	Petaluma R.	Petaluma
Dow Wetlands	Kirker Cr.	Pittsburg
Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore
Gateway Park	San Mateo Cr.	San Mateo
Lower Permanente Cr.	Permanente Cr.	Mountain View

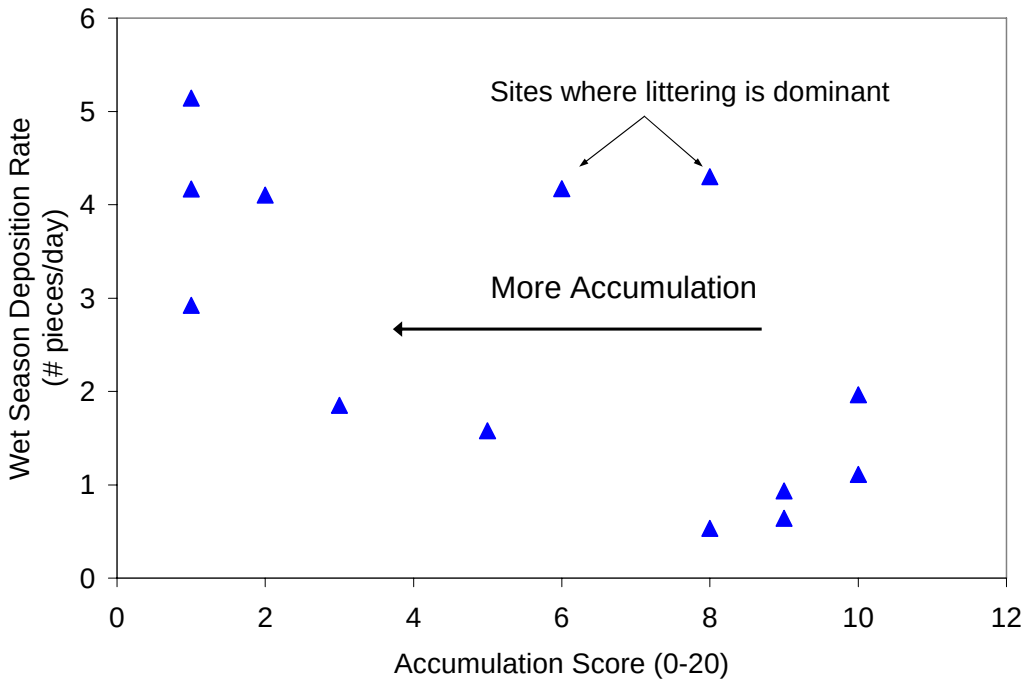

Figure 8: Wet-season trash deposition rates relative to the RTA accumulation score. As the accumulation score decreases (more accumulation) the deposition rates are higher, except at several sites where littering is responsible for high deposition rates during the wet season.

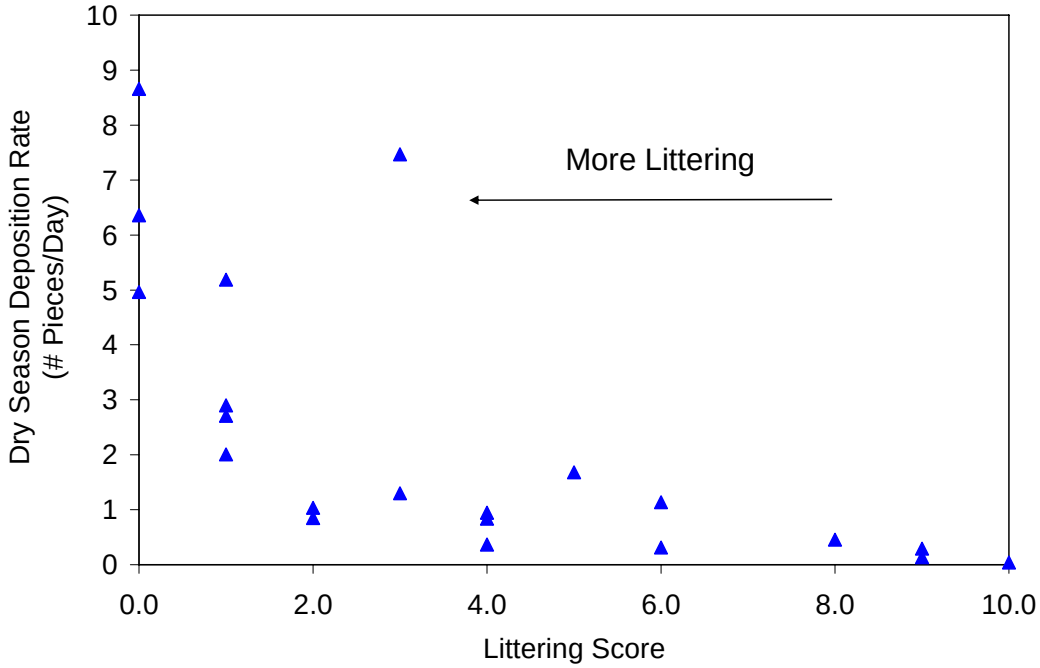

Figure 9: Dry season trash deposition rates relative to the RTA littering score. As the littering score decreases (more littering) the deposition rates are higher.

Case Studies- High Trash Deposition Rates

1. Booker T. Anderson Park, Baxter Creek

The two highest trash deposition rates recorded in the study occurred at the BOTW site of the Baxter Creek watershed in Richmond and El Cerrito. The initial site survey, prior to trash pickup, yielded the most pieces of trash per 100 feet of any survey conducted (1,133). This site absorbs the impact of trash delivered from upstream during storm events, but there is much evidence of local littering and dumping as well, which combine to result the highest rates of deposition recorded in the regional study.

The site is surrounded by residential areas. A stream restoration project several years ago removed concrete channel and planted riparian vegetation that is now well established (though at most 20' in width). There was evidence of park use during each survey, particularly on the east bank where there is grass, a playground, and a ball field. At the upstream end of the park is a culvert and a large pool. Many dumped items were observed in this pool, but it is not located within the 100-foot survey reach. The pool is at the edge of the park, along a road, with easy dumping access for vehicular traffic. Some of the dumped items were carried downstream, such as mattresses that were observed in the stream at the lower end of the park. Littering is prevalent here also, though trash cans and a dumpster are present. On the west side of the creek is a recreation center and a large parking lot. A street sweeper was observed cleaning the parking lot. The recreation center has a dumpster at the curb which probably prevents some large items from being dumped into the creek.

The highest trash deposition rate measured in this study occurred at this site during the dry summer months. Following site cleanup on June 8, 2005, 658 pieces of trash were collected on August 23, yielding a trash accumulation rate of 8.66 pieces of trash per day. Much of this trash was believed to have been directly littered (littering score = 0) in the stream at Booker T. Anderson Park. There was also evidence, however, of significant levels of trash coming from upstream sources (accumulation score = 2), even during summer baseflow conditions.

The second highest deposition rate (7.47 pieces/day) was recorded during the survey of November 19, 2004, soon after the first significant rain event of the season. Despite the trash removal associated with the first survey, the site received a lower RTA score during the November survey than the initial site visit. There were 543 plastic pieces of trash located below the high water line, and 33 above. The combination of significant downstream transport, with notable littering and dumping, makes the Booker T. Anderson site particularly unique.

Potential Management Measures

Trash is managed at this park, but the management activities are not successfully preventing littering or dumping. Many park patrons simply ignore the trash receptacles that have been made available. A major change in the behavior of park patrons and illegal dumpers is needed to improve the trash issue in Baxter Creek. Downstream transport is also a significant problem at Booker T. Anderson Park, however, so trash

management practices need to address the entire watershed. The next site upstream, where the creek runs under San Pablo Avenue, received a lower RTA score on November 12, 2004 than this site, due to extensive littering of food wrappers from nearby fast-food restaurants. The San Pablo Avenue site also had the fourth highest deposition rate measured in this study; 6.36 pieces per day were deposited during the summer dry season. The Baxter Creek watershed appears to be a significant source of floatable trash to the Bay, and warrants special attention. A progressive program of education, warnings, and penalties may be needed in order to achieve behavioral change. Given the ubiquitous nature of trash in this watershed, structural trash removal alternatives should be evaluated as well.

Figure 10: View looking upstream from Booker T. Anderson Park trash survey site (BAX030), showing dumped mattress and low fence above culvert at street crossing, upstream of park. Photo by Steve Moore, August 23, 2005.

2. Dow Wetlands, Kirker Creek

The lower portion of Kirker Creek flows in a realigned channel between the Dow Wetlands, a large, restored wetland on the edge of Suisun Bay, and the Dow Chemical industrial facility. The Dow Wetlands is commonly used by bird watchers, hikers, dog walkers, and school groups. Although a dirt road follows the creek along much of its length, the road is not open to public vehicular traffic.

Wet season deposition rates were extremely high (4.3 pieces/day), but dry season deposition was among the lowest recorded for BOTW sites (0.45 pieces/day). After the

initial trash collection effort, only 58 pieces of trash were deposited during the summer dry season. Even during the dry season, accumulation from upstream sources was judged to be the dominant source of trash, rather than local littering and dumping. During the subsequent wet season, 887 pieces of trash were deposited, all of which was judged to come from upstream sources. In both summer and winter, over 90% of the deposited trash was plastic pieces. Plastic pieces are buoyant, and are easily transported long distances. They accumulate at sites such as this one in low gradient channels near the mouths of watersheds.

Potential Management Measures

Although this site is open to public access, little or none of the trash at the site appears to come from littering. Dumping is not possible at this site because vehicular access is limited. Virtually all of the trash deposited at this site is plastic pieces that are efficiently transported from the streets of Pittsburg into the storm drain system. Management actions must focus on this conveyance system in order to remove trash before it enters the stream network.

3. Washington and McDowell, Washington Creek (Petaluma River)

The highest dry season trash deposition rate recorded in this study occurred at Washington Creek, at the corner of Washington and McDowell in the City of Petaluma. This is a very heavy vehicle traffic area, with an off-ramp from Highway 101, a busy intersection, a gas station, and a mall next to the creek at this station.

A concrete channel encloses the stream, with the top of the ~ 15’ tall southeast wall bordering the sidewalk adjacent to Washington Street. On the opposite bank is a plaza-style shopping mall. Dumpsters are located about 100 feet from the creek, with no enclosure. Directly north of the site, near the intersection, is a gasoline station. One dumpster is located behind the gas station in a concrete block enclosure with a semi-solid gate. A chain link fence separates the creek corridor from the gas station trash enclosure and the mall. The creek is accessible by climbing over the chain link fence (about 4’ high). At the upstream edge of the site the stream flows through a large culvert under a gas station and McDowell Avenue.

The dominant trash at this location was plastic wrappers, cigarette butts, paper, and aluminum foil or cans. An overflowing dumpster at the gas station and wind blown trash from the shopping center parking lot likely contributed most of the plastics and paper, much of which was above the high water line. During the summer survey, 59% of the pieces found above high water line were plastics. 62 of 92 plastic pieces found above the high water line were plastic wrappers. 46 of 157 (29%) pieces above the high water line were paper pieces. 130 of 233 (56%) total pieces were plastic in origin. The winter survey was dominated by plastic (291 of 338 pieces).

Potential Management Measures

The overflowing dumpsters and trash blowing off the large shopping mall parking lot combine to create a continuous loading of trash to this site. The implied message to the

public, due to the perpetually polluted condition, is that it is okay to dispose of solid waste into the creek. Unless nearby businesses improve their trash management, high rates of trash loading will continue. The public needs to be better educated about the harmful effects of disposing trash near water bodies. Education efforts should be followed up by regulation and enforcement.

4. Moss Rock, Stevens Creek

The Moss Rock site (STE100) is located at a roadside pullout in the steep and narrow Stevens Creek Canyon near Stevens Creek County Park. There is minimal upstream human land use, and no adjacent houses or urban land use.

Trash levels were fairly high (290 pieces) at the initial site visit in March, 2003. The vast majority of the trash pieces collected was littered beverage containers, including many broken glass bottles. Also collected in the stream were several hypodermic needles. Trash levels were lower during 3 subsequent visits (97-171 pieces), suggesting that some of the trash picked up during the initial visit was old, relict trash. Trash deposition rates were moderately high throughout the year (0.93-1.38 pieces/day), however, and littering scores and overall scores were consistently low. Based on the types of trash collected, the site is likely commonly used throughout the year as a recreation spot. Most of the trash was related to alcoholic beverages or snack food.

Potential Management Measures

This site is believed to be located on private property just outside of the County Park boundary, although there are no signs indicating if it is public or private property. Thus, many visitors to this site may unknowingly be trespassing. There are no trash receptacles at or near this pullout. There was evidence, however, that visitors deposited trash in a pile at a location near a fence separating the pullout from the creek, where a trash can was expected to be located. This site is used both for water recreation and picnicking, but the human health hazard posed by broken glass bottles and needles makes these two uses virtually incompatible. Installing and maintaining trash receptacles would encourage visitors to properly dispose of trash, making the site, as well as downstream sites in the County Park, safer for water contact recreation.

Case Studies – Low Trash Deposition Rates

1. Dimond Park, Sausal Creek

The assessment site is directly adjacent to the Dimond Park Recreation Center and Swimming Pool. The recreation center is frequently full of children using the jungle gym play area just upstream of the survey reach. There are many trash cans at the recreation center. Maintenance workers have been observed picking up trash on the grass lawn, near the creek. Friends of Sausal Creek are an active volunteer group that picked up trash at this site in May 2005, shortly before our June 2005 trash survey. Most of the trash found in the June 2005 survey was located in the vegetation on the bank opposite the recreation center, and not in the stream itself. Although most of the trash found at this

site comes from littering, management efforts appear to be adequate at keeping high levels of trash from entering the creek. The combined efforts of the recreation center staff, who actively manage trash on the recreation center property, and Friends of Sausal Creek, keep trash levels here lower than at sites in other public park settings. Although there is urban residential land use in the upstream watershed, very low levels of trash accumulate at this site from upstream sources.

2. Joaquin Miller Park, Palo Seco Creek (Sausal Creek)

Juaquin Miller Park is located near the top of the Sausal Creek watershed, upstream of Highway 13. While there is public access to the park, the trailhead is not well-marked. There are two trash cans and plastic bags available for dog waste at the small three-car parking area at the trailhead. This site may have less public use than many parks, which may explain the remarkably low levels of trash in the stream. Still, there is some evidence of littering, probably related to the use of the site by dog walkers and hikers. On one occasion, pet waste was found near the stream.

Figure 11: View of trash survey site on Palo Seco Creek in Joaquin Miller Park, Oakland, CA, showing no trash during dry season survey. Some dog waste was in the creek bed, lowering the RTA score from optimal due to the threat to human health. Photo by Steve Moore, August 23, 2005.

Longitudinal Trends Within Watersheds

To assess how trash levels varied along a longitudinal gradient (i.e., headwaters to mouth) in watersheds, multiple sites were monitored in four watersheds: San Mateo Creek, Petaluma River, Baxter Creek, and Sausal Creek. Overall, trash levels generally increased (and RTA scores decreased) in a downstream direction.

Because trash is removed during the assessments, we would expect RTA scores to increase and trash levels to decrease over successive sampling events. RTA scores tended to improve on subsequent visits at the upstream sites during the dry season, but conditions often worsened following the wet season, due to reintroduction of high levels of trash. BOTW sites exhibited less improvement following cleanup attempts, indicating very high levels of trash deposition throughout the year, though more significant during wet weather. In many cases, even after several assessments had been performed, trash levels returned to pre-assessment conditions following the winter season. These results suggest that picking up trash in streams is not an effective management approach in systems that receive high trash inputs. This also suggests that trash levels may be partly governed by the capture efficiency of channels; once the channel has reached its trash storage capacity, excess trash may be transported downstream.

1. San Mateo Creek Watershed

The San Mateo Creek watershed is a relatively narrow, urbanized watershed, with two main tributaries in the hillside portion of the city (Figure 1). Polhemus Creek drains a residential area, while upper San Mateo Creek runs along a roadway downstream of Crystal Springs Dam and minimal urban land use. Two sites were monitored in the urbanized bayshore plain (Arroyo Court Park (SMA060) and the BOTW site Gateway Park (SMA020)), and two sites were monitored upstream of the confluence of the two main tributaries.

The Gateway Park site, though not initially having the highest trash levels, had higher deposition rates of trash in subsequent surveys and hence lower RTA scores (Figure 12). Located 2 miles upstream of the Gateway Park site, the Arroyo Court Park site improved slightly following trash cleanup events, but winter flows delivered high levels of trash that lowered RTA scores. Dry season RTA scores were lower at the Gateway and Arroyo Court Park sites, due to direct littering into the stream at these publicly accessible sites. The Polhemus Creek (SMA110) site had the lowest initial score, but following cleanup it had the highest score in the watershed. Winter flows brought large levels of trash from the upstream residential area, however, significantly lowering the RTA score. The upper San Mateo creek site (SMA120) saw less return of trash with wet weather, due to less upstream sources.

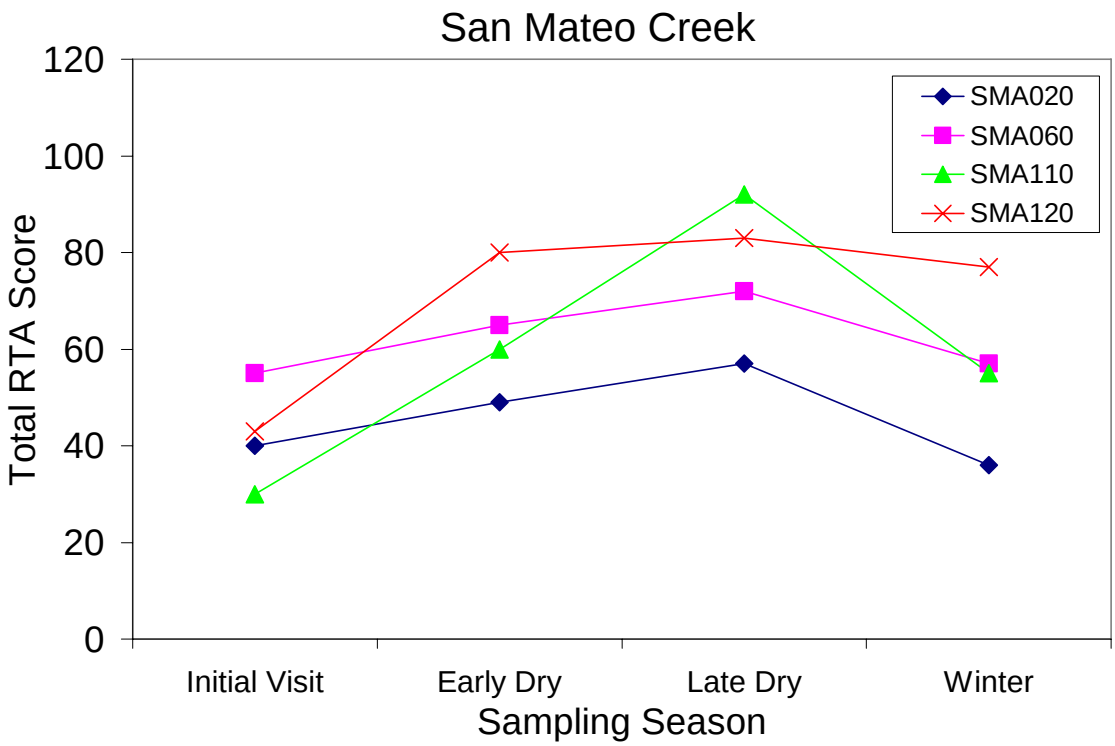

Figure 12: RTA Scores at four sampling sites in the San Mateo Creek watershed along a longitudinal gradient.

2. Petaluma River Watershed

The Petaluma River watershed is a broad, low gradient watershed with many small tributary creeks that flow into a large tidal slough, the Petaluma River (Figure 1). The land use is mixed urban, rural residential, and rangeland. The BOTW site is Schollenberger Park (PET100), located along a tidal shoreline downstream of the confluence of Petaluma River and Adobe Creek, and downstream of the City of Petaluma. The Petaluma Factory Outlets site (PET310) is the most downstream freshwater site on the Petaluma River. Sites located on small tributaries include Washington Creek (PET220) and Lichau Creek at Penngrove Park (PET400).

The Penngrove Park site had relatively low levels trash deposition in both dry and wet seasons, compared to other sites in the watershed. Trash at this site was predominantly legacy trash, as more trash was picked up during the first survey (45 pieces) than during the subsequent three surveys combined (38 pieces). The Factory Outlets site, which is publicly accessible but seldom visited, had low dry season deposition and very high wet season deposition during the winter.

The Washington Creek site, discussed above under Trash Deposition Rates, experienced high levels of trash inputs during the dry season. Although some trash accumulated from upstream sources during the wet season, overall this site appears to be a net source of trash to downstream waters. The adjacent shopping plaza, large paved parking lot, and

gasoline station with overflowing dumpster contributed high levels of litter to the stream and represents a trash source area that should be targeted in watershed-wide trash reduction efforts. During site surveys, wind was observed carrying plastic trash over a 4-foot cyclone fence separating the commercial land uses from the stream corridor.

A similar pattern was seen at the BOTW site in the tidal Petaluma River – indicative of both littering and accumulation in an area characterized by bi-directional flows and deposition on higher tides. The BOTW site in this watershed was unique due to the tidal characteristics and high dry season deposition rates. Management of trash at Schollenberger Park could be improved: trash receptacles are not located in a convenient place for use by the park visitors (trash cans are only located at the parking lot, not at the beach), and there is no evidence that the responsible jurisdiction is cleaning trash from the beach.

The Petaluma River watershed sites had lower scores at the end of the survey, following extensive cleanup, than the initial scores (Figure 13), suggesting that trash deposition is pervasive and watershed-wide management efforts are needed.

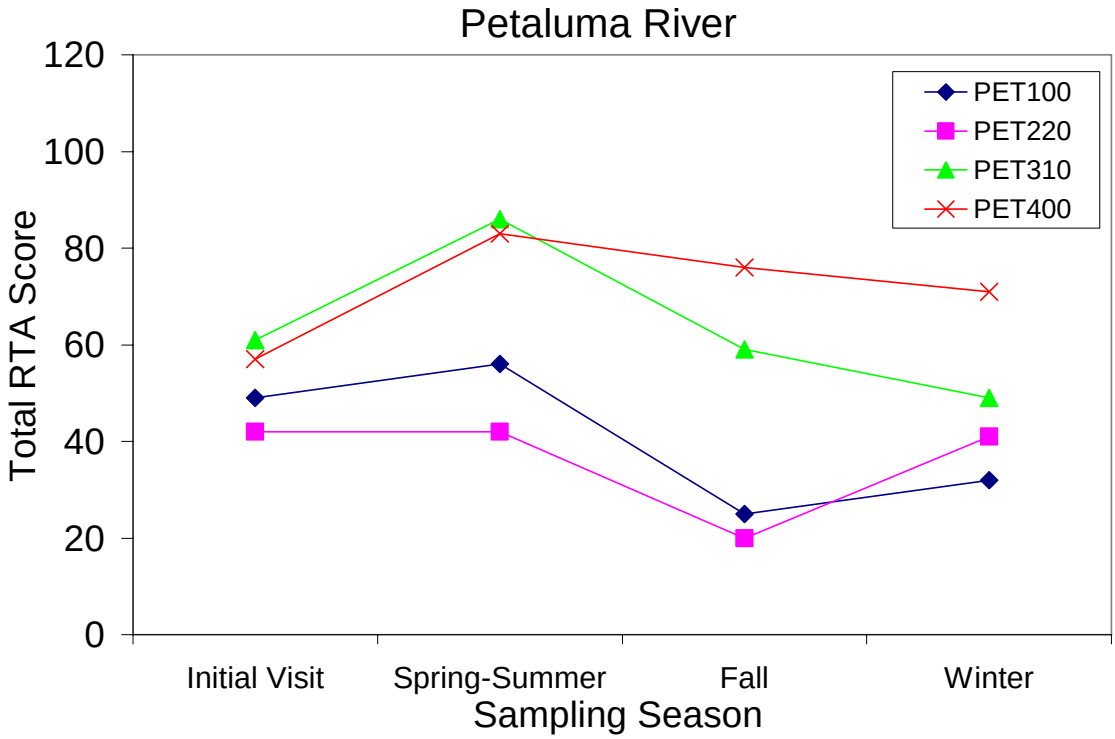

Figure 13: RTA Scores at four sampling sites in the Petaluma River watershed along a longitudinal gradient. PET100 is the lowest site, PET310 is upstream on the main branch, and PET220 and PET400 are the tributary sites. PET220 tributary (Washington Cr.) enters the main branch downstream of PET310. Except for PET400, the final scores are below the initial scores, indicating that trash levels may be getting worse in this watershed.

3. Baxter Creek Watershed

The Baxter Creek watershed is a small watershed with its headwaters in the hills of El Cerrito. It drains to San Francisco Bay through the City of Richmond, in a densely urbanized area (Figure 1).

The downstream site, at Booker T. Anderson Park (BAX030), exhibits extremely high trash inputs in both the dry and wet seasons. The consistently low RTA scores indicate a constant, high level of trash regardless of trash removal efforts and season (Figure 14). Similar problems were documented at the upstream site (BAX040), but there was less wet season deposition than at Booker T. Anderson Park. The site at Canyon Trail Park in the El Cerrito hills (BAX080) had higher RTA scores in both the dry and wet seasons, but the low to moderate scores (50-62) indicate that this site also experiences significant wet-weather and dry-weather trash deposition.

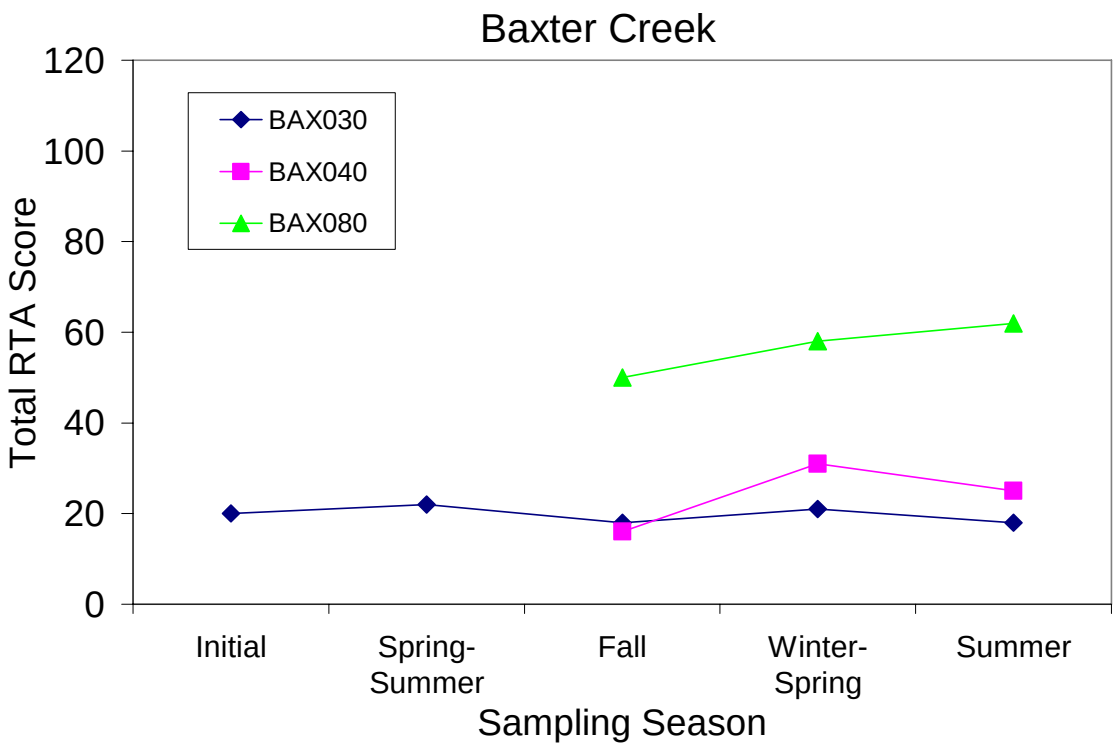

Figure 14: RTA Scores at three sampling sites in the Baxter Creek watershed along a longitudinal gradient. BAX030 is the downstream site, BAX040 is upstream at San Pablo Avenue, and BAX080 is at Canyon Trail Park, in El Cerrito.

4. Sausal Creek Watershed

The Sausal Creek watershed is a small watershed that begins in the hills above Oakland and drains through a dense urban landscape to the Oakland Inner Harbor (Figure 1). The active Friends of Sausal Creek group has elevated the visibility of the creek to the City

and the community, and effective cleanup and restoration projects have been implemented in this watershed.

The two upper sites in the watershed, Dimond Park (SAU060) and Joaquin Miller Park (SAU130), have the lowest deposition rates in this regional study (discussed above). The City of Oakland's Parks Department and local volunteers from the Friends of Sausal Creek actively manage and remove trash in Dimond Park. Scores at the Dimond Park site improved with successive site surveys; the highest RTA score was recorded at the last site visit during the summer season. The site on Palo Seco Creek in Joaquin Miller Park (SAU130) is publicly accessible, but upstream of most urban areas and not as frequently visited. This site serves as a regional "reference" site in this study because of the very low trash levels.

The downstream Sausal Creek site at East 22nd St. (SAU030) is heavily impacted by trash. The open channel upstream of the site appears to attract illegal dumping and littering, and adjacent landowners were observed dumping their household trash into the stream area. This area could be a focus for progressive education, warning and enforcement of existing littering laws.

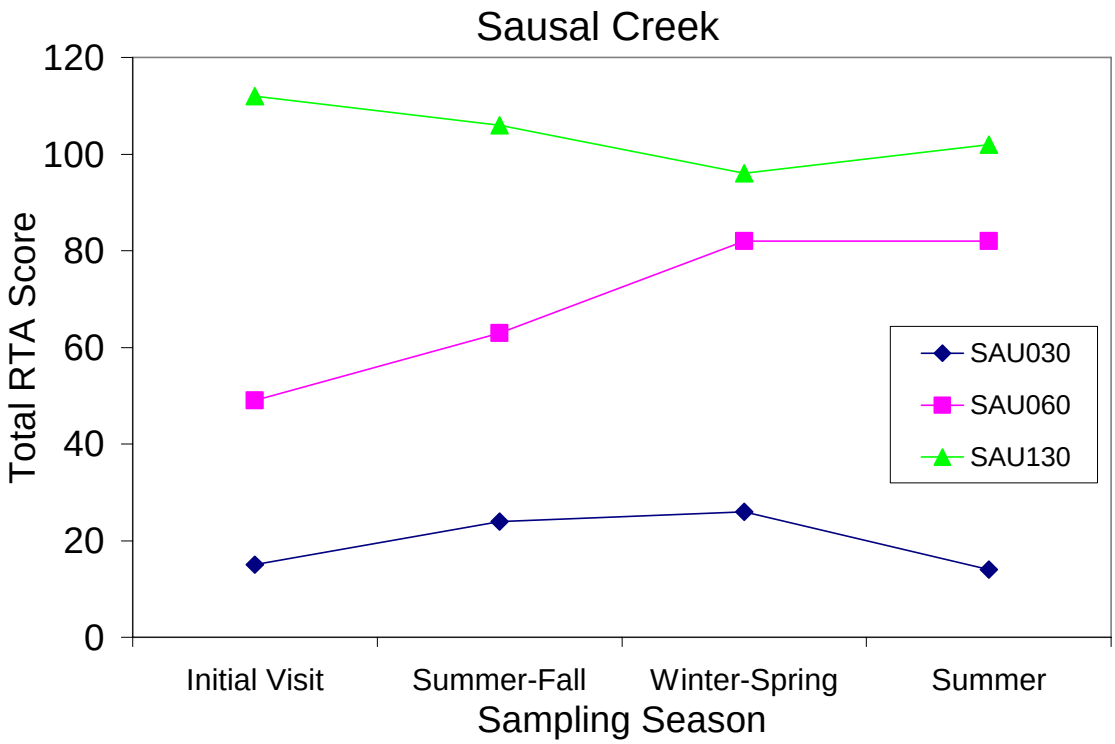

Figure 15: RTA scores at three sampling sites in the Sausal Creek watershed along a longitudinal gradient. SAU030 is the downstream site at E. 22nd Street, SAU060 is at Dimond Park, and SAU130 is on Palo Seco Creek in Joaquin Miller Park, all in Oakland, CA.

Conclusions and Recommendations

Levels of trash in the waters of the San Francisco Bay Region are very high, despite the fact that the Basin Plan prohibits discharge of trash and that littering is illegal with potentially large fines. Based on 93 surveys conducted at 26 sites throughout the Bay Area, we found an average of 2.88 pieces of trash per linear foot of stream channel. Following trash removal, there were very high return rates of trash, even during the dry season. Over the 2003-2005 study, an average of 2.16 pieces of trash were deposited in each study reach each day. There did not appear to be one county or region with higher trash levels, as high and low deposition rates were measured in each county surveyed. Rather, high trash levels were most common at lower watershed sites in urban areas, where both upstream accumulation and local littering was prevalent. Without an assessment method such as the one used in this study, people could draw the wrong conclusion that high trash levels at bottom of the watershed sites are due solely to localized littering. This study shows that these areas, which tend to have lower property values, are polluted cumulatively by the entire watershed.

In summary, the trash assessment data collected for this study using the Rapid Trash Assessment methodology confirms that:

- All watersheds studied in the San Francisco Bay region (Figure 1) have high levels of trash.

- Lower watershed sites tend to have higher densities of trash.

- Trash source hotspots near creek channels, usually associated with parks, schools, roads, or poorly kept commercial facilities, contribute a significant portion of trash that is deposited at lower watershed sites.

- Dry season deposition of trash is primarily associated with localized littering and dumping, wind-blown trash from nearby sources, and, at certain sites, accumulation from upstream sources due to dry season runoff.

- Wet season deposition of trash is primarily due to accumulation from upstream sources. This trash is predominantly plastic, especially at lower watershed sites, which suggests that urban runoff is a major source of floatable plastic found in the ocean and on beaches as marine debris.

- Parks that have more evident management of trash by City staff and local volunteers, including cleanup within the creek channel, have measurably less trash pieces and higher RTA scores. At sites that drain urban areas, however, trash can rapidly accumulate from upstream sources even in the absence of local littering and dumping.

The ubiquitous, unacceptable levels of trash in waters of the San Francisco Bay Region warrant a comprehensive and progressive program of education, warning, enforcement, and structural controls. Based on our informal discussions with members of the public, even the well-educated are unaware that storm drain systems are directly connected to streams and the Bay. It seems that the public do not grasp the risks associated with littering on streets that drain to waters, let alone in parks that have running streams. A more aggressive campaign for educating the public about the ultimate fate of litter is overdue.

Municipal jurisdictions should implement comprehensive trash management programs. Employees of parks and schools that pick up trash need to be instructed to pick up trash near and within streams, and equipped accordingly. Trash receptacles need to be placed near publicly accessible waters, with educational messages about marine debris and human health risks of trash. These receptacles need to be actively managed so they do not become a source of trash to waters. Curbside trash pickup and recycling can be a source of trash if containers are overflowing or not effectively storing debris.

Businesses need to do a better job of keeping trash associated with their operations from waters of the state. Styrofoam pellets were one of the most common and abundant types of trash surveyed and removed in this study, and the literature shows that they are long-lived and harmful to marine life (Marine Mammal Commission, 1996). They are most often used as packing and shipping materials. Businesses should be a target of education and then enforcement with respect to management of packing and shipping materials. Large amounts of these pellets were documented downstream of downtown Berkeley in Strawberry Creek, and this serves as an example of business contribution to the trash problem. This Styrofoam (303 pellets and 125 pieces in December 2004) could be coming from careless handling of packing materials and their allowance to enter the storm drains.

Similarly, dumpsters at gasoline stations such as the one at Washington St. and McDowell Blvd. in Petaluma should be identified and regulated as potential sources of trash to waters of the state. The adjacent shopping plaza at that location was an unmanaged, continuous source of litter and trash to waters of the state, regardless of season. These businesses need to be first educated and then regulated, preferably by municipalities as part of the municipal stormwater program, as potential sources of trash to streams, bays and the ocean.

Structural controls and treatments may be the most effective options for reducing trash inputs into water bodies in many areas. As with most issues, not every member of the public will follow littering rules, even if better educated about the harm litter can do to people and animals. Certain watersheds with chronic trash problems will warrant structural controls, as has been the case with the 303d-listed Lake Merritt in Oakland. Structural controls in the Los Angeles region have been effective at intercepting large amounts of trash from entering streams, bays and the Pacific Ocean. The results documented in this report suggest that the maintenance of structural controls should not be limited to wet weather loading events.

The Rapid Trash Assessment protocol has been shown to be useful in distinguishing trash levels in streams between sites, in determining trash deposition rates, in ranking sites, and determining whether significant deposition of trash occurs in the dry season, wet season or both. The RTA method examines the types of trash that have been deposited at a site, and allows for identification of sources. This approach is most useful for identifying the site-specific management actions that will have the most potential for reducing trash loading to streams. In many cases the results of the assessment confirmed what could be determined by visual observation. The benefits of using this rigorous protocol, however, include: (1) providing a systematic quantification and indexing of sites that can facilitate prioritization for pollution abatement, and (2) providing quantitative data on rates of trash deposition following initial clean-up efforts.

The RTA method does not directly measure loading of trash to downstream waterbodies. Given the observed high accumulation rates of trash resulting from winter floods, it is expected that even greater amounts of trash are delivered directly to downstream water bodies, including San Francisco Bay. Future efforts should focus on developing a monitoring approach for measuring transport rates of trash during flood events.

The San Francisco Bay Region has a problem with trash in streams and the Bay. This protocol has assisted the Water Board in understanding the sources, management issues, and the overall scope of the problem of trash in waters of the state. It is hoped that the protocol will be as useful in evaluating the success of management efforts yet to come.

Acknowledgements

Many staff members and student interns of the San Francisco Bay Regional Water Quality Control Board helped in the collection of trash data, including Carrie Austin, Glynnis Collins, Orrin Cook, Matt Cover, Patrick Evans, Terri Fashing, Kim Harrison, Jeff Kapellas, Alicia Mariscal, Steve Moore, Tom Ro, Daniella Rough, Anne Senter, Shelby Sheehan, Karen Taberski, Arnie Thompson, and Nelia White. Staff and volunteers from other agencies and organizations provided helpful comments on the protocol and helped in sampling, including Paul Randall and Linda Burkeley (EOA, Inc.), the Santa Clara Valley Urban Runoff Program, the Alameda County Clean Water Program, Friends of Five Creeks, and the San Pablo Creek Watershed Awareness Network.

Figure 16: Water Board staff remove a shopping cart from the Booker T. Anderson Park site on Baxter Creek. Photo by Kim Harrison, August 23, 2005.

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APPENDIX A

RAPID TRASH ASSESSMENT PROTOCOL

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

WATERSHED/STREAM: _____ DATE/TIME: _____
MONITORING GROUP, STAFF: _____ SAMPLE ID: _____
SITE DESCRIPTION (Station Name, Number, etc.): _____

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Level of Trash	On first glance, no trash visible. Little or no trash (<10 pieces) evident when streambed and stream banks are closely examined for litter and debris, for instance by looking under leaves.	On first glance, little or no trash visible. After close inspection small levels of trash (10-50 pieces) evident in stream bank and streambed.	Trash is evident in low to medium levels (51-100 pieces) on first glance. Stream, bank surfaces, and riparian zone contain litter and debris. Evidence of site being used by people: scattered cans, bottles, food wrappers, blankets, clothing.	Trash distracts the eye on first glance. Stream, bank surfaces, and immediate riparian zone contain substantial levels of litter and debris (>100 pieces). Evidence of site being used frequently by people: many cans, bottles, and food wrappers, blankets, clothing.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Actual Number of Trash Items Found	0 to 10 trash items found based on a trash assessment of a 100-foot stream reach.	11 to 50 trash items found based on a trash assessment of a 100-foot stream reach.	51 to 100 trash items found based on a trash assessment of a 100-foot stream reach.	Over 100 trash items found based on a trash assessment of a 100-foot stream reach.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Threat to Aquatic Life	Trash, if any, is mostly paper or wood products or other biodegradable materials. Note: A large amount of rapidly biodegradable material like food waste creates high oxygen demand, and should not be scored as optimal.	Little or no (<10 pieces) transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. Presence of settleable, degradable, and non-toxic debris such as glass or metal.	Medium prevalence (10-50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts Larger deposits (< 50 pieces) of settleable debris such as glass or metal. Any evidence of clumps of deposited yard waste or leaf litter.	Large amount (>50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, balloons, Styrofoam, cigarette butts; toxic items such as batteries, lighters, or spray cans; large clumps of yard waste or dumped leaf litter; or large amount (>50 pieces) of settleable glass or metal.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Threat to Human Health	Trash contains no evidence of bacteria or virus hazards such as medical waste, diapers, pet or human waste. No evidence of toxic substances such as chemical containers or batteries. No ponded water for mosquito production. No evidence of puncture and laceration hazards such as broken glass or metal debris.	No bacteria or virus hazards or sources of toxic substances, but small presence (<10 pieces) of puncture and laceration hazards such as broken glass and metal debris. No presence of ponded water in trash items such as tires or containers that could facilitate mosquito production.	Presence of **any one** of the following: hypodermic needles or other medical waste; used diaper, pet waste, or human feces; any toxic substance such as chemical containers, batteries, or fluorescent light bulbs (mercury). Medium prevalence (10-50 pieces) of puncture hazards.	Presence of **more than one** of the items described in the marginal condition category, or high prevalence of any one item (e.g. greater than 50 puncture or laceration hazards).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
5. Illegal Dumping	D: No evidence of illegal dumping. No bags of trash, no yard waste, no household items placed at site to avoid proper disposal, no shopping carts.	D: Some evidence of illegal dumping. Limited vehicular access limits the amount of potential dumping, or material dumped is diffuse paper-based debris.	D: Presence of **one** of the following: furniture, appliances, shopping carts, bags of garbage or yard waste, coupled with vehicular access that facilitates in-and-out dumping of materials to avoid landfill costs.	D: Evidence of chronic dumping, with **more than one** of the following items: furniture, appliances, shopping carts, bags of garbage, or yard waste. Easy vehicular access for in-and-out dumping of materials to avoid landfill costs.
Illegal Littering	L: Any trash is incidental litter (< 5 pieces) or carried downstream from another location.	L: Some evidence of litter within creek and banks originating from adjacent land uses (<10 pieces).	L: Prevalent (10-50 pieces) in-stream or shoreline littering that appears to originate from adjacent land uses.	L: Large amount (>50 pieces) of litter within creek and on banks that appears to originate from adjacent land uses.
D-SCORE	10 9	8 7 6	5 4 3	2 1 0
L-SCORE	10 9	8 7 6	5 4 3	2 1 0
6. Accum-ulation of Trash	There does not appear to be a problem with trash accumulation from downstream transport. Trash, if any, appears to have been directly deposited at the stream location.	Some evidence (<10 pieces) that litter and debris have been transported from upstream areas to the location, based on evidence such as silt marks, faded colors or location near high water line.	Evidence that (10 to 50 pieces) trash is carried to the location from upstream, as evidenced by its location near high water line, siltation marks on the debris, or faded colors.	Trash appears to have accumulated in substantial quantities at the location based on delivery from upstream areas, and is in various states of degradation based on its persistence in the waterbody. Over 50 items of trash have been carried to the location from upstream.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Total Score _____

SITE DEFINITION:

UPPER/LOWER BOUNDARIES OF REACH: _____

HIGH WATER LINE: _____

UPPER EXTENT OF BANKS OR SHORE: _____

_____

NOTES:

_____

_____

_____

_____

_____

_____

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

TRASH ITEM TALLY (Tally with (•) if found above high water line, and (|) if below)

PLASTIC # Above___ # Below____	**METAL** # Above___ # Below____
Plastic Bags	Aluminum Foil
Plastic Bottles	Aluminum or Steel Cans
Plastic Bottle Caps	Bottle Caps
Plastic Cup Lid/Straw	Metal Pipe Segments
Plastic Pipe Segments	Auto Parts (specify below)
Plastic Six-Pack Rings	Wire (barb, chicken wire etc.)
Plastic Wrapper	Metal Object
Soft Plastic Pieces	**LARGE (specify below)** # Above___ # Below____
Hard Plastic Pieces	Appliances
Styrofoam cups pieces	Furniture
Styrofoam Pellets	Garbage Bags of Trash
Fishing Line	Tires
Tarp	Shopping Carts
Other (write-in)	Other (write-in)
BIOHAZARD # Above___ # Below____	**TOXIC** # Above___ # Below____
Human Waste/Diapers	Chemical Containers
Pet Waste	Oil/Surfactant on Water
Syringes or Pipettes	Spray Paint Cans
Dead Animals	Lighters
Other (write-in)	Small Batteries
CONSTRUCTION DEBRIS#Above___#Below__	Vehicle Batteries
Concrete (not placed)	Other (write-in)
Rebar	**BIODEGRADABLE** # Above___ # Below____
Bricks	Paper
Wood Debris	Cardboard
Other (write-in)	Food Waste
MISCELLANEOUS # Above___ # Below____	Yard Waste (incl. trees)
Synthetic Rubber	Leaf Litter Piles
Foam Rubber	Other (write-in)
Balloons	**GLASS** # Above___ # Below____
Ceramic pots/shards	Glass bottles
Hose Pieces	Glass pieces
Cigarette Butts	**FABRIC AND CLOTH** # Above___# Below____
Golf Balls	Synthetic Fabric
Tennis Balls	Natural Fabric (cotton, wool)
Other (write-in)	Other (write-in)
Total pieces Above: **Below:** **Grand total:**	
Tally all trash in above rows; make notes below as needed to facilitate scoring.	
Littered:	
Dumped:	
Downstream Accumulation:	

SPECIFIC DESCRIPTION OF ITEMS FOUND:_____

_____

APPENDIX B

RAPID TRASH ASSESSMENT METHOD EVALUATION
OCTOBER 2002

Evaluation of the Rapid Trash Assessment Methodology

October 20, 2002

The rapid trash assessment methodology was developed by Steve Moore and Matthew Cover of the San Francisco Bay Regional Board's Surface Water Ambient Monitoring Program. The scoring system is based on the physical habitat evaluation forms associated with the federal and state guidance on rapid bioassessment. This methodology was developed with three goals: to be representative, sensitive, and objective.

To be representative, the generated scores need to represent an assessment of impairment of beneficial uses by trash. Beneficial uses affected by trash include aquatic life uses, water contact uses, and aesthetic enjoyment of waters. Also, the assessment methodology needs to consider how trash gets to the water body (direct dumping vs. accumulation in drainage systems) to represent an evaluation of management actions related to controlling dumping, littering, or accumulation of trash. The six trash assessment parameters of the methodology cover this range of issues associated with beneficial uses and management actions related to trash in water bodies. The assessment methodology has been structured to balance these issues in a scoring system, which we believe has achieved the necessary level of representativeness.

To be sensitive, the generated scores need to be able to distinguish light, medium, and heavy states of impairment of beneficial uses by trash at different sites and seasons. The overall score range of 0 to 120 should provide this sensitivity, where sites with scores of 60 +/- 15% can be distinguished in threat to beneficial uses from sites with scores of 80 +/- 15%.

To be objective, variability needs to be minimized. The generated scores by different teams on the same reach should not range too widely. The scores should not be more than 15% different than one another.

To evaluate sensitivity and objectivity of this methodology, three teams were deployed on the same day at four sites located along East Bay creeks. One site was located on Wilkie Creek, a tributary to San Pablo Creek in El Sobrante (next to a high school). Another site was located on Wildcat Creek in Alvarado Park in Richmond. These two sites were surveyed by Regional Board staff on August 14, 2002. Two sites were located on Sausal Creek in Oakland, at Dimond Park and at Barry Street (residential area), surveyed on August 20, 2002 by staff of the Regional Board and the Alameda and Santa Clara urban runoff programs.

Of these test sites, the two urban park sites are considered to be more actively "managed" for trash, with nearby trashcans and available park and volunteer personnel. The high school site and the residential site had no evident active management, and these sites had higher trash tallies. Therefore, in evaluating whether the assessment methodology is sufficiently sensitive, we believe the scores generated for the park sites should be statistically higher (more optimal) than the other sites.

TABLE 1
RAPID TRASH ASSESSMENT
RESULTS OF METHODOLOGY EVALUATION

				Trash Assessment Parameter Scores							Trash Item
Site	**Water Body**	**Date**	**Staff**	**1** Qual.	**2** Quant.	**3** Aq. Life	**4** Hum. Health	**5** Dumping	**6** Accum.	**Total Score**	**Tally Total**
Alvarado Park	Wildcat Creek	8/14/02	NW, GC	10	5	10	13	15	15	**68**	**55**
Alvarado Park	Wildcat Creek	8/14/02	SM, PE	14	4	9	10	8	15	**60**	**68**
Alvarado Park	Wildcat Creek	8/14/02	MC, KT	10	5	6	6	13	16	**56**	**50**
	Coefficients of Variation:			0.20	0.12	0.25	0.36	0.30	0.04	0.10	0.16
Anza School	Wilkie Creek	8/14/02	GC, MC	5	0	3	16	10	2	**36**	**334**
Anza School	Wilkie Creek	8/14/02	SM, PE	3	1	3	13	14	2	**36**	**140**
Anza School	Wilkie Creek	8/14/02	KT, NW	6	0	6	13	12	2	**39**	**444**
	Coefficients of Variation:			0.33	1.73	0.43	0.12	0.17	0.00	0.05	0.50
Dimond Park	Sausal Creek	8/20/02	GC, Alej.	13	0	11	20	15	15	**74**	**138**
Dimond Park	Sausal Creek	8/20/02	MC, PR	10	4	10	15	11	14	**64**	**70**
Dimond Park	Sausal Creek	8/20/02	SM, NW	8	4	9	10	13	14	**58**	**75**
	Coefficients of Variation:			0.24	0.87	0.10	0.33	0.15	0.04	0.12	0.40
Barry Street	Sausal Creek	8/20/02	MC, PR	2	1	5	10	6	8	**32**	**291**
Barry Street	Sausal Creek	8/20/02	NW, SM	3	1	3	12	5	9	**33**	**293**
Barry Street	Sausal Creek	8/20/02	GC, Alej.	4	0	5	11	6	10	**36**	**404**
	Coefficients of Variation:			0.33	0.87	0.27	0.09	0.10	0.11	0.06	0.20

The tallies and scores from the test assessments are summarized in Table 1. Overall, they demonstrate that the assessment methodology is sufficiently sensitive and objective to be useful in evaluating ambient conditions, trash management actions, and the effect of public access on trash levels. Except for two experienced staff persons, these test assessments were conducted mostly by staff with little or no experience, but some limited training in the use of the methodology. As such, the test assessment is a reasonable representation of what would be expected if a team of municipal employees or interested citizens conducted the assessment. The consistency of the scores in the test assessment underscores the confidence that Regional Board staff have in the methodology. Nevertheless, a few lessons were learned through this exercise and improvements made to create Version 6 of the Rapid Trash Assessment, discussed below.

