Sonoma County Water Agency

Stream Maintenance Program

Final Manual

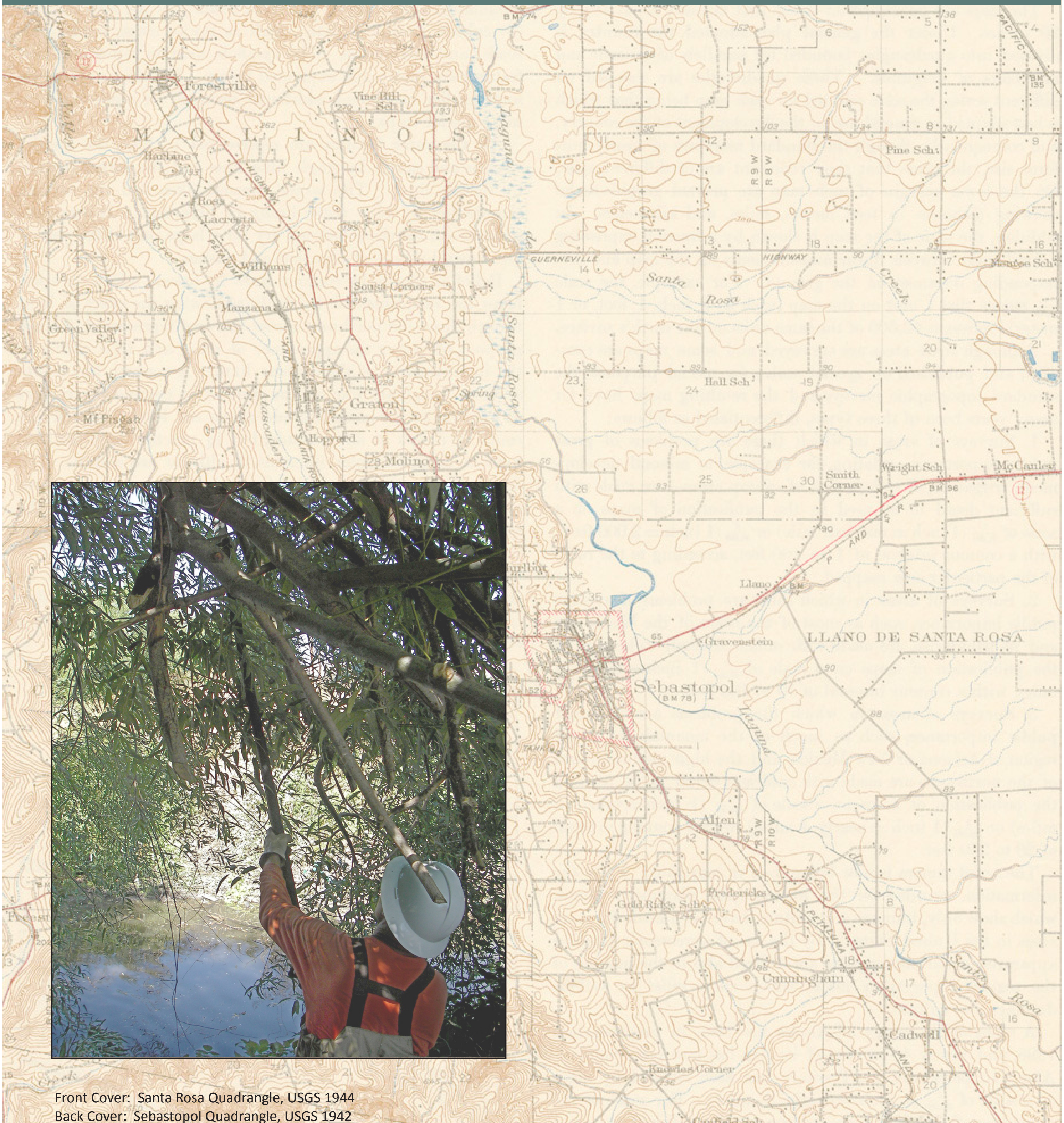
Santa Rosa Creek

East Washington Creek

Horizon
WATER and ENVIRONMENT

September 2009

SONOMA COUNTY WATER AGENCY



Front Cover: Santa Rosa Quadrangle, USGS 1944
Back Cover: Sebastopol Quadrangle, USGS 1942

Horizon WATER and ENVIRONMENT

Stream Maintenance Program
Final Manual

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September 2009

Horizon Water and Environment. 2009. *Stream Maintenance Program Manual*. Final. September. (HWE 08.002.) Oakland, CA.