As shown in Table 1, the total scores for the 4 sites were clustered closely, with some variability noted in individual trash assessment parameters. The exception was the Dimond Park site at Sausal Creek, with scores ranging from 58 to 74. During the field exercise, the staff discussed this difference and traced it to the variable human health score (20, 15, and 10). The key to the scoring difference was that one team noted the presence of a used diaper on the stream bank near the water, and others had mis-characterized it as paper or fabric waste. Also, some broken glass on the bank was noted by the team that scored a "15." This example shows the importance of identifying human health hazards, if any, and how the presence of one or two items can change the score significantly. The instructions have been modified accordingly, emphasizing that tallying can be estimated, but that bio-hazards must be carefully tallied to allow consistent scoring. All field staff agreed that the scores would have been less variable if all the teams had correctly identified the diaper.

Despite some variability between teams, the assessment methodology achieved the desired level of sensitivity. As hoped, the urban park sites had significantly higher scores than the unmanaged sites, demonstrating the desired sensitivity of the methodology. Alvarado Park (mean=61, CV=0.10) and Dimond Park (mean=65, CV=0.12) were clearly distinguishable from Anza School (mean=37, CV=0.05) and Barry Street on Sausal Creek (mean=34, CV=0.06).

In Table 1, the coefficient of variation (CV), which is the standard deviation divided by the arithmetic mean, expresses the variability of the scores and tallies of the rapid trash assessment. The CV overstates variability at the low end (scores of 0, 1, and 2), so the relatively high CVs associated with these scores for the quantitative level of trash (assessment parameter 2) can be ignored and the scores visually compared. For the overall score, a CV of 0.15 or less is desirable for demonstrating objectivity of the methodology. As discussed above, the only case where significant variability occurred was Dimond Park, and the variability was due to improper field identification of trash. As with the physical habitat evaluation associated with the rapid bioassessment procedures, such skills are expected to be acquired by a field technician through experience, and variability of that technician's scoring subsequently minimized.

The total trash tallies were substantially more variable than the assessment scores, as expected (Table 2). The rapid trash assessment procedure does not emphasize that these tallies be exact, but rather be used to help guide the assessment scoring by characterizing relative levels of different trash items and materials. Much of the variability in the overall tallies in Table 2 is ascribed to different teams' conventions of counting broken items as individual pieces or just as one item (e.g., a broken glass bottle). Additional guidance is now provided in Version 6 regarding conventions to be used for tallying "broken" trash items, rooted in the principle of exposure to fish, wildlife, or human users of the water body. Tallies less than 50 are expected to be less variable and with the additional guidance, we expect tallies to exhibit less variability than these test assessments.

TABLE 2
RAPID TRASH ASSESSMENT METHODOLOGY EVALUATION
TRASH ITEM TALLY RESULTS

Site	Water Body	Date	Staff	Trash Item Tally: Plastic in*	Plastic out*	Biohaz. in	Biohaz. out	Const. in	Const. out	Misc. in	Misc. out	Metal in	Metal out	Large in	Large out	Toxic in	Toxic out	Biodeg. in	Biodeg. out	Glass in	Glass out	Fabric in	Fabric out	TOTAL
Alvarado Park	Wildcat Creek	8/14/02	NW, GC	21	4	0	0	0	0	7	1	1	1	0	1	0	0	3	7	7	0	1	1	**55**
Alvarado Park	Wildcat Creek	8/14/02	SM, PE	11	19	0	2	1	1	7	3	0	1	0	5	0	0	10	3	2	0	0	3	**68**
Alvarado Park	Wildcat Creek	8/14/02	MC, KT	15	6	0	1	0	0	3	2	5	0	0	0	1	0	7	2	3	3	1	1	**50**
	Coefficients of Variation:																							0.16
Anza School	Wilkie Creek	8/14/02	GC, MC	192	87	0	0	3	4	14	0	3	6	0	0	0	0	8	13	1	1	1	1	**334**
Anza School	Wilkie Creek	8/14/02	SM, PE	21	69	0	0	11	4	7	0	3	3	0	0	0	0	3	19	0	0	0	0	**140**
Anza School	Wilkie Creek	8/14/02	KT, NW	200	147	0	0	3	4	1	17	7	8	0	0	0	0	10	46	1	0	0	0	**444**
	Coefficients of Variation:																							0.50
Dimond Park	Sausal Creek	8/20/02	GC, Alej.	8	88	0	0	0	0	2	2	5	4	0	0	0	3	23	0	0	0	3	0	**138**
Dimond Park	Sausal Creek	8/20/02	MC, PR	20	17	0	0	0	0	1	0	5	3	0	0	0	0	9	8	2	2	3	0	**70**
Dimond Park	Sausal Creek	8/20/02	SM, NW	16	25	0	1	6	0	2	1	2	3	0	0	0	0	6	9	0	0	3	1	**75**
	Coefficients of Variation:																							0.40
Barry Street	Sausal Creek	8/20/02	MC, PR	59	26	0	0	26	2	35	1	25	1	0	1	1	2	13	9	82	2	5	1	**291**
Barry Street	Sausal Creek	8/20/02	NW, SM	65	42	0	0	49	8	9	2	10	14	0	1	1	1	8	15	57	6	2	3	**293**
Barry Street	Sausal Creek	8/20/02	GC, Alej.	63	50	0	0	84	8	5	4	15	13	0	1	0	0	10	13	73	59	5	1	**404**
	Coefficients of Variation:																							0.20

* "in" refers to in-stream, and "out" refers to above high water line, but on banks or shore where transport to water body is probable.

The tallies above 50 do not have a significant effect on the scoring outcome, because the assessment parameter 2, actual number of trash items, allows a small range of 0-5 scoring for sites with more than 50 items. Resolution is not required at these higher levels of trash, but items that can substantially affect the score, such as large appliances or health-related items need to be tallied to ensure consistent and accurate scoring.

In applying the methodology, it has been SWAMP staff's experience that photography does not provide adequate illustration of trash conditions, unless there are large items or the photography is very close-up (but then it only represents a few square feet). Much of the trash that can affect aquatic life or human health is not visible in a digital photograph of a sampling site, due to vegetative cover and reflection of the water surface. Based on evaluations at over 40 sites, we have determined without exception that photography is less effective at documenting trash conditions than the Rapid Trash Assessment scoring methodology.

The Rapid Trash Assessment is less sensitive at the low end of the scoring range, corresponding to conditions commonly observed in the lower watersheds of urbanized areas. Based on SWAMP surveys conducted in 2002, many of the urban sites located in the lower portions of watersheds exhibit total scores below 40. It is difficult to distinguish conditions at these "trash hotspots," since this Rapid Trash Assessment methodology covers the range of conditions from optimal to poor. Since the urban areas that register "poor" scores tend to be of most interest in cleanup programs sponsored by local organizations and agencies, some concern has been expressed that a separate hotspot evaluation methodology may need to be developed, perhaps making more use of photography. A separate methodology may be necessary to demonstrate progress at the most impacted sites, but this methodology evaluation, utilizing independent assessment teams, has shown that the Rapid Trash Assessment can distinguish sites within urban areas that are receiving more trash management from areas that are not. In both examples evaluated, the urban parks had significantly higher scores than the sites that appear to receive little or no trash management.

APPENDIX C
RAW RTA TRASH SCORE DATA

				Trash Assessment Parameter Scores							
Date	**Station ID**	**BOTW**	**Park w/ High Public Access**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
				Qualitative	Quantitative	Aquatic	Human	Dumping	Littering	Accumulation	
3/19/2004	203BAX030	1	1	5	0	0	10	5	0	0	**20**
7/12/2004	203BAX030	1	1	9	3	1	2	3	0	4	**22**
11/19/2004	203BAX030	1	1	3	0	0	4	8	3	0	**18**
6/8/2005	203BAX030	1	1	8	1	3	5	2	2	0	**21**
8/23/2005	203BAX030	1	1	6	0	0	5	5	0	2	**18**
11/12/2004	203BAX040			0	0	0	3	8	0	5	**16**
6/8/2005	203BAX040			5	3	4	3	1	0	15	**31**
8/23/2005	203BAX040			5	1	1	4	0	0	14	**25**
11/12/2004	203BAX080			10	4	2	17	10	5	2	**50**
6/8/2005	203BAX080			15	4	5	13	10	9	2	**58**
8/23/2005	203BAX080			19	5	4	15	10	5	4	**62**
3/26/2004	203CER010	1	1	3	3	4	9	5	2	2	**28**
7/12/2004	203CER010	1	1	3	2	0	4	9	0	9	**27**
11/5/2004	203CER010	1	1	1	1	1	3	8	2	0	**16**
5/17/2003	203COD040		1	7	3	8	9	7	0	5	**39**
3/12/2004	203COD040		1	7	0	3	0	6	5	3	**24**
7/12/2004	203COD040		1	10	3	4	3	6	0	3	**29**
11/5/2004	203COD040		1	8	3	4	0	7	1	4	**27**
3/12/2004	203STW010	1		0	0	1	3	9	9	0	**22**
8/18/2004	203STW010	1		13	5	5	9	3	8	5	**48**
12/10/2004	203STW010	1		5	0	0	5	8	5	0	**23**
4/23/2004	204AMO080		1	10	10	7	19	10	4	8	**68**
8/20/2004	204AMO080		1	7	5	6	5	4	2	15	**44**
6/10/2005	204AMO080		1	8	1	5	15	4	1	14	**48**
7/19/2004	204AVJ020		1	3	2	1	4	7	2	2	**21**
9/1/2004	204LME100	1		10	4	3	5	3	0	3	**28**
12/10/2004	204LME100	1		14	4	3	10	9	8	2	**50**
6/10/2005	204LME100	1		13	3	3	8	3	8	3	**41**
8/25/2005	204LME100	1		10	6	7	10	10	3	7	**53**
9/1/2004	204LME130		1	7	2	4	3	3	2	10	**31**
12/10/2004	204LME130		1	10	0	3	0	8	4	0	**25**
6/10/2005	204LME130		1	14	0	3	0	10	9	2	**38**
8/25/2005	204LME130		1	7	5	5	9	10	1	9	**46**
7/19/2004	204PRL020	1	1	3	0	0	0	2	3	0	**8**
8/16/2004	204SAU030	1		0	0	0	0	7	0	8	**15**
12/3/2004	204SAU030	1		8	2	3	3	3	1	4	**24**
6/17/2005	204SAU030	1		8	4	2	2	2	5	3	**26**
8/25/2005	204SAU030	1		3	3	0	0	0	0	8	**14**
8/16/2004	204SAU060		1	9	5	4	10	10	1	10	**49**
12/3/2004	204SAU060		1	13	7	7	15	10	4	7	**63**
6/17/2005	204SAU060		1	19	13	9	15	10	8	8	**82**
8/25/2005	204SAU080			14	10	8	14	10	4	8	**68**
8/16/2004	204SAU130		1	20	19	19	15	10	9	20	**112**
12/3/2004	204SAU130		1	20	18	15	15	10	9	19	**106**
6/17/2005	204SAU130		1	20	18	14	10	10	9	15	**96**
8/25/2005	204SAU130		1	19	19	15	9	10	10	20	**102**
3/21/2003	204SMA020	1	1	11	0	8	6	9	4	2	**40**
7/23/2003	204SMA020	1	1	6	6	8	10	8	1	10	**49**
10/20/2003	204SMA020	1	1	10	4	10	13	6	4	10	**57**
2/13/2004	204SMA020	1	1	9	2	9	2	8	4	2	**36**
10/7/2004	204SMA020	1	1	11	4	4	9	10	0	15	**53**
3/21/2003	204SMA060		1	13	5	6	13	9	5	4	**55**
7/23/2003	204SMA060		1	14	9	9	10	10	7	6	**65**
10/20/2003	204SMA060		1	14	10	10	15	4	6	13	**72**
2/13/2004	204SMA060		1	12	5	9	9	7	5	10	**57**
3/21/2003	204SMA110			5	3	3	3	4	9	3	**30**
7/23/2003	204SMA110			11	9	6	13	7	9	5	**60**
10/20/2003	204SMA110			17	13	14	13	9	9	17	**92**
2/13/2004	204SMA110			11	4	4	14	9	8	5	**55**
3/21/2003	204SMA120			9	4	4	13	6	2	5	**43**
7/23/2003	204SMA120			16	13	10	15	10	7	9	**80**
10/20/2003	204SMA120			17	10	10	17	7	9	13	**83**
2/13/2004	204SMA120			19	9	7	18	9	7	8	**77**
3/27/2003	205PER010	1	1	6	2	2	13	9	5	1	**38**
7/29/2003	205PER010	1	1	6	3	2	13	10	5	2	**41**
10/31/2003	205PER010	1	1	9	7	4	4	9	6	8	**47**
3/14/2004	205PER010	1	1	10	3	5	7	9	10	3	**47**
3/27/2003	205STE100		1	12	3	9	11	7	1	14	**57**
7/29/2003	205STE100		1	9	4	9	3	8	1	15	**49**
10/31/2003	205STE100		1	15	6	6	8	10	2	5	**52**
3/14/2004	205STE100		1	14	5	9	1	5	10	9	**53**
3/20/2003	206PET100	1	1	7	3	2	19	10	7	1	**49**
7/22/2003	206PET100	1	1	10	5	3	19	10	5	4	**56**
11/7/2003	206PET100	1	1	7	3	0	7	5	1	2	**25**
2/6/2004	206PET100	1	1	6	1	0	9	10	6	0	**32**
3/20/2003	206PET220			5	4	3	15	9	4	2	**42**
7/22/2003	206PET220			3	3	3	14	9	1	9	**42**
11/7/2003	206PET220			0	1	0	10	3	0	6	**20**
1/27/2004	206PET220			7	3	0	15	10	0	6	**41**
3/20/2003	206PET310			10	8	8	13	9	9	4	**61**
7/22/2003	206PET310			15	14	14	14	10	10	9	**86**
11/7/2003	206PET310			9	7	5	9	9	2	18	**59**
1/27/2004	206PET310			8	4	4	14	8	1	10	**49**
3/20/2003	206PET400		1	9	8	6	14	9	9	2	**57**
7/22/2003	206PET400		1	16	14	13	12	6	5	17	**83**
11/7/2003	206PET400		1	18	12	7	9	10	4	16	**76**
1/27/2004	206PET400		1	14	10	9	10	10	9	9	**71**
3/19/2003	207KIR020	1		7	4	3	13	10	10	1	**48**
7/25/2003	207KIR020	1		10	10	6	17	9	8	5	**65**
2/20/2004	207KIR020	1		0	0	0	15	10	10	0	**35**
3/19/2003	207KIR110		1	9	2	3	7	8	1	7	**37**
7/25/2003	207KIR110		1	3	2	2	2	9	0	8	**26**
2/20/2004	207KIR110		1	8	2	3	3	7	0	8	**31**

APPENDIX D
FIELD VISIT AND TRASH COLLECTION HEALTH AND SAFETY SOPs

California Regional Water Quality Control Board, San Francisco Bay Region (Region 2)
Surface Water Ambient Monitoring Program (SWAMP)

Field Visit Health and Safety Standard Operating Procedure (SOP)
Version 2.0 2/27/2007

This document describes the health and safety procedures and equipment that SWAMP staff should follow for all field visits. The procedures below are in addition to what is specified in the SWAMP Quality Assurance Management Plan (QAMP) Appendix D and H (Puckett 2002).

1. All SWAMP staff and student technicians must receive, at a minimum, a 4-hour health and safety training and any appropriate refresher courses given by a certified industrial hygienist within the previous 12 months.

2. It is recommended that all personnel review the SWAMP Field Methods Training CD prior to any field visit.

3. Prior to visiting a site, permission to access the site should be obtained from the landowner or manager. Permission should be either in writing or verbal. Written permission documents should be on file at the office. Complete written notes should reference all verbal permissions granted.

4. Prior to visiting a site, a field reconnaissance form should be completed. This form contains the location and route to the nearest hospital, cell phone coverage information, 911 information, and specific site access information. A copy of this form should accompany the personnel visiting the site.

5. Prior to visiting a site, the field technicians' planned site visits, contact info, and schedule should be shared with at least one other staff member who will be working in the office during the site visit. The field crew will establish a time by which they will return to the office. If the crew has not returned by the appointed time nor made phone contact, the staff member in the office should attempt to contact the crew. If unsuccessful, the staff member in the office should notify the appropriate authorities in the area the field crew is working.

6. Site visits should always be performed by a minimum of two persons.

7. The following equipment should be on hand any time SWAMP field technicians perform a field visit:
   - First aid kit
   - Copy of field recon sheet
   - Information on nearby hospitals
   - Road maps
   - Cell phone with charger
   - Copy of access permission(s)

Reference

Puckett, M. 2002. Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program ("SWAMP"). California Department of Fish and Game, Monterey, CA. Prepared for the State Water Resources Control Board, Sacramento, CA. 145 pages plus Appendices.

California Regional Water Quality Control Board, San Francisco Bay Region (Region 2)
Surface Water Ambient Monitoring Program (SWAMP)

Rapid Trash Assessment (RTA) Health and Safety Standard Operating Procedures (SOPs)
Version 2.0 2/27/2007

This document describes the health and safety procedures and equipment that SWAMP staff should follow for all field work performed during the Rapid Trash Assessment (RTA) methodology. The procedures below are in addition to what is specified in the SWAMP Field Visit SOP, SWAMP Quality Assurance Management Plan (QAMP) Appendix D and H (Puckett 2002).

1. All SWAMP staff and student technicians must receive, at a minimum, a 4-hour health and safety training and any appropriate refresher courses given by a certified industrial hygienist within the previous 12 months.

2. The following equipment should be on hand, in addition to equipment specified in the Field Visit SOP:
   - Nitrile gloves
   - Heavy duty rubber or neoprene gloves
   - Puncture resistant gloves
   - Safety glasses
   - Hard hat
   - N-95 face masks
   - Heavy duty trash bags
   - Sharps disposal container
   - Hazardous waste disposal container
   - Trash litter pick-up tools (e.g. Nifty Nabber©, EZ-Reacher©)

3. Field technicians picking up trash should have current vaccinations for tetanus and hepatitis A and B.

4. During most RTA field visits sampling technicians are required to remove all trash items found at the site. Some trash items may pose a threat to the health and safety of field technicians. The following precautions should be followed:
   a. Appropriate protective gloves and safety glasses should always be worn when handling trash.
   b. When possible, trash should be picked up with the litter pick-up tool.
   c. When picking up uncontaminated sharp objects, such as glass or metal, puncture resistant gloves should be worn. Sharps should be stored in a sharps disposal container.
   d. Do not remove trash objects that are an unsafe weight or size to lift and carry.

e. Trash objects that are obviously hazardous, such as feces (human or other) and hypodermic needles, should only be removed by trained personnel. If an object poses a substantial health risk to people visiting the site, and it can be removed safely, the objects should be picked up using the trash litter pick-up tool and placed into a hazardous waste disposal container.
f. Many common household and construction materials found in trash may be hazardous, and should be disposed of separately as hazardous waste. These include fluorescent and high-intensity light bulbs and lamps (mercury), lighting ballasts (PCBs), thermostats (mercury), old pipes (lead), painted wood (prior to 1978: lead), batteries (heavy metals), transformers (PCBs), smoke detectors (metals), cleaning solutions, electronic equipment, and motor oil.
g. If crystalline material is noted on or in any container, the contents shall be considered to be a shock-sensitive waste and the container shall not be moved.
h. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled by trained personnel.
i. Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved.
j. Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials and should not be moved.
k. Drums and containers containing radioactive wastes shall not be handled or moved.
l. Report any suspicious, inappropriate or potentially hazardous waste dumping to appropriate authorities.

Reference

Puckett, M. 2002. Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program ("SWAMP"). California Department of Fish and Game, Monterey, CA. Prepared for the State Water Resources Control Board, Sacramento, CA. 145 pages plus Appendices.

APPENDIX 6A-6

MMP, 2001

LOWER SILVER CREEK WATERSHED PROJECT

UPDATED

MITIGATION AND MONITORING PROGRAM

Prepared by:

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Santa Clara Valley Water District
Coyote Creek Watershed Program
2471 Autumnvale Dr., Suite G
San Jose, California 95131

December 2001

Table of Contents

SECTION PAGE

Summary 1
1. Background and Purpose of this Update 2
2. Project Description 3
A. Location 3
B. Summary of Overall Project 3
1983 Recommended Plan 3
1998 Plan Update 3
2001 Plan Modifications 5
Cross-section Changes 5
C. Responsible Party 6
D. Jurisdictional Areas to be Filled 6
E. Type, Functions and Values of Jurisdictional Areas to be Filled 8
3. Goal of Mitigation 9
4. Success Criteria 11
A. Target Function and Values 11
In-Channel Corps Jurisdictional Habitat (Wetlands and Open Water) 11
Upland Trees and Shrubs 11
SRA and Riparian Habitat 12
Dedicated Conveyance Area 12
Vegetated Gabions 12
B. Target Hydrological Regime 12
C. Target Jurisdictional Acreages 12
5. Proposed Mitigation Site 13
A. Location and Size of Mitigation Area 13
B. Ownership Status 13
C. Existing Functions and Values of Mitigation Areas 13
D. Present and Proposed Uses of Mitigation Area 13
E. Present and Proposed Uses of Adjacent Areas 13
6. Implementation Plan 14
A. Rationale for Expecting Implementation Success 14
B. Responsible Party 14
C. Site Preparation 14
Site Design/Grading Plans 14
Soil Preparation 14
Irrigation Plans 14
Planting Areas 15
In-Channel Jurisdictional Habitat (Wetlands and Open Water) 15
Upland Plantings 15
SRA/Bank Riparian Habitat 15
Dedicated Conveyance Area 15
Vegetated Gabions 15
Planting Plans 16
Plant Procurement 16
Plant Installation 16

Table of Contents (Continued)

SECTION PAGE

Irrigation 16
Weed Control 16
Construction Inspection 19
Implementation Schedule 19
As-built drawings 19
Establishment period 20
Long-Term Maintenance 20
7. Monitoring Plan 21
A. Monitoring Methods 21
In Channel Corps Jurisdictional Habitat (Wetlands and Open Water) 21
Upland plantings 22
Bank riparian Habitat (and SRA) 22
Dedicated Conveyance Area 22
B. Long-Term Monitoring 23
C. Reports 23
D. Completion of Monitoring Period and Final Report 23
8. Contingency Measures 24
A. Remedial Action 24
B. Responsible Party 24
C. Funding Mechanism 24

Attachment 1: ..... Typical Cross-Sections for Reaches 1 through 6
Attachment 2: ..... Conceptual Revegetation Plans for Reaches 1 through 6

List of Tables and Figures

TABLES PAGE

Table 1: Corps Jurisdictional and CDFG (California Department of Fish and Game)-Jurisdictional Areas (acres) within Project Footprint [1] 7
Table 2: Plant List for Lower Silver Creek 17
Table 2: Plant List for Lower Silver Creek (Continued) 18
Table 3: Ultramafic Soil Adapted Species (for Reach 6) 19

FIGURES

Figure 1: Location Map 4

Summary

This updated Mitigation and Monitoring Program (MMP) addresses changes to the 1999 MMP prepared by the NRCS and is required by the 2001 Lower Silver Creek Plan Modifications. The updated MMP focuses on the creation of on-site jurisdictional waters and wetlands and on upland plantings. The goal of this MMP is to provide adequate compensation for project impact within the US Army Corps of Engineers jurisdictional waters and wetlands and to about 2 acres of upland trees and shrubs. All mitigation areas will be created on the project site as an integral part of the project design.

A main feature of the MMP is the creation of a minimum of 12 acres of jurisdictional waters (including wetlands) that will develop within a "sediment transport channel" sized to mobilize and transport sediment at an ecologically relevant frequency. It is the relatively frequent occurrence of erosion and deposition during storm events that will shape and reshape the area and over time lead to a channel in dynamic equilibrium that provides open water, floodplain and wetland habitat.

Other elements of this MMP are:

- Approximately 7 acres of upland habitat along the length of the project to add foraging habitat, nesting sites, cover and perches for wildlife and connect with the patches of vegetation existing upstream (at Lake Cunningham) and downstream (Coyote Creek).
- Revegetating the channel invert and slopes with desirable native species to provide erosion and weed control.

Also described in the MMP is the creation of approximately five acres of riparian and shaded riverine aquatic habitat (SRA) habitat mainly to provide shading to the base-flow channel and improve wildlife habitat conditions. The riparian/SRA habitat is an integral part of the Lower Silver Creek Watershed project. Because it is not associated with any project impact, it is not proposed as mitigation for this project but would be considered as an enhancement per the District's Policy E-1.

1. Background and Purpose of this Update

In February 1999, the Natural Resource Conservation Service (NRCS) submitted a Mitigation and Monitoring Program (MMP) for supporting the Lower Silver Creek Watershed Project individual permit application pursuant to section 404 of the Clean Water Act. Constraints identified during the detail design as well as suggestions made during coordination with the Regional Water Quality Control Board, pursuant to the section 401 Water Quality Certification have prompted the Santa Clara Water District (District) to make revisions to the design proposed in the 1999 application (known as the 1998 Plan Update). The project modifications required that the February 1999 Mitigation and Monitoring Program be updated.

This MMP addresses two specifically different requirements of the Project. The first requirement is of a regulatory nature and is to provide adequate compensation for the disposal of fill in waters of the US (per section 404 of the Clean Water Act) and associated wetlands, as well as, for the temporary loss of upland trees and shrubs along the creek (per section 1600 of the California Fish and Game Code). The second requirement is not required by environmental regulations, but is related to District Ends Policy E-1, that states that mitigation, enhancements, or restorations are implemented when determined appropriate by the District's Board. Therefore, the MMP includes additional environmental enhancement and created riparian habitat areas that are an integral part of this project and were approved by the District Board of Directors on December 19, 2000.

2. Project Description

A. Location

Lower Silver Creek, a 4.58-mile tributary of Coyote Creek, is located in the eastern portion of the City of San Jose and the adjacent unincorporated area of Santa Clara County (Figure 1 – Location Map).

B. Summary of Overall Project

A large portion of the Lower Silver Creek project area is urbanized and includes residential, commercial and industrial development. The current channel is man-made and has many bank stabilization and flood control features. It was constructed in the early 1950's as a means to reclaim wetland areas for agriculture around what is presently Lake Cunningham. Over the last 18 years, the Lower Silver Creek Watershed project underwent a number of changes as summarized below.

1983 Recommended Plan

In 1983, a watershed plan was prepared under the authority of the Watershed Protection and Flood Prevention Act. The lead federal agency was the NRCS (at that time known as the Soil Conservation Service), and participating local agencies were the District and Guadalupe Coyote Resource Conservation District. This plan is referred to as the 1983 Recommended Plan.

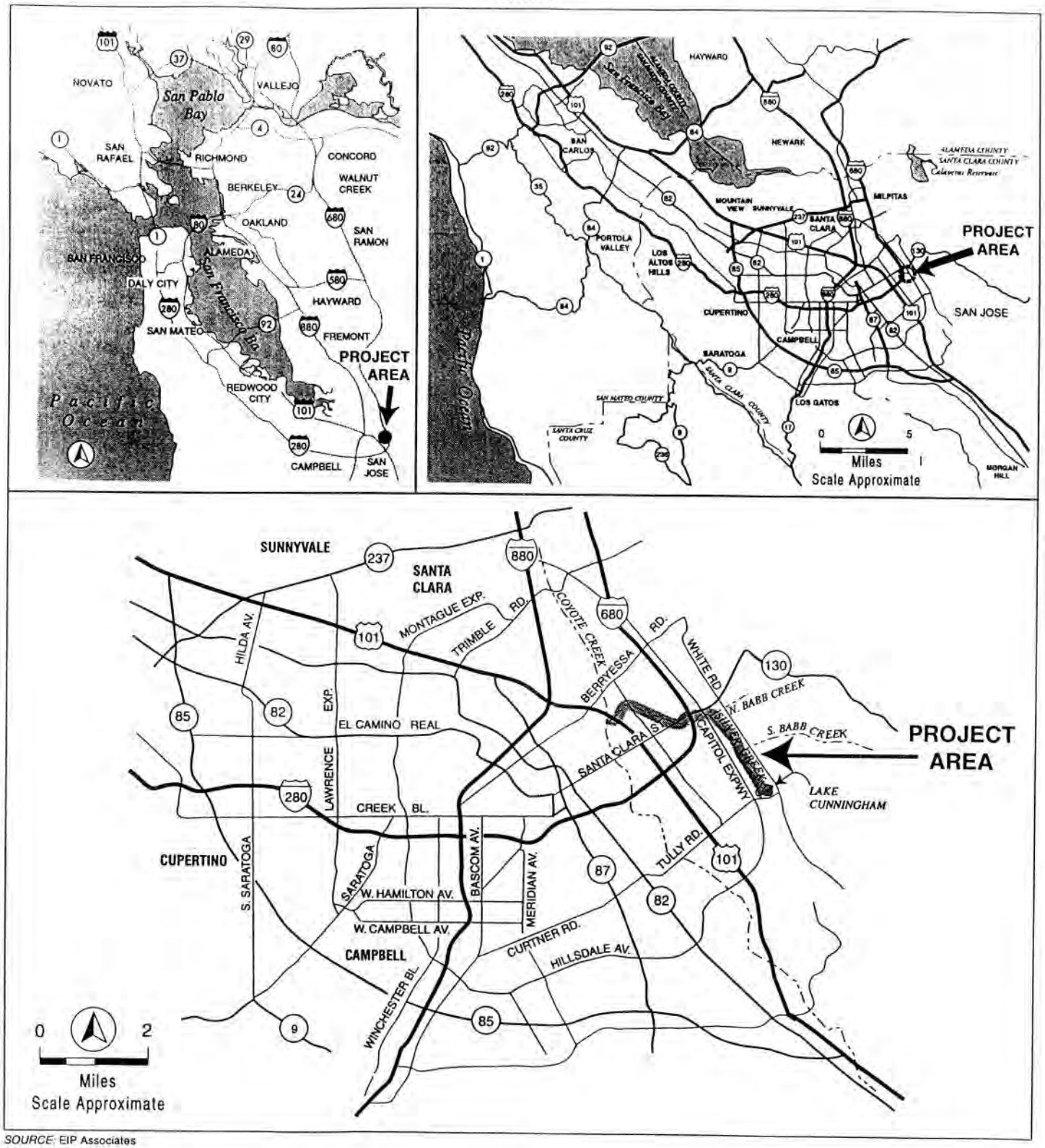
The project envisioned in the 1983 Recommended Plan consisted of approximately five miles of channel modifications, including approximately 0.9 miles of excavated earthen channel and over three miles of newly constructed or retrofitted concrete-lined channel.

In March 1991, the application for a U.S. Army Corps of Engineers (Corps) permit was withdrawn because of concerns expressed regarding the amount of concrete hardscape included in the project plan. Subsequently, the 1983 Recommended Plan was modified by taking into account environmental concerns from federal, state, and local resource and regulatory agencies, as well as, those of environmental groups.

1998 Plan Update

The 1983 Recommended Plan was subsequently modified by the 1998 Plan Update. The purposes and objectives of the 1998 Plan Update were the same as for the 1983 Recommended Plan, but incorporated the following mitigation measures and enhancements.

- Increase the amount of riparian and/or upland habitat along the sides of and in the Lower Silver Creek channel while continuing to provide the same level of flood protection;
- Make the channel potentially more attractive to fish by including a defined low-flow channel for all new channel work (does not include retrofitting existing structures that will not be modified), and the aforementioned riparian habitat potentially cooling the water;
- Improve the channel's visual appearance (i.e., reducing the amount of concrete channel);
- Reduce the amount of concrete channel compared to the 1983 Recommended Plan;
- Enhance the value of wetland vegetation.



SOURCE: EIP Associates

LOWER SILVER CREEK WATERSHED PROJECT
1998 PLAN UPDATE INITIAL STUDY/ENVIRONMENTAL ASSESSMENT

FIGURE 1: REGIONAL LOCATION MAP

2001 Plan Modifications

The 2001 Plan Modifications include changes to the general cross-sections as well as additional environmental enhancements. A complete description of the 2001 Plan Modifications is provided in the [draft] Addendum to the Initial Study/Negative Declaration and Environmental Assessment/Finding of No-Significant Impact (SCVWD 2001).

Cross-section Changes

As part of the 2001 Plan Modifications, the cross-sections along most of the creek would be altered by moving the maintenance road above the channel invert, thereby allowing for the construction of a sediment transport channel and the creation of a naturally formed base-flow channel in all earthen bottom channel sections. These modifications are described below and illustrated for each reach and sub-reach in typical cross sections provided under Attachment 1.

Maintenance Road. The 1998 Plan Update would be modified to construct the creek maintenance road above the channel invert rather than in the bottom of the channel. Removing the maintenance road from the channel bottom allows for the construction of the sediment transport channel.

Sediment Transport Channel. The 1998 Plan Update (NRCS 1998) included a "low-flow" channel throughout the length of the project and a maintenance road directly adjacent to the low-flow channel to provide stability and access for in-stream maintenance activities. During the design review process, these elements raised concerns about the susceptibility of the low-flow channel to excessive sedimentation and the stability of the maintenance road during storm events. A concern was also expressed over the absence of an effective means of transporting sediment downstream and the subsequent requirement for frequent sediment removal activities.

The design review led to the development of an alternative approach to the 1998 Plan Update low-flow channel design. The rationale for proceeding with this alternative approach was that it satisfied the same general objectives that the original design while incorporating a sediment transport channel sized to mobilize and transport sediment and a base-flow channel sized and formed by natural fluvial processes. Given the dynamic nature of Lower Silver Creek and the variability of the factors affecting the creek, it was decided that a design that takes advantage of fluvial processes to achieve ecological restoration would be more effective than a design that relies on structural means and regular maintenance.

The sediment transport channel and naturally formed base-flow channel approach actually depends on the natural processes of erosion, deposition, and sediment transport. In this regard, the short-term success of the proposed design is probably less predictable than that of the 1998 Plan Update. However, long-term success is much more likely for this process-based approach as the habitat that develops will be appropriately sized and distributed in Lower Silver Creek by the natural processes in the channel.

The sediment transport channel will be designed so that sediment will be mobilized during flow events with return intervals that are ecologically relevant (i.e. occur frequently enough to maintain habitat diversity and complexity). It is the relatively frequent occurrence of erosion and deposition during storm events that will shape and reshape the area during inundated and base flow conditions and over time lead to a channel in dynamic equilibrium that provides open water and wetland habitat. Large storm events will flow out of the sediment transport channel. This will dissipate the energy associated with these higher flows and help maintain a more appropriately sized open-water habitat area within the base-flow channel.

As shown in the attached cross-sections, the proposed design will be implemented in varying degrees to accommodate the range of right of way availability in each project sub-reach. It should be noted that the this design approach will be the most effective in areas with relatively wide right of way because a larger in-channel "floodplain" will allow more of the energy associated with high flows to be dissipated.

The sediment transport channel concept will be applied to all earth-lined sub-reaches. In concrete-lined sections (Reaches 2, 3b, 4a) a fixed low-flow channel will be designed to connect with the sediment transport channel so that base flows are uninterrupted. Where feasible, this concrete low-flow channel will be designed to optimize sediment transport in concrete-lined sections, However, the base flow will be interrupted as it runs into some concrete box culverts (i.e. King and McKee intersection, I-680, Story Road) or over concrete slabs (i.e. US-101). At these crossings, waters are expected to flow over the concrete surface and flow back into the sediment transport channel at the downstream end. Box culverts at Sunset Avenue, Alum Rock Boulevard, Jackson Drive and Capitol Expressway will be retrofitted during project construction to allow for continuity of base flows.

C. Responsible Party

The responsible party for this Mitigation Program is the Santa Clara Valley Water District, represented by Mr. Marc Klemencic, Assistant Operating Officer of the Coyote & Uvas/Llagas Watersheds Office of the District. This unit is located at 5750 Almaden Expressway, San Jose, California, 95118-3686.

Questions regarding technical aspects for this MMP should be directed to René Langis Ph.D., biologist for the Coyote Watershed Program, Santa Clara Valley Water District, 2471 Autumnvale Drive, San Jose, CA 95131, (408) 586-0110.

D. Jurisdictional Areas to be Filled

The project impacts to Corps and California Department of Fish and Game (CDFG) jurisdictional areas result mostly from grading and the reconfiguration of the six channel reaches, not from the placement of fill. A total of 4.7 acres of wetlands and 4.1 acres of open water are within the Corps' jurisdiction (Table 1). The wetlands within the project area occur exclusively inside the banks of Lower Silver Creek. Emergent wetland vegetation and other wetland plants are growing along the low-flow channel and at varied distances upslope. The limit of US Army Corps of Engineers (Corps) jurisdictional waters was determined by direct field observation and an analysis by USDA's Unit Hydrograph Model TR-20 for the @ 2.3 year discharge.

For base map showing Corps verified jurisdictional area(s) see companion report "Identification of Waters of the U.S. Jurisdictional Delineation" prepared by the NRCS (1998).

Table 1:
Corps Jurisdictional and CDFG (California Department of Fish and Game)-Jurisdictional Areas (acres) within Project Footprint [1]

	Area Delineated (ac.)	Area Impacted by Project (ac.)	Proposed Areas (ac.)	Mitigation Replacement Area ratio
CORPS JURISDICTIONAL AREAS				
Wetlands	4.7	4.7	—	
Waters (summer low flow)	4.1	4.1	—	
Total	8.8	8.8	12.7	1.4:1
CDFG JURISDICTIONAL AREAS				
Upland trees and shrubs[2]	2.0[2]	2.0[2]	2.0	1:1
Additional top-of-bank plantings			4.0	(landscaping feature)
Riparian/SRA[3]	0	0	5.0	(enhancement feature per District Policy E-1)
Total	2.0	0	11.0	

[1] From NRCS. 1998. Lower Silver Creek Watershed Project - Identification of Waters of the U.S. Jurisdictional Delineation.
[2] Definition and acreage revised from the 4.1 acres of riparian habitat reported in NRCS (1998) and 4.5 acres reported in 1983 EIR/EIS following field verification by the NRCS for the 1999 MMP.
[3] SRA: Shaded Riverine Aquatic Habitat.

E. Type, Functions and Values of Jurisdictional Areas to be Filled

Based on the jurisdictional wetland delineation, performed in July 1998, 8.8 acres of jurisdictional wetlands and waters of the United States were identified within the project area, 4.7 acres are wetlands and 4.1 are open water habitat (Table 1). The limit of jurisdictional waters was determined to be the elevation of the ordinary high water (OHW) line, calculated as the 2.3-year probability discharge of 1,340 cubic feet per second at the confluence with Coyote Creek and 700 cubic feet per second at Cunningham Avenue. According to the NRCS, numerous factors were used to determine the OHW line. Stream gauge data, flood history and frequency of inundation were analyzed. Field visits were undertaken to observe inundation, saturated soil, sediment deposition, watermarks and erosion. The corresponding elevations were then transposed to base maps. Construction of the Project would directly impact the all 8.8 acres of jurisdictional waters and wetlands surveyed within the right of way. See companion report "*Identification of Waters of the U.S. Jurisdictional Delineation*" prepared by the NRCS (1998).

Jurisdictional wetlands are typical of wetlands located in Santa Clara County channelized streams. Dominant wetland vegetation species reported during the 1998 wetland delineation included native erect emergent vegetation such as cattails (*Typha angustifolia, T. latifolia)* and hardstem bulrush *(Scirpus acutus)*, as well as a mix of non-natives and annuals. The non-native/annual mix is dominated by a variety of weedy, non-native annual and perennial grasses and forbs such as common smartweed (*Polygonum lapathifolium*), dotted smartweed (*Polygonum punctatum*), barnyard grass (*Echinochloa crus-galli*), rabbitfoot grass (*Polypogon monspeliensis*), Italian ryegrass (*Lolium multiflorum*), and cocklebur (*Xanthium strumarium*).

Functions and values of these wetlands are generally limited to water quality improvement and wildlife habitat for native and non-native species. Fish include the native prickly sculpin (*Cottus asper*) and three-spine stickleback (*Gasterosteus aculeatus*), as well as the non-native carp (*Cyprinus carpio*). Birds include great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), mallards (*Anas platyrhynchos*), American coots (*Fulica americana*), and gulls. Typical mammals include red foxes (Vulpes vulpes), raccoons (*Procyon lotor*), and muskrats (*Ondatra zibethicus*). These wetlands do not support any federally or state listed rare or endangered species. No recreational use, besides bird-watching, is known to occur along the project site.

There is no riparian habitat within the project area. The vegetation survey for Lower Silver Creek indicates that 2.0 acres of upland trees, shrubs and other plants are growing within the channel right of way. Because it is mostly man-made, it is doubtful that Lower Silver Creek ever had any quality riparian habitat. There are few trees existing along the creek at Plata Arroyo Park and Mayfair Park. These trees were presumably planted as part of the park landscaping and include a few eucalyptus and sycamores. Other reaches of the creek have scattered ornamentals species planted near apartments.

3. Goal of Mitigation

The goal of the mitigation for the Lower Silver Creek Watershed Project is to replace wetland habitat and upland vegetation affected by flood control construction with higher quality native plantings. The project also will provide erosion and weed control within the channel and banks, as well as, create some additional riparian habitat where appropriate in consistency with the District policy of improving the natural habitat when economically feasible.

The mitigation objectives for this project are:

- Create **12.7 acres** of jurisdictional wetlands and open water habitat within **the sediment transport channel**. Because the sediment transport channel and the naturally formed base-flow channel will be a dynamic element of the overall flood control channel, especially for the first few years after implementation of the project, it is difficult to predict the actual areas of emergent wetlands and open water habitat. The actual configuration of wetlands and open water will depend largely on the hydrology in the watershed after construction and erosion/deposition process, therefore several years might be necessary for the naturally formed base-flow channel to achieve a dynamic equilibrium. The naturally meandering base-flow channel will likely form within the sediment transport channel (which will vary between 20 and 60 feet in width depending on available right of way) following the general model of natural channel formation. Storm flows will erode and excavate bed materials from some locations of the sediment transport channel and deposit them in others and different species of wetland vegetation will colonize these "new surfaces", as they become available. Based on field observations and a recent District study (Rankin 2000), it is expected that emergent wetlands will colonize the appropriate areas of the sediment transport channel as early as one to two years after channel excavation.
- The District maintenance staff will need to control the establishment of woody vegetation (e.g. willows and box elders) in the sediment transport channel to meet the project's tight flood conveyance requirements. Removal of target woody vegetation would be combined with removal of invasive species, such as the giant reed (*Arundo donax)*, which might invade the newly established wetland areas. Removal of target vegetation would follow the methods and Best Management Practices (BMPs) described in the District Stream Maintenance Program (SMP). Target woody vegetation consists of native riparian species such as willows and box elders and non-natives such as eucalyptus. The woody riparian vegetation removed is comprised of seedlings and saplings no greater than 2" in diameter at breast height (at height of 48" dbh) for herbicide application and 6" for hand removal methods. Large stature, mature vegetation is not removed. Herbicide application and hand removal would be generally conducted once every year during the July 1st to October 15 period.

- Mitigate 2.0 acres of upland trees and shrubs to be removed during construction by establishing approximately **2 acres of self-sustaining native upland plantings**. When added to the approximately 4 acres of other top of bank native planting, this would provide a vegetated corridor along most of the length of the project that would add foraging habitat, nesting sites, cover and perches for wildlife as well as connect the ecological patches of riparian vegetation existing at Lake Cunningham and Coyote Creek. Self sustaining upland plantings are located in Reaches 1a, 1d, 3a, 3e, 3f and 6b will require a minimum of three years of irrigation. However in narrow sections, where upland planting areas will be cut-off from the groundwater table by floodwall foundations or gabions, permanent irrigation might be required. Upland plantings are expected to attain full canopy development within 10 to 15 years.
- Provide **erosion and weed control** by revegetating the channel slopes, gabions and floodplain with desirable native species. Prior to final revegetation, a hydroseed mix of grasses and forbs will be applied to the entire project area. However, as described under the first bullet, the sediment transport channel will be revegetated through volunteer wetland species.

As an added habitat enhancement, per District Policy E-1, the District would also create approximately five acres of shaded riverine aquatic habitat (SRA) and riparian habitat. SRA would be installed in all earth bottom reaches where flood conveyance capacity can accommodate the higher roughness associated with SRA plantings (i.e. Reaches 1, 3, 4, 5 and 6). The SRA will consist of a 5 feet wide bench of willows and cottonwoods located on the south/east [right] bank to optimize shading of the base-flow channel. In earthen channel sections, the SRA will be extended to the top of the bank forming a wider riparian habitat.

The SRA would shade the base-flow channel to lower heat gain, provide a source of energy input to the creek and provide low cover for wildlife moving along the creek corridor. The total area of SRA formed would be approximately 1.5 acres and the riparian habitat would reach approximately 4 acres. The SRA is expected to have a developed canopy within 5 years and depend on the existing ground water table instead of irrigation. Although not required to mitigate project impacts, the SRA/Riparian habitat would improve overall habitat value.

4. Success Criteria

A. Target Function and Values

In-Channel Corps Jurisdictional Habitat (Wetlands and Open Water)

The created jurisdictional habitat to be created within the active sediment transport channel will provide a highly dynamic system creating open water habitat within a continuous base-flow channel and wetland and emergent wetland habitat adapted to a variable microtopography. Sediment will be mobilized during storms and form sediment bars with sufficient varying elevations to result in an assemblage of emergent and non-emergent wetlands. Because the application of the sediment transport channel concept in a constricted urban setting such as Lower Silver Creek is innovative, success criteria will be linked to its main function, which is to effectively move sediment through the system while providing open water, floodplain and wetland habitat.

Non-native wetland species are diverse and common in Santa Clara County flood control channels and cannot be effectively controlled; therefore, weed control efforts will be concentrated on the more ecologically significant and invasive giant reed.

Final (Year 10) success criteria associated with the created jurisdictional habitat are:

- Open water habitat is provided within the base-flow channel along the entire project length, except under exceptionally prolonged drought conditions;
- Wetland vegetation with a dominance of obligate, facultative wetland or facultative plant species is established according to channel microtopography (except in severe drought years or following catastrophic flood event). These wetlands should establish over most of the channel area.

In addition, the following performance criteria are added to measure trends toward channel stability and establishment of appropriate wetland habitat:

- Channel sedimentation does not cause channel realignments that would jeopardize adjacent and downstream plantings on SRA bench and channel banks;
- Localized erosion or scour does not jeopardize the stability or function of SRA bench, channel banks and floodplain;
- The sediment transport channel will be kept free of significant stands of giant reed.

Upland Trees and Shrubs

- By year 5, all self-sustaining planted stock (trees and shrubs) must have either 70 percent survival or the revegetation sites must have an absolute woody vegetation canopy cover of 30 percent or greater within a specific sub-reach planting site.
- At year 10, the average absolute woody vegetation canopy cover of trees and shrubs must show a steady trend towards 70 percent or greater, and no less than 50 percent absolute woody vegetation canopy cover of trees and shrubs species is to occur at any revegetation site.

Because of some planting areas could be isolated from the groundwater table by floodwall foundations or gabions, permanent irrigation will likely be necessary to meet canopy cover goals are to be reached. In other areas, plants are expected to become self-sustaining three to five years after planting.

SRA and Riparian Habitat

80% (CDFG)

- By year 5, all self-sustaining planted stock (trees and shrubs) must have either 70 percent survival or the revegetation sites must have an absolute woody vegetation canopy cover of 30 percent or greater within a sub-reach planting site.
- At year 10, the average absolute woody vegetation canopy cover of trees and shrubs must show a steady trend towards 70 percent or greater, and no less than 50 percent absolute woody vegetation canopy cover of trees and shrubs species is to occur at any revegetation site.

Dedicated Conveyance Area

Although intended as native grass community, this habitat type will be regularly mowed to maintain design flood conveyance and is not expected to provide any specific wildlife use other than for food and loafing. The primary goal of the revegetation will be to provide erosion control in the higher flow, non-jurisdictional subsection. No mitigation credits are requested for these areas, therefore, no success criteria are proposed.

Vegetated Gabions

The primary goal of the vegetation on gabions is to provide higher aesthetic value and minimize heat reflection, therefore, no mitigation credits are requested from these plantings and no success criteria are proposed.

B. Target Hydrological Regime

Jurisdictional areas, as determined by the Corps' definition of the Ordinary High Water mark, should approximately correspond to the area of the sediment transport channel. The development of hydric soil conditions and establishment of wetland vegetation is dependent on ponding or water saturation. Therefore, the target hydrological regime will follow the Corps 1987 Wetland Delineation Manual definition of seasonal wetland hydrology as conditions that provide inundated or saturated soils for a minimum of 12.5 percent of the growing season (or 45 consecutive days) in most years.

Observations of Lower Silver Creek, conducted in October 2000, showed that water flows in the low-flow channel under dry conditions. Minimal flow measurements of 3 cubic feet per second were made at the upstream end of the project alignment and of 8 cubic feet per second at the confluence with Coyote Creek. To provide functional open water habitat and account for possible drought years, flowing water must be present in the base-flow channel for a minimum of 10 months in most years.

C. Target Jurisdictional Acreages

Target acreages for jurisdictional and non-jurisdictional areas are provided in Table 1.

5. Proposed Mitigation Site

A. Location and Size of Mitigation Area

This project is self-mitigating since mitigation measures (revegetated areas and sediment transport channel) are and integral part of the project. In consequence, the mitigation areas are distributed along the entire project footprint from the confluence with Coyote Creek to Lake Cunningham. Mitigation areas will cover a total area of approximately 24 acres.

B. Ownership Status

The mitigation areas are located within the Santa Clara Valley Water District's right of way except for limited areas of Reach 3 and Reach 6 where permanent easements or right of way would be purchased.

C. Existing Functions and Values of Mitigation Areas

Mitigation will be conducted on the project site. For description of functions and values under existing conditions see Section 2 E, Type, Function and Values of Jurisdictional Areas.

D. Present and Proposed Uses of Mitigation Area

The mitigation area is primarily used for flood control purposes. Under the Project, this area will continue to be used for flood protection but will also provide natural habitat functions as well as aesthetic and recreational values for residents of the east San Jose. Recreational values would however be subordinate to habitat goals as they would be limited to passive activities such as wildlife observation, nature walks, etc., from access areas such as Plata Arroyo Park and Mayfair Park. In addition it is anticipated that outdoor classroom activities would be conducted in creek-adjacent schools (i.e. Mathson Middle School, Ocala Middle School and Rogers Elementary).

E. Present and Proposed Uses of Adjacent Areas

The mitigation sites border residential, commercial, industrial and recreational properties (City Parks). No change in neighboring land uses is anticipated.

6. Implementation Plan

A. Rationale for Expecting Implementation Success

Wetlands and other jurisdictional areas will be established or reestablished within the existing project area under known hydrological and soil conditions. Information collected to this date indicates that conditions are favorable to a successful implementation of the mitigation project if appropriate installation measures are followed.

Hydrology data available at this time shows that hydrological conditions can adequately support the Project mitigation goals. Groundwater elevation is currently adequate to provide wetland hydrology along Lower Silver Creek. In addition, data collected in October 2000 indicates that there is sufficient surface water flowing in the creek during the dry season to maintain open water habitat year-round. Hydrological modeling results indicate that during a 1 percent flood event (100 year event), flow velocities would only be marginally erosive and therefore would be unlikely to cause substantial scour, even during the first few years following construction.

Preliminary engineering studies have shown that soils conditions along specific sections of the project alignment are less than ideal for planting. For example, soils in the lower part of Reach 1 and most of Reach 3 are characterized by dense and poorly drained soils. Dense soils can hamper root penetration resulting in shallow rooting systems. Many riparian species require deep roots to acquire water during dry periods. Without adequate amendments, plantings in this section are likely to exhibit stunted growth and high mortality. To improve planting area conditions, 2 to 4 feet of native topsoil will be removed and replaced with coarse topsoil. In addition, species known to be tolerant of clay soils will be selected for planting. Reach 6 soils have been shown to be ultramafic (i.e. possess severe calcium imbalances, high pH (up to pH 9.1), high magnesium, boron, and sodium). The plantable surfaces of Reach 6 will either require plants that are adapted to ultramafic soils as shown in table 3 or their soils will need to be improved through addition of topsoil, organic matter, and/or gypsum and sulfur as required. Other reaches of the project have acceptable soil conditions.

B. Responsible Party

The Santa Clara Valley Water District, represented by Mr. Marc Klemencic, Assistant Operating Officer of the Coyote & Uvas/Llagas Watersheds Office of the District would be responsible for implementing the mitigation project. Mr. Klemencic's unit is located at 5750 Almaden Expressway, San Jose, California, 95118-3686. He can be reached at (408) 265-2607, extension 2084.

C. Site Preparation

Site Design/Grading Plans

Design plans and grading details will be prepared as part of the final bidding package.

Soil Preparation

Soil preparation details will be prepared as part of the final bidding package.

Irrigation Plans

Detailed irrigation plans will be prepared as part of the final bidding package.

Planting Areas

In-Channel Jurisdictional Habitat (Wetlands and Open Water)

Jurisdictional habitat will be created exclusively within the sediment transport channel (see cross-sections, Attachment 1). Native emergent wetland species, such as those presented in Table 2, are expected to naturally colonize this area as well as locally common non-native species. To maintain the channel's flood capacity woody vegetation will not be allowed to establish in the sediment transport channel.

Upland Plantings

The upland revegetation sites will be planted along the top of the channel banks with a composition of plants species that are typically found between mid slope and top of the bank in the lower reaches of the Lower Silver Creek watershed. Plant species will be combined to form a complex structure including an overstory, midstory and understory canopies, where possible. The overstory will include trees such as valley and coast live oaks. The mid-story canopy would include box elder, buckeye and blue elderberry. Native shrubs such as California rose and Coyote brush will comprise the dominant understory.

In some space-restricted planting areas, where floodwalls are combined with gabions, such as along Reach 3c, 3d, most of reaches 4, 5 and 6, plantings would be limited to native grasses and/or shrubs such as snowberry or coffeeberry (in ultramafic soil areas) and will likely require permanent irrigation.

SRA/Bank Riparian Habitat

SRA and bank riparian habitat, which not offered for mitigation on this project but as an enhancement, will be located between the top of right bank and the toe of the slope. Plant species will be combined to form a complex structure of different canopy layers. Overstory plantings will include, California sycamore, coast live and valley oaks, and Fremont cottonwood. Mid-story layer will include box elders, California buckeyes, blue elderberries and arroyo willows. Mugwort, marsh baccharis, coyote brush, California rose, California blackberry common snowberry, and western asterwill dominate the understory.

The lower section of Bank Riparian Habitat (as well as limited section of gabion-lined reaches) will provide the SRA habitat and will be planted immediately adjacent to the sediment transport channel. The SRA habitat will provide shade and overlying cover to the sediment transport channel and the base-flow channel depending on location of meanders. Typical species will include Fremont cottonwood, willows, mugwort, and creeping wild rye.

Dedicated Conveyance Area

A section of the channel would be dedicated to conveyance and will be maintained to allow only short grasses and forbs through the application of a hydroseed mix including California brome, meadow barley, three-week fescue, and other herbaceous species appropriate to the watershed.

Vegetated Gabions

In sections where right of way constraints do not allow for earth-lined banks, gabions must be used to prevent bank failure. This area will be covered with native grasses and vines.

The conceptual cross-sections (Attachment 1) and the revegetation plans (Attachment 2) illustrate the typical location of each habitat type for each sub-reach. In most reaches, the top of bank tree canopy will be only one tree wide due to the right of way constraints. Wider corridors of trees and shrubs will be planted along reaches 1a, 1d, 3a, 3f and 6b.

The trees and shrubs are planted to shade the base-flow channel to help reduce heat gain between 10:00 AM and 3:00 PM and provide cover for fish. The vegetation would also provide a food source for invertebrates. Native emergent freshwater marsh vegetation is expected to colonize most of the sediment

transport channel, except for deeper areas of the base-flow channel. Trees and shrubs planted on top of banks and on the south bank slope will serve as a corridor for birds and small mammals between Coyote Creek and the upstream reaches through Lake Cunningham Park.

Soil analyses revealed interleaved high clay and coarse loam or sand along portions of several reaches. These soils are most susceptible to compaction by grading equipment. Heavy equipment will be kept away from planting locations where topsoil or soil amendments have been introduced over the graded surface, or where planting wells have been prepared. This is to avoid either compaction or unwanted dispersal of topsoil.

Areas disturbed during site preparation will be seeded with a native seed mix, mulched with straw, or treated with erosion control blankets.

Planting Plans

Plant Procurement

The container stock to be installed will be contract grown. Efforts will be made to collect all propagules, first, from the Lower Silver Creek watershed at sites similar to the mitigation areas and, second, from adjacent drainages within the Diablo Range drainage of Santa Clara County, if sufficient supply of propagules for a particular species is not available. Seeds and cuttings will be collected approximately one year prior to installation to allow sufficient time for plants to grow. Plant collection and growth would be monitored by qualified biologists to ensure that healthy and vigorous plants are installed.

A list of proposed plant species is presented in Table 2. In addition, Table 3 presents a list of species that are adapted to the ultramafic soils (calcium imbalanced, high pH, high magnesium) of Reach 6.

Plant Installation

The size of the plant materials to be used will range from seed, rooted and unrooted cuttings, *treepots (4-inch by 14-inch)*, *deepots (2.5-inch by 6-inch)* and *treeband (2.25-inch by 5-inch)* container stock. Willow fascines, brush layering, joint planting and other soil bioengineering techniques will be used, where appropriate, to stabilize and vegetate earth channel banks. Trees, shrubs and groundcovers will be established along the tops of banks and along the south-side slope down to the sediment transport channel, as directed by the plans. Conceptual planting plans are presented in Attachment 2. Final planting plans, details, specifications, cost estimates and detailed mitigation maintenance and operation plans will be prepared concurrently with the preparation of the phased structural construction drawings.

Plants will be installed in fall or spring following channel excavation. Planting holes will be irrigated before and after planting. Amendments will include the addition of coarse textured soils in Reach 1a. A 3-foot diameter irrigation basin with a 4-inch high lip will be constructed around each plant. The proposed planting density is 450 trees and shrubs per acre, which is an average density for comparable restoration sites given soil and water conditions. Some herbaceous species will be planted at a density of 650 planting basins per acre. Relative amounts of each species will be determined as part of the preparation of plans and specifications.

Irrigation

Plants will be irrigated with a sub-surface system to avoid potential damage by rodents and vandals. Although efforts will be made to promote self-sufficiency within 2 to 3 years, specific structural constraints, such as the presence of floodwall or gabions may dictate the use of permanent irrigation for upland plantings.

Weed Control

Weeds around individual trees and shrubs will be controlled with wood chips or rice straw mulch or weed control fabric. Mulch will be applied so that it does not contact plant stem. Outside of planting basins,

weeds will be controlled by mowing, post emergent herbicide, hand pulling or a combination thereof. Care will be taken to avoid damage to native woody species that may colonize the gap between plantings.

Table 2:
Plant List for Lower Silver Creek

Scientific Name	Common Name	Habitat / Plant Association
Trees:		
Acer negundo	Box elder	Upland/Riparian: Bank and Top of Bank
Aesculus californica	California buckeye	Upland/Riparian: Bank and Top of Bank
Platanus racemosa	California sycamore	Riparian: Bank
Populus fremontii	Fremont cottonwood	Riparian: Bank and SRA
Quercus agrifolia	Coast live oak	Upland/Riparian: Bank and Top of Bank
Quercus douglasii[1]	Blue oak	Upland/Riparian: Bank and Top of Bank
Quercus lobata	Valley oak	Upland/Riparian: Bank and Top of Bank
Salix exigua	Sandbar willow	Riparian: SRA
Salix laevigata	Red willow	Riparian: SRA
Salix lasiolepis	Arroyo willow	Riparian: SRA
Sambucus mexicana	Blue elderberry	Riparian: Bank and Top of Bank
Umbellularia californica	California bay	Upland/Riparian: Bank and Top of Bank
Shrubs and Vines:		
Artemisia californica[1]	California sagebrush	Upland/Riparian: Bank and Top of Bank
Artemisia douglasiana	Mugwort	Riparian: Bank
Aster chilensis	Western aster	Riparian: Bank
Baccharis douglasii	Marsh baccharis	Riparian: Bank
Baccharis pilularis	Coyote brush	Upland/Riparian: Bank and Top of Bank
Baccharis salicifolius[1]	Mule fat	Upland/Riparian: Bank and Top of Bank
Prunus ilicifolia[1]	Holly-leaf cherry	Upland/Riparian: Bank and Top of Bank
Rosa californica	California rose	Upland/Riparian: Bank and Top of Bank
Rubus ursinus	California blackberry	Riparian: Bank
Symphoricarpos albus var. *laevigatus*	Common snowberry	Riparian: Bank
Symphoricarpos mollis[1]	Creeping snowberry	Upland/Riparian: Bank and Top of Bank

Table 2:
Plant List for Lower Silver Creek (Continued)

Scientific Name	Common Name	Habitat / Plant Association
Grasses and Forbs:		
Bromus carinatus[1]	California brome	Hydroseed Mix
Hordeum brachyantherum[1]	Meadow barley	Hydroseed Mix
Leymus triticoides[1]	Creeping wild rye	Riparian: SRA and Bank
Lupinus succulentus[1]	Arroyo lupine	Hydroseed Mix
Nassella lepida	Foothill needlegrass	Riparian: Bank/Gabions
Nassella pulchra	Purple needlegrass	Riparian: Bank/Gabions
Satureja douglasii[1]	Yerba buena	Riparian: Bank/Gabions
Vulpia microstachys[1]	Three week fescue	Hydroseed Mix
Wetland / Aquatic Species:		
Typha angustifolia[2]	Narrow leaf cattail	Emergent Wetland
Typha latifolia[2]	Broad leaf cattail	Emergent Wetland
Scirpus acutus var. occidentalis[2]	Common tule	Emergent Wetland
Scirpus californicus[1, 2]	California bulrush	Emergent Wetland

[1] Additions to MMP plant list (NRCS 1999)
[2] These species are expected to volunteer

Table 3:
Ultramafic Soil Adapted Species (for Reach 6)

Scientific Name	Common Name	Habitat/Plant Association
Shrubs		
Ceanothus cuneatus	Buckbrush	Riparian: Bank and Top of Bank
Rhamnus californica[3]	Coffeeberry	Riparian: Bank and Top of Bank
Toxicodendron diversilobum[3]	Poison oak	Riparian: Bank and Top of Bank
Grasses and Forbs		
Eschscholtzia californica[3]	California poppy	Riparian: Bank and Top of Bank
Festuca californica[3]	California fescue	Riparian: SRA, Bank and Top of Bank
Wetland/Aquatic Species		
Hordeum brachyantherum[3]	Meadow barley	Seasonal Wetland
Juncus balticus[3]	Baltic rush	Seasonal/Emergent Wetland
Juncus xiphioides[3]	Iris-leaved rush	Emergent Wetland

[1] Species with local or regional preference for ultramafic soil substrates in California according to Kruckeberg (1984).
[2] Serpentine endemic species with the highest fidelity to grow on ultrabasic substrates according to Kruckeberg (1984).
[3] Bodenvag plant species, taxa indifferent to serpentine substrates confirmed by Kruckeberg (1984) and/or Franklin & Dyrness 1973.

Construction Inspection

The Santa Clara Valley Water District or the USDA/NRCS will administer the mitigation contract Service as a District or federal contract. An inspector will monitor the contractor to insure full compliance with the project plans and specifications.

Implementation Schedule

Mitigation contracts will be installed reach by reach directly after the completion of the structural contract for that reach. In some cases, certain components (e.g. irrigation mainlines) will be installed by the structural contractor. Irrigation systems may be installed at any time, while container plants will be installed only during certain fall and spring planting periods. Bio-technical plantings, such as willow matting or willow fascines, would be installed during winter, which is the dormant season for willows.

As-built drawings

The mitigation contractor will be obligated to prepare a set of as-built drawings while construction is in progress. All changes in locations of irrigation system components, plants or other mitigation features or changed site conditions will be illustrated on a final as-built drawing set and turned over to the contracting officer for reference. Drawings will show location and boundaries of all mitigation sites and other planting sites (Riparian/SRA and native landscaping).

Establishment period

The contractor will be retained for a three to five-year establishment period to insure proper function of the irrigation systems and to monitor for possible changed site conditions, plant stress or other emergency. The contractor will be responsible for weed control, irrigation system inspection and maintenance, basin repair, herbivore protection, replanting of any dead or dying plant material and assisting in site assessment and joint inspections.

Long-Term Maintenance

The District is responsible for long-term maintenance activities. Most of the revegetation areas are planned to become self-sustaining systems and are not expected to require maintenance past year 5. However, yearly maintenance of revegetation in the higher flow channel inverts and along the sediment transport channel may be required. The revegetation areas will be inspected yearly to identify any potentially significant problems, such as large dead or downed trees or invasion by non-native species. In addition, thinning of planted stock might be required if plant competition and/or density is shown to be detrimental to site development towards meeting the success criteria.

Long-term maintenance associated with the **sediment transport channel** would include the removal of woody vegetation, occasional sediment removal, and bank protection. Sediment removal would be required although the sediment transport channel is designed optimize sediment transport, uncertainties associated with a mostly impermeable watershed as well as the potential for landslides in the upper watershed. The District would only consider sediment removal if flood conveyance capacity is reduced so that water elevation of a 1- percent flood event would reach half of the freeboard height or if localized sediment deposit threatens the alignment of the sediment transport channel. Further information on the project's maintenance requirements is provided in the *Lower Silver Creek Watershed Project Maintenance Plan.*

The **SRA/Riparian area** (which is not a mitigation site for this project) would only require the minimal maintenance such as removal of large debris items (dead trees, shopping carts, etc.) since the project hydraulic modeling accounted for the roughness of a fully developed SRA/Riparian area on the south [right] bank of the creek. Maintenance would also need to include minimal bank repair following potential failures as described in the companion *Lower Silver Creek Maintenance Plan.*

7. Monitoring Plan

A. Monitoring Methods

The District will monitor the sediment transport channel and revegetation sites for the ten years following completion of each phase of the project. All revegetation monitoring activities will be conducted by or under the supervision of a qualified biologist while physical processes related to the sediment transport channel will be supervised by an engineer/geomorphologist. Monitoring procedures will be followed to determine overall success of the created in-channel jurisdictional habitat and of the upland plantings. Monitoring transects extending from top-of-bank to top-of-bank will be set up at representative reaches. Permanent photographic stations will be established within and overlooking sections of the project area. Photos will be taken at the same time period in years 1, 2, 3, 5, 7 and 10. Photos will also be taken to document events that could significantly affect the development of the sediment transport channel and the revegetation success such as floods, fire, or vandalism.

Monitoring and reporting would end in Year 10. However, if the final success criteria are not met in Year 10, monitoring will continue on year to year basis until success criteria have been met or an alternative monitoring plan has been prepared and approved by the regulatory agencies (Corps, Regional Water Quality Control Board [RWQCB], and CDFG). Elements to be monitored include:

- Formation of a functional base-flow channel
- Successful development of open water habitat in the sediment transport channel
- Sediment transport/deposition
- Wetland vegetation cover, species composition and wetland indicator status
- Survival and canopy development in upland plantings

Also proposed is a monitoring plan are areas not targeted for mitigation on this project but to provide valuable ecological benefits to the Lower Silver Creek system.

In Channel Corps Jurisdictional Habitat (Wetlands and Open Water)

Because the sediment transport channel process-based design approach will result in a dynamic system, the proposed monitoring and adaptive management program will be critical to the long term success of the project as well as be valuable for design of future similar projects. Therefore channel geometry and vegetation establishment will be monitored for the naturally formed base-flow channel and the sediment transport channel.

Cross-sectional profiles will be measured at permanent monitoring stations in each project reach shortly after construction to assess the magnitude of erosion/deposition of sediment in the sediment transport channel and the development of the base-flow channel. Twenty representative stations will be established, one per sub-reach. Cross-sectional profile measurements (width and depth at each channel stage) would be done in years 1, 2, 3, 5, 7, and 10, as well as dictated by significant "channel-forming" storm events. These cross-sectional measurements will also provide information on the development of the channel's longitudinal profile.

Photo points will also be established at each station to monitor geomorphic patterns and vegetation development. This will provide information that could be used to estimate the roughness in the sediment transport channel and identify areas of overgrowth that could inhibit natural channel forming processes.

The District will install a stage gage and recorder at one of these cross sections (or at a bridge crossing) to collect post project flow information. This would make it possible to determine the magnitude and duration of the flow events that form the base-flow channel.

The development of wetland habitat will be monitored more specifically at the same 20 stations during the summer using methods described in the Corps 1987 Wetland Delineation Manual. Vegetation cover and species diversity will be assessed in years 1, 3, 5, 7 and 10. Wetland hydrology will be determined in years 5 and 10 as part of a formal wetland delineation of the created jurisdictional area. Qualitative or visual observations of hydrology will be made in years 1, 3 and 7. It is anticipated that the wetland portion of the sediment transport channel will meet the vegetation (obligate, facultative wet, or facultative) and hydrology criteria as described in the 1987 Corps Wetland Delineation Manual by the end of the 5-year period.

Upland plantings

As-built landscaping plans will be prepared soon after upland plantings are complete to provide a monitoring baseline at "time = zero." The as-built plans will show all deviations from the planting plans including number of plants installed, planting locations, unplanted areas and any feature not shown on landscape plans.

Plant survivorship will be determined by field counts of at least 10 percent of all planted trees and shrubs. Plantings to be monitored will be randomly selected within each sub-reach. These plants will also be assessed for plant health and vigor and documented by photographs. Plant survivorship will be conducted over the first 5 years or until such time that the growth of plants makes survivorship too difficult to assess. At that time percent cover will become the primary indicator of planting success. Plant survivorship will be recorded by species.

Percent cover will be estimated by the line intercept method (Bonham 1989). Permanent transects will be established (one per distinct monitoring site) to facilitate accurate replication over successive years. At least one transect will be established per sub-reach. Transect location (within sub –reach) will be randomly selected. Photo documentation will be made at each station to monitor quality of canopy development. Tree and shrub cover will be recorded by species.

Bank riparian Habitat (and SRA)

As-built landscaping plans will be prepared soon after upland plantings are complete to provide a monitoring baseline at "time = zero The as-built plans will show all deviations from the planting plans including number of plants installed, planting locations, unplanted areas and any feature not shown on landscape plans.

Plant survivorship will be determined by field counts of at least 10 percent of all planted trees and shrubs. Plantings to be monitored will be randomly selected within each sub-reach. These plants will also be assessed for plant health and vigor and documented by photographs. Plant survivorship will be conducted over the first 5 years or until such time that the growth of plants makes survivorship too difficult to assess. At that time percent cover will become the primary indicator of planting success. Plant survivorship will be recorded by species.

Percent cover will be estimated by the line intercept method (Bonham 1989). Permanent transects will be established to facilitate accurate replication over successive years. At least one transect will be established per sub-reach. Transect location (within sub –reach) will be randomly selected. Photo documentation will be made at each station to monitor quality of canopy development. Tree and shrub cover will be recorded by species.

Dedicated Conveyance Area

No performance criteria and, therefore, no monitoring are proposed.

B. Long-Term Monitoring

A long-term monitoring program of the revegetation sites was proposed under the 1999 MMP for the life of the project (100 years). Although not a regulatory requirement, long-term monitoring would also be conducted under this updated MMP but would focus on the main project elements. The goal of long-term monitoring is to allow the District, the NRCS and the GCRCD to assess the general condition of the project site and determine the need for additional management.

Monitoring would focus on the stability of the sediment transport channel and the conditions of planted vegetation. Sediment transport channel assessment would include the identification of zones of erosion, incision and sedimentation that could cause channel realignment and threaten the integrity of adjacent or downstream channel/bank stabilization. This assessment would be conducted on a yearly basis and coordinated with regular maintenance inspections.

The condition of all mitigation revegetation sites would be assessed every two to five years mainly to identify sick and dead trees and monitor invasive weeds.

C. Reports

Reports of monitoring results will be submitted following each monitoring event, in years 1, 2, 3, 5, 7 and 10. Any deficiencies will be noted and a remedial plan will be prepared for agency review and approval if project fails to meet success criteria in years 5 and 10 for upland planting areas and year 10 for in-channel Corps jurisdictional habitat mitigation area. The reports will include the names of monitoring personnel, a copy of the Corps permit and 1601 Streambed Alteration Agreement and special conditions and modifications, analysis of monitoring data, photographs for all specified photopoints, maps or plans of monitoring areas and copies of field data sheets.

Mitigation and monitoring reports for Lower Silver Creek mitigation will be prepared between May and October of each year for years 1-3, 5 and 7 with a final report in year 10. Special reports will be prepared for any unforeseen occurrence or for any repair or replacement necessary to bring the mitigation areas to targeted success criteria.

D. Completion of Monitoring Period and Final Report

When the initial monitoring period is complete and after it is demonstrated that the final success criteria have been met, the sponsor will submit a final report and new jurisdictional delineation to the Corps for approval. A site visit to be attended by the Corps, the RWQCB, CDFG and the project sponsors will then be arranged.

8. Contingency Measures

The District is responsible for insuring the integrity and success of the mitigation areas. If success criteria are not met at the end of the 10-year monitoring program, monitoring will be prolonged and remedial actions will be taken with appropriate coordination with permitting agencies. The frequency of monitoring activities will allow the District to identify and correct problems early enough to avoid major failures and increase probability of meeting mitigation goals. Problems and discrepancies from mitigation objectives and applied corrective measures will be documented in the scheduled monitoring reports. It is understood that only the project element associated with the corrective or remedial action would be object of any extension of the monitoring period.

A. Remedial Action

If scheduled monitoring indicate that the year 5 and 10 success criteria for the upland planting area and/or the year 10 success criteria for the in-channel Corps jurisdictional habitat will not be met, a remedial action plan will be prepared and submitted to the Corps, RWQCB and CDFG for approval. The action plan will include a review of the monitoring data, study of possible contributing factors, and description of remedial action. Alternative mitigation sites are not considered at this time since the Lower Silver Creek project site is deemed suitable for habitat revegetation under the proposed implementation plan. Planning of alternative sites or the rearrangement of project revegetation sites will be initiated if it becomes apparent that the final success criteria will not be reached in a foreseeable future.

Depending on the severity of the problem, remedial actions addressing channel configuration could involve the stabilization of the creek banks, addition of rock material to control incision, or removal of sediment, all these are considered to be part of routine maintenance activities. The sediment transport channel is designed to maximize sediment transport, however uncertainties associated with a mostly impermeable watershed as well as the potential for landslides in the upper watershed do not completely eliminate the need for sediment removal. The District would only consider sediment removal if flood conveyance capacity is reduced below the 1-percent flood conveyance design criteria or if localized sediment deposit threatens the alignment of the sediment transport channel.

If remedial action is required, the monitoring schedule will be reset to year zero and would only apply to the mitigation element that is subject to a remedial action. This new monitoring plan would be submitted to the to regulatory agency for approval.

B. Responsible Party.

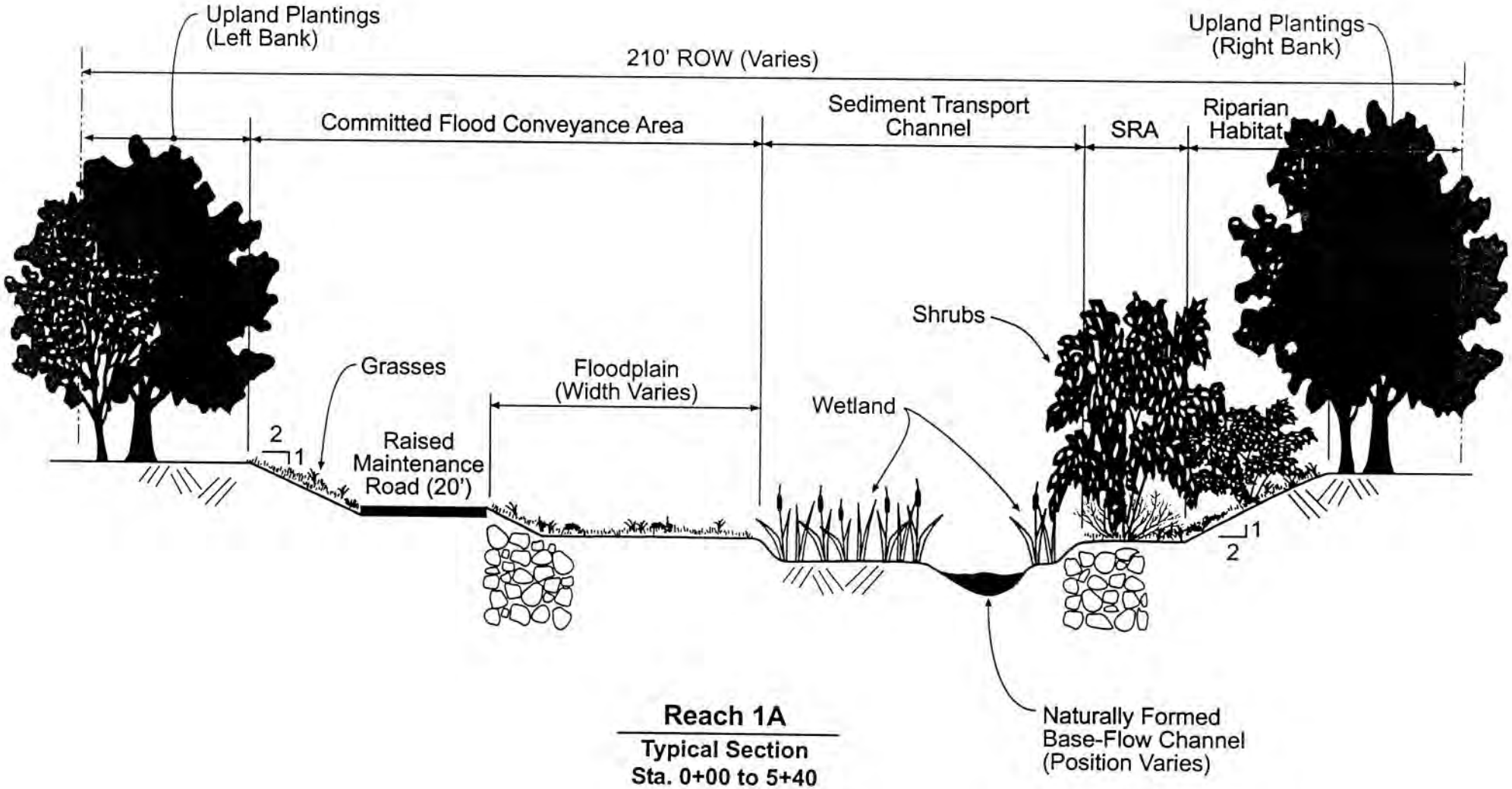
The responsible party for contingency action is the Santa Clara Valley Water District, represented by Mr. Marc Klemencic, the Assistant Operating Officer of the Coyote & Uvas/Llagas Watersheds Unit of the District. This unit is located at 5750 Almaden Expressway, San Jose, California, 95118-3686.

C. Funding Mechanism

Any required contingency actions will be funded by the same mechanism used to fund the mitigation. This funding consists of existing revenues form property tax allocation and flood control benefit assessments, and debt financing by way of certificates of participation or other borrowing mechanisms.

Attachment 1: Typical Cross-Sections for Reaches 1 through 6

162578.A0.T2.03 Reach1A.fh9 8/2/01(CE)



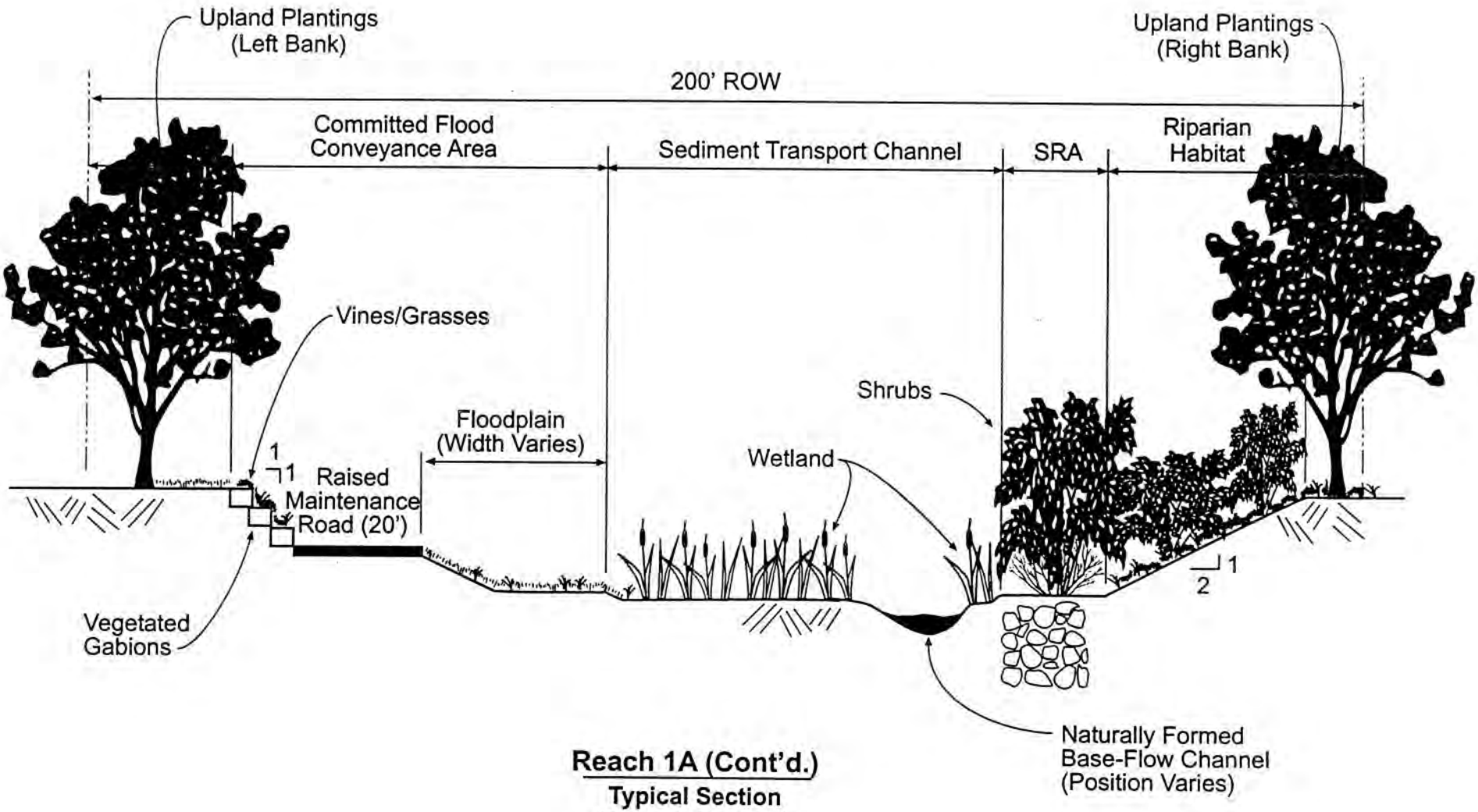
Reach 1A

Typical Section
Sta. 0+00 to 5+40
Length = 500'
Earthen Channel

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach1A_Cont.fh9 8/31/01(CE)



Reach 1A (Cont'd.)

Typical Section

Sta. 5+40 to 9+30

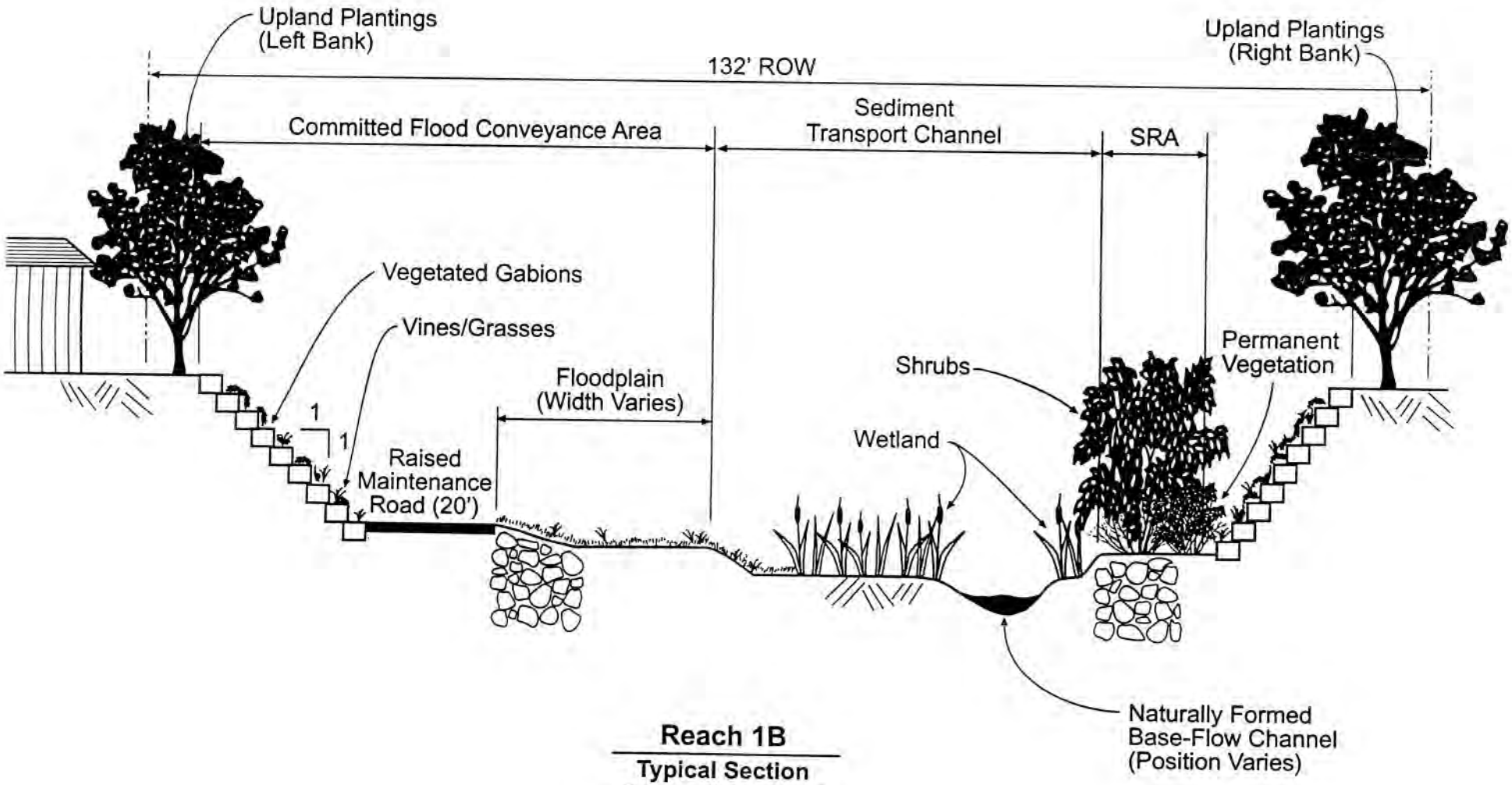
Length = 400'

Earthen Channel/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach1B.fh9 8/2/01(CE)



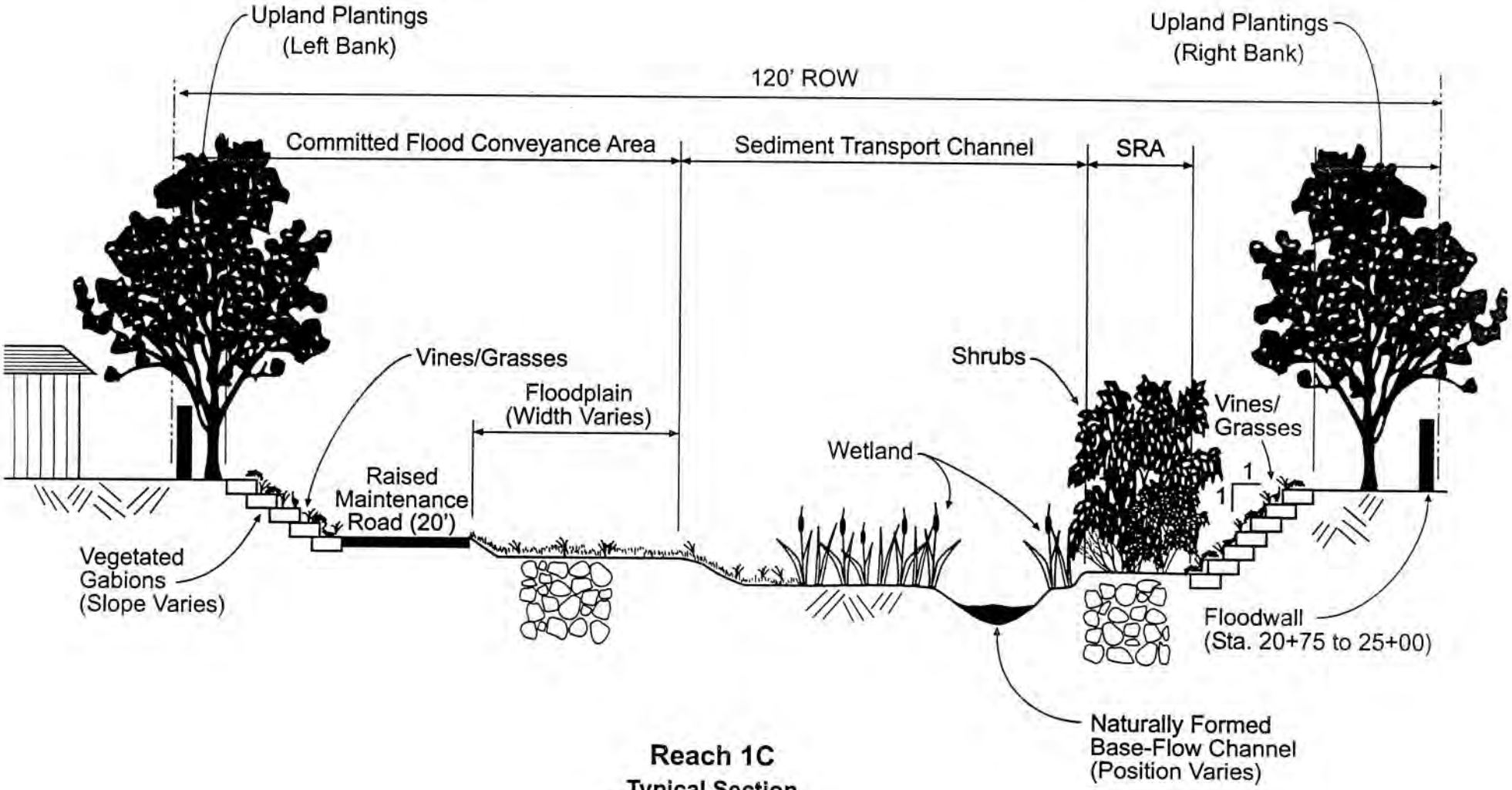
Reach 1B

Typical Section
Sta. 9+30 to 13+00
Length = 300'
Vegetated Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach1C.fh9 8/2/01(CE)



Reach 1C

Typical Section

Sta. 14+00 to 25+00

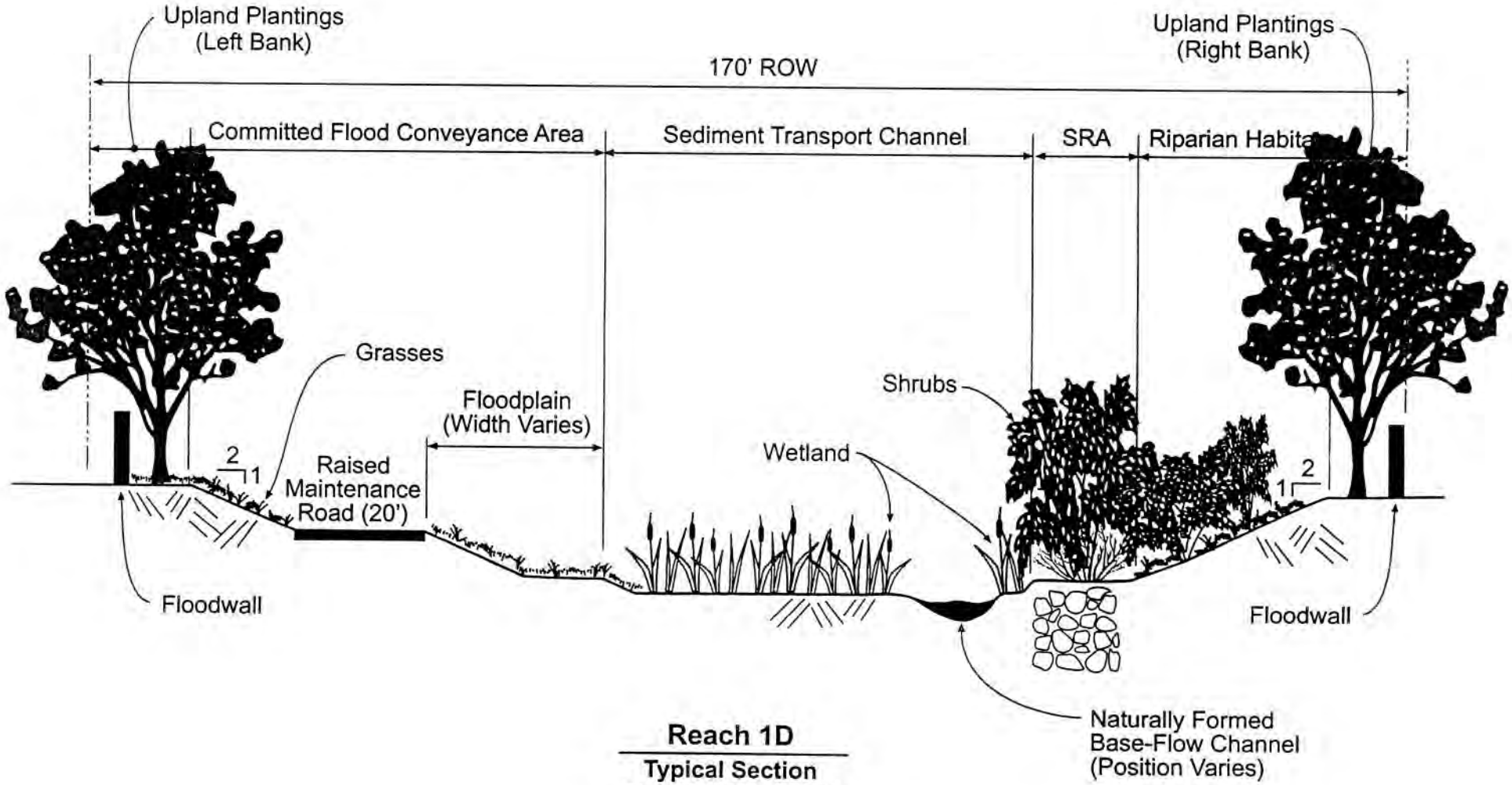
Length = 1100'

Vegetated Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach1D.fh9 8/2/01(CE)



Reach 1D

Typical Section
Sta. 26+00 to 32+00
Length = 600'
Earthen Channel

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

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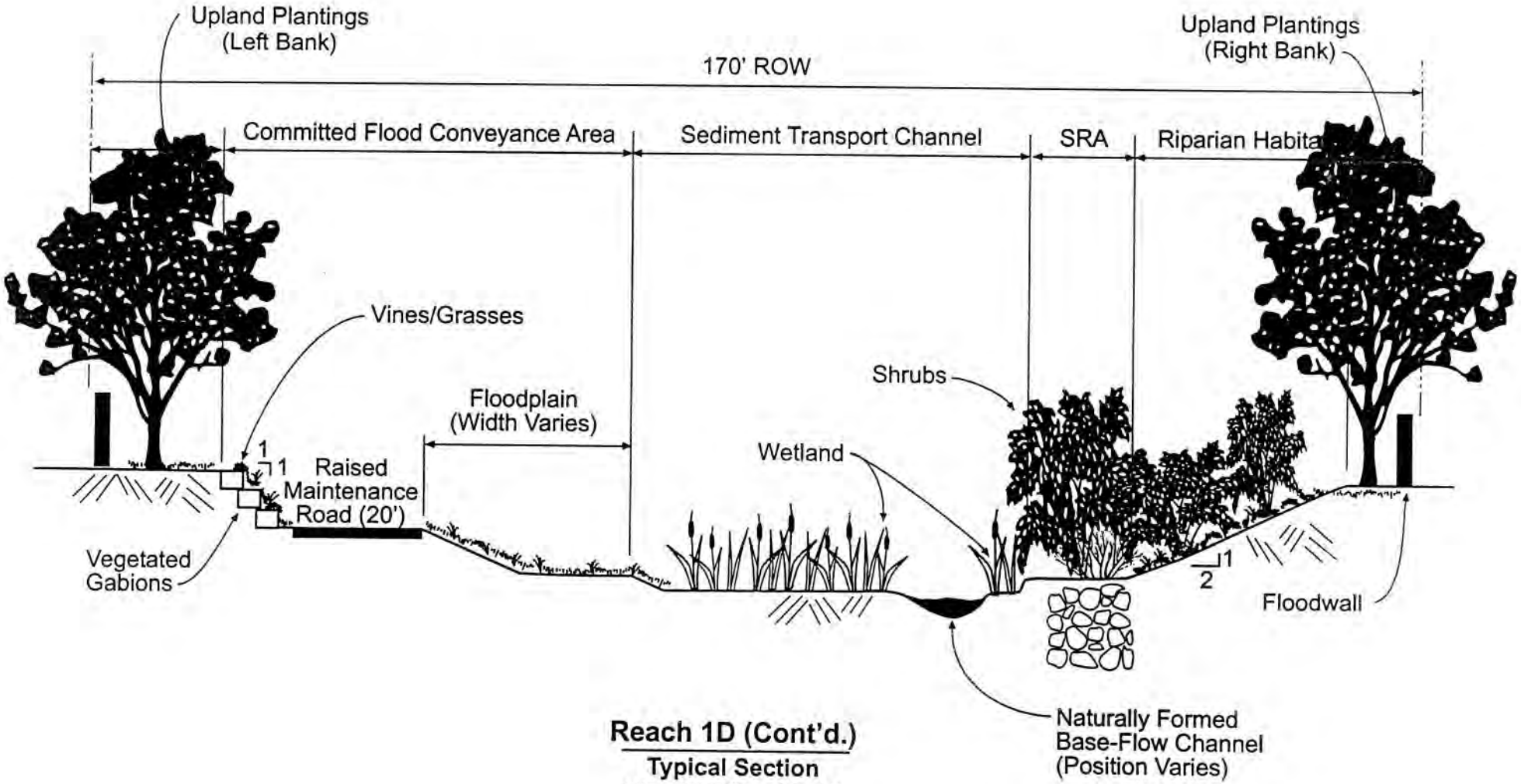


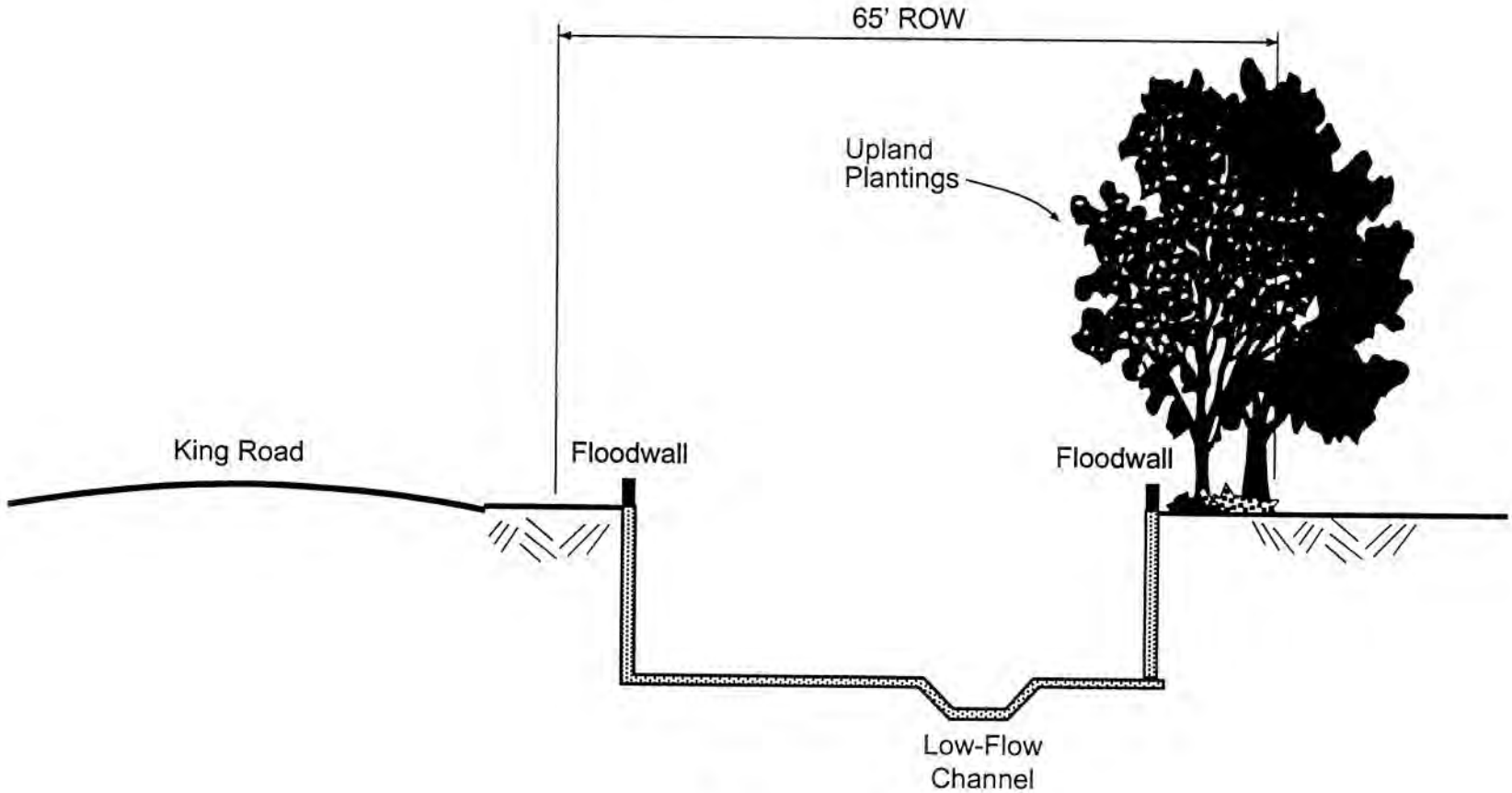
Reach 1D (Cont'd.)