TABLE OF CONTENTS

List of Appendices

List of Tables

After page:

List of Figures

All figures located at end of chapter

LIST OF ACRONYMS

ARM	Agreement for Routine Maintenance
BA	Biological Assessment
BAAQMD	Bay Area Air Quality Management District
Basin Plans	water quality control plans
BMP	Best Management Practices
BO	Biological Opinion
°C	Celsius
CCC	Cotati Creek Critters
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
CFWS	California freshwater shrimp
City	City of Santa Rosa
CIP	capital improvement projects
CMP	corrugated metal pipe
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CSC or SSC	California Species of Special Concern lists
CSCB	Coho Salmon Captive Broodstock
CSWP	Central Sonoma Watershed Project
CVFF	Coyote Valley Fish Facility
CWA	Clean Water Act
cu. yds.	cubic yards
DCFH	Don Clausen Fish Hatchery
DPR	California Department of Pesticide Regulation
DSOD	California Division of Safety of Dams
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
F&G Code	California Fish and Game Code
FCDC	Flood Control Design Criteria
FE	Federally Endangered
FEMA	Federal Emergency Management Agency
FIRM	flood insurance rate map
FLD	Flood Peak Attenuation/Flood Water Storage
FMP	Fishery management plans
ft.	feet
GIS	geographic information system
IAWG	Inter Agency Working Group
IP	Individual Permit
IS	Initial Study
K(f)	Soil Erodibility Factor
LID	Low Impact Development
LWD	large woody debris

m	meters
MBTA	Migratory Bird Treaty Act
MCRRFCD	Mendocino County Russian River Flood Control and Water Conservation Improvement District
MEP	Maximum Extent Practicable
MOA	Memorandum of Agreement
MS4	municipal separate storm sewer system
MSL	mean sea level
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NCRWQCB	North Coast Regional Water Quality Control Board
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWPs	nationwide permits
OHWM	Ordinary High Water Mark
PRMD	Permit and Resource Management Department
RCDs	Resource Conservation Districts
RWQCBs or Regional Boards	Regional Water Quality Control Boards
RGL	Regulatory Guidance Letter
RGP	Regional general permits
RPACCC	Rohnert Park and Cotati Creeks Council
RPM	Reasonable and Prudent Measures
RUSLE	Revised Universal Soil Loss Equation
SAA	Streambed Alteration Agreement
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SCWA or Agency	Sonoma County Water Agency
SHPO	State Historic Preservation Officer
SMP	Stream Maintenance Program
sq. mi.	square miles
SRPCS	Santa Rosa Plain Conservation Strategy
SSURGO	Soil Survey Geographic Database
Stream Policy	Stream and Wetlands System Protection Policy
SUSMP	Standard Urban Storm Water Mitigation Plan
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB or State Board	State Water Resources Control Board
TMDL	Total Maximum Daily Load
TOB	top-of-bank
USACE	United States Army Corps of Engineers
USCFF	United States Commission of Fish and Fisheries
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirements
WPP	Watershed Partnerships Program

Chapter 1
INTRODUCTION AND PROGRAM SUMMARY

1.1 Program Background and Need

The Sonoma County Water Agency (SCWA or Agency) was created as a special district in 1949 by the California Legislature to provide flood protection and water supply services to portions of Sonoma and Marin counties. Legislation enacted in 1995 added the treatment and disposal of wastewater to SCWA's responsibilities. Today, SCWA is a multi-objective and integrated water resources agency providing many services that integrate natural resource management including providing water supply, flood protection services, treatment of wastewater and distribution of recycled water, and recreational opportunities. SCWA's mission and vision statements are as follows:

> SCWA Mission Statement:
>
> *The mission of Sonoma County Water Agency is to effectively manage the resources in our care for the benefit of people and the environment in our service area (Sonoma County Water Agency 2007a).*
>
> SCWA Vision Statement:
>
> *The Agency will achieve the sustainable use of natural resources in all aspects of water resources management (Sonoma County Water Agency 2007).*

The Stream Maintenance Program (SMP) was developed by SCWA to improve and define the management and maintenance of flood control channels and streams under SCWA's authority. The SMP establishes programmatic guidance to conduct maintenance activities and avoid and minimize environmental impacts. The SMP also provides the organizational framework to oversee routine channel maintenance activities and ensure the program is compliant with the terms and conditions of its permits. The SMP was developed to be consistent with SCWA's mission and vision statements.

As background to the SMP it is important to note that SCWA has operated and maintained engineered, modified, or natural channels for several decades. Many of the engineered channels included in this SMP Manual were initially constructed as a result of the Central Sonoma Watershed Project (CSWP) Work Plan (Sonoma County 1958) in the Laguna de Santa Rosa watershed. The 1958 CSWP Work Plan described facility and channel maintenance as follows:

> *The Flood Control District*[1] *will assume full responsibility for operating and maintaining all structural works of improvement installed under this plan in such a manner that they will serve the purpose for which they were installed, to the degree for which they were designed (Sonoma County 1958).*

[1] Flood Control District was a predecessor agency to today's SCWA.

The original Work Plan did not provide detailed guidance on how routine maintenance should occur for the CSWP. However, the Work Plan did require that all works were to be inspected twice annually and after each major flood event. Spring, fall, and other interim inspections were to occur as needed to determine required maintenance activities prior to the coming rainy season. Since the CSWP program, several other channels and facilities have been constructed within the Laguna de Santa Rosa, Petaluma River and Sonoma Creek watersheds. Since the initial flood management programs of the 1950s, routine maintenance needs have been assessed and prioritized through seasonal and annual inspections with sediment removal, bank stabilization, and vegetation management activities prioritized as necessary following inspections. It is also worthwhile to note that the original channel design capacities for the CSWP and other programs typically assumed that the stream banks would be maintained in grass vegetation with little or no tree growth and that the streambed would be maintained clear of vegetation and sediment.