Typical Section
Sta. 32+00 to 38+00
Length = 600'
Earthen Channel/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach2.fh9 8/2/01(CE)



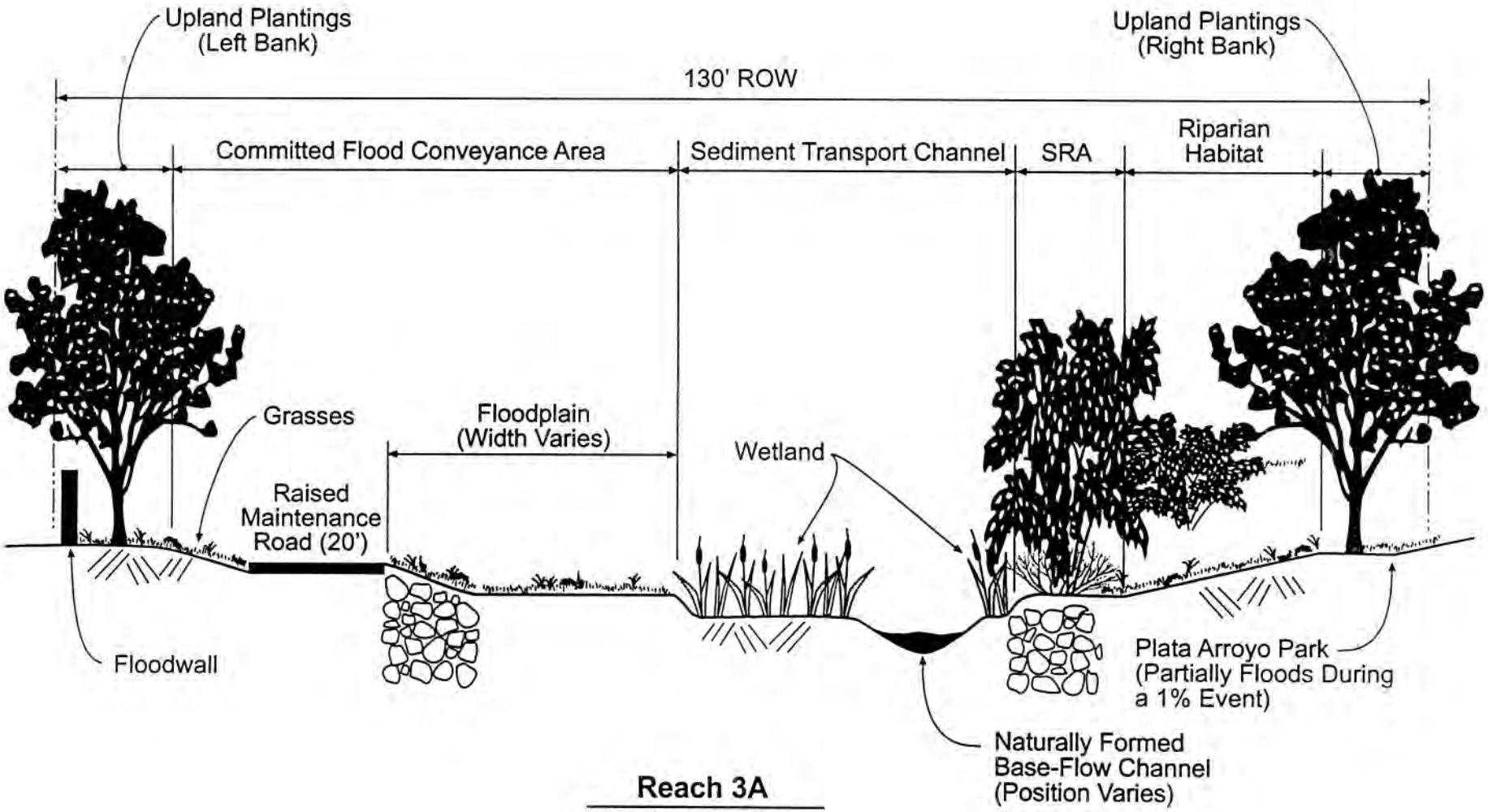
Reach 2

Typical Section
Sta. 39+00 to 51+00
Length = 1200'
Rectangular Concrete Channel

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach3A.fh9 8/2/01(CE)

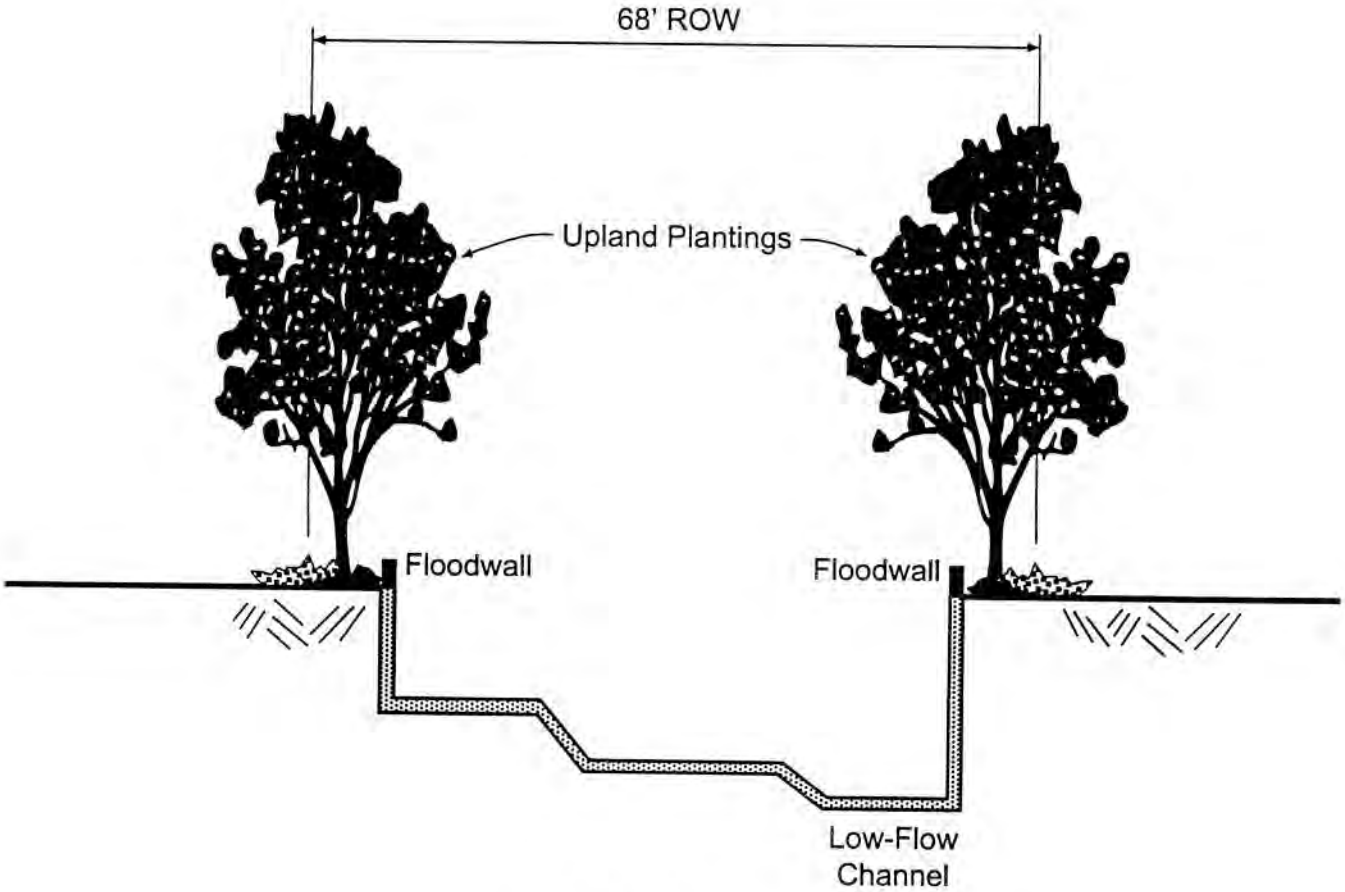


Reach 3A

Typical Section
Sta. 54+00 to 70+00
Length = 1600'
Earthern Channel
Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach3B.fh9 8/2/01(CE)

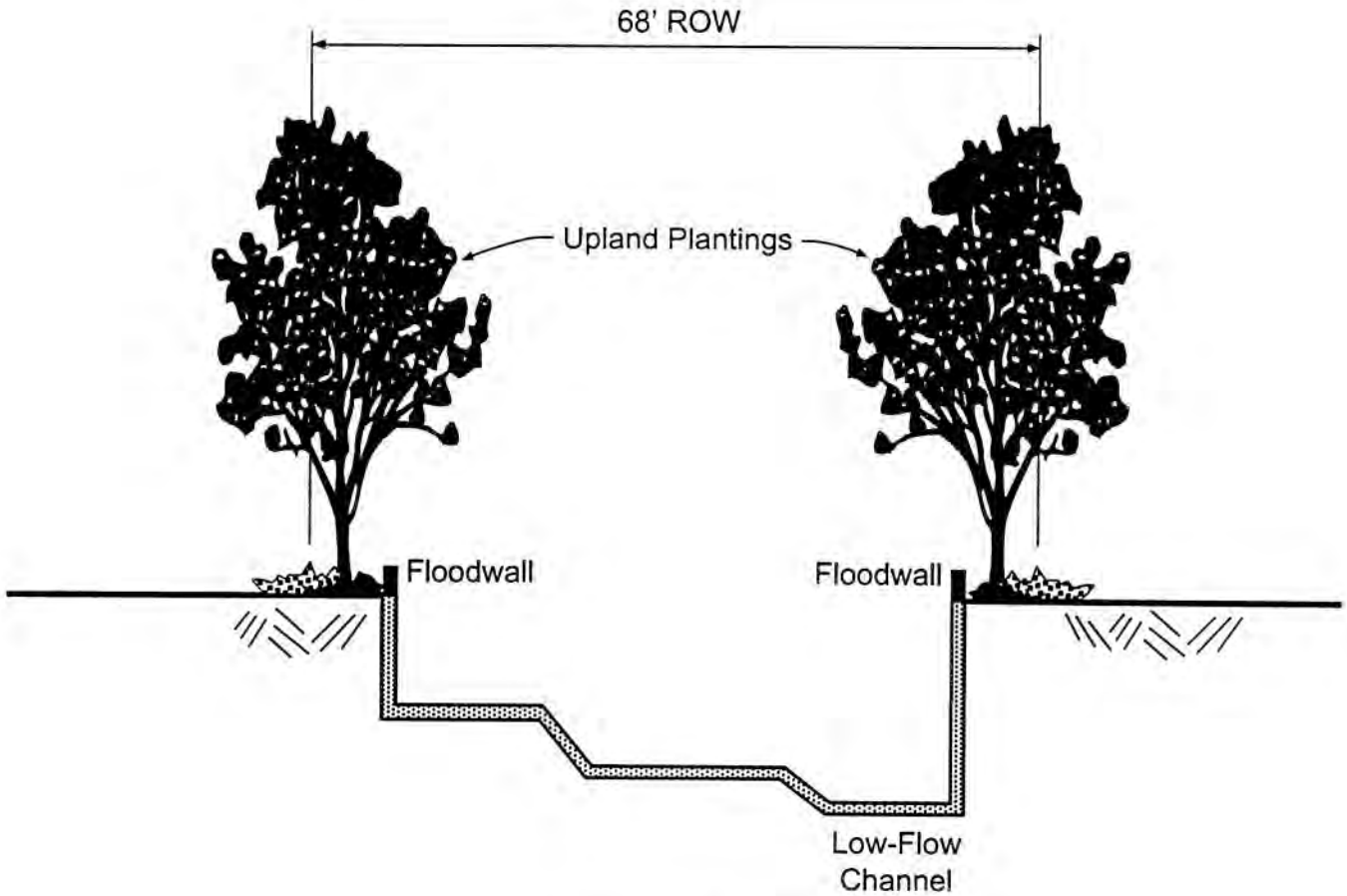


Reach 3B

Typical Section
Sta. 70+00 to 79+75
Length = 925'
Concrete Channel
Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

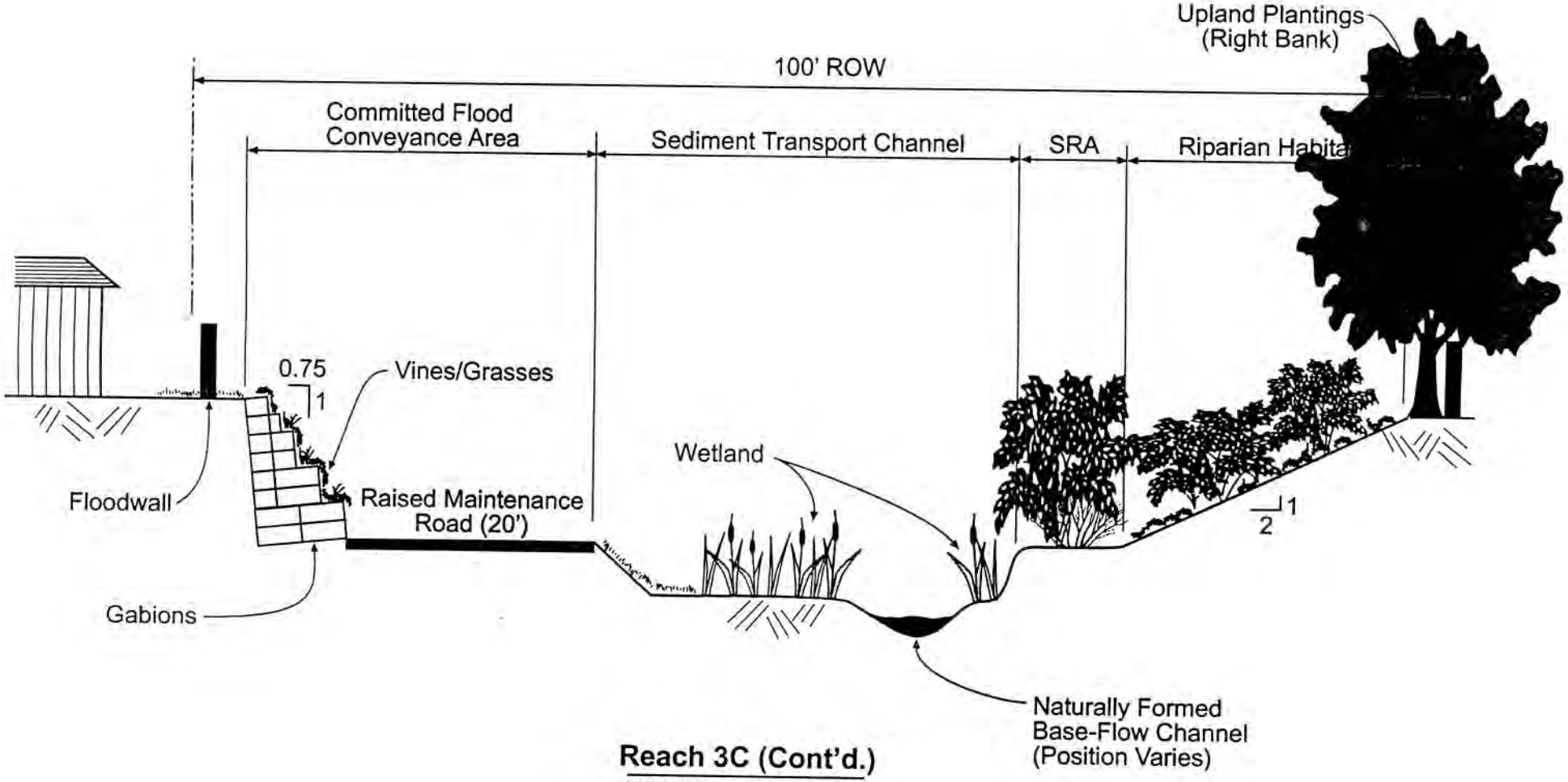
162578.A0.T2.03 Reach3C.fh9 8/31/01(CE)



Reach 3C

Typical Section
Sta. 79+75 to 87+00
Length = 725'
Concrete Channel
Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District



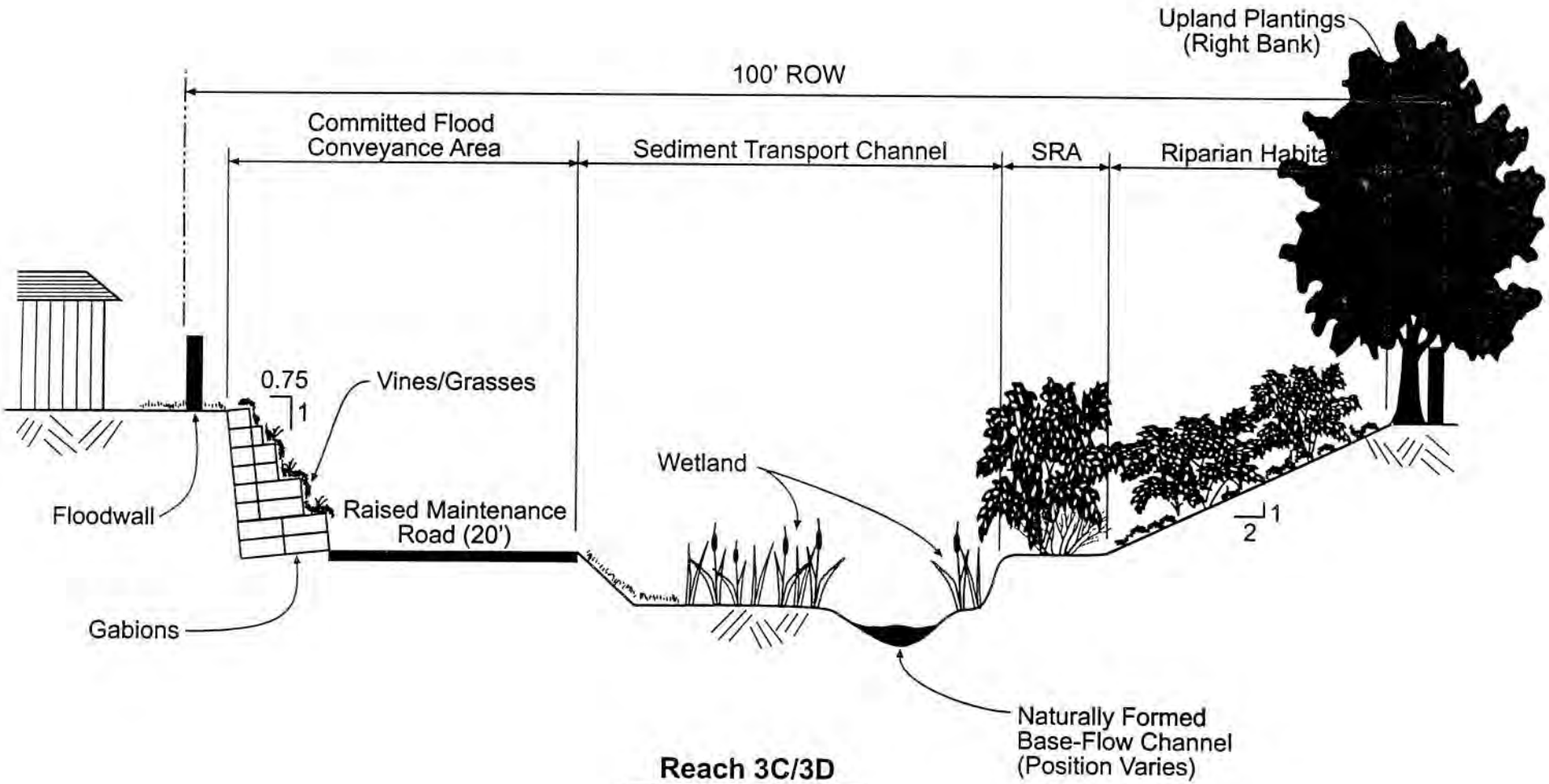
Reach 3C (Cont'd.)

100'- Wide Alternative
Typical Section
Sta. 88+25 to 93+00
Length = 475'
Earthen Channel/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach3C-3D.fh9 8/31/01(CE)



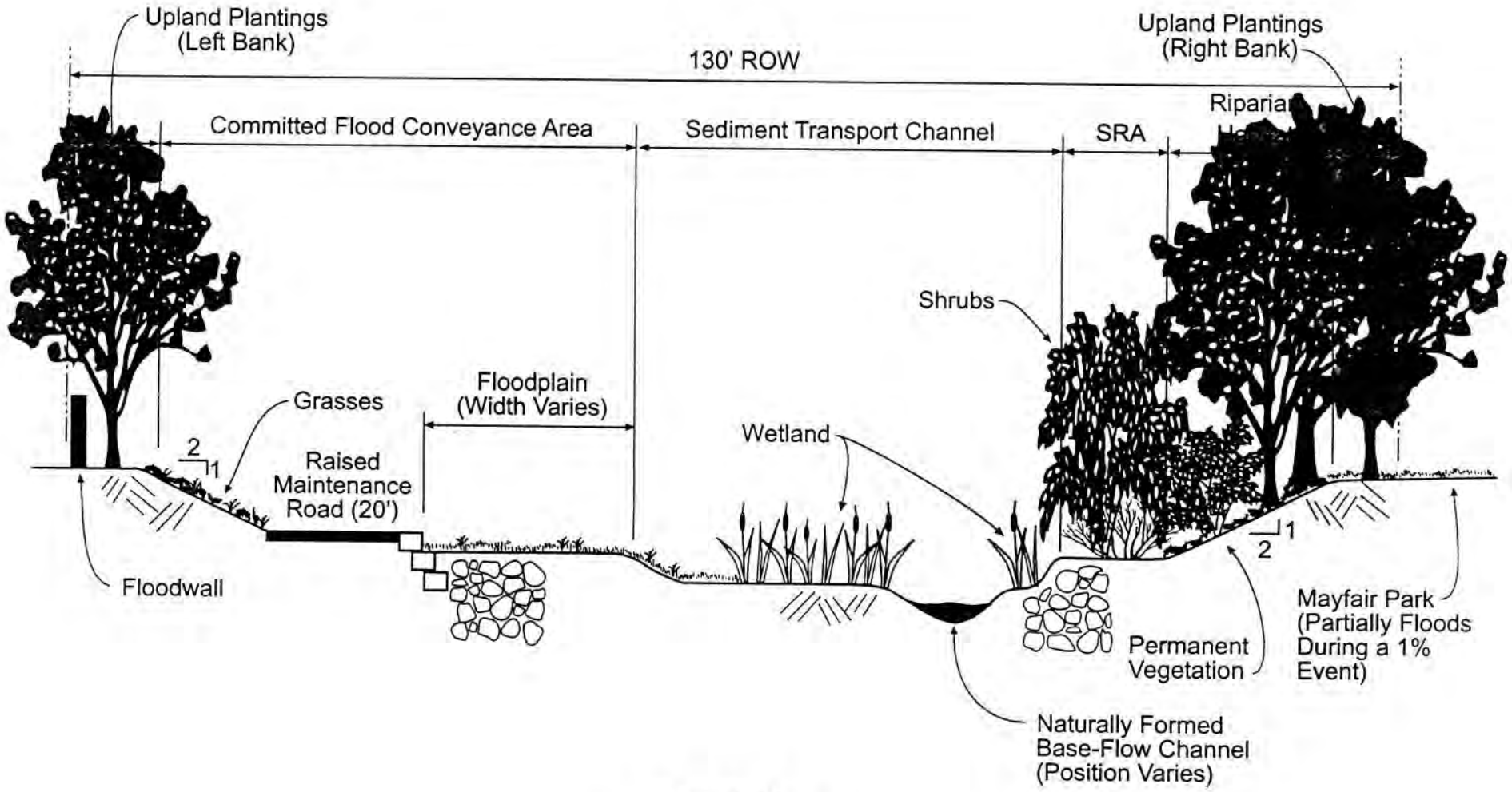
Reach 3C/3D

Typical Section
Sta. 94+00 to 103+50
Length = 950'
Earthen Channel/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach3E.fh9 8/2/01(CE)



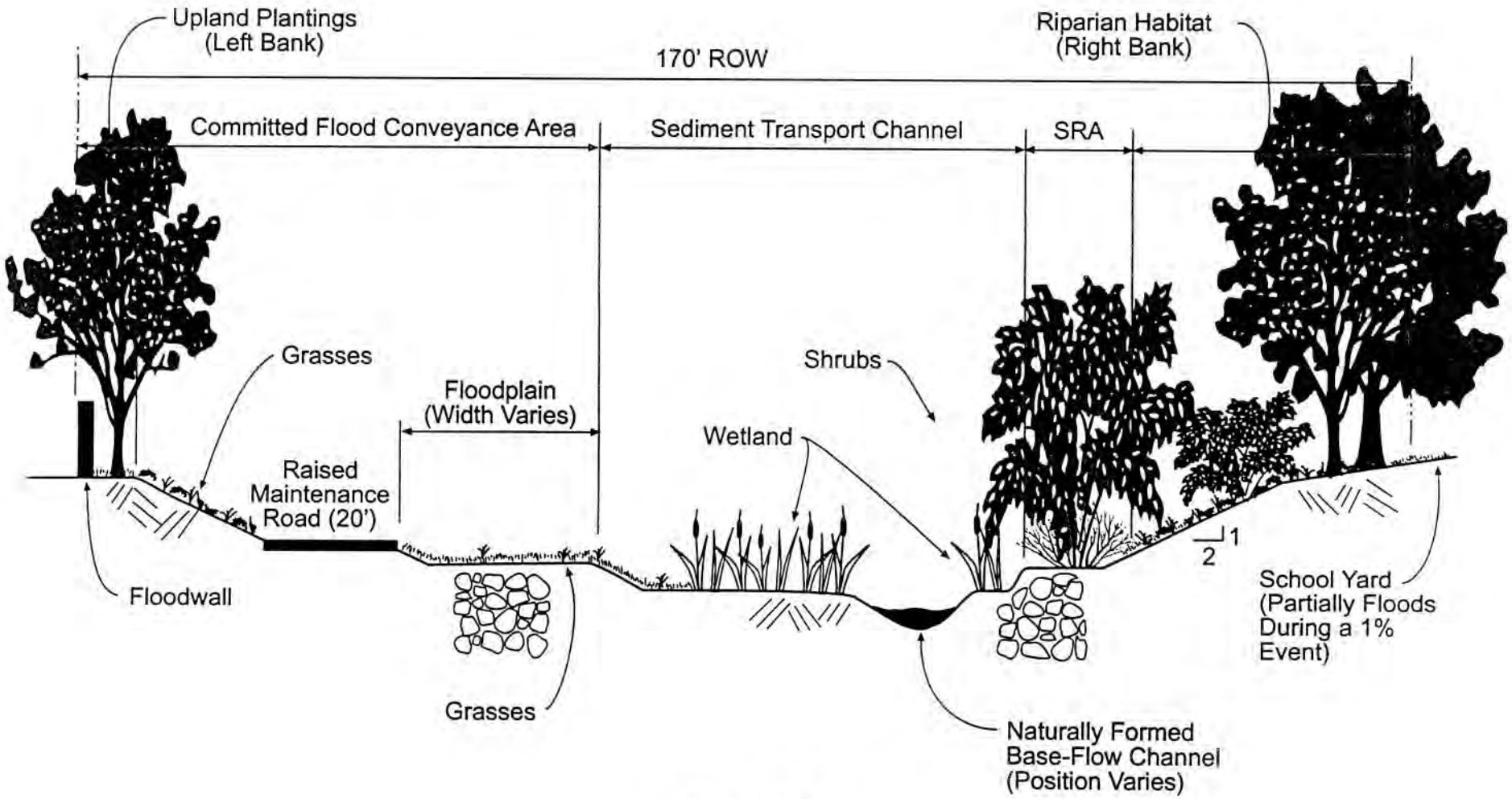
Reach 3E

Typical Section
Sta. 107+00 to 114+00
Length = 655'
Earthen Channel

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

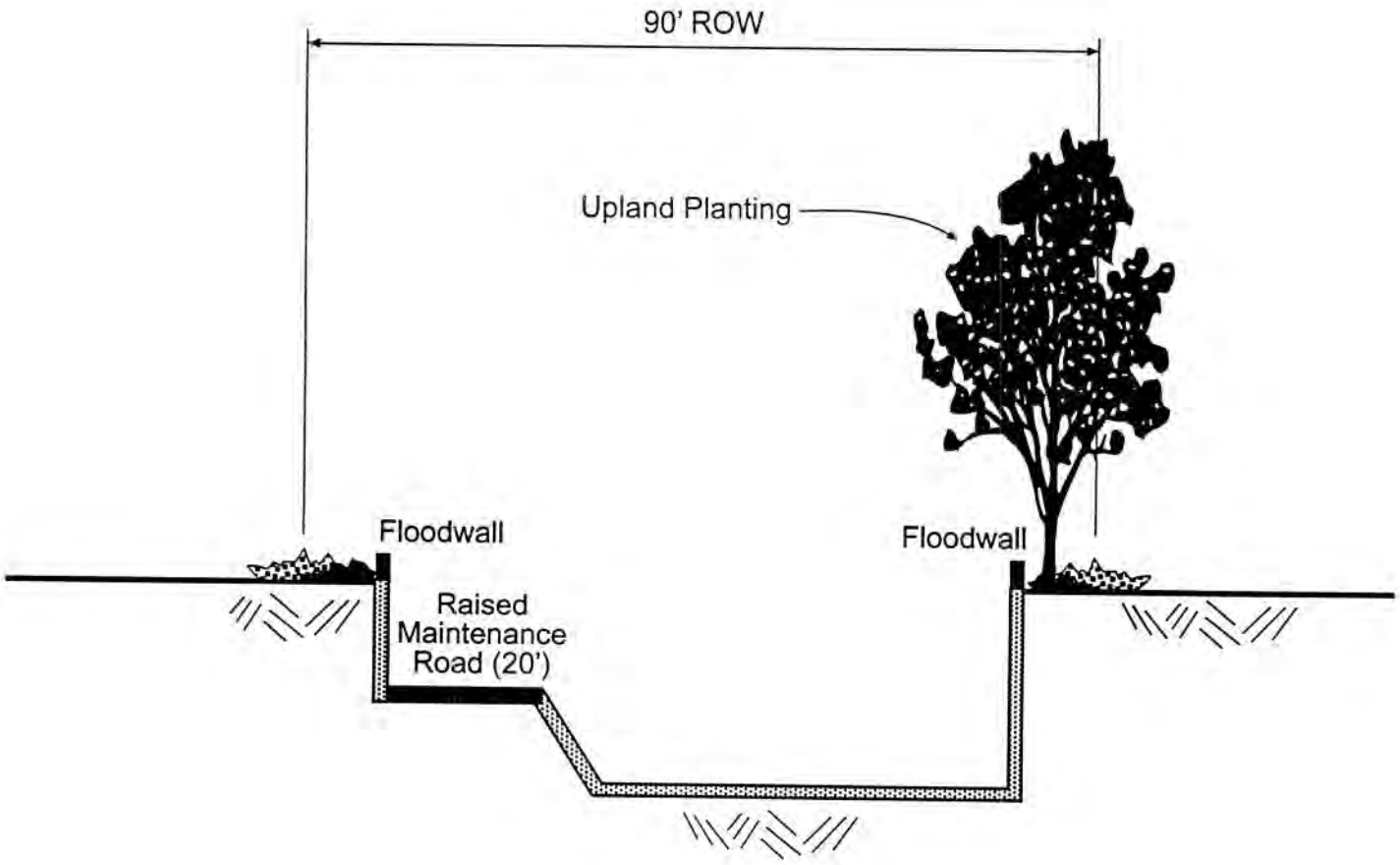
162578.A0.T2.03 Reach3F.fh9 8/2/01(CE)



Reach 3F

Typical Section
Sta. 114+40 to 123+40
Length = 900'
Earthen Channel
Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District



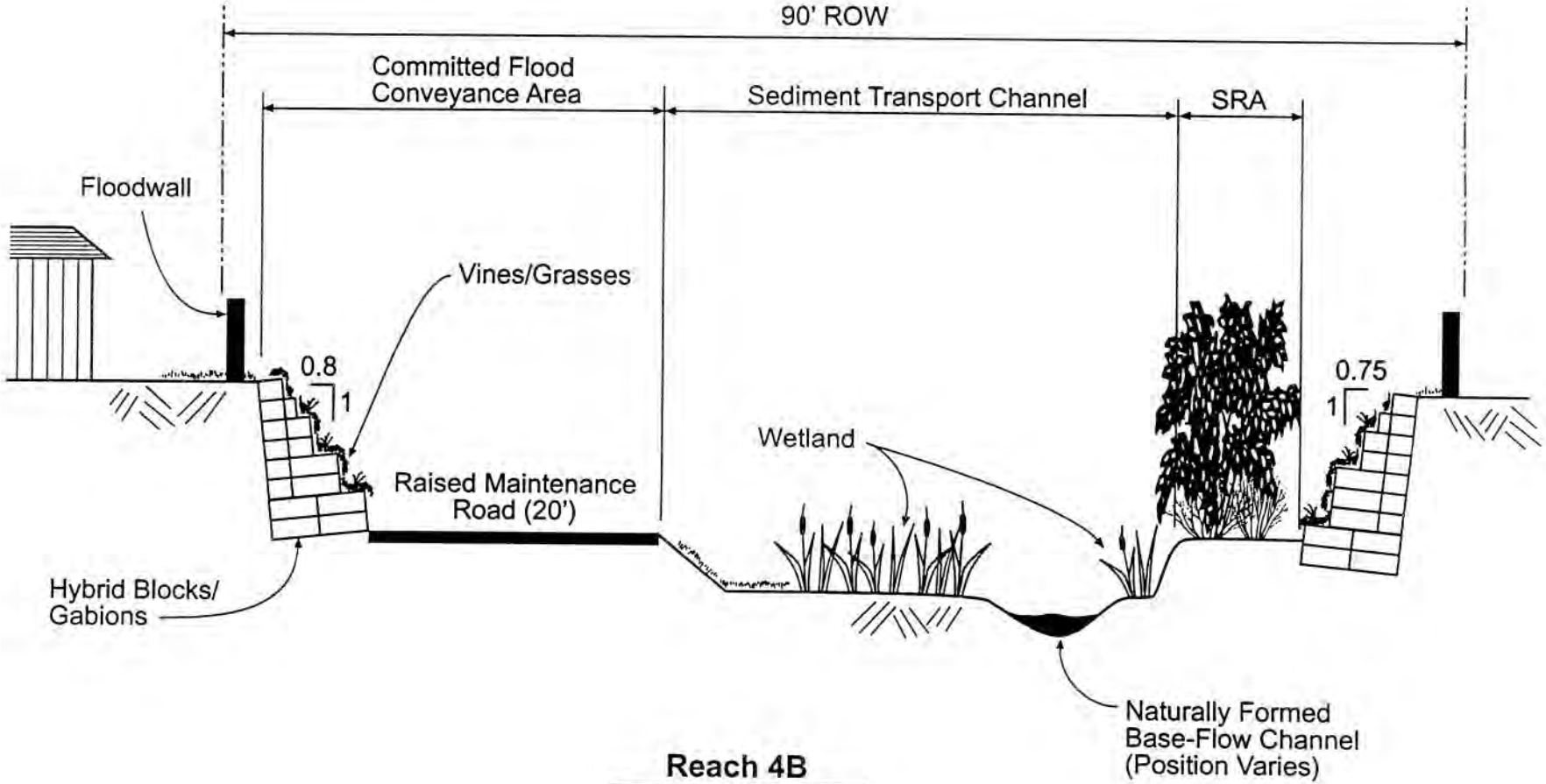
Reach 4A

Typical Section
Sta. 128+00 to 130+20
Length = 220'
U-Frame Concrete Channel/Sediment Trap

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach4B.fh9 8/31/01(CE)



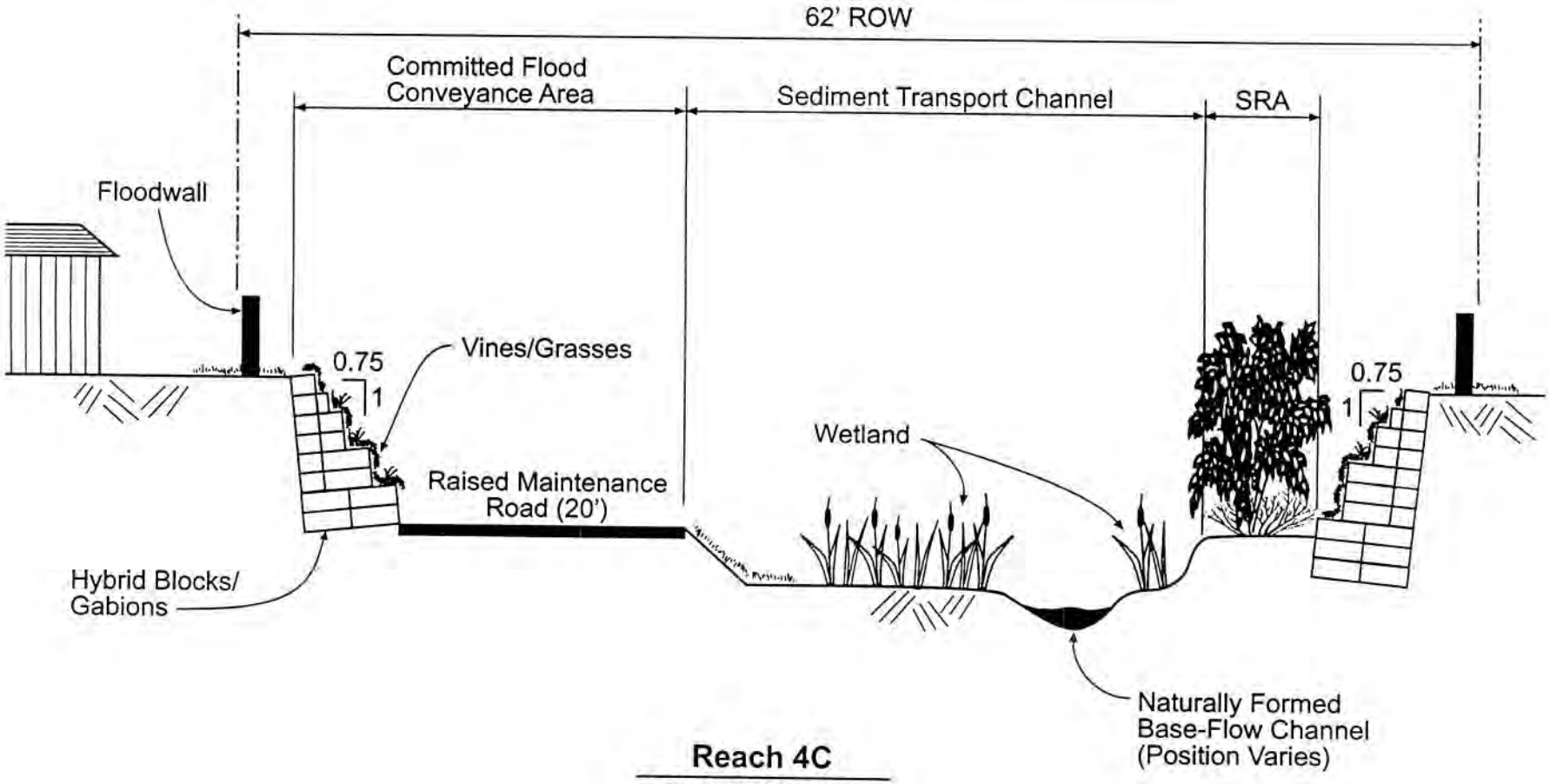
Reach 4B

Typical Section
Sta. 132+00 to 154+00
Length = 2200'
Vegetated Hybrid Block Walls/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach4C.fh9 8/31/01(CE)



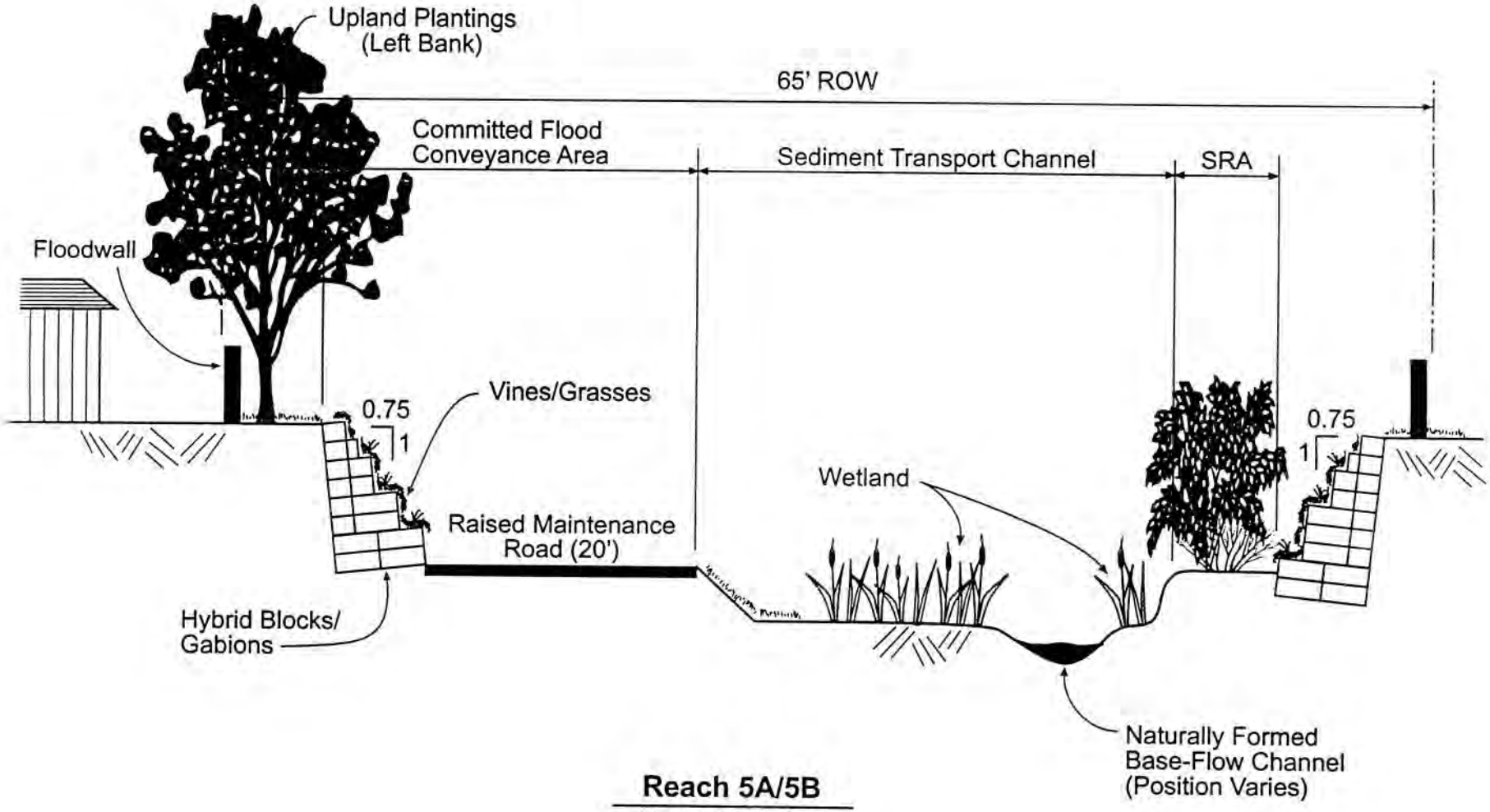
Reach 4C

Typical Section
Sta. 153+00 to 170+00
Length = 1700'
Vegetated Hybrid Block Walls/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach5A-5B.fh9 8/31/01(CE)

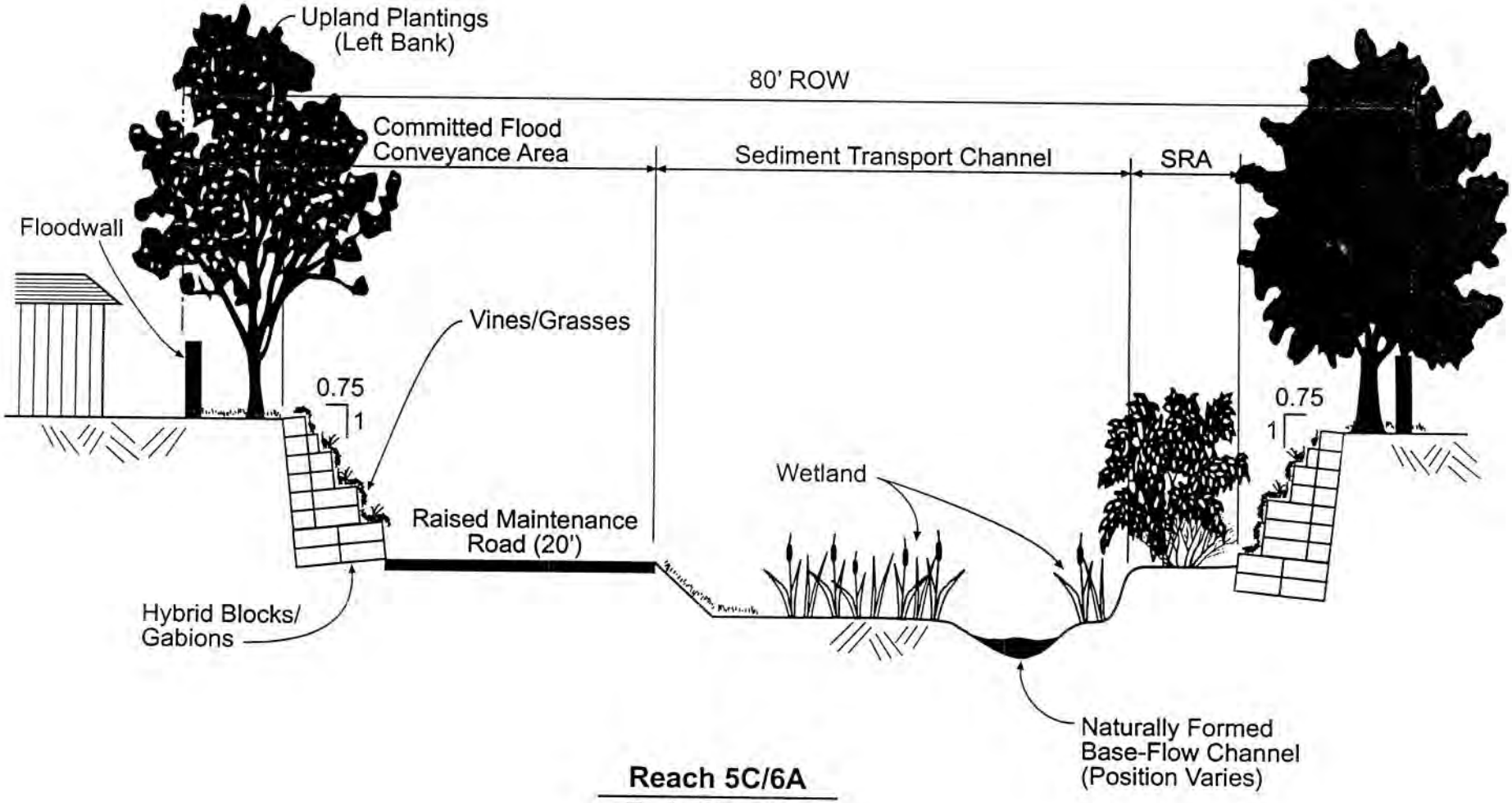


Reach 5A/5B

Typical Section
Sta. 170+00 to 180+40
Length = 1040'
Vegetated Hybrid Block Walls/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District



Reach 5C/6A

Typical Section

Sta. 182+60 to 217+00

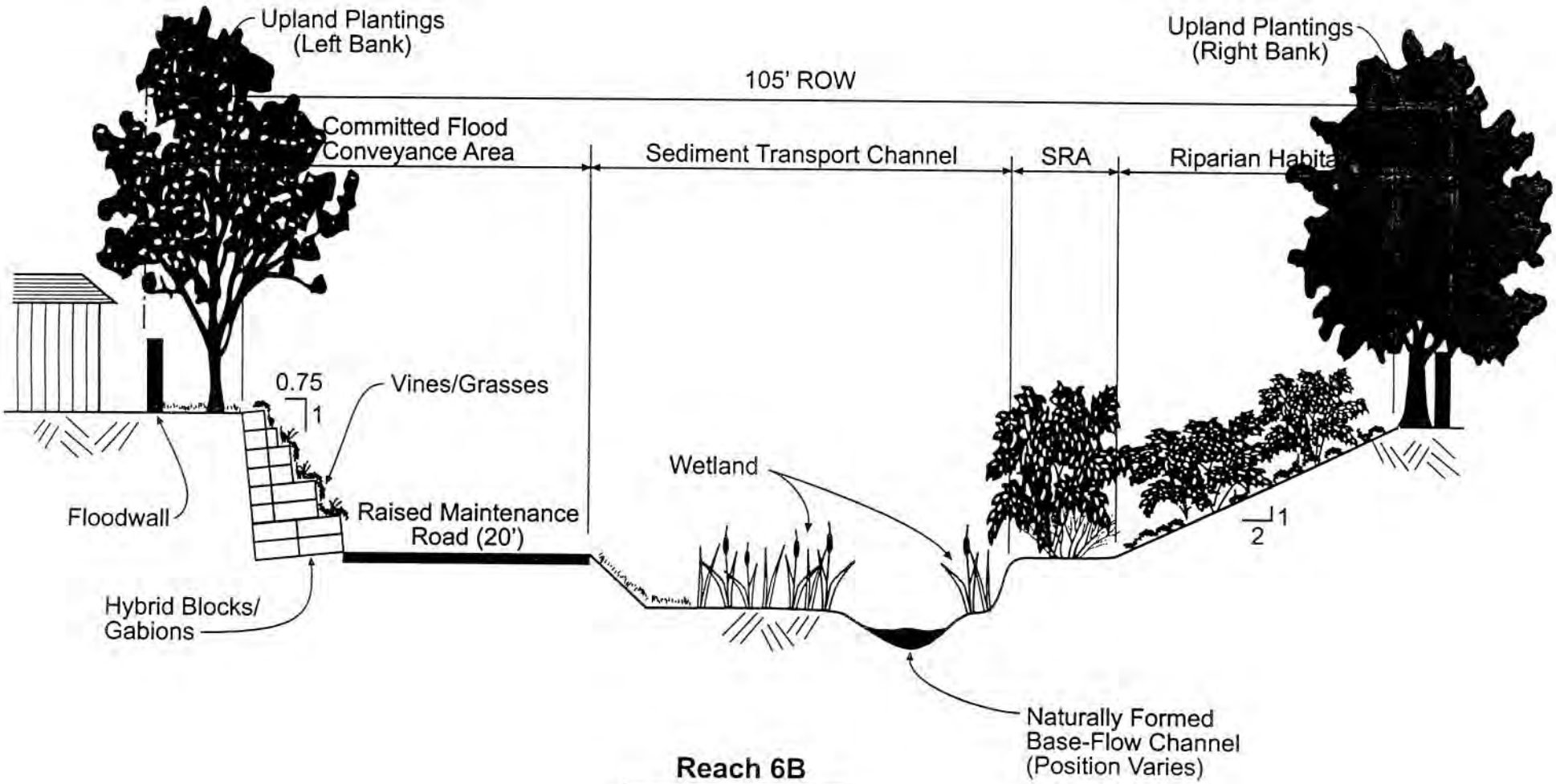
Length = 3310'

Vegetated Hybrid Block Walls/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

162578.A0.T2.03 Reach6B.fh9 8/31/01(CE)



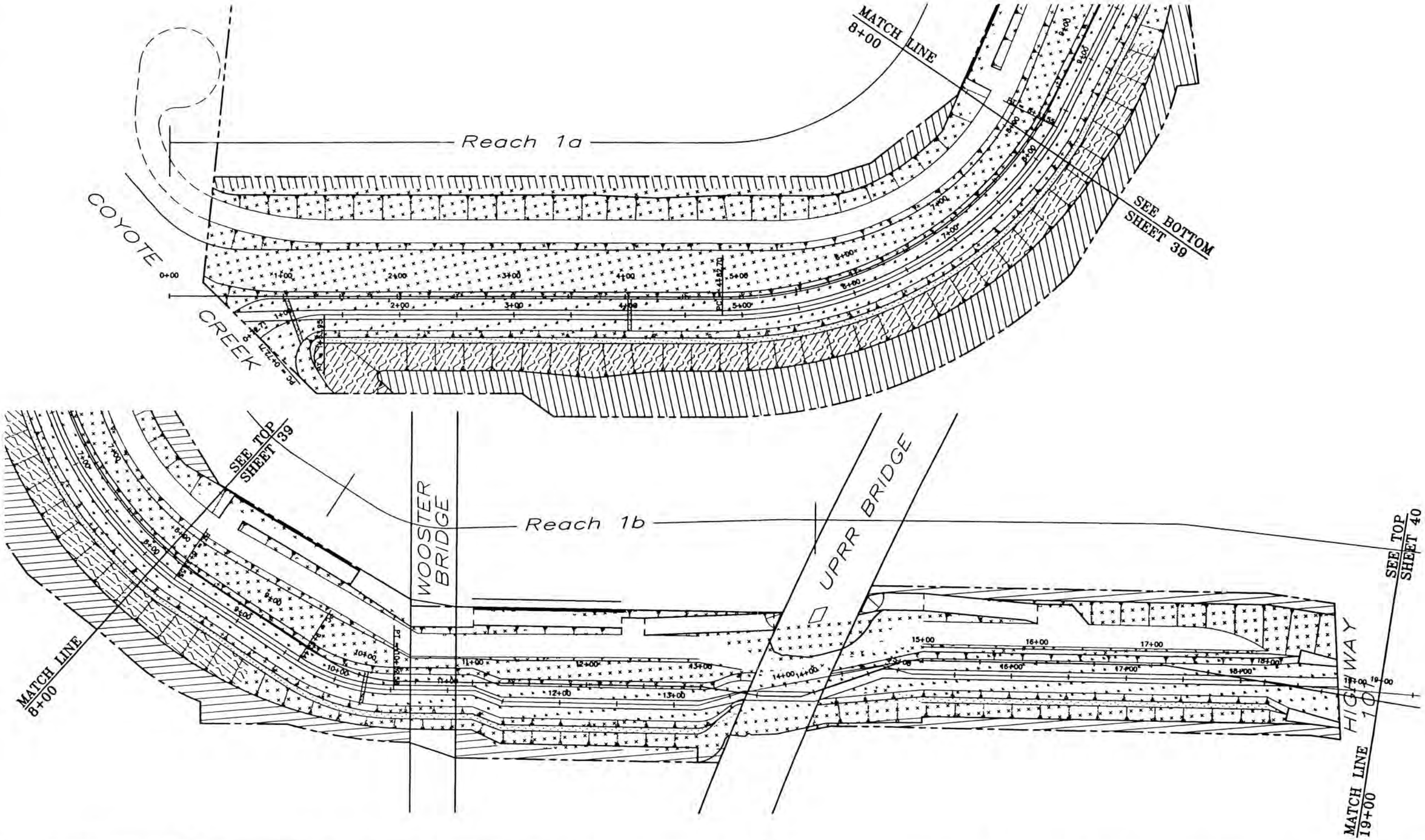
Reach 6B

Typical Section
Sta. 217+00 to 244+42
Length = 2540'
Earthen Channel Vegetated Hybrid Block Walls/Gabions

Not To Scale

Coyote Creek Watershed
Santa Clara Valley Water District

Attachment 2: Conceptual Revegetation Plansfor Reaches 1 through 6



DESCRIPTION	DATE	APPR

MACKAY & SOMPS
INFRASTRUCTURE GROUP
CIVIL ENGINEERING • PLANNING • LAND SURVEYING
SAN RAMON, CA. 94583 (925) 901-1190

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DATE	09/07/2000
DESIGN	RTO
DRAWN	SSG
CHECKED	RTO

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO.

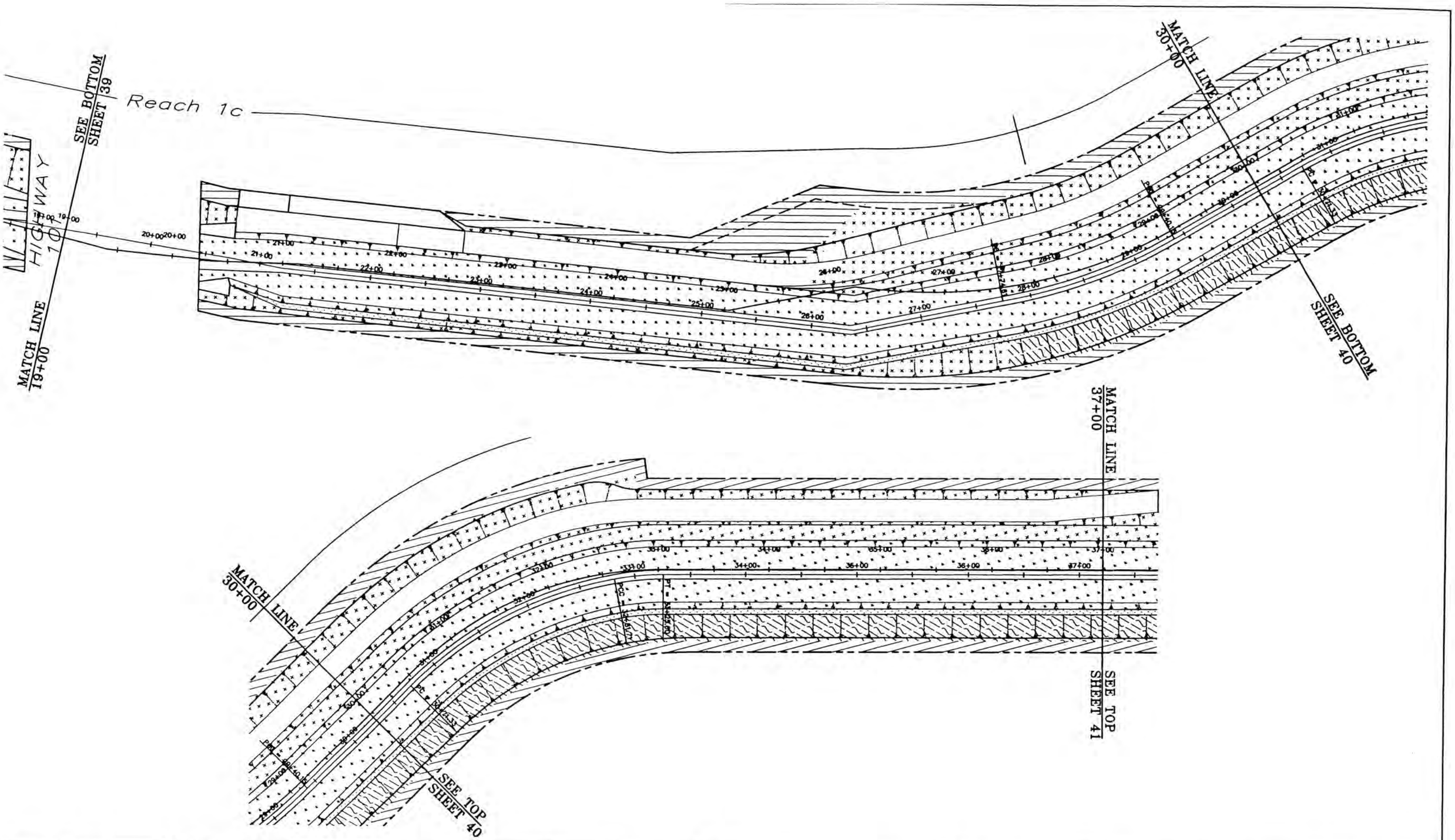
ENGINEERING APPROVAL
SUPERVISING ENGINEER

LOWER SILVER CREEK
REACH 1 AND 2
PLANTING CONCEPT

SCALE 1" = 40'

SHEET RL-39

? OF ?



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DESIGN	RTO
DRAWN	SSG
CHECKED	RTO

Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. NO.

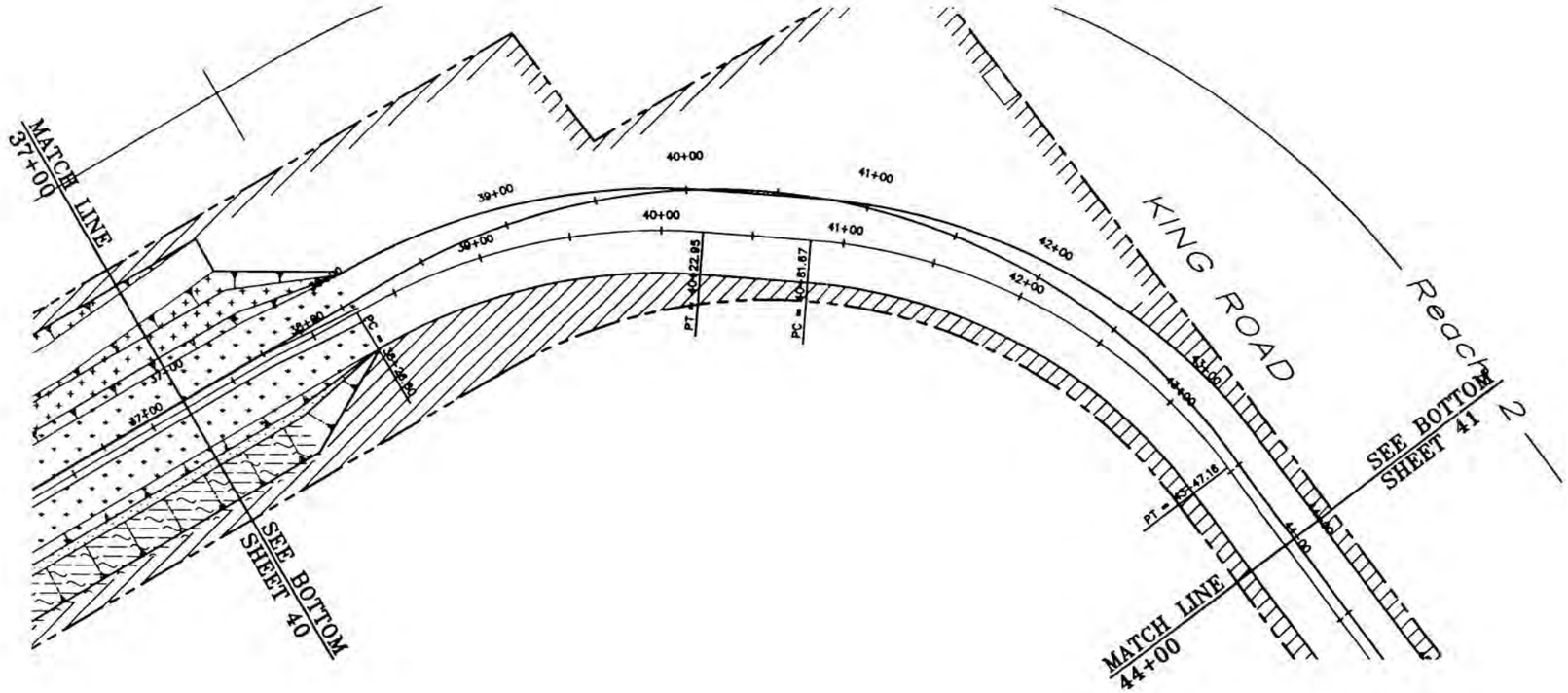
ENGINEERING APPROVAL — SUPERVISING ENGINEER

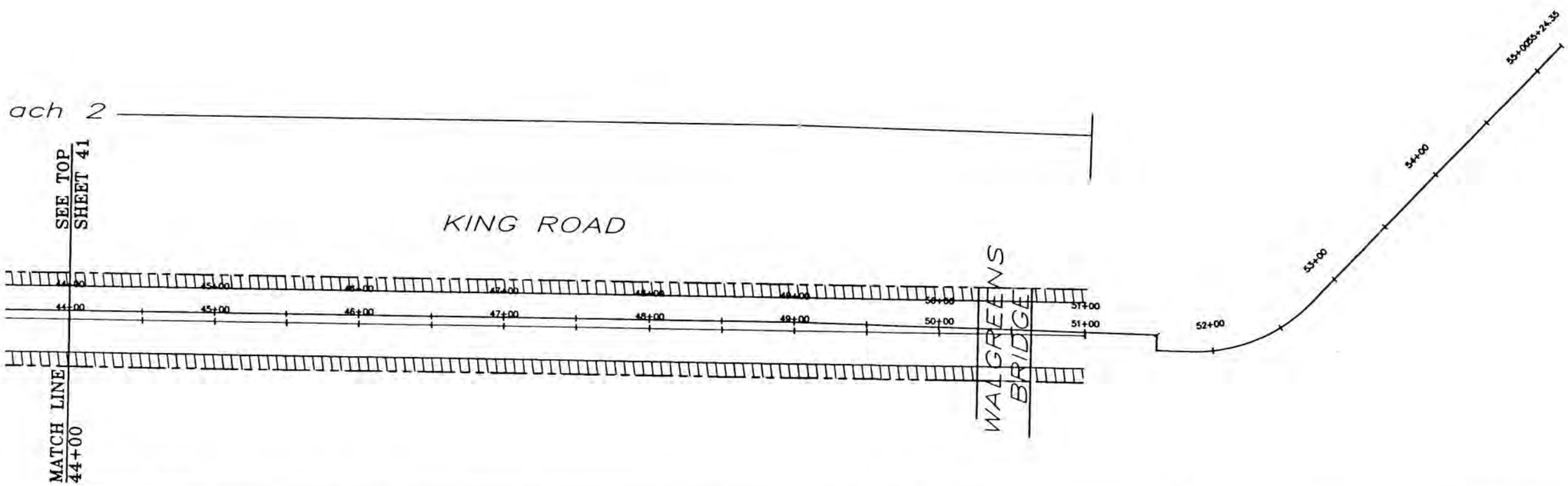
LOWER SILVER CREEK
REACH 1 AND 2
PLANTING CONCEPT

SCALE 1" = 40'

SHEET RL-40

? OF ?





DESCRIPTION	DATE	APPR

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DESIGN	RTO
DRAWN	SSG
CHECKED	RTO

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL
SUPERVISING ENGINEER

LOWER SILVER CREEK
REACH 1 AND 2
PLANTING CONCEPT

SCALE
1" = 40'

SHEET
RL-41
? OF ?

TOP OF BANK RIPARIAN FOREST

The Top of Bank Riparian Forest will be located at the top of banks and planted with native riparian vegetation including trees, shrubs, and vines that are typically found between mid slope and top of bank. It will be designed to provide a diverse and complex habitat. Plant species will be combined to form three distinct canopy layers. The layers will include an overstory, midstory and understory.

NO MAINTENANCE

BOTANICAL NAME	COMMON NAME
TREES:	
ACER NEGUNDO	BOX ELDER
AESCULUS CALIFORNICA	CALIFORNIA BUCKEYE
QUERCUS AGRIFOLIA	COAST LIVE OAK
QUERCUS LOBATA	VALLEY OAK
SAMBUCUS MEXICANA	BLUE ELDERBERRY
SHRUBS:	
BACCHARIS PILULARIS	COYOTE BRUSH
ROSA CALIFORNICA	CALIFORNIA ROSE

BANK RIPARIAN FOREST

The Bank Riparian Forest will be located between the Top of Bank Riparian Forest and the Shaded Riverine Aquatic Habitat and will be planted with native riparian vegetation including trees, shrubs and vines that are typically found at this location. It will be designed to provide a diverse and complex habitat. Plant species will be combined to form three distinct canopy layers. The layers will include an overstory, midstory and understory.

NO MAINTENANCE

BOTANICAL NAME	COMMON NAME
TREES:	
ACER NEGUNDO	BOX ELDER
AESCULUS CALIFORNICA	CALIFORNIA BUCKEYE
QUERCUS AGRIFOLIA	COAST LIVE OAK
QUERCUS LOBATA	VALLEY OAK
PLATANUS RACEMOSA	CALIFORNIA SYCAMORE
POPULUS FREMONTII	FREMONT COTTONWOOD
SAMBUCUS MEXICANA	BLUE ELDERBERRY
SHRUBS:	
ARTEMISIA DOUGLASIANA	MUGWORT
ASTER CHILENSIS	WESTERN ASTER
BACCHARIS DOUGLASII	MARSH BACCHARIS
BACCHARIS PILULARIS	COYOTE BRUSH
ROSA CALIFORNICA	CALIFORNIA ROSE
RUBUS URSINUS	CALIFORNIA BLACKBERRY
SYMPHORICARPOS ALBUS "LAEVIGATUS"	SNOWBERRY
GRASSES:	
LEYMUS TRITICOIDES	CREEPING WILD RYE

EMERGENT WETLAND

The Emergent Wetland will be located within the sediment transport channel. Native emergent wetland plants are expected to naturally colonize this site. This habitat will provide shelter, food, and breeding area for many wildlife species.

LOW MAINTENANCE

BOTANICAL NAME	COMMON NAME
NATIVE AQUATIC VEGETATION EXPECTED TO NATURALLY COLONIZE:	
SCIRPUS CALIFORNICUS	CALIFORNIA BULRUSH
SCIRPUS ACUTUS	COMMON TULE
TYPHA ANGUSTIFOLIA	NARROW LEAF CATTAIL
TYPHA LATIFOLIA	BROAD LEAF CATTAIL

HYDROSEED MIX

The hydroseed mix shall be applied throughout the project site and will consist of native grasses and forbs. The primary purpose of this mix is to provide erosion control throughout the site.

NO, LOW AND HIGH MAINTENANCE

BOTANICAL NAME	COMMON NAME
GRASSES	
BROMUS CARINATUS	CALIFORNIA BROME
HORDEUM BRACHYANTHERUM	MEADOW BARLEY
VULPIA MICROSTACHYS	THREE WEEK FESCUE
FORB:	
ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY
CLARKIA AMOENA	FARWELL TO SPRING
LUPINUS SUCCULENTUS	ARROYO LUPINE

SHADED RIVERINE AQUATIC (SRA)

The Shaded Riverine Aquatic (SRA) habitat will be located along the bench at the toe of the southern bank immediately adjacent to the Sediment Transport Channel. The SRA habitat will provide shade to the low flow channel to benefit fish and other aquatic organisms.

NO MAINTENANCE

BOTANICAL NAME	COMMON NAME
TREES:	
POPULUS FREMONTII	FREMONT COTTONWOOD
SALIX EXIGUA	SANDBAR WILLOW
SALIX LASIOLEPIS	ARROYO WILLOW
SALIX LAEVIGATA	RED WILLOW
SHRUBS:	
ARTEMESIA CALIFORNICA	MUGWORT
GRASSES:	
LEYMUS TRITICOIDES	CREEPING WILD RYE

HABITAT TYPE MATRIX

	Habitat Type	Habitat Description	1A	1B	1C	1D	REACH 1 TOTAL	REACH 2 TOTAL	
No Maintenance	A	Top of Bank Riparian**	0.88	0.16	0.50	0.66	2.20	0.37	
	A'	Top of Bank Riparian	0.00	0.00	0.00	0.00	0.00	0.33	
	B	Bank Riparian	0.51	0.00	0.00	0.49	1.00	0.00	
	C	SRA	0.10	0.05	0.11	0.12	0.38	0.00	
	H	No Planting Zone*	0.00	0.15	0.26	0.01	1.03	0.00	
							3.57	0.37	Riparian Habitat Total
Low Maintenance	D	Emergent Wetlands	0.41	0.24	0.93	1.08	2.66	0.00	Emergent Wetlands Total
	D'	Emergent Wetlands	0.26	0.12	0.28	0.22	0.88	0.00	
	E	Open Water	0.16	0.09	0.22	0.19	0.66	0.00	Open Water Habitat Total
High Maintenance	F	No Planting Zone*	0.32	0.00	0.00	0.00	0.32	0.00	
	G	Maintenance Road	0.41	0.34	0.62	0.50	1.87	0.68	
	H'	No Planting Zone*	0.74	0.32	0.58	0.81	1.84	0.00	
		Total	3.78	1.47	3.50	4.08	12.83	1.39	

NOTE: All numbers are in acres.
A' Area only for left top of bank in "U-Frame" reaches.
D' Area along the banks of the Sediment Transport Channel.
H' Areas only for slopes steeper than 2 to 1 and bench areas.
* Hydro seeding shall be applied in all areas.
** This includes the left and right top of banks, except for area A'.

DESCRIPTION	DATE	APPR

MACKAY & SOMPS
INFRASTRUCTURE GROUP
CIVIL ENGINEERING • PLANNING • LAND SURVEYING
SAN RAMON, CA. 94583 (925) 901-1190
MACKAY & SOMPS IS NOT RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF REPRODUCTIONS OF THIS DOCUMENT THAT ARE GENERATED BY OTHERS FROM ELECTRONIC MEDIA

DATE 09/07/2000
DESIGN RTO
DRAWN SSG
CHECKED RTO

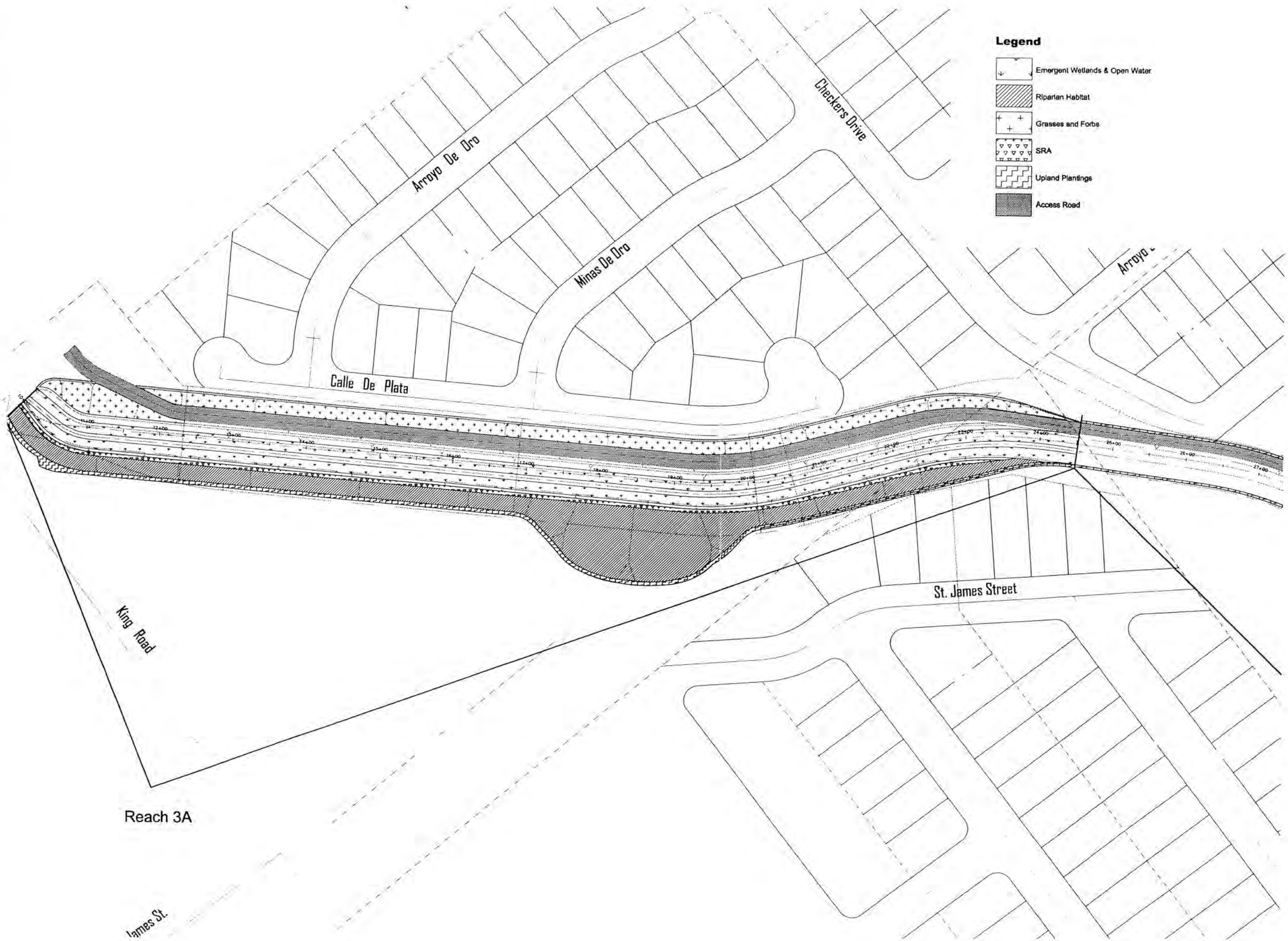
Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL
SUPERVISING ENGINEER

LOWER SILVER CREEK
REACH 1 AND 2
PLANTING PALETTE AND MATIX

SCALE 1" = 40'
SHEET RM-42
? OF ?



TOM RICHMAN & ASSOCIATES
Urban Design, Planning and Landscape Architecture
654 Gilman Street, Palo Alto, CA 943
Voice 650 462.8880 Fax 650 325.10

REVISION DATE DESCRIPTION

PROJECT TITLE:

Lower Silver Creek Reach 3

San Jose, California

SHEET TITLE:

Reach 3A

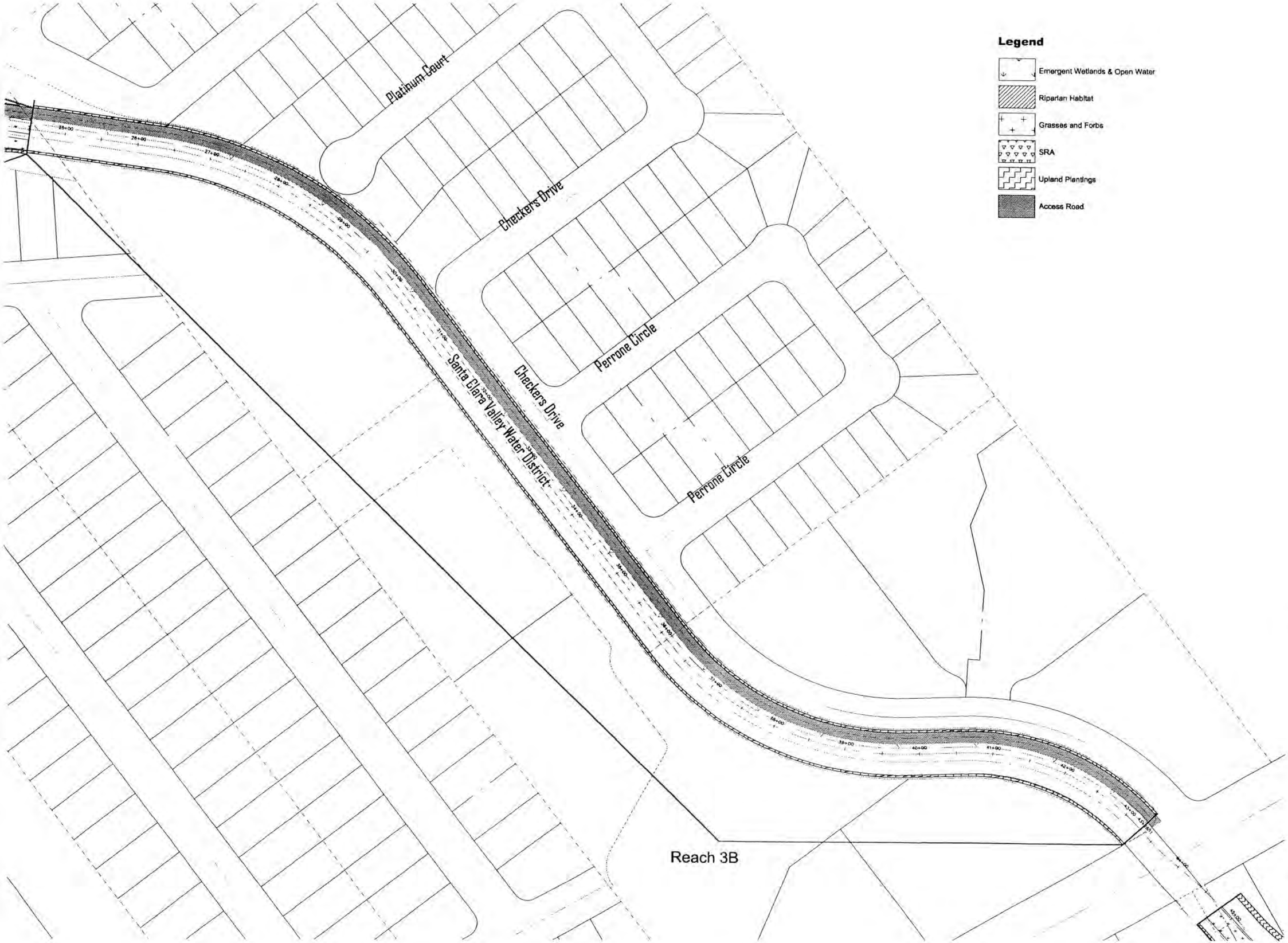
DATE: 07/09/01

SCALE: 1"=50'

DRWN: jm

SHEET NUMBER

L1



Legend

- Emergent Wetlands & Open Water
- Riparian Habitat
- Grasses and Forbs
- SRA
- Upland Plantings
- Access Road

TOM RICHMAN & ASSOCIATES
Urban Design, Planning and Landscape Architecture
654 Gilman Street, Palo Alto, CA 9430
Voice 650 462.8880 Fax 650 325.101

REVISION DATE DESCRIPTION

PROJECT TITLE:

Lower Silver Creek Reach 3

San Jose, California

SHEET TITLE:

Reach 3B

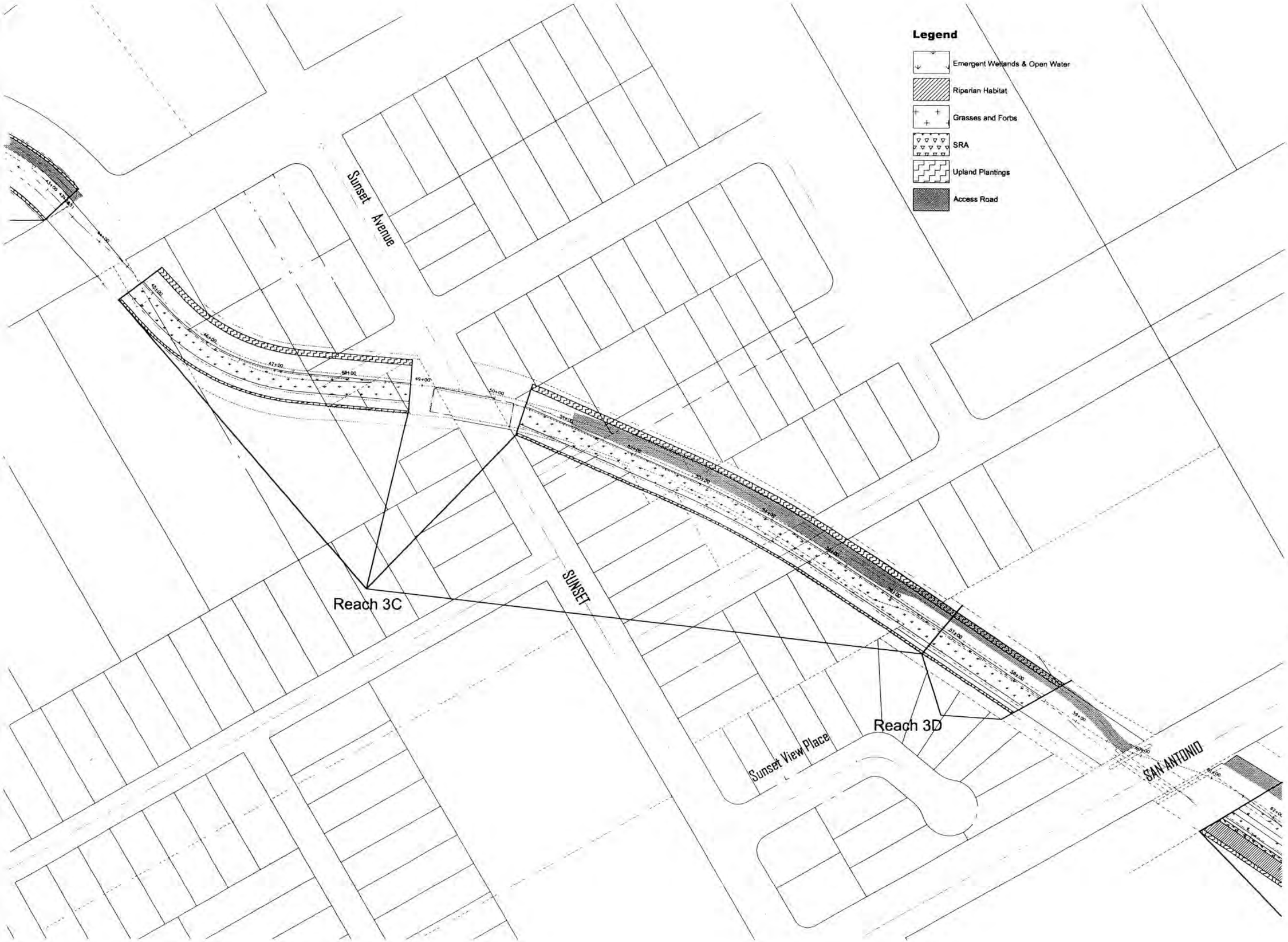
DATE: 07/09/01

SCALE: 1"=50'

DRWN: rm

SHEET NUMBER

L2



TOM RICHMAN & ASSOCIATES
Urban Design, Planning and Landscape Architecture

654 Gilman Street, Palo Alto, CA 9430
Voice 650 462.8880 Fax 650 325.101

REVISION DATE DESCRIPTION

PROJECT TITLE:

Lower Silver Creek
Reach 3

San Jose, California

SHEET TITLE:

Reach 3C & 3D

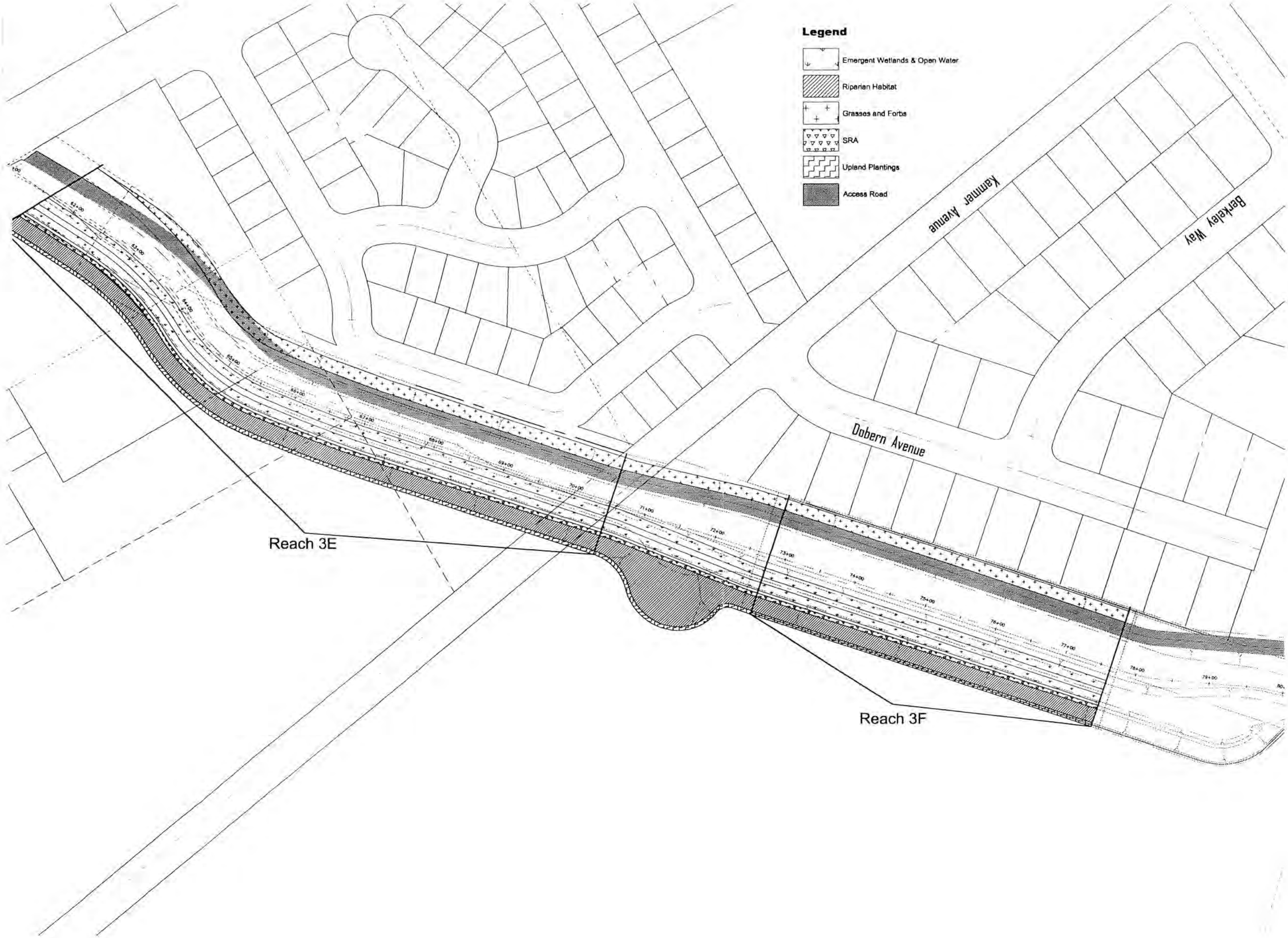
DATE: 07/09/01

SCALE: 1"=50'

DRWN:

SHEET NUMBER

L3



TOM RICHMAN & ASSOCIATES
Urban Design, Planning and Landscape Architecture
654 Gilman Street, Palo Alto, CA 9430
Voice 650 462.8880 Fax 650 325.10

REVISION DATE DESCRIPTION

PROJECT TITLE:

Lower Silver Creek
Reach 3

San Jose, California

SHEET TITLE:

Reach 3E & 3F

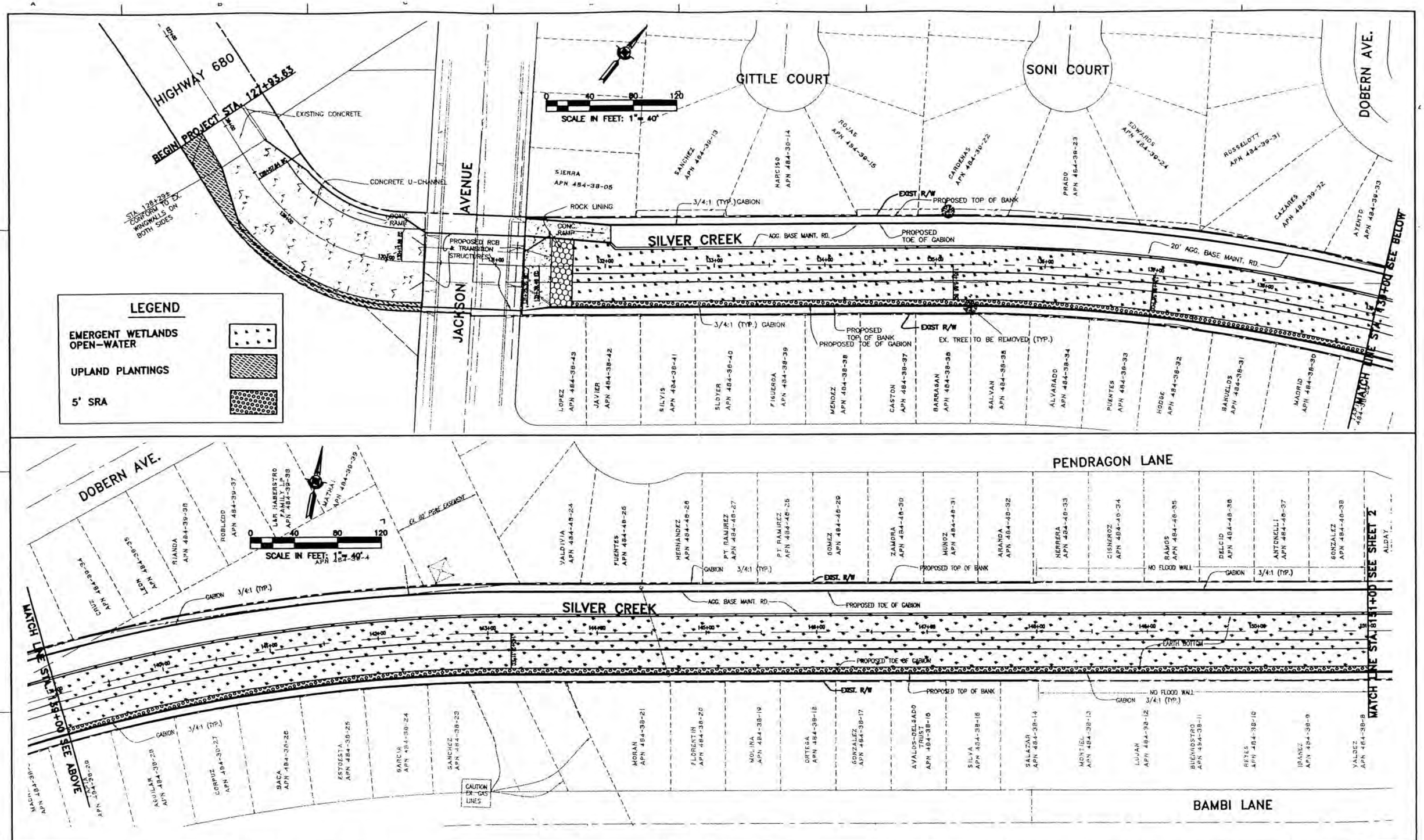
DATE: 07/09/01

SCALE: 1"=50'

DRWN: jm

SHEET NUMBER

L4



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

Ruggeri - Jensen - Azar & Associates
100 N. MILPITAS BLVD., SUITE 160, MILPITAS, CA 95035
PHONE (408) 934-1388 • FAX (408) 934-1288

CONSULTANT STAMP

DATE	7/26/01
DESIGN	E.H.
DRAWN	E.H.
CHECKED	M.E.R.