Over the years SCWA's stream management perspective has expanded to include multiple objectives including resource protection and environmental sustainability in addition to just flood control and channel maintenance. The Agency has also received requests from the public to incorporate more environmentally conscious management principles, such as wildlife habitat enhancement, into stream maintenance activities. Additionally, local, state, and federal regulations and their requirements have changed over time. Compliance with federal environmental laws and regulations such as the federal Endangered Species Act (ESA) and Clean Water Act (CWA), and state laws and regulations administered by the California Department of Fish and Game (CDFG) and Regional Water Quality Control Boards (Regional Boards or RWQCBs) has required an increasingly extensive authorization process.

Prior to the SMP, each individual maintenance project underwent separate permit approval. This typically involved submitting between 5-15 individual permit applications to various regulatory agencies per year. The time, effort, and costs of the annual permitting process were key factors in developing the SMP. The annual permitting process required a 10 to 18 month planning and application process for a work period that typically lasted only 3 to 4 months. Likewise, the costs of annual permitting often exceeded the costs of the maintenance work itself. Similarly, the work effort and time commitment for the regulatory agencies had also become heavy. As a result, for both SCWA and the regulatory agencies, the annual permitting process for routine and repeating maintenance activities had become inefficient. The RWQCBs specifically requested that SCWA develop a long-term plan to streamline and shorten this annual permitting process.

Beside the time and effort requirements for the annual permitting of maintenance projects, there was also a loss of maintenance efficiency and resource protection with planning projects individually. The SMP was developed to provide consistent program actions, avoid and minimize program impacts, characterize Program Area resources, develop suitable mitigation, and provide oversight across the Program Area. An integrated SMP will better utilize time and funding, and offer a regional perspective for resource management versus developing and permitting a series of individual projects year after year. It is with this background and need that the SMP was developed.

1.2 Program Purpose and Objectives

The primary purpose of the SMP is to provide an efficient and organized program to conduct stream maintenance activities, comply with all relevant environmental regulations, and maintain flood capacity while enhancing the Program Area's natural resources. The SMP has been developed carefully to balance these goals of flood protection, permitting, and protecting and enhancing natural resources.

The following list summarizes the SMP objectives:

- Provide adequate flood protection and channel conveyance capacity for channels under SCWA authority;
- Use a systemic and scientific understanding of the watershed and individual stream reaches to guide maintenance activities;
- Use the stream system understanding to develop informed maintenance approaches that avoid and/or minimize environmental impacts;
- Improve communication, coordination, and permitting efficiency between regulatory agencies and SCWA through an open and collaborative program notification and reporting process;
- Develop an adaptable and sustainable program that can respond to changing environmental, maintenance, and regulatory conditions;
- Provide an administratively stable program that provides consistency in oversight and implementation of program activities;
- Obtain long-term permits providing coverage of program activities under Federal and State regulations such as ESA and CWA; and
- Comply with the California Environmental Quality Act (CEQA) and National Environmental Protection Act (NEPA) requirements.

The purpose of this SMP Manual is to establish and define the overall maintenance program and describe the program's maintenance activities, natural resources, and approaches to avoid or minimize impacts to environmental resources. This SMP Manual is intended for use by SCWA maintenance staff, engineers, and resource managers, as well as environmental regulatory agency staff and other watershed stakeholders.

This SMP Manual provides a description of the activities that will be conducted as part of the SMP. As such, this manual serves as the description of activities permitted by the relevant regulatory agencies. The evaluation of program environmental impacts is addressed through a parallel Environmental Impact Report (EIR) developed in compliance with CEQA. The SMP EIR uses the description of program activities in this manual as the basis for its evaluation.

The SMP is envisioned to be a flexible program subject to periodic revisions reflecting improved understanding of resource conditions, maintenance technologies, or management practices over time. In developing the program and supporting the technical needs of this

SMP Manual, the SMP EIR, and the programmatic permits, several additional technical studies and coordinating activities were conducted, including:

- Inventorying and assessing the natural resources of the Program Area including vegetation mapping and identification of special status plant, wildlife, and fish species;
- Conducting a wetland delineation for the Program Area's engineered flood control channels;
- Evaluating geomorphic and biologic conditions for each engineered flood control channel in the Program Area;
- Evaluating the Program Area's cultural and historic resources;
- Creating an SMP data management system to organize program information and communicate information regarding maintenance activities and natural resources;
- Developing an operations manual for stream maintenance activities;
- Developing a sediment disposal plan for the SMP;
- Revising SCWA's current hydrology and flood control design criteria manual;
- Establishing an Inter-Agency Working Group (IAWG) comprised of regulatory agency representatives to provide the program guidance and regulatory coordination through an open and transparent forum; and
- Establishing an integrated watershed mitigation program to help mitigate environmental consequences of the SMP through stream restoration, erosion control, education and other land management practices implemented by local partner organizations.