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT-ENGINEER

LOWER SILVER CREEK, REACH 4
HABITAT PLANTING AREAS

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET 1 2 OF SHTS

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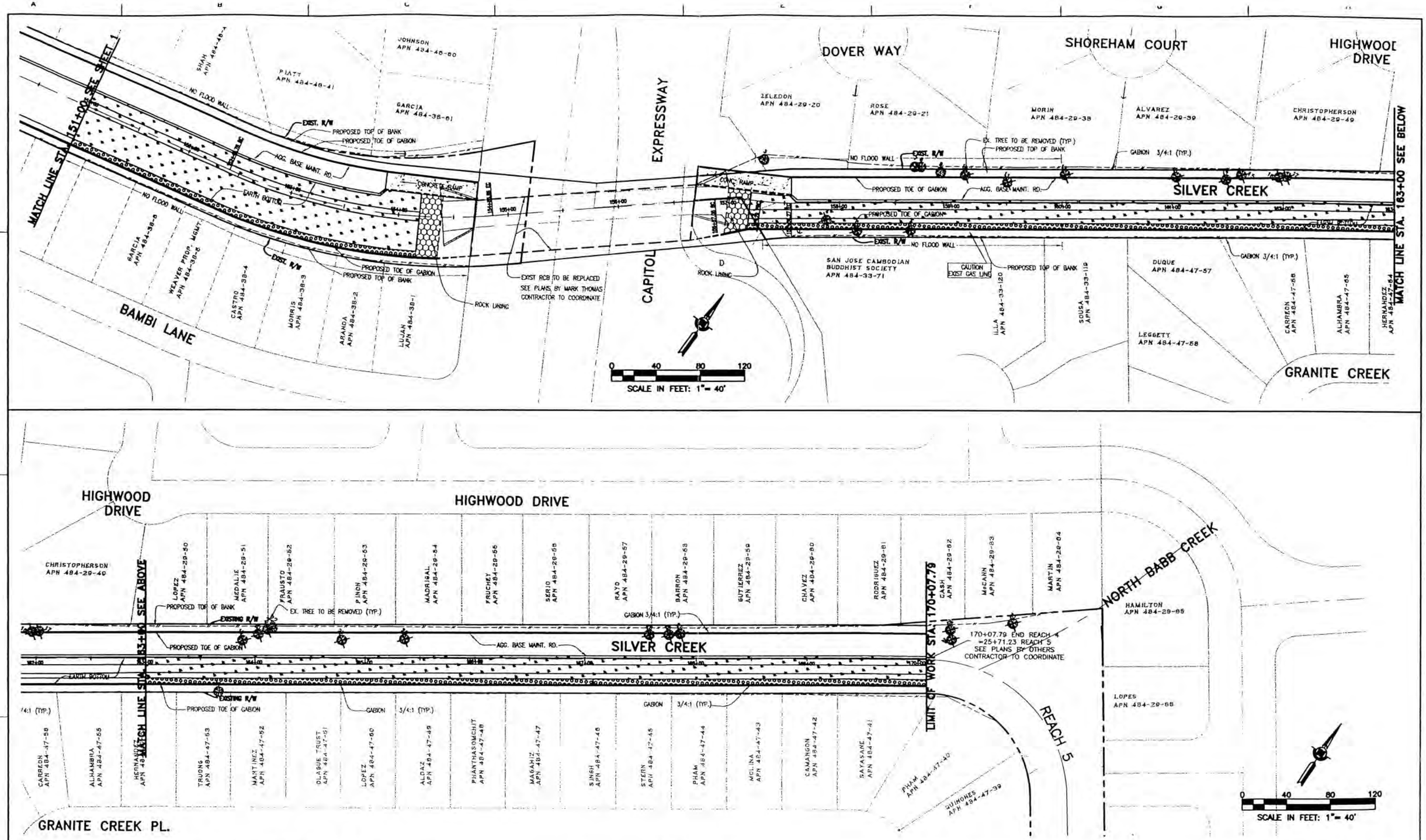

REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

Ruggeri - Jensen - Azar & Associates
100 N. MILPITAS BLVD., SUITE 160, MILPITAS, CA 95035
PHONE: (408) 934-1388 • FAX: (408) 934-1288

DATE	7/26/01
DESIGN	E.H.
DRAWN	E.H.
CHECKED	M.E.R.

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

LOWER SILVER CREEK, REACH 4
HABITAT PLANTING AREAS

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET 2 OF SHTS

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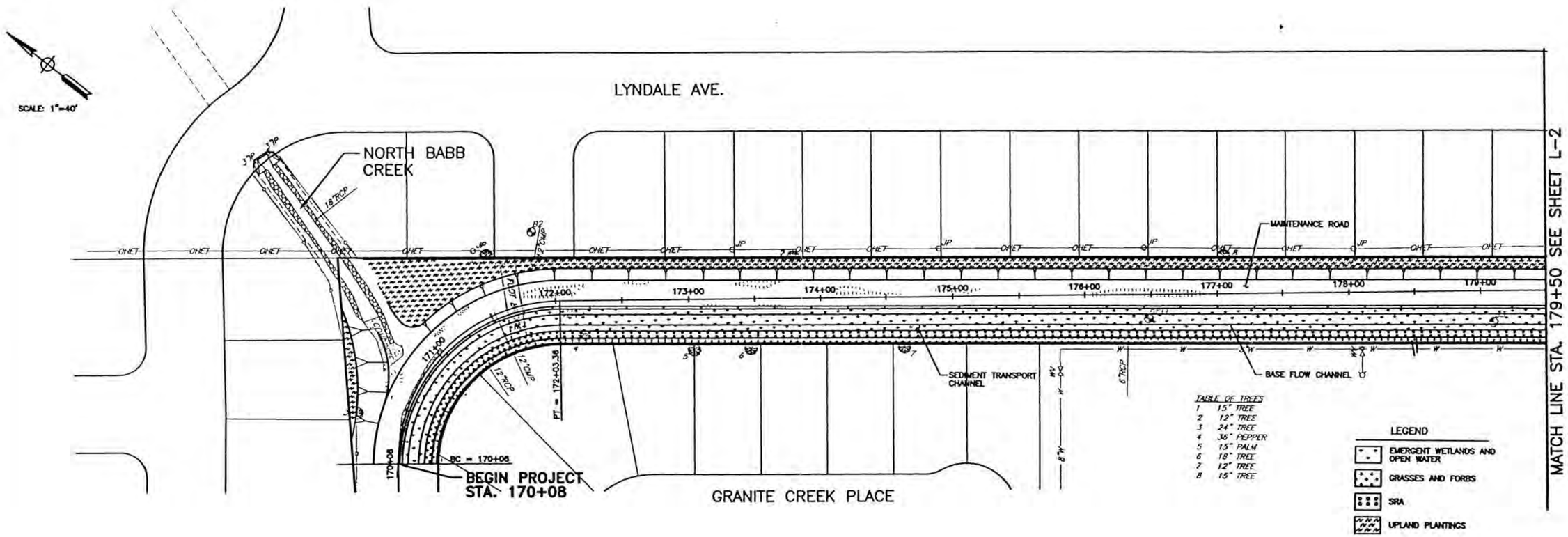

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REFERENCE INFORMATION AND NOTES

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PARSONS ENGINEERING SCIENCE, INC.
Oakland, California
(510) 891-9065

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DATE	MM/DD/YY
DESIGN	RMG
DRAWN	MD
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Santa Clara Valley Water District

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DATE

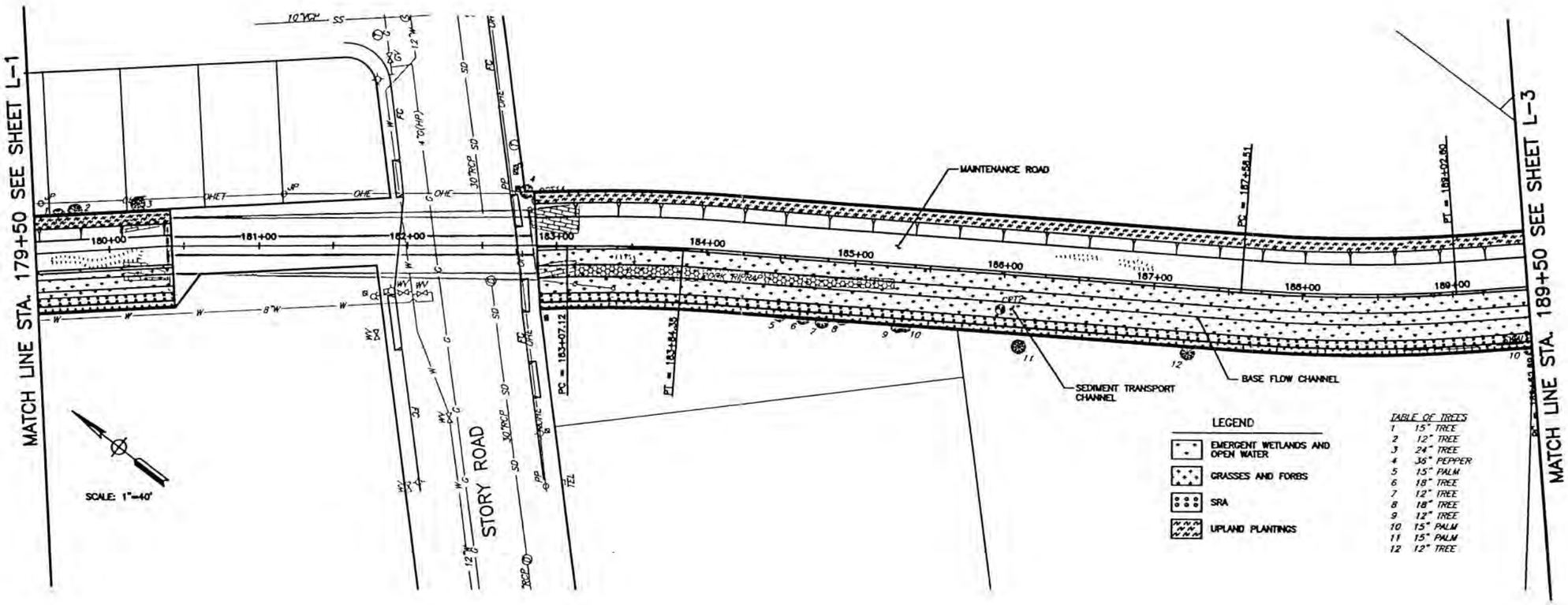
PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6
HABITAT AREAS
PLAN AND PROFILE
STA. 170+08 TO STA. 179+50

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET
L-1
XX OF XXX



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Santa Clara Valley Water District

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DATE

PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6
HABITAT AREAS
PLAN AND PROFILE
STA. 179+50 TO STA. 189+50

VERIFY SCALES
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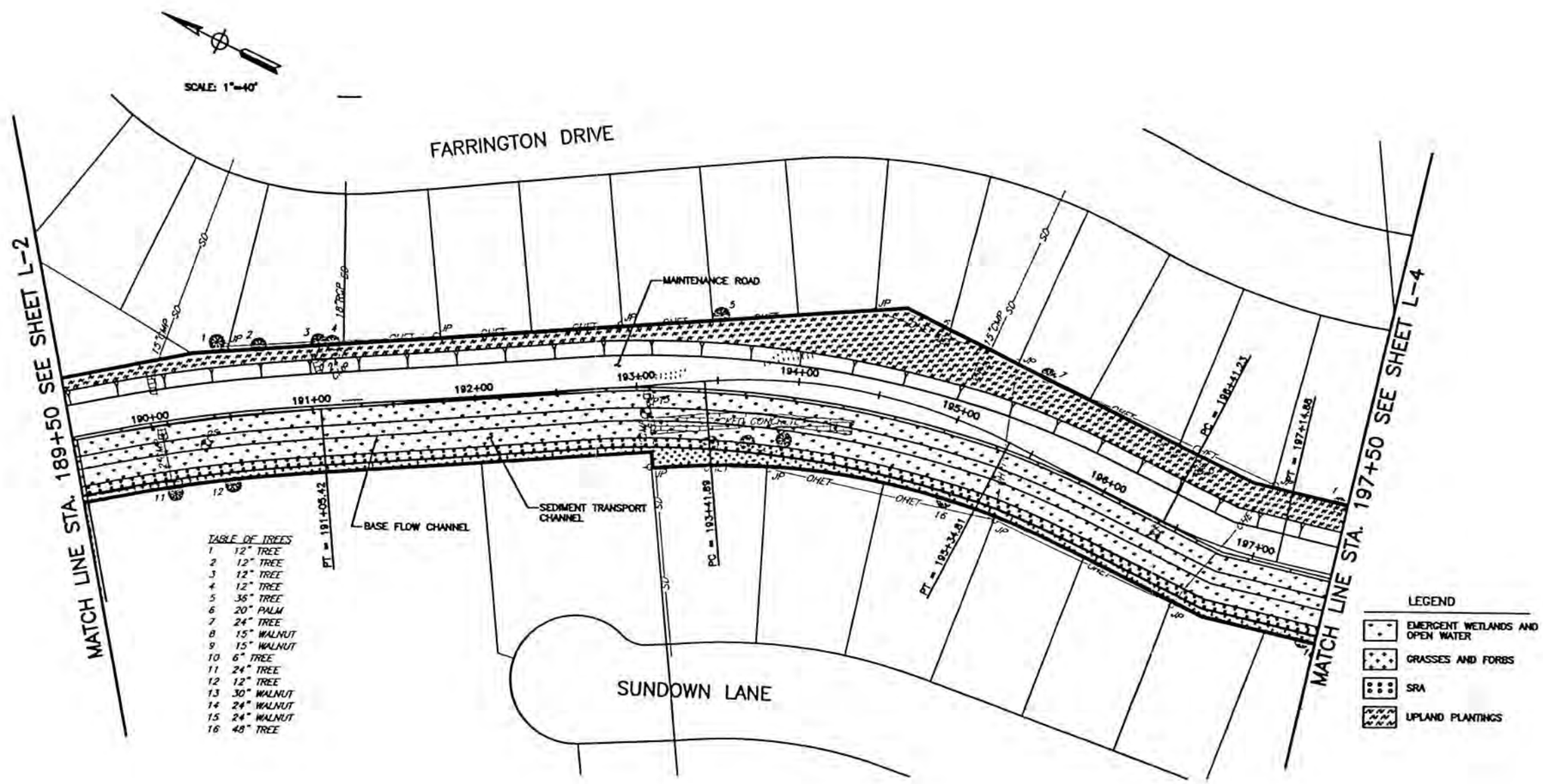
SCALE AS SHOWN

SHEET L-2 XX OF XXX



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REFERENCE INFORMATION AND NOTES

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DESIGN	RMG
DRAWN	MD
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Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6

HABITAT AREAS PLAN AND PROFILE

STA. 189+50 TO STA. 197+50

VERIFY SCALES
0 1'
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-3

XX OF XXX

LEGEND

- EMERGENT WETLANDS AND OPEN WATER
- GRASSES AND FORBS
- SRA
- UPLAND PLANTINGS

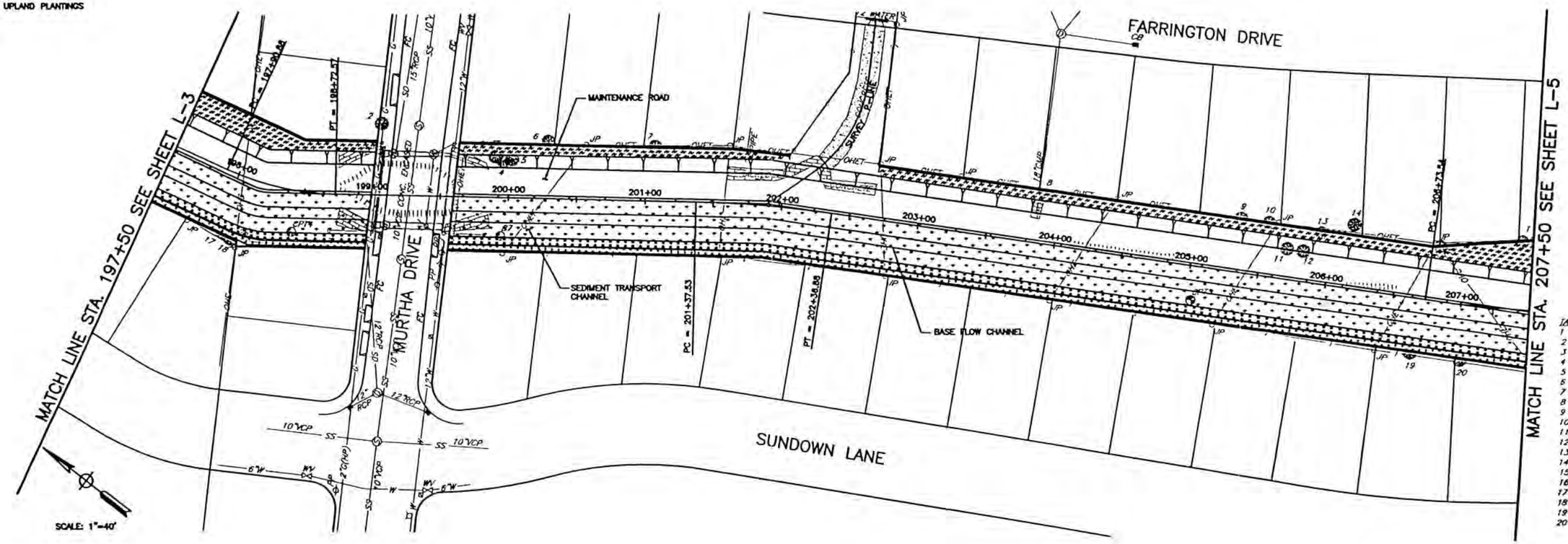

TABLE OF TREES

1	24" WALNUT
2	30" TREE
3	15" TREE
4	15" PEPPER
5	8" TREE
6	36" TREE
7	18" TREE
8	15" TREE
9	32" TREE
10	12" TREE
11	20" TREE
12	20" TREE
13	20" TREE
14	36" TREE
15	24" TREE
16	?
17	?
18	?
19	12" TREE
20	12" TREE

REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

PARSONS ENGINEERING SCIENCE, INC.
Oakland, California
(510) 891-9065

AUG 1, 2001 – 9:15am Wonshare\ESOL\DAOT\738703 Sonrd\habitat\L-4.dwg

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DATE MM/DD/YY	
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DRAWN MD	
CHECKED VMB	

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6

HABITAT AREAS PLAN AND PROFILE

STA. 197+50 TO STA. 207+50

VERIFY SCALES 0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-4

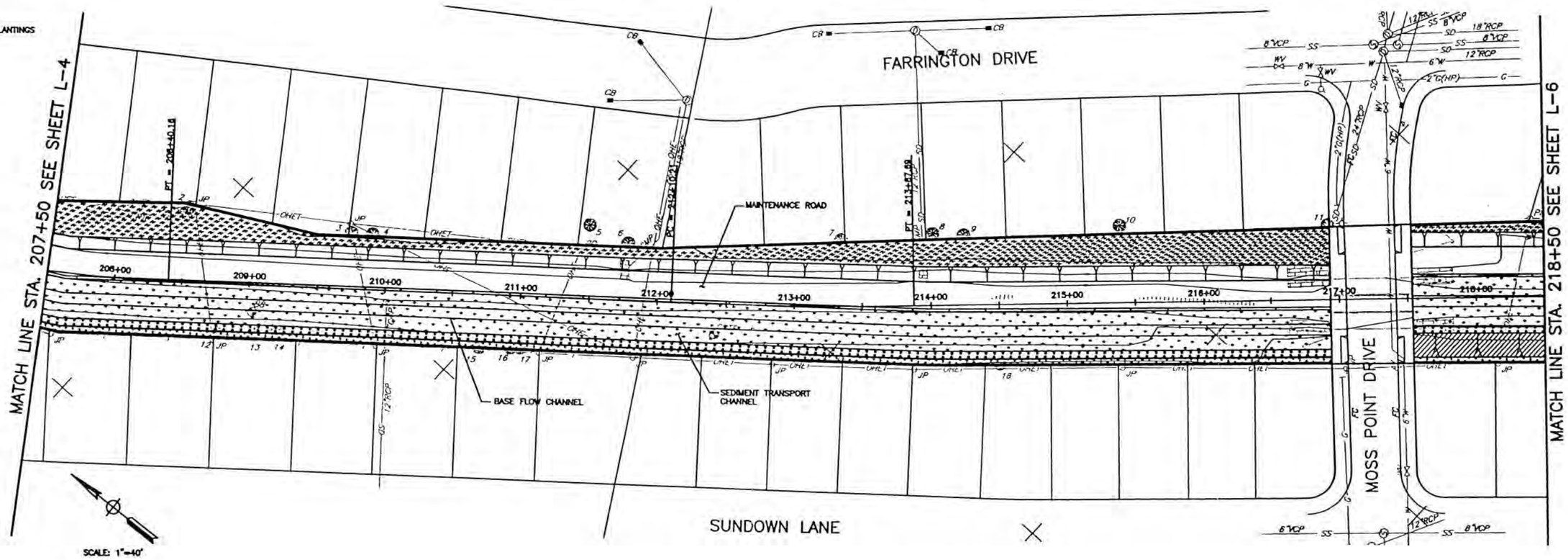
XX OF XXX

LEGEND

- RIPARIAN HABITAT
- EMERGENT WETLANDS AND OPEN WATER
- GRASSES AND FORBS
- SRA
- UPLAND PLANTINGS

TABLE OF TREES

1	18" TREE
2	6" TREE
3	5" TREE
4	5" PEPPER
5	30" PALM
6	12" TREE
7	6" TREE
8	30" TREE
9	12" TREE
10	30" TREE
11	8" TREE
12	36" TREE
13	12" TREE
14	24" WALNUT
15	4" TRE
16	10" TREE
17	10" TREE
18	12" TREE



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

PARSONS ENGINEERING SCIENCE, INC.
Oakland, California
(510) 891-9085

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CONSULTANT STAMP

DATE MM/DD/YY	
DESIGN RMQ	
DRAWN MD	
CHECKED VMB	

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6

HABITAT AREAS PLAN AND PROFILE

STA. 207+50 TO STA. 218+50

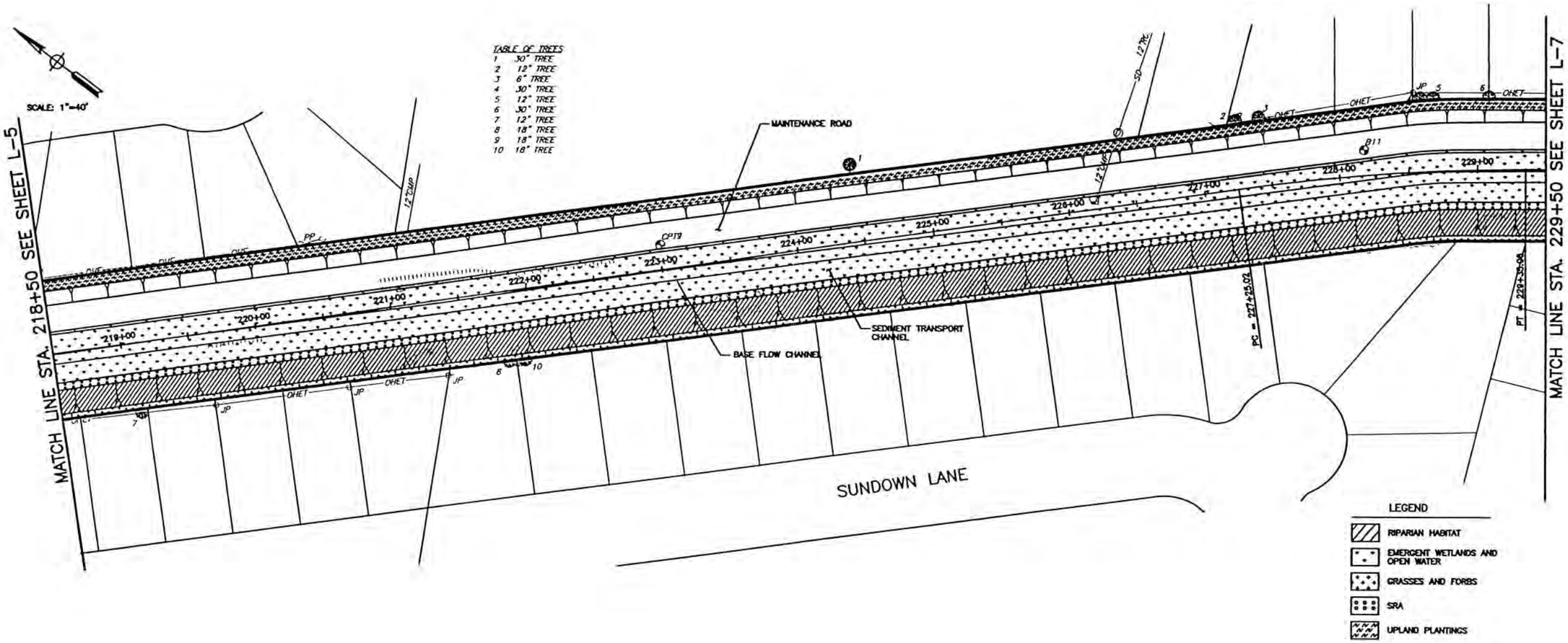
VERIFY SCALES 0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-5

XX OF XXX



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

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PARSONS ENGINEERING SCIENCE, INC.
Oakland, California
(510) 891-9085

CONSULTANT STAMP

DATE MM/DD/YY	
DESIGN RMG	
DRAWN MD	
CHECKED VWB	

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

STA. 74+00 TO 85+00
REACHES 5 & 6
HABITAT AREAS
PLAN AND PROFILE
STA. 218+50 TO STA. 229+50

VERIFY SCALES
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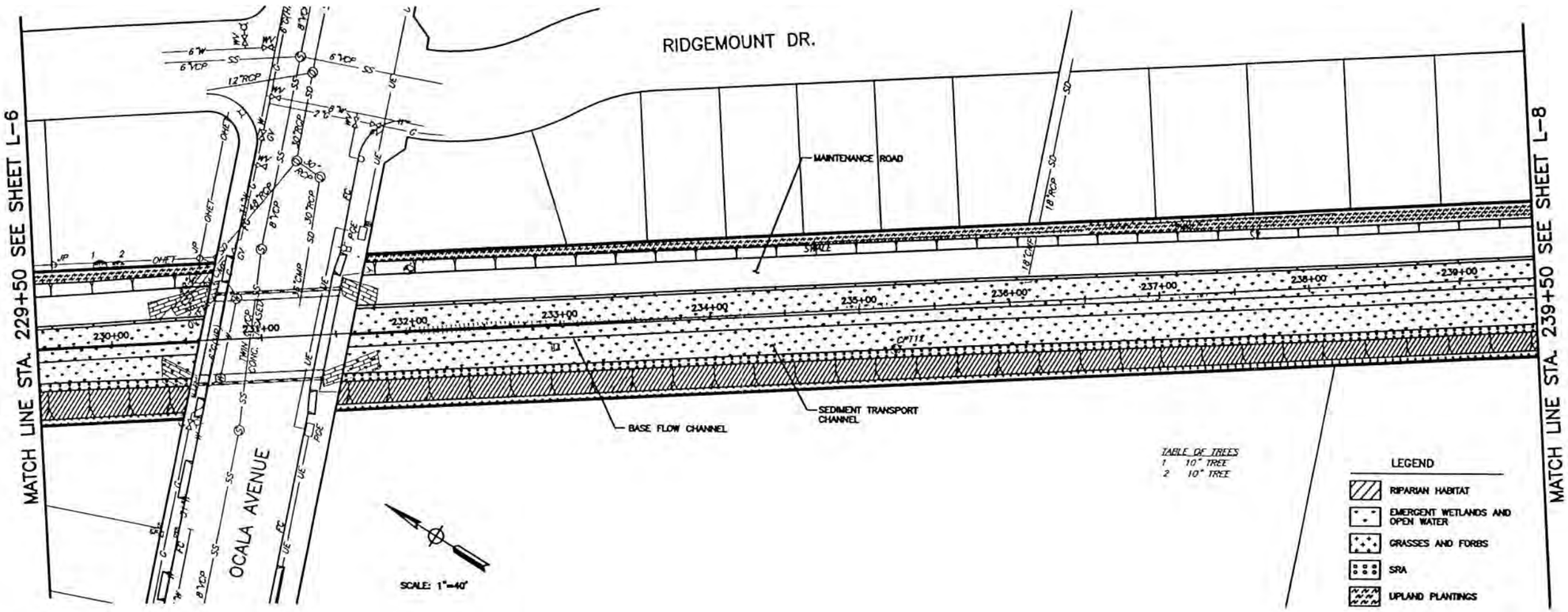
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-6

XX OF XXX



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

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Oakland, California
(510) 891-9065

CONSULTANT STAMP

DATE MM/DD/YY	
DESIGN	RMG
DRAWN	MD
CHECKED	VMB

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

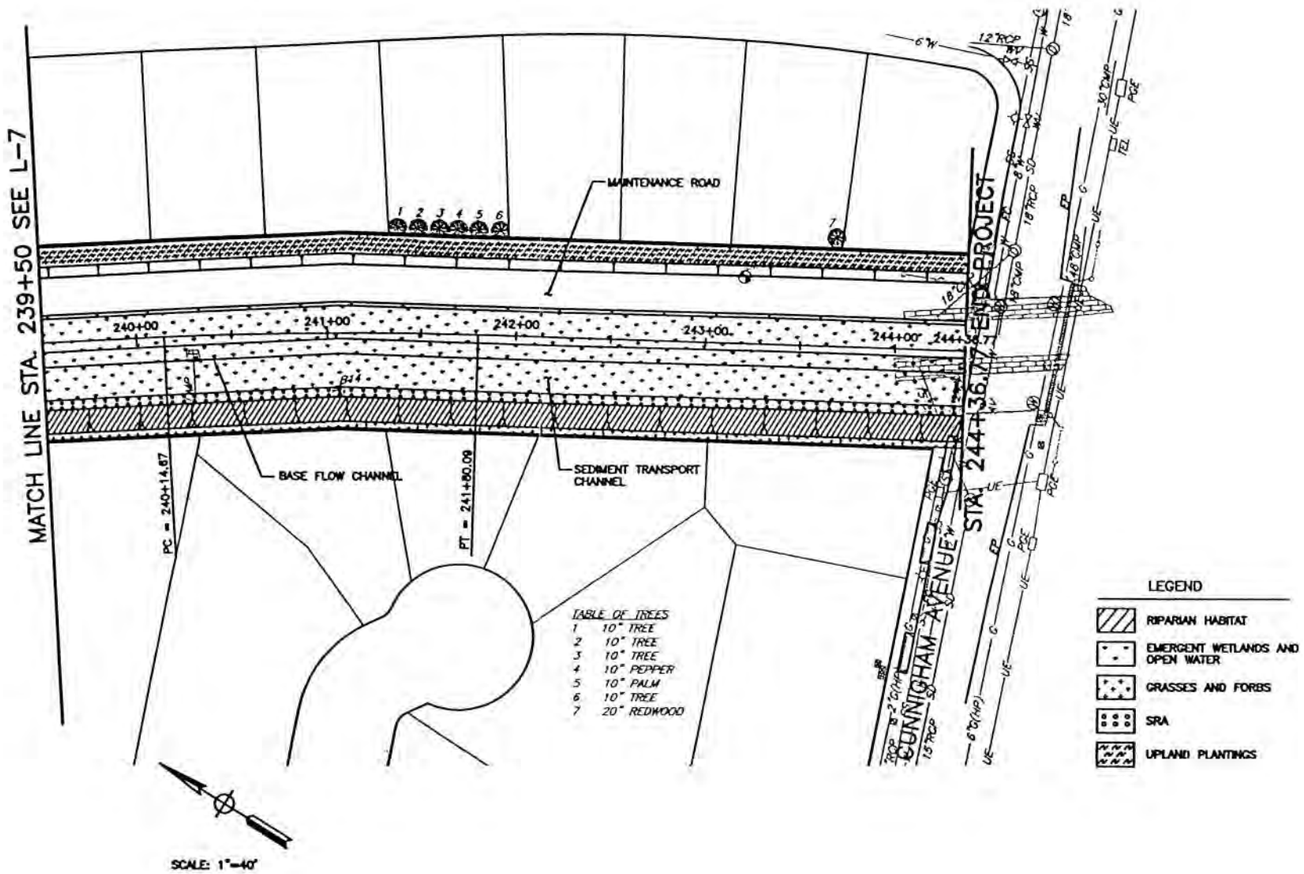
LOWER SILVER CREEK REACHES 5 & 6

HABITAT AREAS PLAN AND PROFILE STA. 229+50 TO 239+50

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-7 XX OF XXX



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

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Oakland, California
(510) 891-9065

CONSULTANT STAMP

DATE MM/DD/YY	
DESIGN	RMG
DRAWN	MD
CHECKED	VMB

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

PROJECT ENGINEER

LOWER SILVER CREEK REACHES 5 & 6

HABITAT AREAS PLAN AND PROFILE

STA. 239+50 TO STA. 244+36.77

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET L-8

XX OF XXX

APPENDIX 6A-7

FISH CRITERIA

DFG Exhibit 4

Effects of Water Temperature on Anadromous Salmonids in the San Joaquin River Basin

California Department of Fish and Game
Central Region
1234 E. Shaw Avenue
Fresno, CA 93710

February 2010

Prepared for the Informational Proceeding to Develop
Flow Criteria for the Delta Ecosystem
Necessary to Protect Public Trust Resources
Before the State Water Resources Control Board

Beginning March 22, 2010

Effects of Water Temperature on Anadromous Salmonids in the San Joaquin River Basin

In February 2007, the Department of Fish and Game (DFG) responded to the Central Valley Regional Water Quality Control Board's "Public Solicitation of Water Quality Data and Information for 2008 Integrated Report – List of Impaired Waters and Surface Water Quality Assessment," and DFG proposed a Clean Water Act section 303(d) listing for temperature impairment of the lower Stanislaus, Tuolumne, and Merced Rivers. (DFG 2007). In 2009, the Central Valley Regional Water Quality Control Board (Board) placed these Rivers on the Section 303(d) list (Category 5). The Board used the same temperature data that DFG used for its analysis, but used a different methodology to analyze those data. The proposed list was approved in June 2009 by the Board and has been forwarded to the California State Water Resources Control Board for review and approval. Once approved by the State Board, the 303(d) list will be forwarded to the U.S. Environmental Protection Agency for review and approval.

DFG presented water temperature results collected from the San Joaquin River and its tributaries (1998 through 2006) in support of our concern that elevated water temperatures are impairing fishery beneficial uses and commonly exceeding the "cool" water quality standards within the relevant Water Quality Control Plans (Basin Plans). The DFG proposal emphasized temperature protections for the last remaining unblocked reaches (downstream from the dams), for all life stages, for the last remaining genetic population of Chinook salmon and steelhead in the San Joaquin River Basin. The presence of dams at the upper end of these reaches has now blocked Anadromous fish that once could migrate up to higher elevation cooler waters.

Rivers in the San Joaquin Basin do not meet (cool) temperature water quality criteria to protect anadromous fish beneficial uses (The Criteria are presented in Table 1). DFG believes that one critical factor limiting anadromous salmon and steelhead population abundance is high water temperatures which exist during critical life-stages in the tributaries and the main-stem. This results largely from water diversions, hydroelectric power operations, water operations and other factors. Figures 1 to 4 provides a visual summary of the percent of habitat-impaired areas for the 52-mile reach of the Tuolumne River downstream from La Grange Dam. Figure 1 shows the extreme length of adult Chinook salmon migration habitat impairment across weeks for all years including above normal and wet water years. Figure 2 provides spawning habitat impaired areas within the 24-mile reach down stream from La Grange Dam. Except for the last three to four weeks in the season (i.e., December), length of impairment across years including above normal and wet water years is extreme. Figure 3 provides percent of smoltification habitat-impaired areas within the entire 52-mile reach down stream from the La Grange Dam. The differences of impairment across weeks between the wet years (1998, 2005, 2006) are extreme compared to the dry years (2001, 2002, 2004). Figure 4 provides a visual summary of the percent steelhead rearing habitat impaired areas within the first 10 miles downstream from the La Grange Dam. The differences of impairment across weeks between the wet years (1998, 2005, and 2006) are extreme

compared to the dry years (2001, 2002, 2004). Figures 5 to 12 provide a visual summary of the percent of habitat-impaired areas for the 52-mile reach of the Merced River downstream from Crocker Dam and the Stanislaus River downstream from Goodwin Dam. Similar to the Tuolumne River, river miles of habitat are impaired across years including wet to above normal years.

Table 1. EPA temperature thresholds for Pacific migratory salmonid species and life stages.

Salmonid Life History Phase Terminology	EPA-based Recommended Temperature Thresholds to Protect Salmon and Trout[1] (Criteria are based on the 7-day average of the daily maximum values)
Adult migration	<64°F (<18°C) for salmon and trout migration
	<68°F (<20°C) for salmon and trout migration - generally in the lower part of river basins that likely reach this temperature naturally, if there are cold-water refugia available
Incubation	<55°F (<13°C) for salmon and trout spawning, egg incubation, and fry emergence
Juvenile rearing (early year)	<61°F (<16°C) for salmon "core" juvenile rearing - generally in the mid- to upper part of river basins
Smoltification	<59°F (<15°C) for salmon smoltification
	<57°F (<14°C) for steelhead smoltification (for composite criteria steelhead conditions are applied)
Juvenile rearing (late year)	<64°F (<18°C) for juvenile salmon and steelhead migration plus non-Core Juvenile Rearing - generally in the lower part of river basins

[1] Water temperature thresholds taken from: United States Environmental Protection Agency (EPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. 49 pp. April. The EPA identified temperature unit is: Seven day average of the daily maximum water temperature (7DADM).

DFG considers the reproduction and recruitment success of the entire population across multiple generations in recognition of the evolution and importance of the multi-year class life history strategy of salmon and steelhead. Unlike the use of "tolerance" temperatures which apply to the survival of a group of individuals across a short time line, our systematic approach is the more comprehensive method in assuring the survival of the population over time. In order to use this approach, DFG's recommended temperature criteria emphasize the following life stages for managing the species: Chinook salmon adult migration, egg incubation, smoltification, smolt migration, and steelhead summer rearing.

Fish are exothermic (e.g., physiologically controlled by ambient water temperature levels). As such, water temperature controls all life stage needs, such as physiological

function (oxygen/carbon dioxide exchange, blood chemistry/pH, organ function, heart rate, egg and sperm viability), basic survival, food consumption, rearing location preference, ability to successfully spawn, spawning location preference, growth rates, stress factors, immune function, disease resistance, predator avoidance, etc.

Elevated water temperatures appear to be a factor in the continued decline in adult salmon escapement abundance in the San Joaquin River Basin watershed, either by: (1) inducing adult mortality as adults migrate into the San Joaquin River, and tributaries, to spawn (i.e., pre-spawn mortality); (2) reducing egg viability for eggs deposited in stream gravels (redds), (3) increasing stress levels and therefore reducing survival of juveniles within the tributary nursery habitats, and (4) reducing salmon smolt out-migration survival as smolts leave the nursery habitats within tributaries to migrate down the San Joaquin River to Vernalis and through the south Delta. For rainbow trout and anadromous steelhead, excessively warm water temperatures have the potential to limit trout/steelhead population abundance by restricting juvenile and adult resident over-summer rearing habitat to very short stream reaches, due to downstream thermal regimes. As such, too few miles of suitable habitat may exist to sustain healthy population levels.

Warm water temperatures can decrease dissolved oxygen in the water and can act as a barrier to migration. Increased water temperatures can decrease the availability of dissolved oxygen to the eggs, decrease egg hatchability, and decrease the survival of fry once they emerge from the eggs. Warm temperatures can decrease, inhibit, or reverse the physiological function of smoltification, as well as, decrease available oxygen to the smolt. Similar to adult migrants, warm water temperatures can act as a barrier to migrating smolts moving downstream, decrease physiological function and growth, and decrease dissolved oxygen availability to the fish.

Secondary effects are likely as well, especially in predator-rich systems like Central Valley rivers. As thermal optima for salmon/steelhead/rainbow trout are exceeded at temperatures above 64 to 65°F (17.7 to 18.3°C), major predators like pikeminnow, striped bass, and black bass are just entering their thermal optima. As cold water fish become stressed at temperatures above 64°F, salmon and trout become more vulnerable to predation.

Steelhead require appropriate water temperatures on a year-round basis. DFG evaluated the rearing period for this report because this is considered the most critical life stage/period for steelhead survival. The other life stage periods overlap with Chinook salmon, which if salmon water temperatures are met, by default, steelhead water temperature criteria will also be met.

The temperature criteria are chronic thresholds to protect a population of anadromous fish across multiple generations. As such, the daily water temperature range is narrow (on the higher temperature scale) in the San Joaquin River Basin, thus the fish are not briefly exposed to elevated temperatures, but are chronically exposed to warm temperatures across both a temporal (time) and spatial (space) continuum. In addition,

temperature monitoring results do not indicate that fish have the benefit of a brief exposure to optimal cool temperatures (i.e., cool temperature refugia) during a 24-hour period in the San Joaquin Valley Basin river systems. These fish require extended cool water exposure over the length of the river system to successfully complete its complex life cycle. Without changes in the flow regime and water temperatures that support anadromous fish populations, they will continue to decline and remain potentially at risk to extinction.

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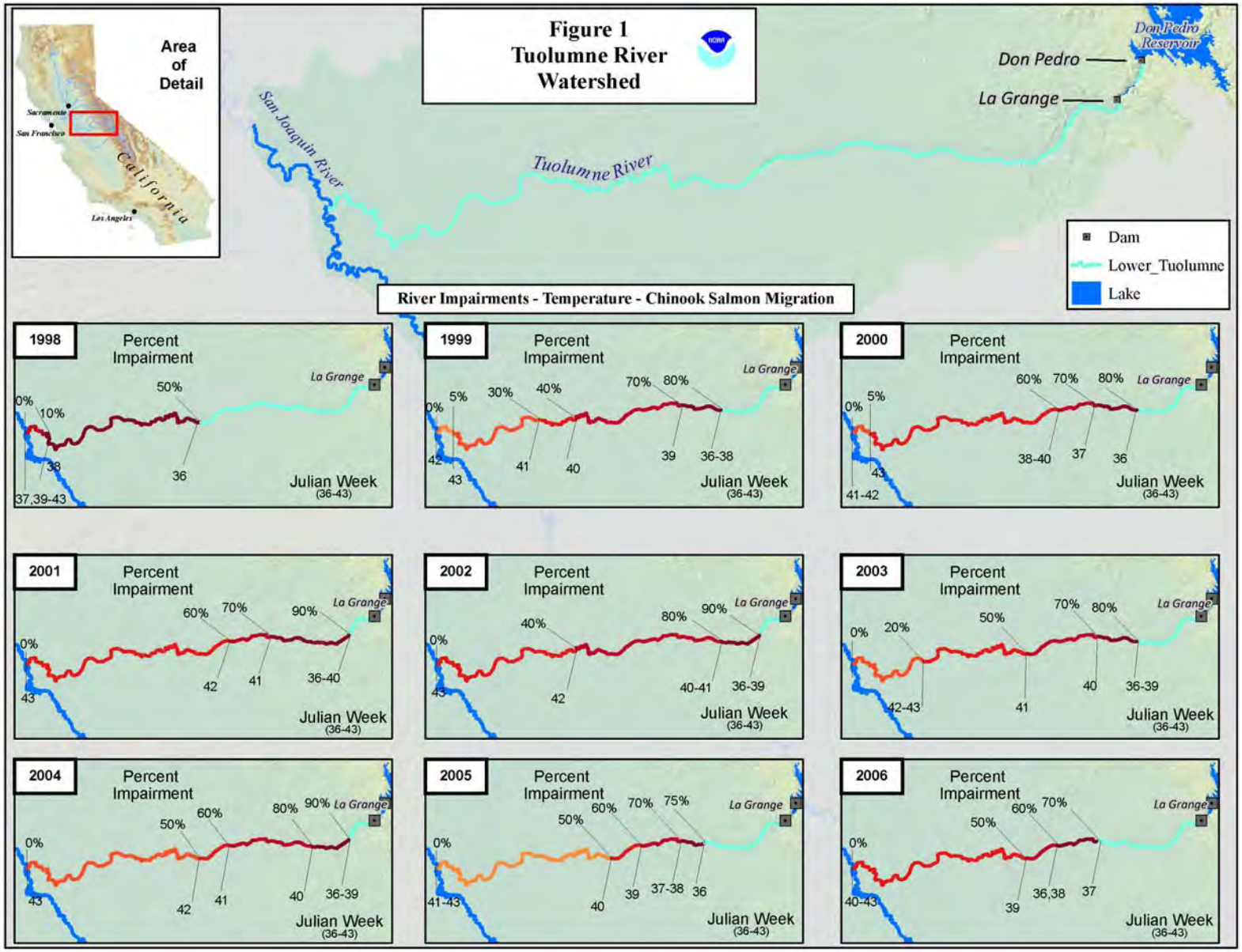


Figure 1
Tuolumne River
Watershed
Area
of
Detail
Sacramento
San Francisco
California
Los Angeles
San Joaquin River
Tuolumne River
Don Pedro
La Grange
Don Pedro
Reservoir
Dam
Lower_Tuolumne
Lake
River Impairments - Temperature - Chinook Salmon Migration
1998
Percent
Impairment
0%
10%
50%
38
36
37,39-43
La Grange
Julian Week
(36-43)
1999
Percent
Impairment
0%
5%
30%
40%
70%
80%
42
43
41
40
39
36-38
La Grange
Julian Week
(36-43)
2000
Percent
Impairment
0%
5%
60%
70%
80%
38-40
37
36
43
41-42
La Grange
Julian Week
(36-43)
2001
Percent
Impairment
0%
60%
70%
90%
43
42
41
36-40
La Grange
Julian Week
(36-43)
2002
Percent
Impairment
0%
40%
80%
90%
43
42
40-41
36-39
La Grange
Julian Week
(36-43)
2003
Percent
Impairment
0%
20%
50%
70%
80%
42-43
41
40
36-39
La Grange
Julian Week
(36-43)
2004
Percent
Impairment
0%
50%
60%
80%
90%
43
42
41
40
36-39
La Grange
Julian Week
(36-43)
2005
Percent
Impairment
0%
50%
60%
70%
75%
41-43
40
39
37-38
36
La Grange
Julian Week
(36-43)
2006
Percent
Impairment
0%
50%
60%
70%
40-43
39
36,38
37
La Grange
Julian Week
(36-43)

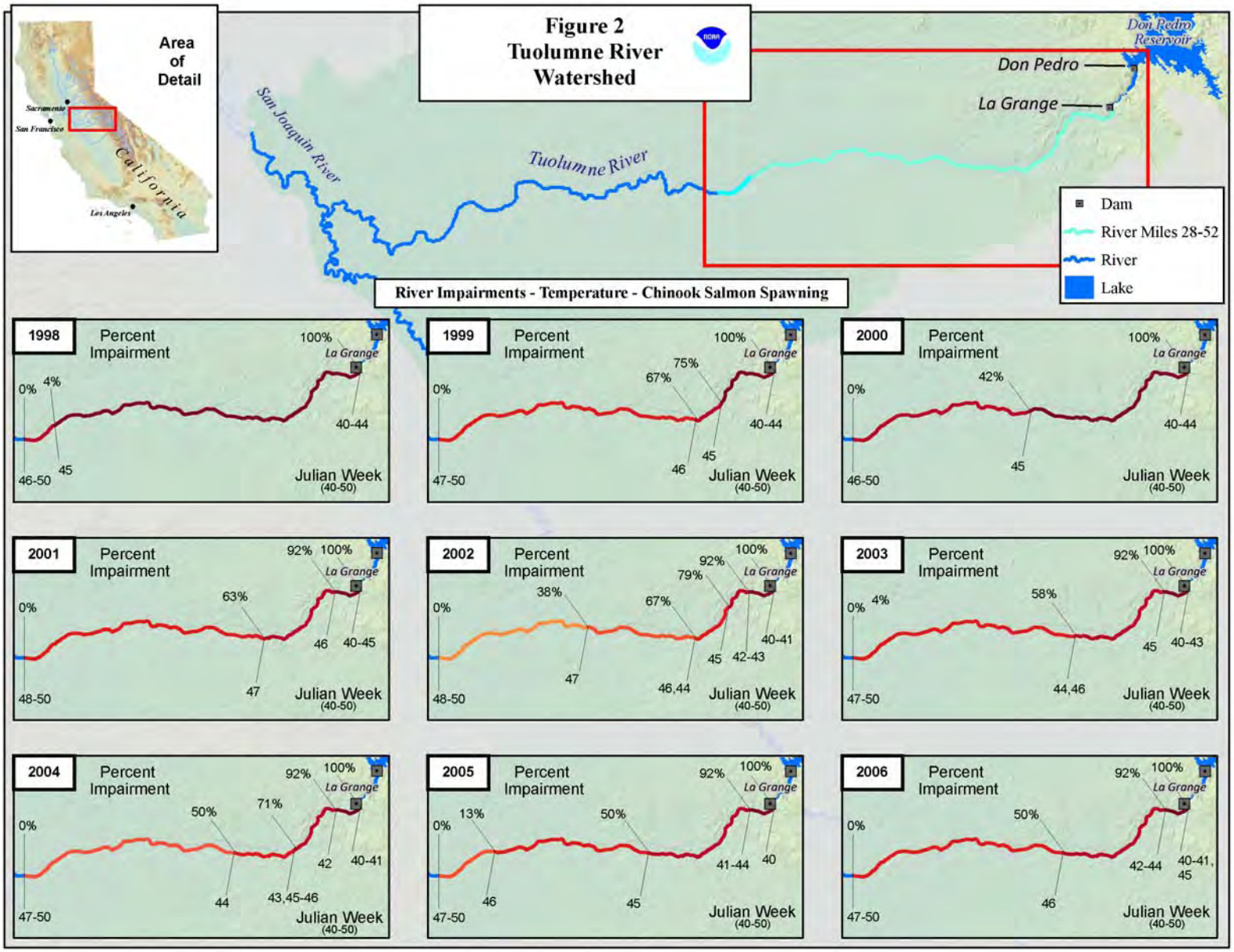


Figure 2
Tuolumne River
Watershed
Area
of
Detail
Sacramento
San Francisco
California
Los Angeles
San Joaquin River
Tuolumne River
Don Pedro
Reservoir
Don Pedro
La Grange
Dam
River Miles 28-52
River
Lake
River Impairments - Temperature - Chinook Salmon Spawning
1998
Percent
Impairment
100%
La Grange
0%
4%
40-44
46-50
45
Julian Week
(40-50)
1999
Percent
Impairment
100%
La Grange
75%
67%
0%
40-44
47-50
46
45
Julian Week
(40-50)
2000
Percent
Impairment
100%
La Grange
42%
0%
40-44
46-50
45
Julian Week
(40-50)
2001
Percent
Impairment
92%
100%
La Grange
63%
0%
46
40-45
48-50
47
Julian Week
(40-50)
2002
Percent
Impairment
92%
100%
La Grange
79%
38%
67%
0%
40-41
45
42-43
47
48-50
46,44
Julian Week
(40-50)
2003
Percent
Impairment
92%
100%
La Grange
58%
0%
4%
45
40-43
47-50
44,46
Julian Week
(40-50)
2004
Percent
Impairment
92%
100%
La Grange
50%
71%
0%
42
40-41
44
43,45-46
47-50
Julian Week
(40-50)
2005
Percent
Impairment
92%
100%
La Grange
13%
50%
0%
41-44
40
46
45
47-50
Julian Week
(40-50)
2006
Percent
Impairment
92%
100%
La Grange
50%
0%
42-44
40-41,
45
46
47-50
Julian Week
(40-50)

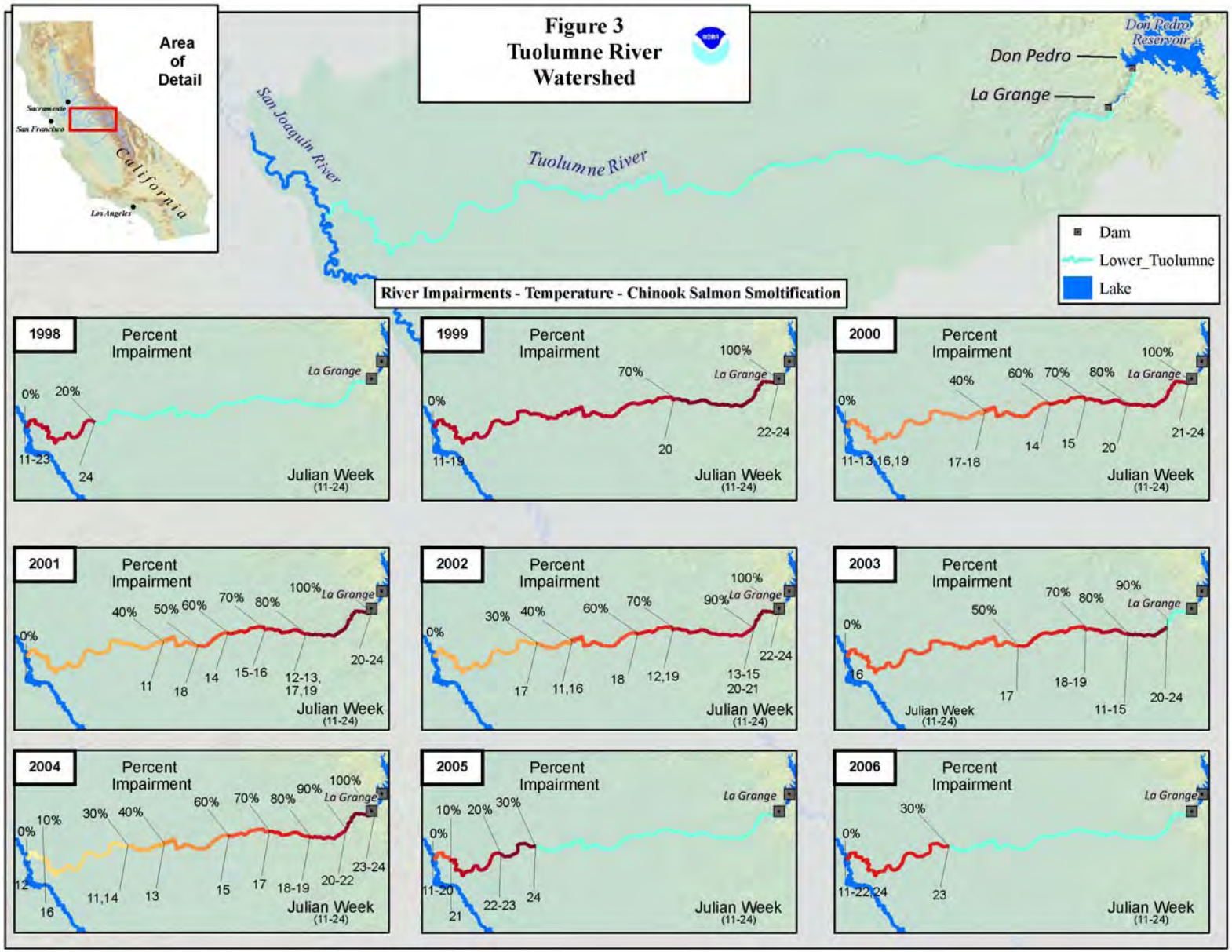


Figure 3
Tuolumne River
Watershed
Area
of
Detail
Sacramento
San Francisco
California
Los Angeles
San Joaquin River
Tuolumne River
Don Pedro Reservoir
Don Pedro
La Grange
Dam
Lower_Tuolumne
Lake
River Impairments - Temperature - Chinook Salmon Smoltification
1998
Percent Impairment
0%
20%
11-23
24
La Grange
Julian Week (11-24)
1999
Percent Impairment
0%
70%
100%
11-19
20
22-24
La Grange
Julian Week (11-24)
2000
Percent Impairment
0%
40%
60%
70%
80%
100%
11-13,16,19
17-18
14
15
20
21-24
La Grange
Julian Week (11-24)
2001
Percent Impairment
0%
40%
50%
60%
70%
80%
100%
11
18
14
15-16
12-13, 17,19
20-24
La Grange
Julian Week (11-24)
2002
Percent Impairment
0%
30%
40%
60%
70%
90%
100%
17
11,16
18
12,19
13-15 20-21
22-24
La Grange
Julian Week (11-24)
2003
Percent Impairment
0%
50%
70%
80%
90%
16
17
18-19
11-15
20-24
La Grange
Julian Week (11-24)
2004
Percent Impairment
0%
10%
30%
40%
60%
70%
80%
90%
100%
12
16
11,14
13
15
17
18-19
20-22
23-24
La Grange
Julian Week (11-24)
2005
Percent Impairment
0%
10%
20%
30%
11-20
21
22-23
24
La Grange
Julian Week (11-24)
2006
Percent Impairment
0%
30%
11-22,24
23
La Grange
Julian Week (11-24)

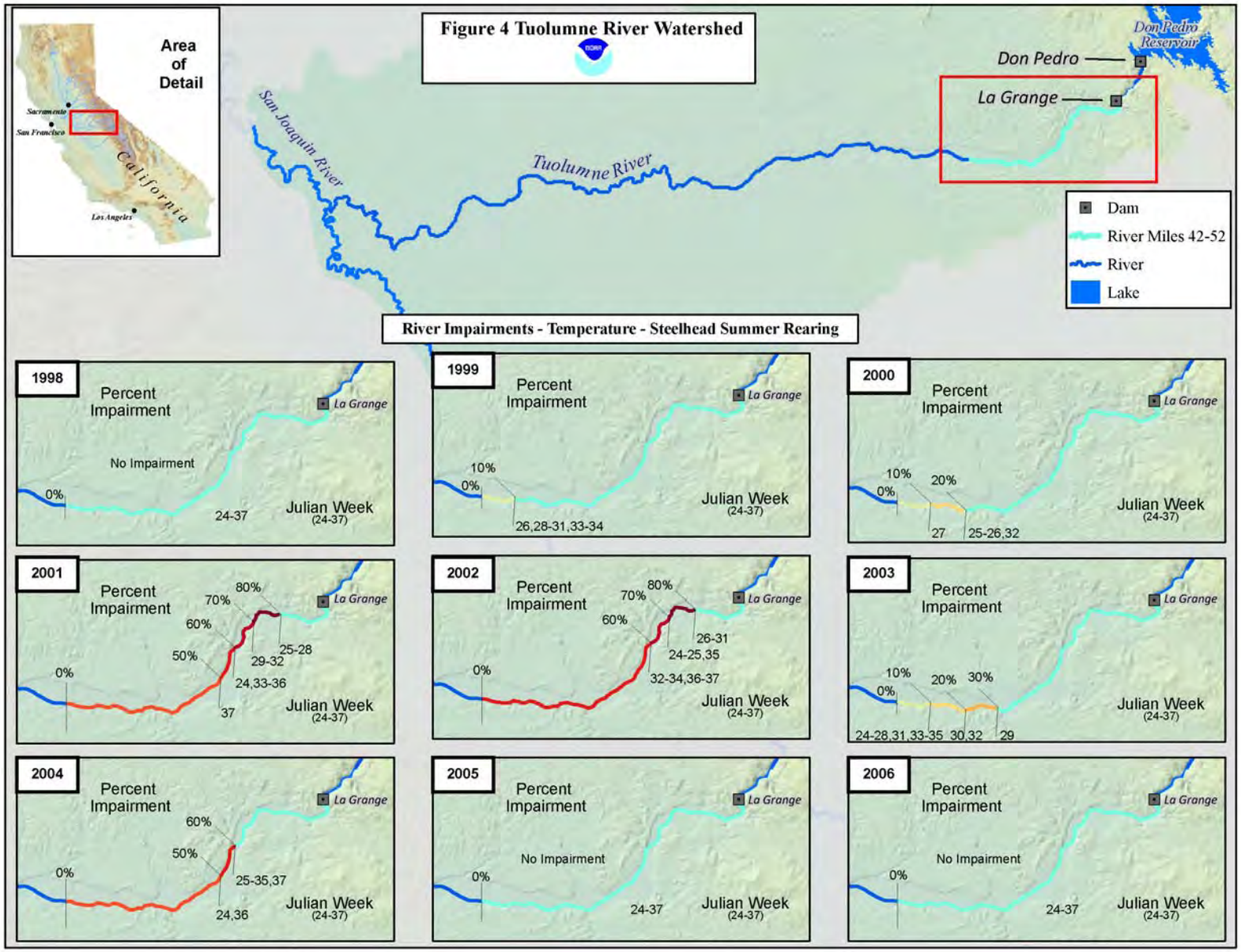


Figure 4 Tuolumne River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Tuolumne River
Don Pedro Reservoir
Don Pedro
La Grange
Dam
River Miles 42-52
River
Lake
River Impairments - Temperature - Steelhead Summer Rearing
1998
Percent Impairment
No Impairment
0%
24-37
Julian Week (24-37)
1999
10%
0%
26,28-31,33-34
2000
20%
27
25-26,32
2001
80%
70%
60%
50%
25-28
29-32
24,33-36
37
2002
26-31
24-25,35
32-34,36-37
2003
30%
24-28,31,33-35
30,32
29
2004
25-35,37
24,36
2005
2006

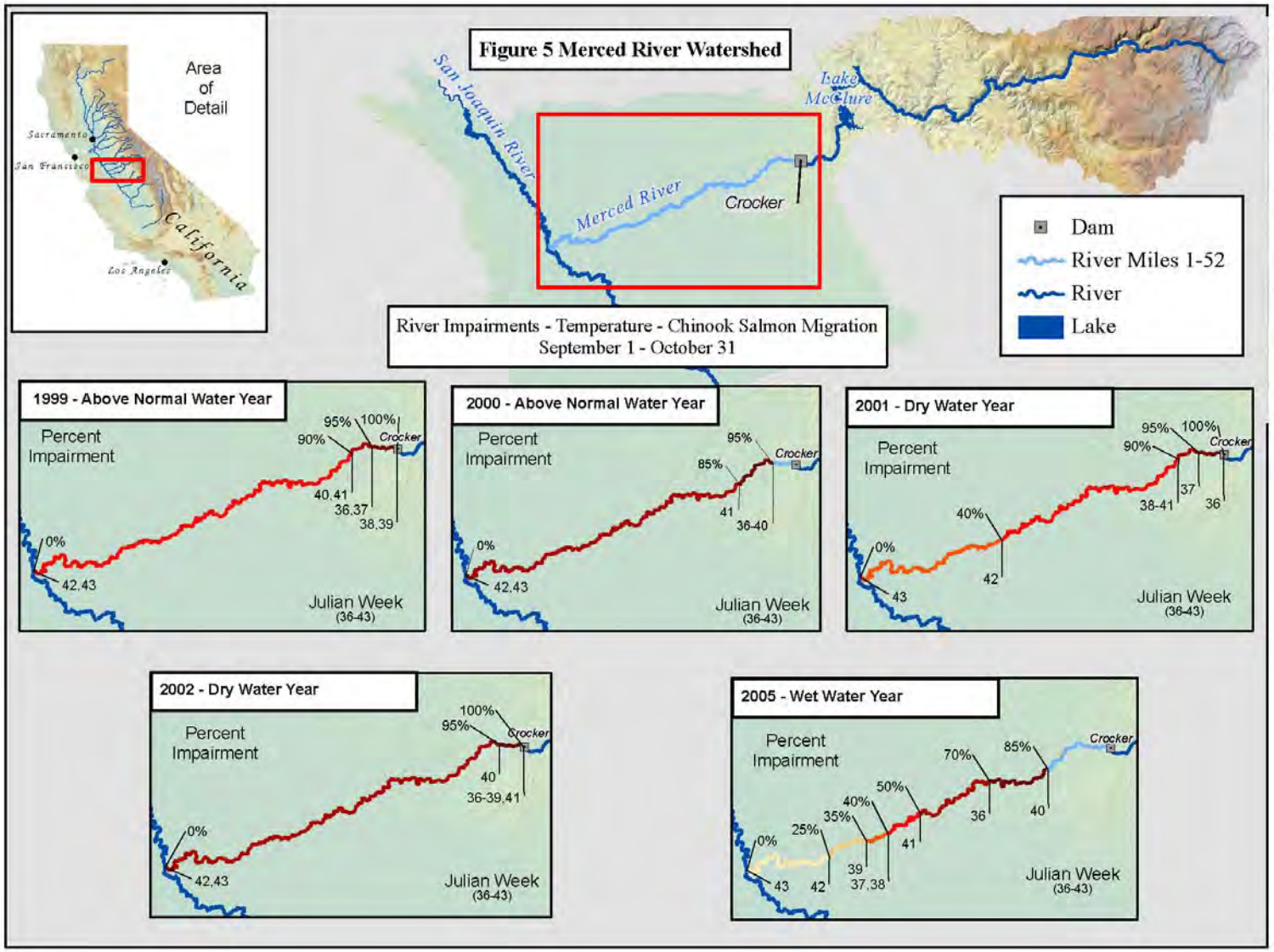


Figure 5 Merced River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Merced River
Crocker
Lake McClure
Dam
River Miles 1-52
River
Lake
River Impairments - Temperature - Chinook Salmon Migration
September 1 - October 31
1999 - Above Normal Water Year
Percent Impairment
0%
42,43
90%
95%
100%
40,41
36,37
38,39
Crocker
Julian Week (36-43)
2000 - Above Normal Water Year
Percent Impairment
0%
42,43
85%
95%
41
36-40
Crocker
Julian Week (36-43)
2001 - Dry Water Year
Percent Impairment
0%
43
40%
42
90%
95%
100%
38-41
37
36
Crocker
Julian Week (36-43)
2002 - Dry Water Year
Percent Impairment
0%
42,43
95%
100%
40
36-39,41
Crocker
Julian Week (36-43)
2005 - Wet Water Year
Percent Impairment
0%
43
25%
42
35%
40%
39
37,38
50%
41
70%
36
85%
40
Crocker
Julian Week (36-43)

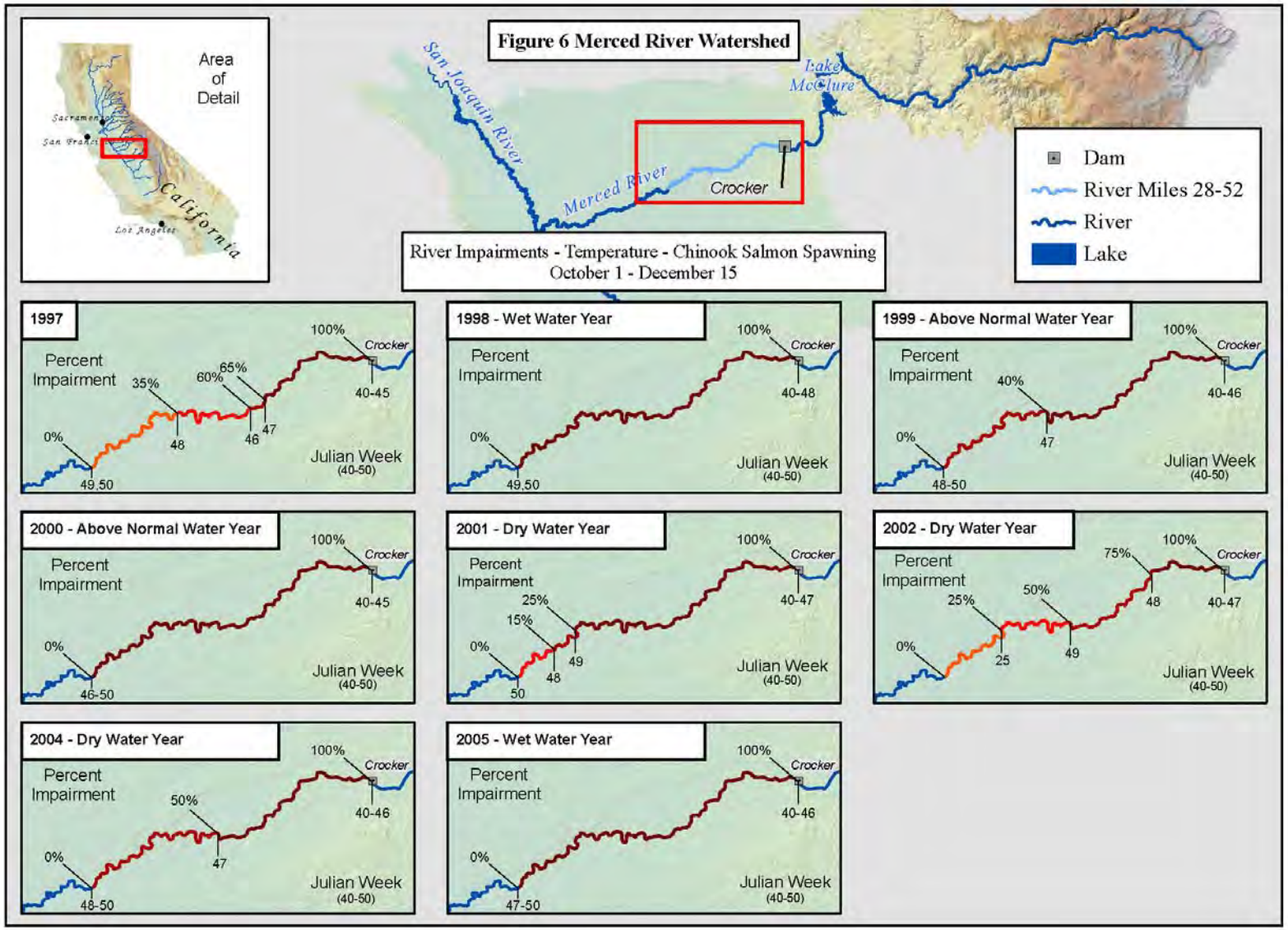
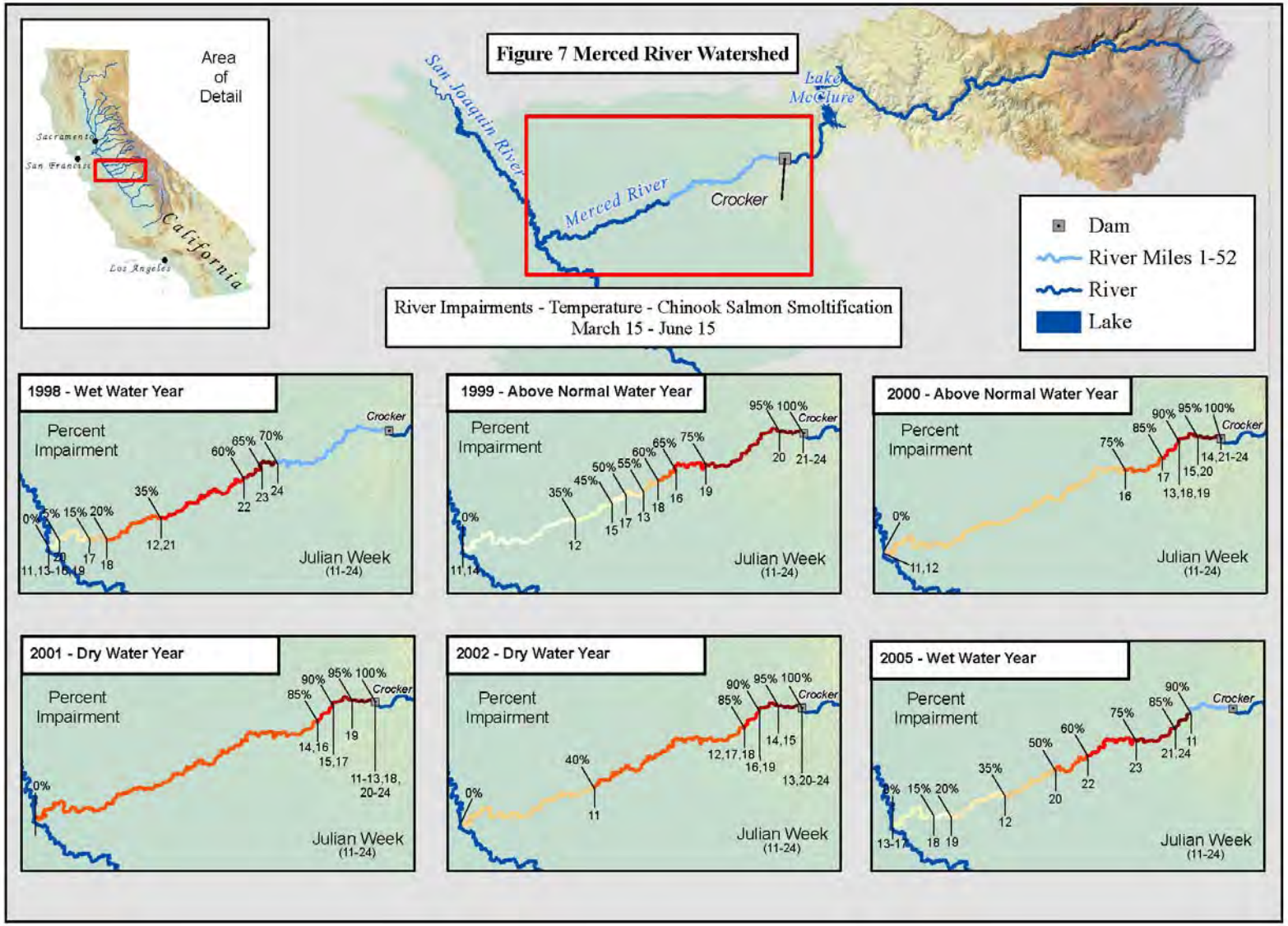


Figure 6 Merced River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Merced River
Lake McClure
Crocker
Dam
River Miles 28-52
River
Lake
River Impairments - Temperature - Chinook Salmon Spawning
October 1 - December 15
1997
Percent Impairment
0%
35%
60%
65%
100%
49-50
48
46
47
40-45
Crocker
Julian Week (40-50)
1998 - Wet Water Year
Percent Impairment
0%
100%
49-50
40-48
Crocker
Julian Week (40-50)
1999 - Above Normal Water Year
Percent Impairment
0%
40%
100%
48-50
47
40-46
Crocker
Julian Week (40-50)
2000 - Above Normal Water Year
Percent Impairment
0%
100%
46-50
40-45
Crocker
Julian Week (40-50)
2001 - Dry Water Year
Percent Impairment
0%
15%
25%
100%
50
48
49
40-47
Crocker
Julian Week (40-50)
2002 - Dry Water Year
Percent Impairment
0%
25%
50%
75%
100%
25
49
48
40-47
Crocker
Julian Week (40-50)
2004 - Dry Water Year
Percent Impairment
0%
50%
100%
48-50
47
40-46
Crocker
Julian Week (40-50)
2005 - Wet Water Year
Percent Impairment
0%
100%
47-50
40-46
Crocker
Julian Week (40-50)


Area of Detail
Sacramento
San Francisco
California
Los Angeles
Figure 7 Merced River Watershed
San Joaquin River
Lake McClure
Merced River
Crocker
Dam
River Miles 1-52
River
Lake
River Impairments - Temperature - Chinook Salmon Smoltification
March 15 - June 15
1998 - Wet Water Year
Percent Impairment
Crocker
0%
5%
15%
20%
35%
60%
65%
70%
11,13-16
19
17
18
12,21
22
23
24
Julian Week
(11-24)
1999 - Above Normal Water Year
Percent Impairment
Crocker
0%
35%
45%
50%
55%
60%
65%
75%
95%
100%
11,14
12
15
17
13
18
16
19
20
21-24
Julian Week
(11-24)
2000 - Above Normal Water Year
Percent Impairment
Crocker
0%
75%
85%
90%
95%
100%
11,12
16
17
13,18,19
15,20
14,21-24
Julian Week
(11-24)
2001 - Dry Water Year
Percent Impairment
Crocker
0%
85%
90%
95%
100%
14,16
15,17
19
11-13,18,
20-24
Julian Week
(11-24)
2002 - Dry Water Year
Percent Impairment
Crocker
0%
40%
85%
90%
95%
100%
11
12,17,18
16,19
14,15
13,20-24
Julian Week
(11-24)
2005 - Wet Water Year
Percent Impairment
Crocker
0%
15%
20%
35%
50%
60%
75%
85%
90%
13-17
18
19
12
20
22
23
21,24
11
Julian Week
(11-24)

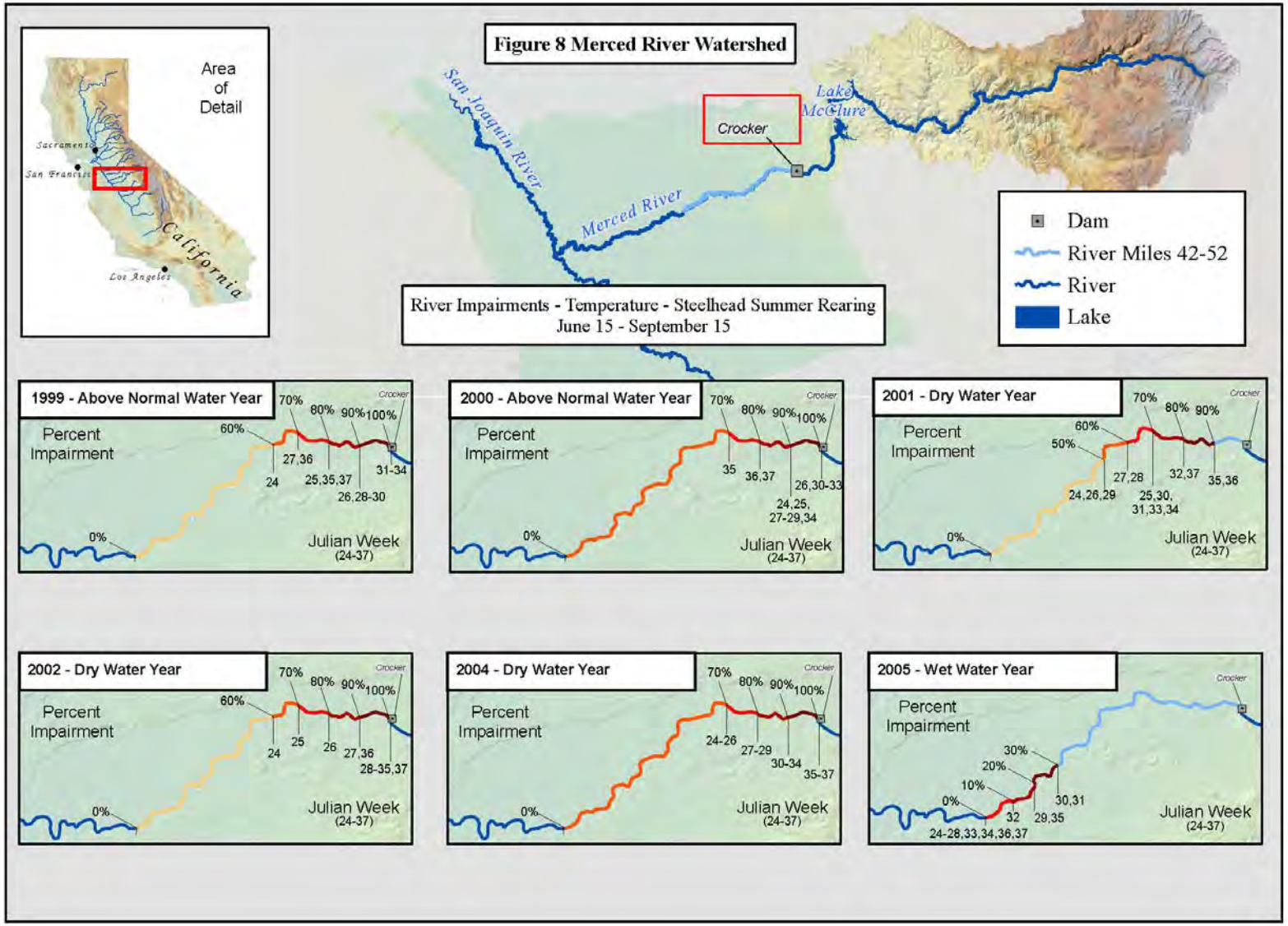


Figure 8 Merced River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Merced River
Crocker
Lake McClure
Dam
River Miles 42-52
River
Lake
River Impairments - Temperature - Steelhead Summer Rearing
June 15 - September 15
1999 - Above Normal Water Year
Percent Impairment
60%
70%
80%
90%
100%
24
27,36
25,35,37
26,28-30
31-34
0%
Julian Week (24-37)
2000 - Above Normal Water Year
Percent Impairment
70%
80%
90%
100%
35
36,37
24,25, 27-29,34
26,30-33
0%
Julian Week (24-37)
2001 - Dry Water Year
Percent Impairment
50%
60%
70%
80%
90%
24,26,29
27,28
25,30, 31,33,34
32,37
35,36
0%
Julian Week (24-37)
2002 - Dry Water Year
Percent Impairment
60%
70%
80%
90%
100%
24
25
26
27,36
28-35,37
0%
Julian Week (24-37)
2004 - Dry Water Year
Percent Impairment
70%
80%
90%
100%
24-26
27-29
30-34
35-37
0%
Julian Week (24-37)
2005 - Wet Water Year
Percent Impairment
0%
10%
20%
30%
24-28,33,34,36,37
32
29,35
30,31
Julian Week (24-37)

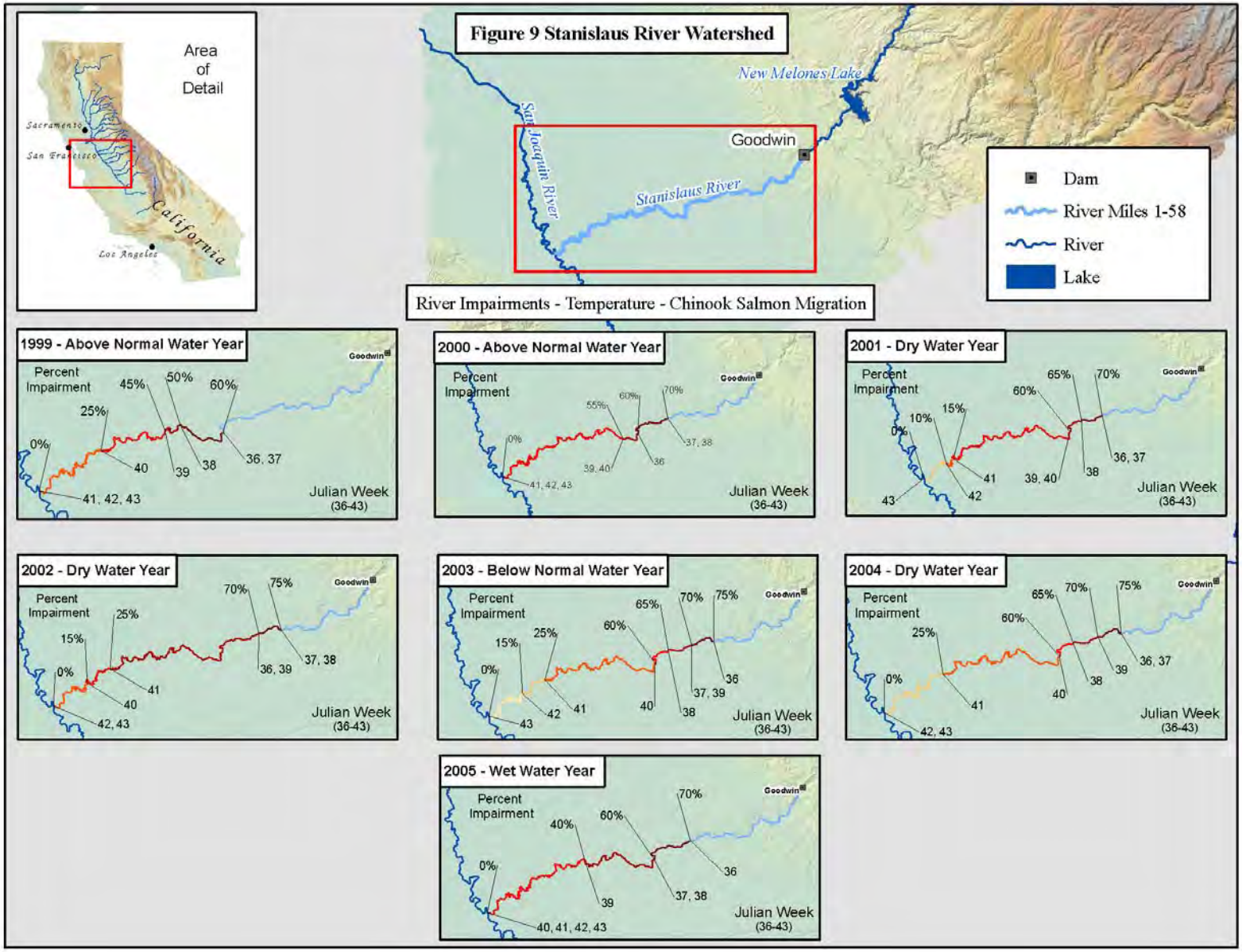


Figure 9 Stanislaus River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
New Melones Lake
San Joaquin River
Goodwin
Stanislaus River
Dam
River Miles 1-58
River
Lake
River Impairments - Temperature - Chinook Salmon Migration
1999 - Above Normal Water Year
Percent Impairment
0%
25%
45%
50%
60%
41, 42, 43
40
39
38
36, 37
Julian Week (36-43)
2000 - Above Normal Water Year
Percent Impairment
0%
55%
60%
70%
41, 42, 43
39, 40
36
37, 38
Julian Week (36-43)
2001 - Dry Water Year
Percent Impairment
0%
10%
15%
60%
65%
70%
43
42
41
39, 40
38
36, 37
Julian Week (36-43)
2002 - Dry Water Year
Percent Impairment
0%
15%
25%
70%
75%
42, 43
40
41
36, 39
37, 38
Julian Week (36-43)
2003 - Below Normal Water Year
Percent Impairment
0%
15%
25%
60%
65%
70%
75%
43
42
41
40
38
37, 39
36
Julian Week (36-43)
2004 - Dry Water Year
Percent Impairment
0%
25%
60%
65%
70%
75%
42, 43
41
40
38
39
36, 37
Julian Week (36-43)
2005 - Wet Water Year
Percent Impairment
0%
40%
60%
70%
40, 41, 42, 43
39
37, 38
36
Julian Week (36-43)

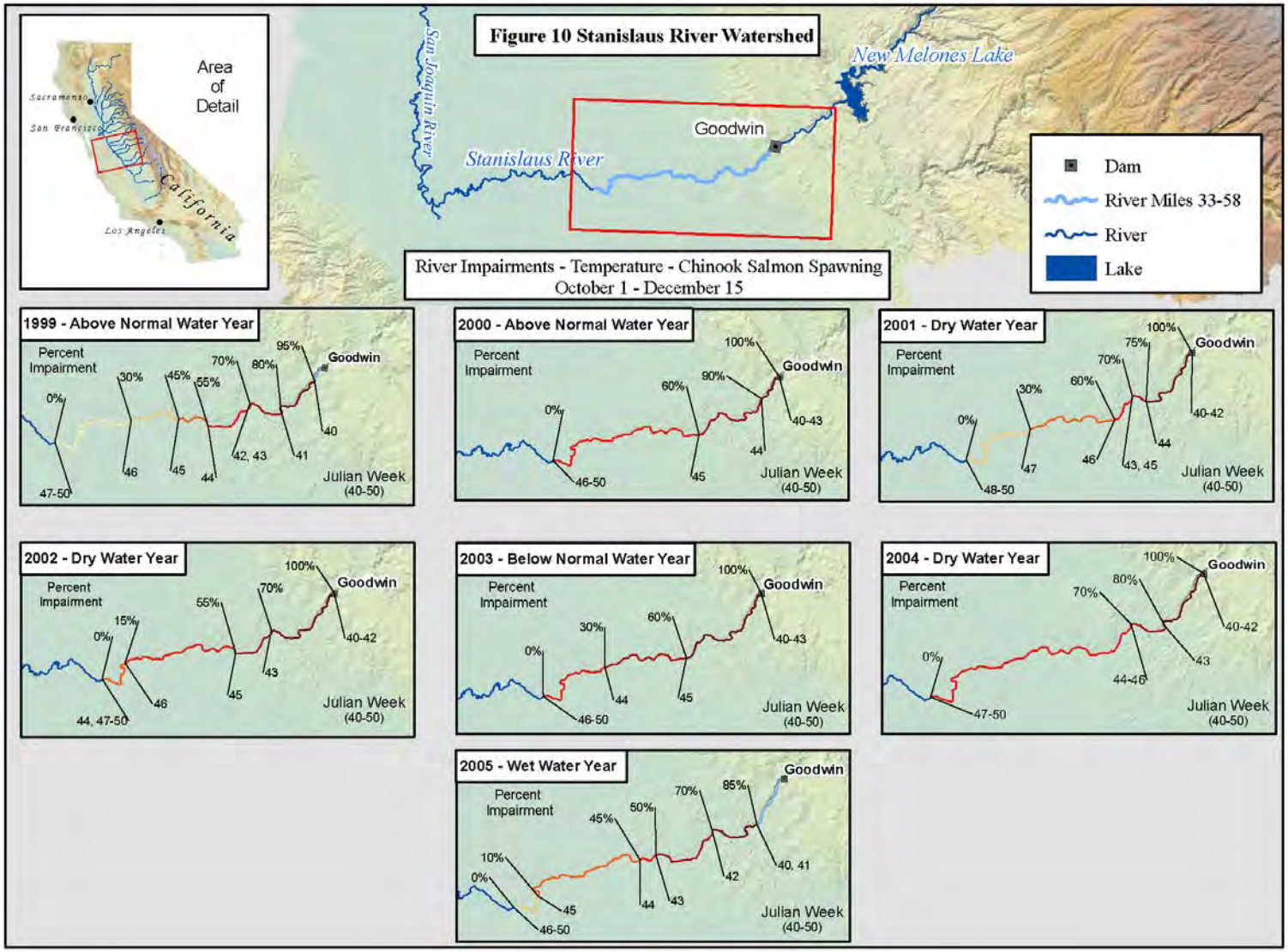


Figure 10 Stanislaus River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Stanislaus River
Goodwin
New Melones Lake
Dam
River Miles 33-58
River
Lake
River Impairments - Temperature - Chinook Salmon Spawning
October 1 - December 15
1999 - Above Normal Water Year
Percent Impairment
0%
30%
45%
55%
70%
80%
95%
Goodwin
47-50
46
45
44
42, 43
41
40
Julian Week (40-50)
2000 - Above Normal Water Year
Percent Impairment
0%
60%
90%
100%
Goodwin
46-50
45
44
40-43
Julian Week (40-50)
2001 - Dry Water Year
Percent Impairment
0%
30%
60%
70%
75%
100%
Goodwin
48-50
47
46
43, 45
44
40-42
Julian Week (40-50)
2002 - Dry Water Year
Percent Impairment
0%
15%
55%
70%
100%
Goodwin
44, 47-50
46
45
43
40-42
Julian Week (40-50)
2003 - Below Normal Water Year
Percent Impairment
0%
30%
60%
100%
Goodwin
46-50
44
45
40-43
Julian Week (40-50)
2004 - Dry Water Year
Percent Impairment
0%
70%
80%
100%
Goodwin
47-50
44-46
43
40-42
Julian Week (40-50)
2005 - Wet Water Year
Percent Impairment
0%
10%
45%
50%
70%
85%
Goodwin
46-50
45
44
43
42
40, 41
Julian Week (40-50)

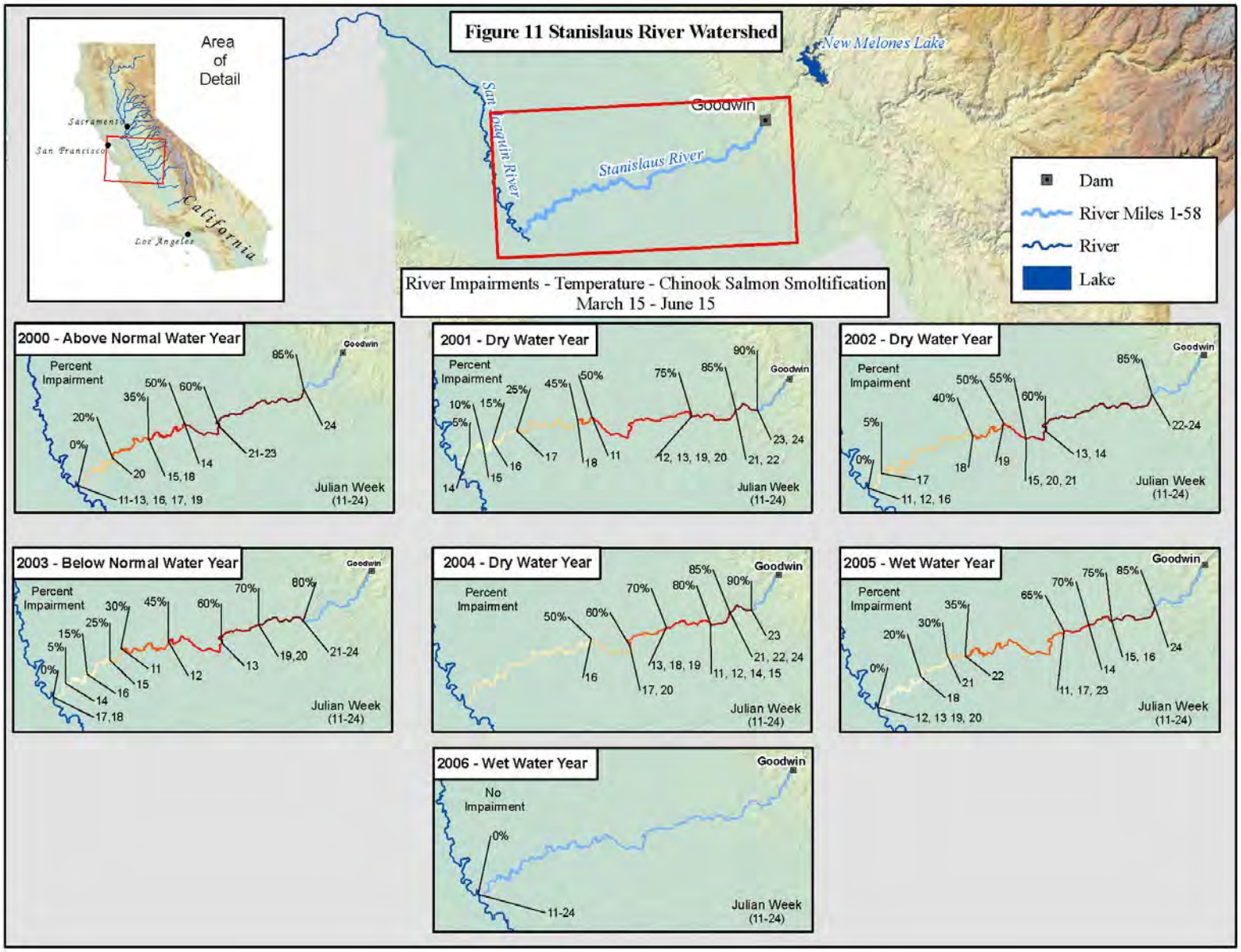


Figure 11 Stanislaus River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
New Melones Lake
Goodwin
Stanislaus River
San Joaquin River
Dam
River Miles 1-58
River
Lake
River Impairments - Temperature - Chinook Salmon Smoltification
March 15 - June 15
2000 - Above Normal Water Year
Percent Impairment
0%
20%
35%
50%
60%
85%
11-13, 16, 17, 19
20
15,18
14
21-23
24
Julian Week (11-24)
2001 - Dry Water Year
Percent Impairment
5%
10%
15%
25%
45%
50%
75%
85%
90%
14
15
16
17
18
11
12, 13, 19, 20
21, 22
23, 24
Julian Week (11-24)
2002 - Dry Water Year
Percent Impairment
0%
5%
40%
50%
55%
60%
85%
11, 12, 16
17
18
19
15, 20, 21
13, 14
22-24
Julian Week (11-24)
2003 - Below Normal Water Year
Percent Impairment
0%
5%
15%
25%
30%
45%
60%
70%
80%
17,18
14
16
15
11
12
13
19,20
21-24
Julian Week (11-24)
2004 - Dry Water Year
Percent Impairment
50%
60%
70%
80%
85%
90%
16
17, 20
13, 18, 19
11, 12, 14, 15
21, 22, 24
23
Julian Week (11-24)
2005 - Wet Water Year
Percent Impairment
0%
20%
30%
35%
65%
70%
75%
85%
12, 13 19, 20
18
21
22
11, 17, 23
14
15, 16
24
Julian Week (11-24)
2006 - Wet Water Year
No Impairment
0%
11-24
Julian Week (11-24)

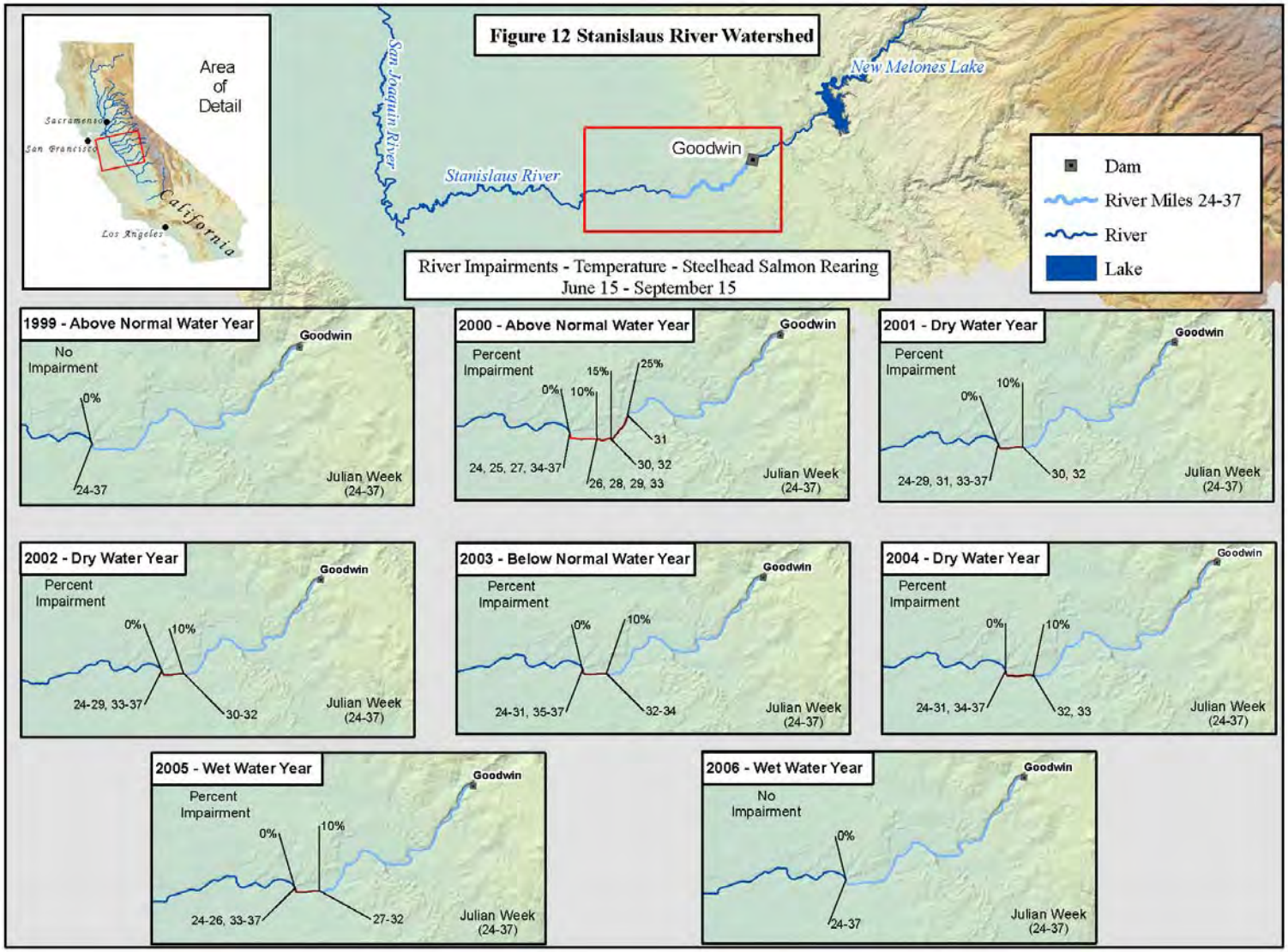


Figure 12 Stanislaus River Watershed
Area of Detail
Sacramento
San Francisco
Los Angeles
California
San Joaquin River
Stanislaus River
Goodwin
New Melones Lake
Dam
River Miles 24-37
River
Lake
River Impairments - Temperature - Steelhead Salmon Rearing
June 15 - September 15
1999 - Above Normal Water Year
No Impairment
0%
24-37
Julian Week (24-37)
2000 - Above Normal Water Year
Percent Impairment
0%
10%
15%
25%
31
30, 32
24, 25, 27, 34-37
26, 28, 29, 33
2001 - Dry Water Year
Percent Impairment
0%
10%
24-29, 31, 33-37
30, 32
2002 - Dry Water Year
Percent Impairment
0%
10%
24-29, 33-37
30-32
2003 - Below Normal Water Year
Percent Impairment
0%
10%
24-31, 35-37
32-34
2004 - Dry Water Year
Percent Impairment
0%
10%
24-31, 34-37
32, 33
2005 - Wet Water Year
Percent Impairment
0%
10%
24-26, 33-37
27-32
2006 - Wet Water Year
No Impairment
0%
24-37

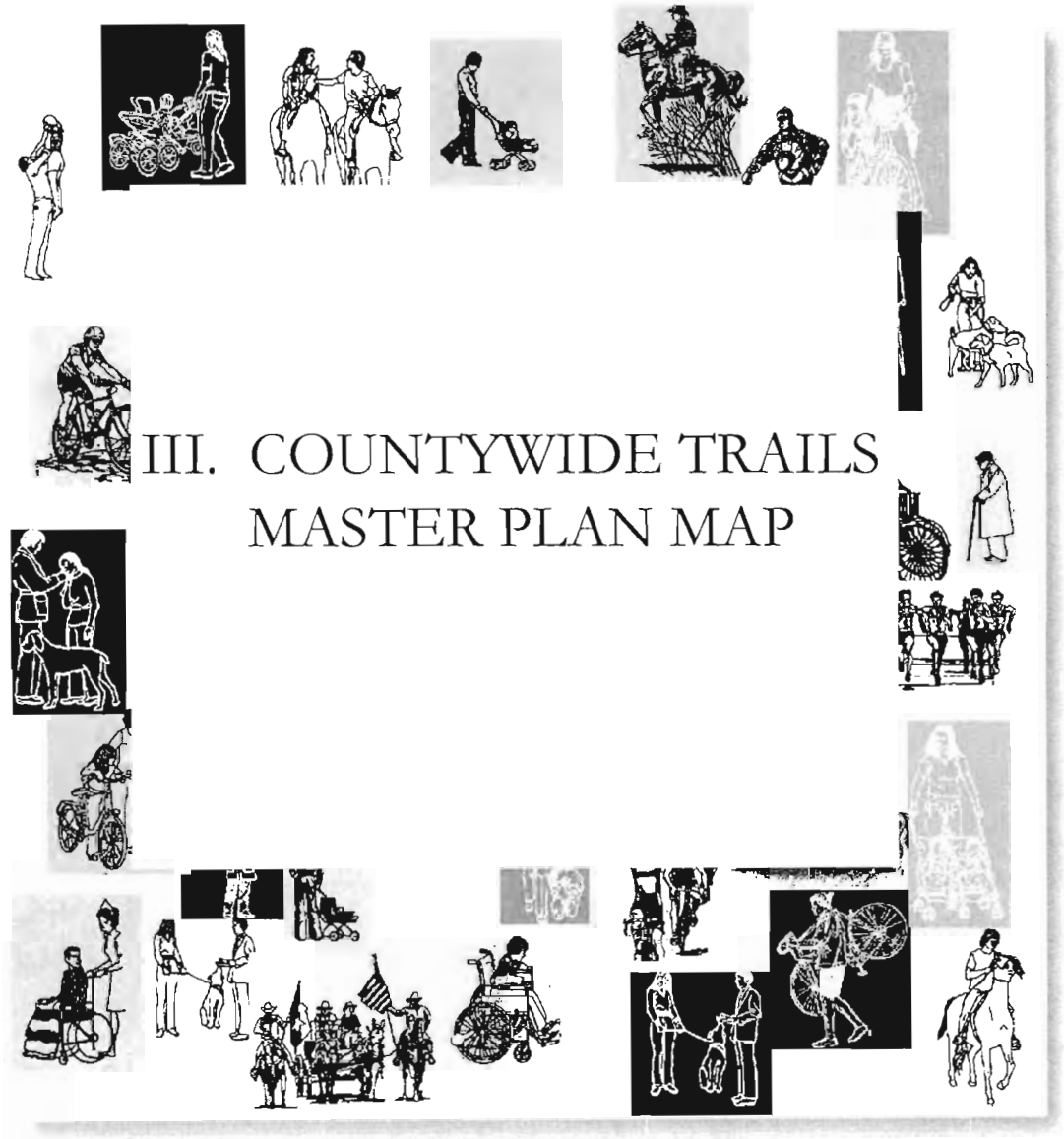
APPENDIX 6A-8

SAN JOSE TRAILS MASTER PLAN

Santa Clara County

COUNTYWIDE TRAILS MASTER PLAN

Update



III. COUNTYWIDE TRAILS MASTER PLAN MAP

Final Report

Santa Clara County Trails Plan Advisory Committee

Adopted November 14, 1995

Santa Clara County Board of Supervisors

III. COUNTYWIDE TRAILS MASTER PLAN MAP

RELATIONSHIP TO COUNTYWIDE TRAIL POLICIES

Strategy #1 of the of the Countywide Trail Policies (see Section II above) refers to a Countywide trails system master plan. This master plan is to be composed of trail routes that meet a public need, offer the trail user a range of convenient urban, rural, and open space experiences, and satisfy other County trail policies. The master plan is also to serve as a general guide in directing the detailed planning, coordination and implementation of trails by the County departments and other trail providers within the County. Other aspects of the policy strategies outlined in Section II direct that the implementation of the trails system master plan will be conducted in a logical, fair, and balanced fashion.