1.3 Program Area and Channel Types

Figure 1-1 presents the SMP Program Area located in Sonoma County, California and shows SCWA's nine flood control zones, Zones 1A – Zone 9A. The great majority of SMP activities (over 95%) are located in the engineered flood control channels of Zones 1A, 2A, and 3A – the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watershed, respectively.

Of these three primary zones of activity, most maintenance activities occur in Zone 1A (Figure 1-2). The majority of the flood control channels of the Program Area are found in the greater Santa Rosa and Rohnert Park regions. These channels of Zone 1A require the most maintenance attention, with typically several projects occurring annually. Maintenance activities in Zone 2A (Figure 1-3), the Petaluma area, are the next most common, with typically only one or two sediment and vegetation removal projects per year. Maintenance activities in Zone 3A (Figure 1-4), the Sonoma Creek watershed, are even less common. Maintenance activities in the other six zones are rare and are not expected to occur with any regular frequency.

There are four different channel types in the Program Area. The zone maps presented in Figures 1-2 through 1-9 include color designations for the four types of channel, and Figure 1-10 provides photograph examples of each type. A typical cross section of an engineered flood control channel is shown in Figure 1-11, illustrating many of the channel features (e.g., top-of-bank, toe-of-slope, etc.) that are referred to throughout this document.

The ownership and general maintenance activities for the four channel types are described below:

Engineered Channel–Owned in Fee (Red Channels): These channels are owned and maintained by SCWA through limited zone-specific property taxes. SCWA is responsible for maintenance of the flood control channels that it owns. SCWA maintains approximately 61 miles of owned in fee-engineered channels. Engineered channels are channels that were designed and built to convey a design discharge. In the Program Area, engineered channels have typically been built with a trapezoidal cross-sectional shape. Most of the engineered channels have earthen banks and streambeds, however some channels have hardened banks and beds. Bed and bank hardening typically occurs at or near road and culvert crossings to protect these structures. Maintenance activities in these engineered channels include bank stabilization, landscaping, fencing, mowing, sediment removal, debris removal, vegetation thinning, herbicide stump treatment, and access road herbicide spraying. Structures such as access roads, drop inlet culverts, outfalls, flap gates, and road crossing culverts constructed in association with the engineered channels also require routine maintenance. Owned in fee-engineered channels are shown in red in the zone maps of Figures 1-2 through 1-9.

Engineered Channel–Easement Maintained (Orange Channels): These channels are not owned by SCWA, but SCWA performs channel maintenance on them through permissive easement agreements. For example, cities such as Petaluma or Rohnert Park may own such channels and may have entered into easement agreements with SCWA to conduct maintenance. These easement agreements authorize SCWA to conduct maintenance, but do not require or obligate SCWA to maintain any specific level of hydraulic capacity or conduct any maintenance. Generally, the level of maintenance is defined by the municipality and implemented by SCWA. SCWA performs some maintenance activities within approximately 15 miles of easement engineered channels. Maintenance activities in these channels are similar to the activities described above for SCWA-owned engineered channels with the exception that for the easement engineered channels, SCWA works only within the channel banks and does not maintain roads, ditches, fences, or other structures outside the channel. Easement engineered channels are shown in orange in the zone maps of Figures 1-2 through 1-9.

Modified Channel–Easement Maintained (Blue Channels): Modified channels are natural channels with existing earthen beds and banks that have been modified either through vegetation removal, in-channel grading, channel widening or straightening, or debris clearing to improve flow conveyance. Though modified, these channels are not engineered or constructed according to specific design criteria to convey a discharge of a particular magnitude. These are permissive easements where another jurisdiction, authority, or private landowner owns the modified channel feature. SCWA is not obligated to conduct maintenance and has no responsibility to perform any specific level of maintenance in easement modified channels. However, SCWA may perform limited maintenance on these channels. SCWA holds hydraulic easements (for work within the channel) for over approximately 49 miles of modified channels. Maintenance activities in modified channels typically include the removal of log jams, debris jams, and clearing vegetation to remove significant flow obstructions. The most common type of work conducted in these channels is the removal of blackberry thickets or fallen trees that significantly increase the potential for flood damage to structures. Trash or vegetation debris may also cause a blockage and require removal. SCWA does not perform sediment removal or bank stabilization work in modified channels. Work in modified channels occurs only on an as-needed basis, usually at the request of an adjacent land-owner during or following a large storm event. Modified channels are shown as blue streams in the maps of Figures 1-2 through 1-9.

Natural Channel–Easement Maintained (Green Channels): Natural channels are non-engineered and non-modified creek systems with a permissive clearing easement. SCWA holds hydraulic easements to work within the channel banks for over approximately 80 miles of natural channels. Natural channels may require maintenance activities to maintain flow conveyance and reduce the flooding hazard. Maintenance work in natural channels typically involves clearing debris or vegetation that is causing a flow obstruction. In this way, maintenance activities for natural channels are similar to modified channels. Work in natural channels is infrequent and typically occurs at the request of an adjacent landowner who has observed a problem. Similar to modified channels, SCWA does not conduct sediment removal or bank stabilization activities in natural channels. Additional environmental protections are included for natural channels as described in Chapter 6, Section 6.5.2 *Natural Channels*. Natural channels are shown as green creeks in the zone maps of Figures 1-2 through 1-9.

1.4 Overview of SMP Approach

This SMP Manual was developed with past maintenance lessons in mind to create an improved program that would maintain channels more effectively, would provide greater environmental protection and benefits, and would be more time and cost efficient for both SCWA and regulatory agency staff. The development of the SMP benefited from review of other stream maintenance programs throughout the state and incorporation of their experiences.

The central tenet of the SMP approach is that management activities are conducted using an informed and systemic approach to minimize stream impacts while providing necessary flow conveyance. A thorough understanding of the physical and biological stream system is at the core of this informed approach. As described in subsequent chapters (Chapter 3 *Environmental Setting,* Chapter 4 *Channel Characterization*) the SMP utilizes an analytic and targeted approach to understand the degree of maintenance work actually required for a given situation. For example, hydraulic and field analysis can be used to assess and guide sediment removal activities whereby flood control channel cross sections can be compared to as-built designs to determine when sediment removal is necessary. In this way the removal of sediment will not be arbitrary or excessive.

While the analysis of maintenance problems may be focused, the development of solutions is watershed-wide in perspective. For example, in the sediment removal case described above, the SMP approach also considers how to reduce in-stream sediment loads from erosion "hot spots" in the watershed lands upstream that are introducing large amounts of sediment to the stream system downstream (see the integrated watershed mitigation program described in Chapter 8 *Program Mitigation*).

The SMP employs a more comprehensive watershed approach than the current project-by-project annual process. The watershed approach of the SMP manages streams and channels with an understanding of the overall stream system and its physical and biological processes. The SMP approach considers each site and reach as a component within a watershed system integrating upstream inputs and downstream outputs. Such a perspective enables improved management of resources across the whole watershed system. For example, consideration of sensitive habitats, sediment sources in the upper watershed areas, or the most efficient way to manage a stream corridor's vegetation are all improved in planning and implementing maintenance through a broader program.

1.5 Program Activities

The Stream Maintenance Program has three primary activities: sediment management, vegetation management, and bank stabilization. These core maintenance activities occur mainly in engineered flood control channels (red and orange channels on Figures 1-2 through 1-9), but may also occur in other engineered structures, sediment basins, or other facilities on an as-needed basis. In addition to the three core SMP activities, the SMP also involves other smaller and infrequent maintenance activities such as road maintenance, sediment removal around reservoir inlet structures, and debris removal. The SMP also includes the transport and disposal of collected sediment and vegetation. SMP activities are summarized below and described in more detail in Chapter 6 *Maintenance Activities*.

1.5.1 Sediment Management

In general, sediment management refers to the removal of excess accumulated sediment from engineered flood control channels and facilities. This accumulated sediment reduces flow capacity and increases the potential for flooding. SMP sediment management activities seek to provide flow capacity while also providing geomorphic and ecologic channel functions, through such means as shaping a two-stage channel form (see Chapter 6) within the original engineered flood control channel (Figure 1-11). Sediment management activities are generally conducted from June 15th to October 31st when streams are typically at their driest. The number of sediment removal projects undertaken annually and the quantity of sediment removed in a given year depend on recent weather and hydrologic conditions, as well as the frequency and extent of past maintenance activities.

There are three general types of sediment removal projects: (1) reach scale projects where sediment is removed from an entire reach (typically 1,000-3,000 ft long); (2) smaller localized sediment removal projects (typically 100-200 ft long) where sediment is removed from individual crossings, culverts, or other in-channel facilities; and (3) intermediate scale sediment removal projects (typically 500-750 ft long) that involve individual bar grading or geomorphic shaping activities to remove sediment, reduce flow deflection, and enhance channel habitat features.

Sediment removed from SCWA facilities will be hauled off-site to an approved upland disposal sites or to the Sonoma County Central Landfill. Sediment disposal activities are essential to the completion of the sediment removal, bank stabilization, and vegetation removal activities of the Program. SCWA anticipates that on average, the SMP will involve removing between 10,000 and 25,000 cubic yards of sediment per year. More detail on sediment disposal activities is provided in the following chapters.

1.5.2 Vegetation Management

Vegetation management refers to the trimming, mowing, and removal of flow-constricting vegetation within the flood control channels and other constructed facilities. Vegetation management activities are conducted to maintain flow conveyance capacity, establish a canopy of riparian trees, and control invasive vegetation. Vegetation management and removal activities are relatively consistent from year to year, though locations change depending on recent growth and blockages. Vegetation management also includes the planting of new trees and shrubs in engineered channels in accordance with the SMP's restoration and mitigation program (see Chapter 8 *Program Mitigation*).

1.5.3 Bank Stabilization

The repair and stabilization of stream or reservoir banks is undertaken when a bank is weakened, unstable, or failing. Negative consequences of failing stream banks include:

- causing damage to adjacent properties;
- increasing the flood hazard and threaten public safety;
- impairing roads, transportation, and access;
- generating erosion and increasing downstream sediment yields; and
- impacting riparian habitat and other natural resources.