The trail system master plan map described in this section accomplishes the intent of Strategy #1. It updates the existing trails map titled "Trails and Pathways Plan for Santa Clara County" (revised and reprinted in May 1982).

CRITERIA FOR EVALUATING COUNTYWIDE SIGNIFICANCE

A series of criteria was developed by the Trails Master Plan Advisory Committee to evaluate whether a proposed trail route was of countywide significance and should be included on the Countywide Trails Master Plan map. These criteria were organized into the following categories:

- Significance of the trail route (national, state, regional, county, local)
- Responsiveness to existing County General Plan policies
- Accessibility to urban areas
- Opportunities for existing or potential use

Further information about these criteria is found in Appendix C.

COUNTYWIDE TRAIL SYSTEM MASTER PLAN

The Countywide Trails Master Plan Map (see map packet) illustrates the proposed countywide trails system. Trails shown on The Countywide Trails Master Plan Map are keyed to the text below. Detailed descriptions of individual trail routes, route segments, lengths, intended uses, and the key jurisdictions that will take the lead in implementing the trails are found in Appendix D.

The countywide trails system master plan is composed of three types of trail routes. The

components of this system are: Regional, Sub-regional, and Connector trails. These are illustrated in Figures 2, 3, and 4 respectively.

Regional Trail Routes (see also Figures 2 and 5)

Regional trail routes are those trails of National, State, or regional recreation significance. In all cases, Regional trail routes extend beyond the borders of Santa Clara County. Regional Trails are generally envisioned as shared-use trail routes in that they would accommodate a variety of trail users. In some instances, where topography and other physical constraints dictate, separate trails along the same general trail route may be needed to accommodate different users (see also Appendix D, Table D-1 for a more detailed description of trail uses proposed on individual trail routes).

As shown on the Trails Master Plan Map, there are five Regional trail routes in the County. These are:

Map Key	Trail Route
R1	**Juan Bautista de Anza National Historic Trail**: In August, 1990 Congress included the Juan Bautista de Anza National Historic Trail in the National Trails System. It commemorates the route taken by Anza in 1775-76 when he led a group of colonists from what is now Horcasitas, Sonora, Mexico to San Francisco Bay where they established a presidio and mission for New Spain. As shown on Figure 5, Anza's expedition to northern California crossed what is now Santa Clara County three times. The Anza party first traveled north from Monterey to San Francisco. Next, after being unable to cross the Bay where the Golden Gate Bridge is now located, the expedition traveled back around the southern margins of San Francisco Bay and northward along the East Bay shoreline. Lastly, after realizing that the Sacramento-San Joaquin Delta was a formidable barrier to land travel, they traveled back to Monterey south through the San Antonio Valley and down the upper reaches of the Coyote Creek drainage system. To recognize this historic journey, markers and information displays along the actual route of the 1775-76 Anza expedition will be constructed for interpretive purposes. A trail will not be constructed along the actual Anza expedition route except as noted below. As called for by the National Park Service in the Draft Comprehensive Management and Use Plan for the Juan Bautista de Anza National Historic Trail a series of "recreation retracement trails" as shown on Figure 5 and the Trails Master Plan Map would be developed. These are shared-use trails that generally follow the journey of the Anza expedition, though the trail route in most locations would not necessarily be coincidental with the actual Anza

route. Like Anza's expedition, there are three branches to the trail. These are:

- **R1-A** **Northern Recreation Retracement Route (hiking, bicycle, and equestrian route)**

  A shared use trail extending from the San Benito County line traveling north along the western side of the Santa Clara Valley to the San Mateo County line. In addition to this off-street, shared use route designed to ensure an equestrian route through the County, there is an on-street bicycle trail that more closely follows the expedition journey than the shared-use trail. This is indicated on the Countywide Trails Master Plan Map as R1-A (bike).

- **R1-B** **Bay Route (hiking and bicycle route)**

  Along the margins of the San Francisco Bay.

- **R1-C** **Southern Expedition Route (hiking, bicycle, and equestrian route)**

  From Coe State Park down the Coyote Creek Drainage and connecting to the expeditions' original route.

R2 **Monterey-Yosemite State Trail**: identified as a corridor of statewide significance in the California Recreational Trails System Plan, this trail route crosses the state from Monterey to Salinas, through Pacheco Pass to the north side of the Merced River basin and Yosemite National Park.

R3 **Benito-Clara Trail:** a loop trail linking recreational resources in northern San Benito County with those in southern Santa Clara County and with the Cities of Morgan Hill, Gilroy, Hollister and San Juan Bautista. Resolutions supporting this trail were passed by both the Cities of Morgan Hill and Gilroy.

R4 **San Francisco Bay Trail (hiking and bicycle route)**: a network of pathways circling San Francisco and San Pablo Bays linking nine Bay Area counties and forty-two shoreline cities. In Santa Clara County, supporting resolutions were passed by the County, and the Cities of Palo Alto, Mountain View, Sunnyvale, San Jose, and Milpitas.

R5 **Bay Area Ridge Trail**: : a trail system that follows the ridges and mountains that circle the San Francisco Bay and connects the nine Bay Area counties on or just below the principal ridgelines nearest the Bay. Within Santa Clara County, the Bay Area Ridge Trail incorporates portions of two trails of statewide significance as identified in the California Recreational Trails System Plan. These are the East Bay Trail and the Santa Cruz Mountains Trail.

In Santa Clara County the Bay Area Ridge Trail consists of five branches:

- **R5-A** **Santa Cruz Mountains**

  Following in a north-south direction the ridgelines of the Santa Cruz Mountains on the west side of the valley from the San Mateo County Line to Mt. Madonna County Park.

- **R5-B Diablo Range**
  Following in a north-south direction, the ridgelines of the Diablo Range on the east side of the valley from the Alameda County Line in Ed Levin County Park south to Coyote Lake County Park.

- **R5-C El Sombroso / Penitencia**
  Connecting the mountain ranges in an west-east direction from El Sombroso east through Almaden-Quicksilver County Park to Alamitos Creek and Santa Teresa County Park continuing east to Coyote Creek Parkway and then north along Coyote Creek to Penitencia Creek, and east to Alum Rock Park.

- **R5-D Santa Teresa / Anderson Lake**
  Connecting the mountain ranges in an west-east direction from the Penitencia / El Sombroso portion of the trail at Parkway Lakes south along Coyote Creek to Anderson Lake County Park.

- **R5-E Mt. Madonna / Coyote Lake**
  Connecting the mountain ranges in an west-east direction south of the City of Gilroy linking Mt. Madonna County Park with Coyote Lake County Park.

In some instances, such as where the San Francisco Bay Trail and portions of Juan Bautista de Anza National Historic Trail could be planned to follow coincidental alignments, Regional trail route alignments have been combined.

Sub-regional Trail Routes (see also Figure 3)

Sub-regional trail routes are those that in some way:

- provide regional recreation and transportation benefits such as providing key links for accessing rail stations, bus routes, or park-and-ride facilities;
- provide for continuity between cities; generally crossing a city or passing through more than one city; or
- provide convenient, long-distance trail loop opportunities by directly linking two or more Regional trails to create an urban trail network.

In rural areas, Sub-regional trail routes are ideally shared-use trails or consist of parallel trails that accommodate different trail users. Equestrian use is often excluded from Sub-regional trails within most urban areas because horses can not be accommodated without going onto a city street.

Nine Sub-regional trail routes are shown in the Trails Master Plan Map. These are:

Map Key	Trail Route
S1	**Matadero Creek/Page Mill Trail:** passing through Palo Alto, Los Altos Hills, and Stanford University from the Bay Trail (R4) to the Bay Area Ridge Trail (R5-A)
S2	**Stevens Creek Trail:** crossing the cities of Mountain View, Sunnyvale, Los Altos, and Cupertino linking the San Francisco Bay Trail (R4) with the Bay Area Ridge Trail (R5-A).
S3	**Guadalupe Trail:** routed in a north-south direction from the Bay Trail (R4) in San Jose, to Guadalupe Reservoir.
S4	**Los Gatos Creek Trail:** from its confluence in San Jose at the Guadalupe/Santa Teresa trail upstream through Campbell and Los Gatos to the Bay Area Ridge Trail (R5-A) at Lexington Reservoir.
S5	**Coyote Creek /Llagas Creek Trail:** from the Alameda County Line and the Bay Trail (R4) to the San Benito County Line and the Monterey-Yosemite Trail (R2).
S6	**West Valley Trail:** from Almaden Lake Park to the southern county link of the Bay Area Ridge Trail (R5-E) (Alternative Highway 152 alignment).
S7	**Morgan Hill Cross -Valley Trail:** an east-west route from the West Valley Sub-regional Trail (S6) to Lake Anderson County Park .
S8	**San Martin Cross-Valley Trail:** an east-west route from the West Valley Sub-regional Trail (S6), crossing the Juan Bautista de Anza National Historic Trail (R1-A) to the Bay Area Ridge Trail (R5-B) near Coyote Lake.

Connector Trail Routes (see also Figure 4)

Connector trail routes are those that:

- form convenient means of access and linkage from urban areas, developed areas, and public lands within the county to the primary trail network of Regional and Sub-regional Trails. Linkages from within urban areas are derived from individual City trails plans and policies; or
- offer benefits such as emergency access or egress, improved fire/vegetation management, provision for safety on County roads, or dispersion of existing trail use patterns that are consistent with County trail policies and guidelines.

Connector trail routes may or may not be shared-use trails. Thirty-one Connector trail

routes listed below are shown in the Trails Master Plan. Except as specifically noted below, Connector trail routes involve off-street trails for some combination of hiking, equestrian, and/or bicycle use.

Map Key	Trail Route
C1	**San Francisquito /Los Trancos Creeks:** connecting Waverly Street in Palo Alto to the intersection with the Juan Bautista de Anza National Historic Trail (R1-A) in Arastradero Preserve.
C2	**Adobe Creek:** connecting the Bay Trail (R4) with the Juan Bautista de Anza National Historic Trail (R1-A) in Arastradero Preserve.
C3	**Calabazas Creek:** connecting the Bay Trail (R4) with the Hetch-Hetchy Trail (C4).
C4	**Hetch-Hetchy Trail:** from Fair Oaks Avenue in Sunnyvale to Coyote Creek in San Jose.
C5	**San Tomas Aquino / Saratoga Creeks:** connecting the Bay Trail (R4) with Prospect Road in San Jose.
C6	**Calera Creek Trail:** connecting Higuera Adobe Park with Ed Levin County Park.
C7	**Calaveras Trail:** a bicycle route connecting the San Francisco Bay Trail (R4) with Ed Levin County Park
C8	**Piedmont Trail:** connecting Piedmont Road in Milpitas with the Bay Area Ridge Trail (R5-B).
C9	**Southern Pacific Rail Trail:** connecting Los Gatos Creek Trail (S4) with the Juan Bautista de Anza National Historic Trail (R1-A) at Rancho San Antonio County Park.
C10	**Coyote Ridge Trail:** connecting the Villa Maria Picnic Area at the Prospect Street entrance of Fremont-Older Open Space Preserve with Stevens Creek Reservoir County Park.
C11	**Stevens Canyon Lookout Trail:** connecting Prospect Road with Stevens Creek Reservoir County Park.
C12	**Congress Springs Trail:** an on-street bicycle route connecting Saratoga /Los Gatos Road with Skyline Boulevard at Saratoga Gap.
C13	**Sanborn Trail:** connecting Stuart Ridge County Park with Sanborn-Skyline County Park.
C14	**El Sereno Trail:** connecting Villa Montalvo with the Juan Bautista de Anza National Historic Trail (R1-A) in the Stuart Ridge County Park/ El Sereno Open Space Preserve area.
C15	**Upper Los Gatos Creek / Mt. Umunhum Trail:** connecting Lexington

Reservoir with the Bay Area Ridge Trail (R5-A) via the historic Wrights Station and Lake Elsman.

C16 **Upper Guadalupe Trail:** connecting the Guadalupe Trail (Route S3) and Guadalupe Reservoir with the Bay Area Ridge Trail (R5-A) in the El Sombroso area.

C17 **Almaden-Hicks Road Loop:** an on-street bicycle route encircling Almaden-Quicksilver County Park and connecting with the Upper Guadalupe Trail (C16), the Bay Area Ridge Trail (R5-C) and Juan Bautista de Anza National Historic Trail (R1-A).

C18 **Guadalupe / Calero Trail:** connecting Guadalupe Reservoir and Almaden-Quicksilver County Park with Calero Reservoir County Park.

C19 **Calero / Santa Teresa Trail:** connecting McKean Road / Calero Reservoir County Park with Santa Teresa County Park.

C20 **Bailey Road Trail:** connecting Calero Reservoir County Park with the Juan Bautista de Anza National Historic Trail (R1-A) and the Bay Area Ridge Trail (R5-C).

C21 **Silver Valley Trail:** connecting Coyote Creek County Park with Joseph D. Grant County Park.

C22 **Silver Creek Loop Trail :** extending from Lake Cunningham Regional Park to create a trail loop through the Silver Valley and connecting to the Bay Area Ridge Trail (R5-B).

C23 **South Metcalf Trail :** connecting Coyote Creek County Park with the Bay Area Ridge Trail (R5-B).

C24 **Willow Springs Trail:** an on-street bicycle route connecting Coyote Creek County Park with Chesbro Reservoir.

C25 **Main Street Trail:** connecting Santa Teresa Blvd. through Morgan Hill with the Juan Bautista de Anza National Historic Trail (R1-A) and the Coyote Creek/Llagas Sub-Regional Trail (S5) to Hill Road (C27).

C26 **Paradise Valley Trail:** an on-street bicycle route connecting the Morgan Hill Cross Valley STrail (S7) with the West Valley Trail (S6) .

C27 **San Martin / South Valley Trails:** connecting Main Street in Morgan Hill with the Juan Bautista de Anza National Historic Trail (R1-A) and the Bay Area Ridge Trail (R5-E).

C28 **Uvas Reservoir to Uvas Canyon County Park Trail:** connecting Uvas Reservoir and the West Valley Trail (S6) with Upper Uvas Creek County Park Trail.

C29 **Little Arthur Creek Trail:** an equestrian and bicycle trail connecting Chitactac-Adams Heritage County Park with Mt. Madonna County Park. (note: the bicycle trail is an on-street route following Redwood Retreat and Old Mount Madonna Roads.)

C30 **Hecker Pass Trail:** an on-street bicycle route connecting the West Valley Trail (S6) at Hwy. 152 with Mt. Madonna County Park.

C31 **Buena Vista - Day Trail :** connecting the Watsonville Road and the West Valley Trail (S6) with Day Road and the Juan Bautista de Anza National Historic Trail (R-1A), the Benito-Clara Trail (R3), and the Coyote Creek / Llagas Creek Trail (S5).

C32 **West Branch Llagas Creek Trail:** connecting a proposed Gilroy Community Park at Santa Teresa / Day Road area with the Juan Bautista de Anza National Historic Trail (R-1A), the Benito-Clara Trail (R3), and the Coyote Creek / Llagas Creek Trail (S5).

C33 **Skyline-Summit Trail:** an on-street bicycle route connecting the Bay Area Ridge Trail (R5-A) in Sanborn-Skyline County Park with the Bay Area Ridge Trail (R5-A) just south of Loma Prieta Mountain

C34 **Guadalupe River / Coyote Creek Trail**: an on-street bicycle route connecting the Los Gatos Creek Trail (S4) and Guadalupe / Santa Teresa Trail (S3) with the Coyote Creek / Llagas Sub-regional Trail (S5).

Regional Staging Areas

Appendix E provides a listing of existing and planned staging areas within the parks and open space preserves of the County. As differentiated from these, Regional Staging Areas provide access opportunities to the countywide trail system outside of "park" areas. Regional Staging Areas are easily accessible by vehicle from the County's urban areas and areas of the County with substantial rural residential development. Regional Staging Areas are strategically located to encourage use of the Regional and Sub-regional trail route system. Regional Staging Areas are day-use facilities that also:

- allow for ease of management and security;
- offer a potential of future expansion;
- complement the pattern of existing and planned staging opportunities within the County's regional park and open space areas;
- are of sufficient size to buffer trail staging activities from potential land use conflicts; and
- have the potential for linkage with a County transit route or for weekday use as a park and ride facility.

Regional Staging Areas, while serving all types of trail users, are generally single-purpose facilities or joint-use facilities associated with commercial developments or educational institutions. Regional Staging Areas are without other recreation amenities that may be typically associated with Regional Parks.

Five Regional Staging Areas are identified on the Trails Master Plan Map to complement existing and planned staging areas at Regional Parks and Open Space Preserves. These are located outside of the County's system of park and open space areas and are at or near the following general locations:

- Evergreen College / Montgomery Hill Park (San Jose)
- Metcalf Road and the Coyote Creek Park Chain (San Jose)
- Lyndon Canyon and Highway 17 Area
- Gavilan College (Gilroy)
- San Martin Avenue / New Avenue Area

Santa Clara County Trails Master Plan Update

November, 1995

NOTE:
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THIS MAP IS NOT A TRAIL GUIDE:
This map is a planning tool. Many of the routes or staging areas identified on the Map are simply proposed and not open to the public for any purpose. This map does not convey any rights to the public to use any trail routes shown on this drawing; nor does this map exempt any person from trespassing charges. For copies of maps about existing trails that are available for public use, contact the Santa Clara County Parks and Recreation Department at (408) 358-3741.

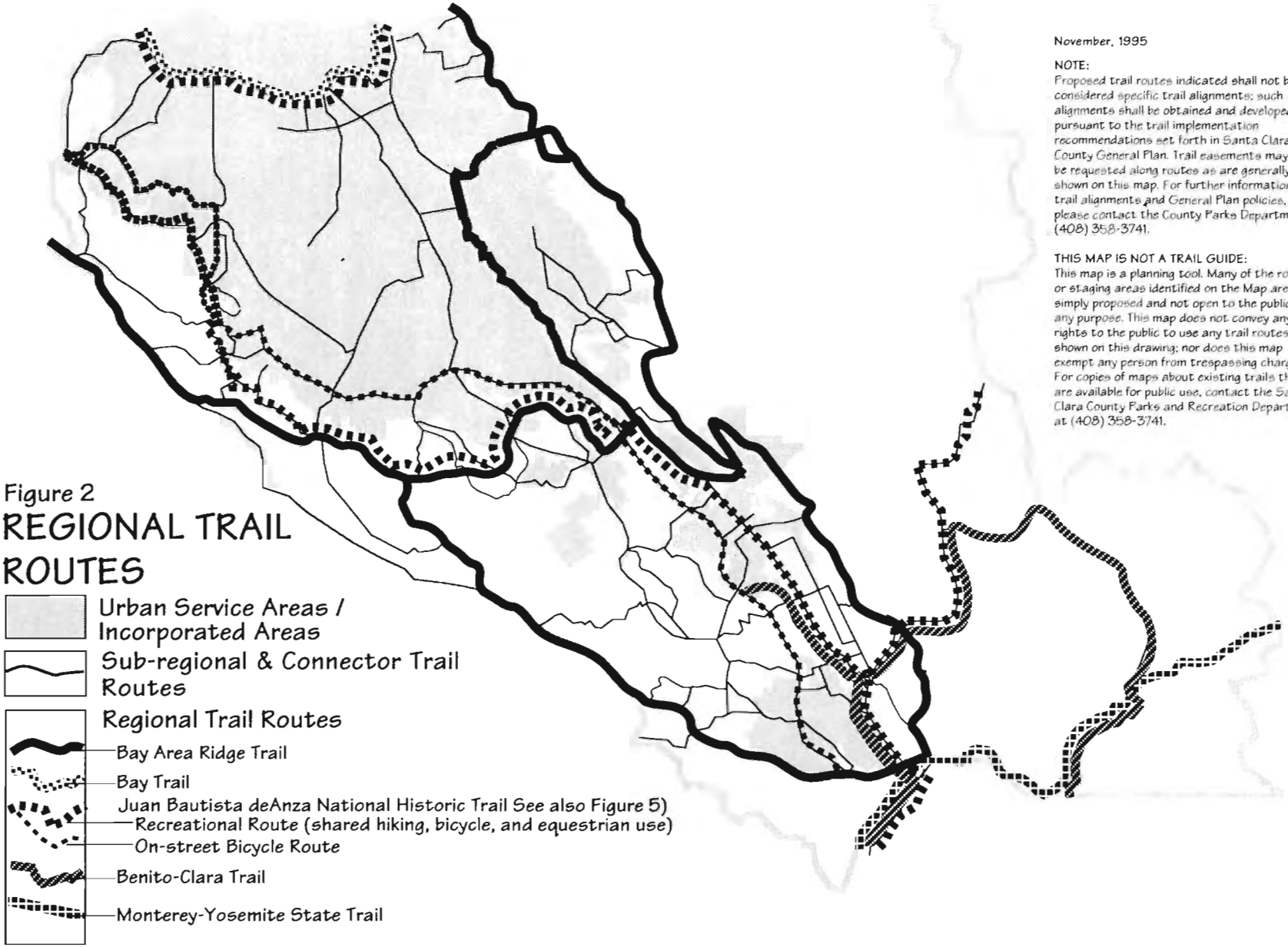

Figure 2
REGIONAL TRAIL ROUTES

Note: See also Countywide Trails Master Plan Map and related text for explanation

Santa Clara County Trails Master Plan Update

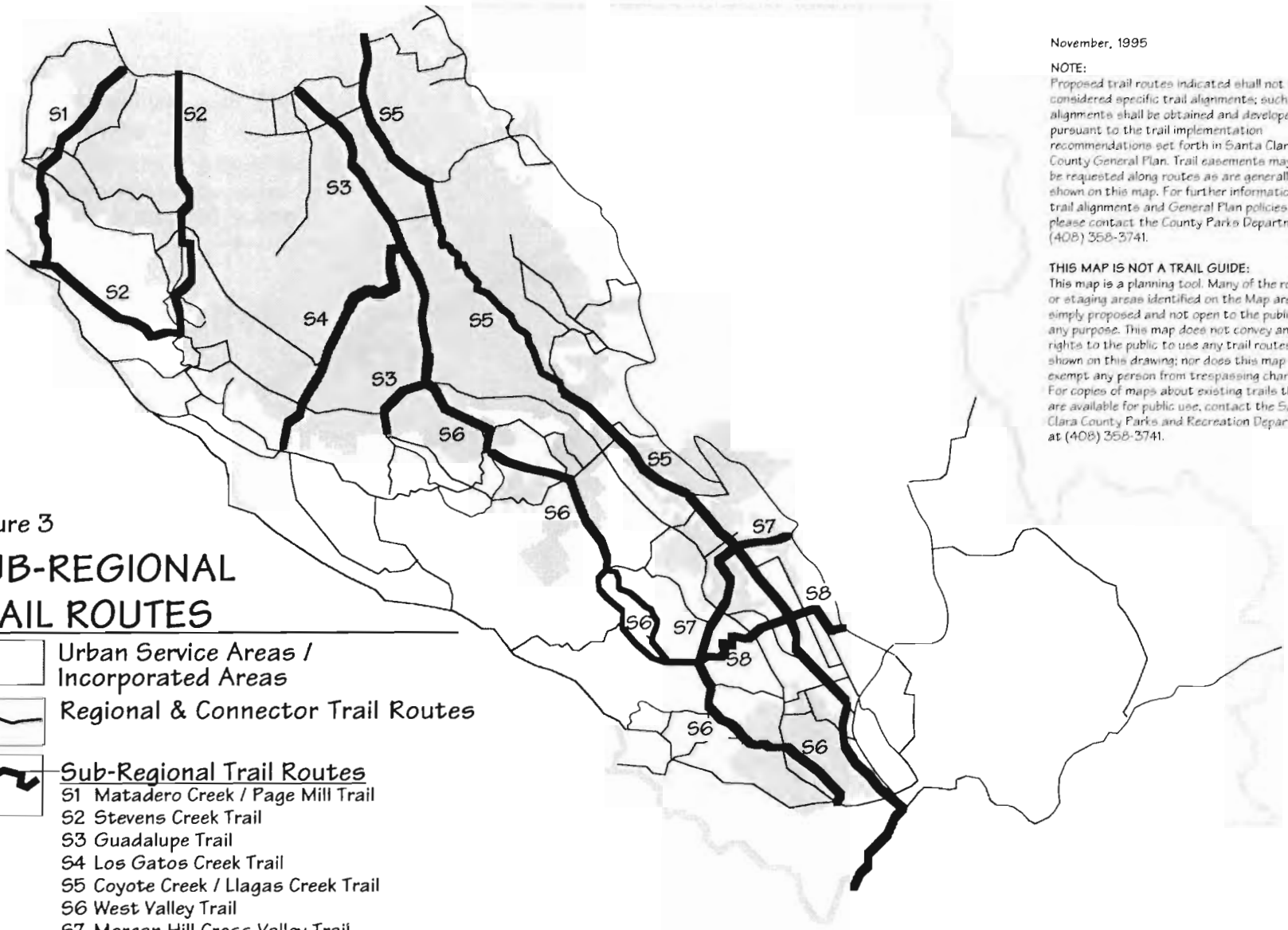

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Figure 3

SUB-REGIONAL TRAIL ROUTES

Urban Service Areas / Incorporated Areas

Regional & Connector Trail Routes

Sub-Regional Trail Routes

S1 Matadero Creek / Page Mill Trail
S2 Stevens Creek Trail
S3 Guadalupe Trail
S4 Los Gatos Creek Trail
S5 Coyote Creek / Llagas Creek Trail
S6 West Valley Trail
S7 Morgan Hill Cross Valley Trail
S8 San Martin Cross Valley Trail

Note: See also Countywide Trails Master Plan Map and related text for explanation

Santa Clara County Trails Master Plan Update

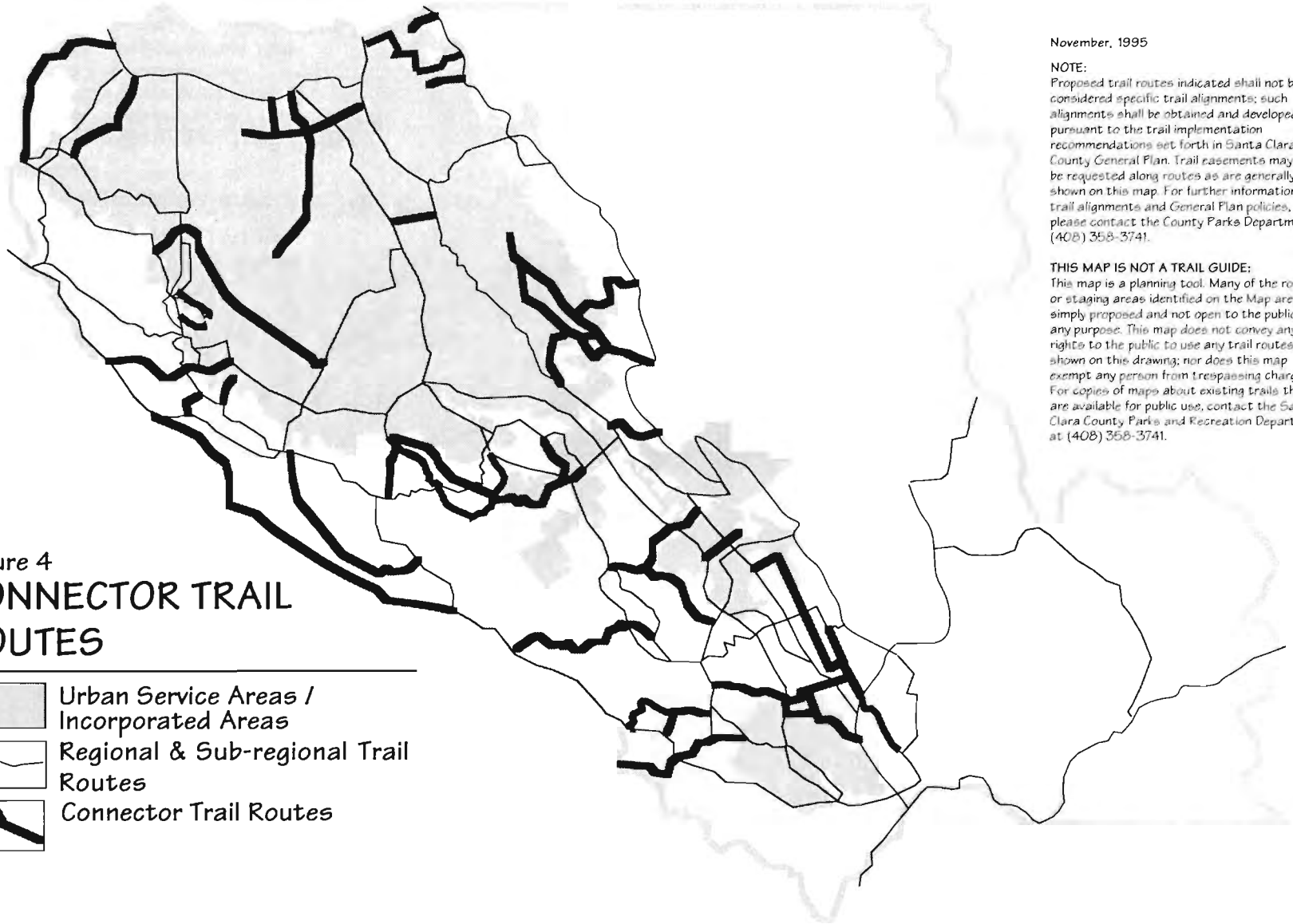

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Figure 4
CONNECTOR TRAIL ROUTES

- Urban Service Areas / Incorporated Areas
- Regional & Sub-regional Trail Routes
- Connector Trail Routes

Note: See also Countywide Trails Master Plan Map and related text for explanation

Santa Clara County Trails Master Plan Update

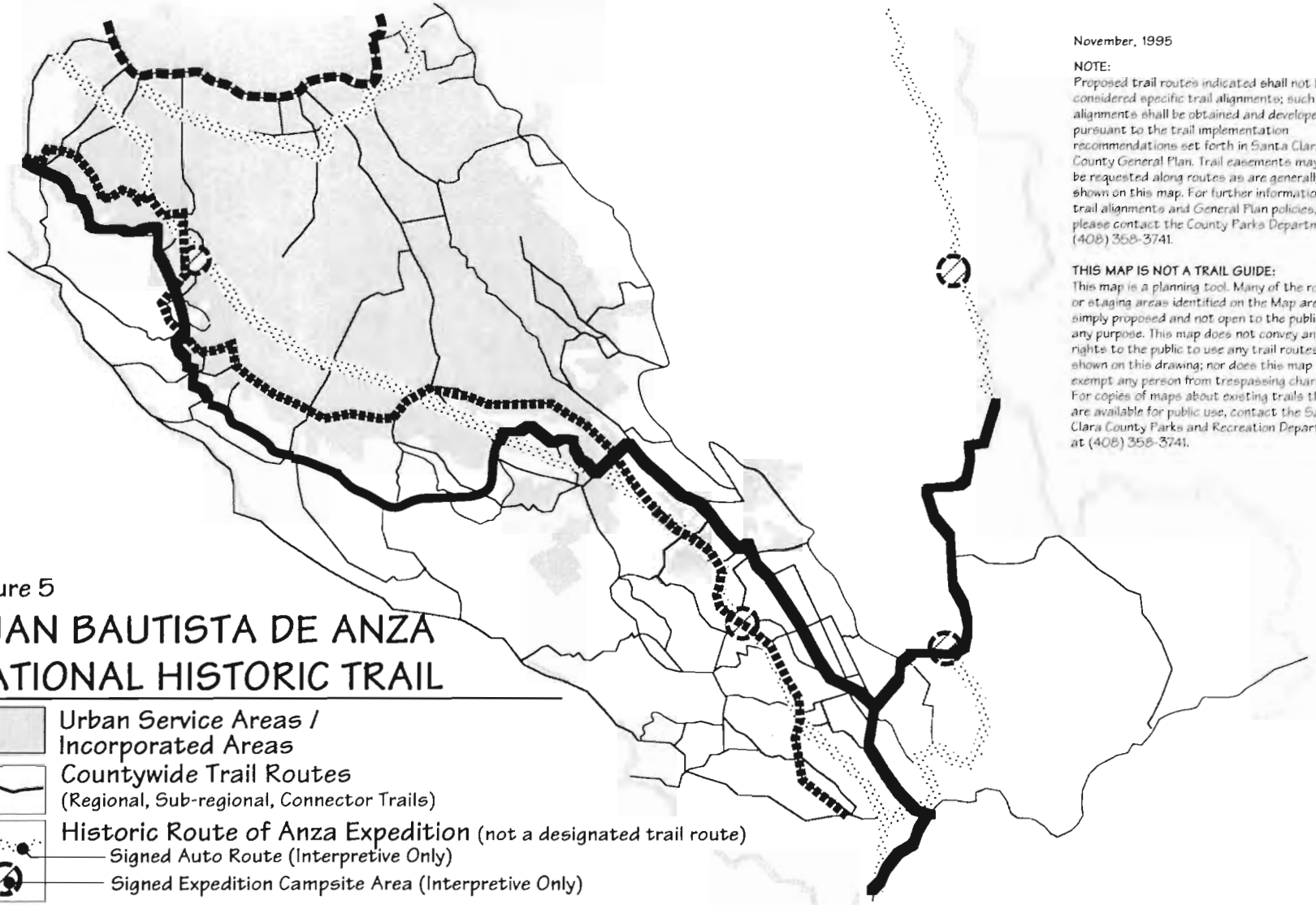

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Figure 5

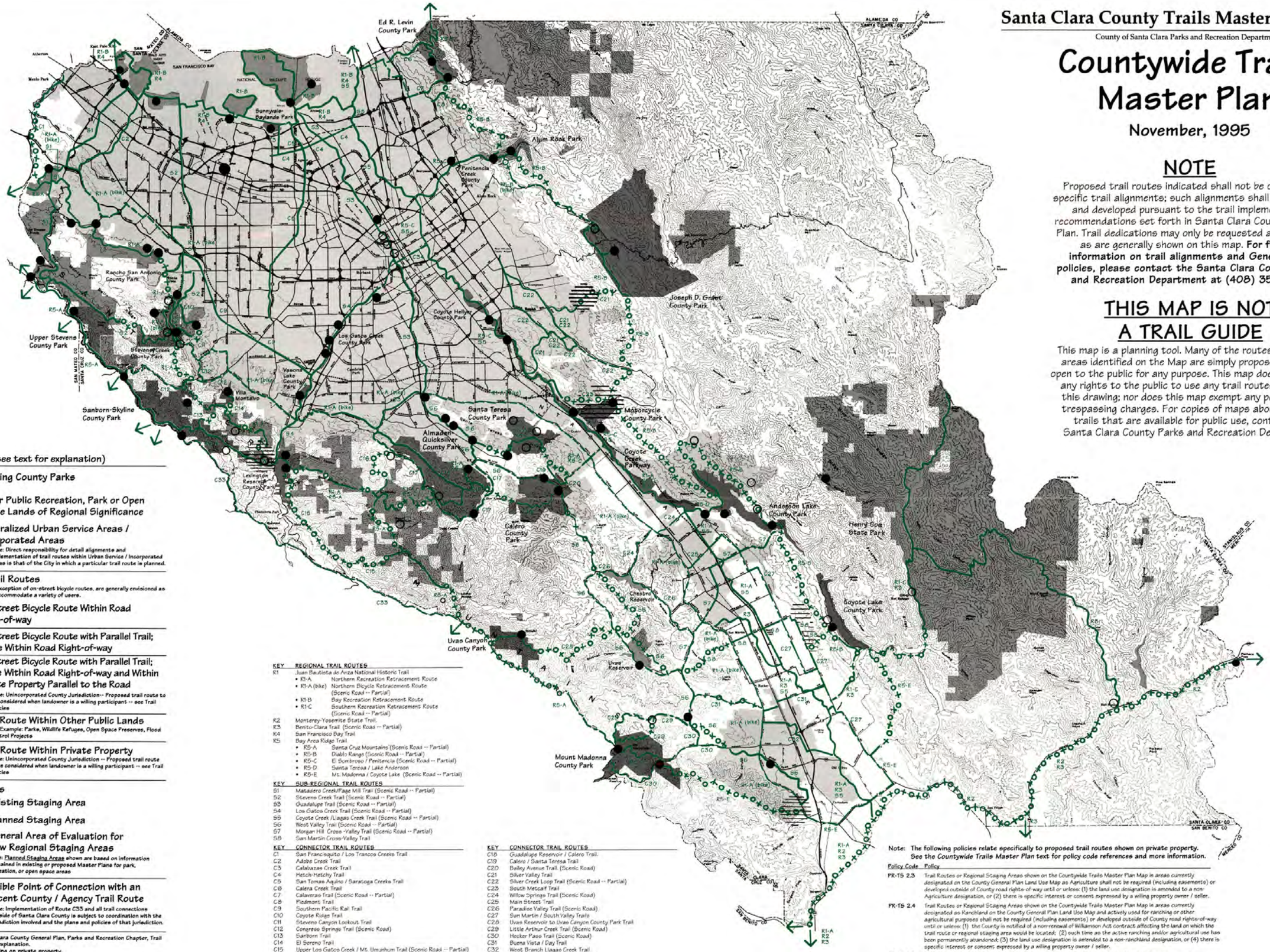
JUAN BAUTISTA DE ANZA NATIONAL HISTORIC TRAIL

Urban Service Areas / Incorporated Areas

Countywide Trail Routes
(Regional, Sub-regional, Connector Trails)

Historic Route of Anza Expedition (not a designated trail route)
- Signed Auto Route (Interpretive Only)
- Signed Expedition Campsite Area (Interpretive Only)

Juan Bautista de Anza National Historic Trail - Recreational Retracement Route
- Shared-Use Trail (hiking, bicycle, and equestrian use)
- Shared-Use Trail (hiking and bicycle use)
- On-street Bicycle Route



Santa Clara County Trails Master Plan Update

County of Santa Clara Parks and Recreation Department

Countywide Trails Master Plan

November, 1995

NOTE

Proposed trail routes indicated shall not be considered specific trail alignments; such alignments shall be obtained and developed pursuant to the trail implementation recommendations set forth in Santa Clara County General Plan. Trail dedications may only be requested along routes as are generally shown on this map. **For further information on trail alignments and General Plan policies, please contact the Santa Clara County Parks and Recreation Department at (408) 358-3147.**

THIS MAP IS NOT A TRAIL GUIDE

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Legend (see text for explanation)

- Existing County Parks
- Other Public Recreation, Park or Open Space Lands of Regional Significance
- Generalized Urban Service Areas / Incorporated Areas

  Note: Direct responsibility for detail alignments and implementation of trail routes within Urban Service / Incorporated Areas is that of the City in which a particular trail route is planned.

Proposed Trail Routes

Trail routes, with the exception of on-street bicycle routes, are generally envisioned as shared-use trails to accommodate a variety of users.

- On-street Bicycle Route Within Road Right-of-way
- On-street Bicycle Route with Parallel Trail; Route Within Road Right-of-way
- On-street Bicycle Route with Parallel Trail; Route Within Road Right-of-way and Within Private Property Parallel to the Road

  Note: Unincorporated County Jurisdiction-- Proposed trail route to be considered when landowner is a willing participant -- see Trail Policies
- Trail Route Within Other Public Lands

  For Example: Parks, Wildlife Refuges, Open Space Preserves, Flood Control Projects
- Trail Route Within Private Property

  Note: Unincorporated County Jurisdiction -- Proposed trail route to be considered when landowner is a willing participant -- see Trail Policies

Staging Areas

- Existing Staging Area
- Planned Staging Area
- General Area of Evaluation for New Regional Staging Areas

  Note: Planned Staging Areas shown are based on information contained in existing or proposed Master Plans for park, recreation, or open space areas

- Possible Point of Connection with an Adjacent County / Agency Trail Route

  Note: Implementation of Route C33 and all trail connections outside of Santa Clara County is subject to coordination with the jurisdiction involved and the plans and policies of that jurisdiction.

Notes: • See Santa Clara County General Plan, Parks and Recreation Chapter, Trail Section for explanation.
• No trespassing on private property.

Scale
0 5000' 15000'
North

KEY	REGIONAL TRAIL ROUTES
R1	Juan Bautista de Anza National Historic Trail
	• R1-A — Northern Recreation Retracement Route
	• R1-A (bike) — Northern Bicycle Retracement Route (Scenic Road -- Partial)
	• R1-B — Bay Recreation Retracement Route
	• R1-C — Southern Recreation Retracement Route (Scenic Road -- Partial)
R2	Monterey-Yosemite State Trail.
R3	Benito-Clara Trail (Scenic Road -- Partial)
R4	San Francisco Bay Trail
R5	Bay Area Ridge Trail
	• R5-A — Santa Cruz Mountains (Scenic Road -- Partial)
	• R5-B — Diablo Range (Scenic Road -- Partial)
	• R5-C — El Sombroso / Penitencia (Scenic Road -- Partial)
	• R5-D — Santa Teresa / Lake Anderson
	• R5-E — Mt. Madonna / Coyote Lake (Scenic Road -- Partial)

KEY	SUB-REGIONAL TRAIL ROUTES
S1	Matadero Creek/Page Mill Trail (Scenic Road -- Partial)
S2	Stevens Creek Trail (Scenic Road -- Partial)
S3	Guadalupe Trail (Scenic Road -- Partial)
S4	Los Gatos Creek Trail (Scenic Road -- Partial)
S5	Coyote Creek /Llagas Creek Trail (Scenic Road -- Partial)
S6	West Valley Trail (Scenic Road -- Partial)
S7	Morgan Hill Cross-Valley Trail (Scenic Road -- Partial)
S8	San Martin Cross-Valley Trail

KEY	CONNECTOR TRAIL ROUTES
C1	San Francisquito / Los Trancos Creeks Trail
C2	Adobe Creek Trail
C3	Calabazas Creek Trail
C4	Hetch-Hetchy Trail
C5	San Tomas Aquino / Saratoga Creeks Trail
C6	Calera Creek Trail
C7	Calaveras Trail (Scenic Road -- Partial)
C8	Piedmont Trail
C9	Southern Pacific Rail Trail
C10	Coyote Ridge Trail
C11	Stevens Canyon Lookout Trail
C12	Congress Springs Trail (Scenic Road)
C13	Sanborn Trail
C14	El Sereno Trail
C15	Upper Los Gatos Creek / Mt. Umunhum Trail (Scenic Road -- Partial)
C16	Upper Guadalupe Trail
C17	Almaden-Hicks Road Loop (Scenic Road)

KEY	CONNECTOR TRAIL ROUTES
C18	Guadalupe Reservoir / Calero Trail.
C19	Calero / Santa Teresa Trail
C20	Bailey Avenue Trail. (Scenic Road)
C21	Silver Valley Trail
C22	Silver Creek Loop Trail (Scenic Road -- Partial)
C23	South Metcalf Trail
C24	Willow Springs Trail (Scenic Road)
C25	Main Street Trail
C26	Paradise Valley Trail (Scenic Road)
C27	San Martin / South Valley Trails
C28	Uvas Reservoir to Uvas Canyon County Park Trail
C29	Little Arthur Creek Trail (Scenic Road)
C30	Hecker Pass Trail (Scenic Road)
C31	Buena Vista / Day Trail
C32	West Branch Llagas Creek Trail
C33	Skyline-Summit Trail (Scenic Road)
C34	Guadalupe River / Coyote Creek Trail

Note: Use of the term 'Scenic Road' means that the trail route parallels a road designated as 'Scenic' in 1995 Santa Clara County General Plan. 'Partial' indicates that any part of the trail route parallels a Scenic Road.

Note: **The following policies relate specifically to proposed trail routes shown on private property. See the *Countywide Trails Master Plan* text for policy code references and more information.**

Policy Code	Policy
PR-TS 2.3	Trail Routes or Regional Staging Areas shown on the Countywide Trails Master Plan Map in areas currently designated on the County General Plan Land Use Map as Agriculture shall not be required (including easements) or developed outside of County road rights-of-way until or unless: (1) the land use designation is amended to a non-Agriculture designation, or (2) there is specific interest or consent expressed by a willing property owner / seller.
PR-TS 2.4	Trail Routes or Regional Staging Areas shown on the Countywide Trails Master Plan Map in areas currently designated as Ranchland on the County General Plan Land Use Map and actively used for ranching or other agricultural purposes shall not be required (including easements) or developed outside of County road rights-of-way until or unless: (1) the County is notified of a non-renewal of Williamson Act contract affecting the land on which the trail route or regional staging area would be located; (2) such time as the active ranching and/or agricultural use has been permanently abandoned; (3) the land use designation is amended to a non-ranchland designation, or (4) there is specific interest or consent expressed by a willing property owner / seller.
PR-TS 2.5	Trail Routes or Regional Staging Areas shown on the Countywide Trails Master Plan Map in areas currently designated as Hillside on the County General Plan Land Use Map and actively used for ranching or other agricultural purposes shall not be required (including easements) or developed outside of County road rights-of-way until or unless: (1) the County is notified of a non-renewal of Williamson Act contract affecting the land on which the trail route or regional staging area would be located; (2) such time as active ranching and/or agricultural use has been permanently abandoned; or (3) there is specific interest or consent expressed by a willing property owner / seller.