Bank stabilization activities may occur in engineered channels or other facilities including culvert outlets and banks around reservoirs. Bank stabilization activities are generally conducted June 15th to October 31st when streams are at their driest.

1.5.4 Other Activities

Other Program maintenance activities include:

- maintaining channel access roads for accessibility;
- maintaining proper drainage along channel access roads;
- maintaining proper functioning of drop-inlet culverts which direct local surface flow toward the flood control channels;
- maintaining culverts free of sediment and vegetative blockages;
- sediment removal around reservoir inlet structures
- repairing fences along the channels; and
- removing or covering graffiti on Agency facilities.

The majority of these activities are considered to be minor and small in scale.

1.5.5 Activities in Modified and Natural Channels

As described above, maintenance activities in modified and natural channels (blue and green channels as shown on Figures 1-2 through 1-9) occur on an as-needed basis usually following large storm events or particularly wet winters with seasonally elevated stormflows. Maintenance in these reaches is conducted only to maintain hydraulic conveyance and reduce flooding potential. For example, SCWA may remove a fallen tree or debris jam that backwaters flows upstream or diverts flows toward a bank or structure in a natural channel. Maintenance may also be required when overgrown vegetation blocks a culvert. Such flow blockages can lead to more excessive bank erosion, the undermining of a facility, or potential overbank flooding if not removed. Maintenance in these channels is usually conducted at the request of an adjacent landowner.

During the SMP development and review process, representatives from the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), CDFG, and Regional Boards identified concerns about maintenance activities conducted in natural channels (where SCWA has hydraulic easements) that support listed salmonids and/or California freshwater shrimp. Through discussions with these agencies, SCWA agreed to remove these channels of concern from coverage under the SMP. As a result, potential direct impacts to these species and their habitat are avoided. The streams supporting sensitive habitats that were removed from the SMP are shown in Figure 1-12. These channels are also represented by green dashed lines in the maps of Figures 1-2 through 1-9.

The one creek that is known to support California freshwater shrimp but was not removed from the SMP is Sonoma Creek. This creek is mostly comprised of modified and natural channel reaches. Two short segments of SCWA owned-in-fee engineered channels are located on the main stem of Sonoma Creek. These reaches are relic parcels that came under SCWA ownership at some point in the past, but are managed by SCWA as if they were modified or natural channel and are treated by this SMP as a natural or modified channel (i.e., no sediment removal or bank stabilization activities will be covered in those reaches by this SMP). Because several homes border this creek, risks to property and safety due to flow blockages and potential flooding exist and SCWA may need to conduct vegetation management in Sonoma Creek. However, specific BMPs to conduct maintenance in this creek were developed to greatly reduce the potential for impacts to California freshwater shrimp (see Table 7-1).

1.5.6 Activities Not Covered in the SMP

Activities not covered under the SMP include:

- maintenance activities on the main stems of the Russian River and Dry Creek in Zone 4A and 6A related to management of Lake Mendocino and Lake Sonoma;
- maintenance activities on streams outside of SCWA authority for which no maintenance agreement exists;
- capital improvement projects (CIPs); and
- emergency activities and procedures.

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). Although emergency situations will not be covered in the SMP, SCWA will make every effort to follow the guidance provided in the SMP when implementing activities under emergency conditions.

Routine stream maintenance does not include projects that would alter the designed flood conveyance capacity of a channel. Large construction projects and CIPs are not considered routine stream maintenance and are not included in the SMP. However, future CIPs may consider using, or adapting, the SMP to cover their maintenance needs and mitigation once their project becomes operational and requires maintenance.

1.6 Impact Avoidance and Minimization

The informed approach of the SMP not only requires a clear understanding of the location, extent, and specifics of maintenance activities; it also requires an understanding of the stream system's natural and aquatic resources. As described in this manual (Chapters 3 and 4), the SMP includes a method to inventory and assess each stream reach for its geomorphic, habitat, and species conditions. Each reach is also considered within its sub-basin and watershed context. Defining this baseline of what resources exist and processes operate at a given reach is fundamental to the SMP. Understanding these resources, their locations and how they interact informs an approach to avoid, minimize, and mitigate environmental impacts. Understanding these resources also influences how, where, and when routine maintenance activities should occur.

Chapter 5 *Pre-Maintenance Planning Approach and Impact Avoidance* describes how planning measures are taken to avoid and reduce impacts before any maintenance work occurs. The following maintenance principles were developed as guidelines to avoid and minimize environmental impacts of the program. Chapter 5 provides additional detail on how these principles are used.

1. No Unnecessary Intervention
2. Understand the System and Its Processes
3. Consider Adjacent Land Uses
4. Apply System Understanding to Maintenance Actions
5. Manage for Incremental Ecologic Improvement
6. Integrate Maintenance Activities towards Sustainability (to reduce frequency of maintenance)

When applied, these principals determine when action is needed, consider the natural function of the system, provide an understanding of local physical constraints, identify sensitive habitats, consider watershed processes, identify the maintenance activities needed at the reach and site scale, and seek solutions to minimize the on-going need for maintenance activities at a particular site or reach.

The maintenance activities described in Chapter 6 incorporate a range of measures to minimize undesired effects that could not be entirely avoided through the pre-maintenance planning approaches described in Chapter 5. These additional measures are described in Chapter 7 *Impact Reduction, Minimization Measures, and Best Management Practices (BMPs)*. Measures to protect natural resources, as well as “good-neighbor” policies were drafted to reduce the effects of maintenance activities. Table 7-1 organizes these measures and BMPs according to program activities and specific environmental resources. Taken together, the pre-maintenance planning measures described in Chapter 5 and the maintenance activity based measures described in Chapter 7 provide a comprehensive and integrated approach to avoiding and minimizing program impacts.

1.7 Program Mitigation

Through the use and application of avoidance and minimization measures and maintenance principals described above, potential impacts are greatly reduced. However, potential impacts that are not reduced through avoidance measures or project elements may require additional mitigation. The mitigation program for the SMP is described in Chapter 8.

The SMP’s mitigation approach was developed through multiple discussions with agency representatives from the RWQCBs, CDFG, NMFS, USFWS, and the U.S. Army Corps of Engineers (USACE). Meetings were held with individual agencies and also together through group meetings of the IAWG. The SMP mitigation approach was also developed over the course of 3 years of interim permitting (2006-2008). During that period maintenance projects were developed, submitted for agency review, permitted, and implemented. The interim permitting period was used to demonstrate and refine program approaches, including the mitigation approach.

The mitigation planning approach follows a three-tiered system where mitigation opportunities are sought sequentially. Tier 1 mitigation is implemented on-site at the specific project reach where the maintenance work was conducted. Mitigation approaches on-site seek to enhance and restore the stream and aquatic functions and resources (in-kind) that were impacted through the maintenance activities.

Tier 2 mitigation is similar to Tier 1 mitigation in seeking in-kind mitigation in stream channels that had undergone maintenance. However, Tier 2 mitigation is applied at other stream channels, and is therefore not specifically on-site. Tier 2 mitigation is sought when there are no suitable opportunities for enhancement or restoration on-site at a specific channel reach and the next best opportunity is to pursue in-kind mitigation at a neighboring reach that does afford an opportunity for mitigation.

Tier 3 mitigation is off-site mitigation that provides compensating watershed based functions and values to SMP program impacts. Tier 3 mitigation addresses residual impacts from SMP activities that are not adequately avoided or minimized as described above or mitigated through Tier 1 and 2 mitigation actions. The Tier 2 and Tier 3 off-site mitigation address the temporary loss of Beneficial Uses and ecological functions and values during the time gap between SMP maintenance activities and when Tier 1 mitigation occurs, and the time when Tier 1 mitigation has become fully functional and the temporary impacts have been eliminated. Tier 3 mitigation provides restorative and mitigating watershed solutions for SMP impacts. Tier 3 mitigation is not only different in its geographic scope, it is also different in that it is not solely a SCWA effort, but is a collaborative effort with partnering agencies. This is accomplished through the off-site watershed mitigation program, whereby SCWA funds Tier 3 projects to be implemented with local non-profit agencies, municipalities, restoration organizations, creek groups, schools and Resource Conservation Districts (RCDs).

During the 2006-2008 interim period, while the SMP was in development, four Tier 3 off-site watershed mitigation projects were successfully implemented with local RCDs, landowners, or non-profit agencies. These projects included headwater erosion control through stream fencing to protect streams from cattle grazing, erosion control activities at an active landslide to reduce downstream sediment yields into SMP flood control channels, and restoration and vegetation planting activities in the Upper Laguna watershed.

A key objective of Tier 3 mitigation is to reduce the overall necessity for channel maintenance. This is achieved through both erosion control and improved land use practices in upper watershed lands. Headwaters are a source for eroded sediments that are transported downstream to the many engineered, modified, and natural channels of the SMP. Reducing the sediment loading from headwater areas or upstream reaches is anticipated to reduce the need for subsequent downstream sediment removal activities.

The three-tiered mitigation approach ensures that mitigation is first and foremost directed to compensate for the impacts occurring at the specific project reach, then expands to consider all impacted reaches, and finally addresses the watershed as a whole. Chapter 8 provides details on the SMP's mitigation program.

1.8 Program Management

1.8.1 SMP Work Cycle

Implementation, administration and oversight of the SMP is described in Chapter 9. The SMP will be managed as an annual cycle of activities. Stream reconnaissance and assessment begins in late winter or early spring, followed by the development of the maintenance workplan. During the spring months, the year's maintenance projects are further refined and described, appropriate mitigation is identified, and the relevant regulatory agencies overseeing program permitting are notified. Projects are then implemented during the summer season, when the channels are at their driest. During the fall, and before the end of the year, an annual summary report of the year's maintenance, mitigation, and monitoring activities is sent to the permitting agencies.

1.8.2 Program Tracking

An important component in managing the SMP is to establish and maintain a comprehensive data management system. Data management is required throughout the SMP work cycle including: organizing the initial stream assessment and inventory; characterizing reach conditions; identifying maintenance needs; identifying sensitive habitats, weed populations, or other environmental considerations; documenting the implemented maintenance activities; documenting and tracking the implementation of restoration and mitigation activities; monitoring the on-going status of mitigation activities; and tracking all regulatory reporting requirements. The SMP database organizes all of this information and other data including reach assessment sheets, GIS mapping, habitat assessment sheets, and aerial photography. This SMP database provides a consistent and transparent way to monitor overall program activities, permitting compliance and track habitat and canopy development.

1.8.3 Program Reporting

As described above, at the conclusion of each year's maintenance season a summary report is developed, posted to the program website, and submitted to the appropriate regulatory agencies. This report includes: a summary of the year's maintenance projects describing what activities occurred and where; a description and confirmation of the restoration and mitigation activities implemented during the current year mitigation; a status and monitoring report of on-going mitigation activities initiated during previous seasons; and other program updates as necessary. The report may include additional information on project area conditions, activities employed, the effectiveness of certain activities, possible recommendations for future maintenance, or suggestions to improve the program's implementation and management.

1.8.4 Program Review

Following the submittal of the annual maintenance report, regulatory agency staff are invited to a review meeting to discuss the events, maintenance activities, and lessons learned over the past work cycle. Every 5 years, SCWA and the permitting agencies will review the SMP for its overall effectiveness. This review will include an assessment of maintenance activities conducted to date, BMPs employed, adequacy of the SMP Mitigation Program, SMP data management, adequacy of SMP adaptive updates and revisions, and overall program coordination and communication between SCWA and the regulatory permitting agencies. The Program is flexible to accommodate new resource information, management standards, and maintenance technology over time. The SMP is a "living program" that is updated and modified as needed.

1.8.5 Regulatory Agency and Stakeholder Input

The SMP, the program manual, and the associated regulatory permitting, environmental compliance, and technical studies conducted to support the program were developed by SCWA during the period 2006-2009. During the program development period, close collaboration with regulatory agency representatives occurred through the IAWG. Numerous meetings were held with individual agencies and as a collective group. Guided field trips also occurred to show regulators the conditions at several sites in the Program Area. Regulatory agency staff members of the IAWG were instrumental in guiding the overall development of the program and providing direction on permitting, resource characterizations, impact avoidance, and mitigation approaches. Members of the IAWG reviewed the Draft SMP Manual thoroughly and provided detailed comments and suggested edits. In addition to regulatory agency guidance and review, SCWA presented the SMP at public meetings in 2008 with key watershed and governmental stakeholders to garner additional input. Additional public review and comment for the program occurred through the CEQA process and public commenting on the SMP EIR.

1.8.6 Program Commitment

Essential to SMP program success is SCWA's commitment to dedicate the required resources and staffing necessary to effectively administer, oversee, implement, and monitor the SMP. One of the key recommendations from reviewing other similar stream maintenance programs was the need for the agency developing and implementing the program to provide consistency, continuity, and a centralized manager in the operation of the program. SCWA has dedicated the resources necessary to ensure program success, including support of a full-time SMP Manager who will oversee implementation of the Manual and compliance with program permitting.

1.8.7 Program Documents and Materials

All documents and supporting materials used in developing the SMP, this manual, the program EIR, and the above referenced technical studies (Section 1.2) are housed in the SMP program library under the management of the SMP Manager and are available for viewing upon request. Most of the program documents and materials will be available for viewing through the program website at:
http://www.scwa.ca.gov/about_your_water/stream_maintenance.php.

1.9 Program Partner – City of Santa Rosa

The SMP was developed in cooperation with the City of Santa Rosa (City). As described above, the City and SCWA have long standing easement agreements for SCWA to conduct maintenance on channels owned by the City. The City supports the flood management, natural resource protection, and recreation objectives of the SMP. In fact, there is strong agreement between many aspects of the SMP and the City's Citywide Creek Master Plan (City of Santa Rosa, 2007).

In addition to the easement relationship, the City provided an important partnering benefit to the SMP through providing valuable long-term sediment disposal opportunities. The North Coast RWQCB developed the Santa Rosa Nutrient Offset Policy in coordination with the City in 2006 to reduce net nutrient loading to the Laguna de Santa Rosa by 2011. The disposal of SMP sediments to suitable sites owned by the City (including the West College Pond and Place-to-Play sites) will provide an effective means to support the nutrient offset program. Additional information on the regulatory background for the nutrient offset program is provided in Chapter 2, Section 2.2.5 *Section 303[d] – Impaired Water Bodies and Total Maximum Daily Loads*. Additional information regarding the role of the City's sites for receiving disposed SMP sediment is described in Chapter 5, Section 5.6.4 *City of Santa Rosa Sediment Disposal Opportunities*.

The SMP EIR will include discussion and evaluation of programmatic impacts associated with using the nutrient offset program and coordinating with the City for SMP sediments to be disposed at City sites such as the West College Pond and Place-to-Play sites. For the SMP EIR, the City of Santa Rosa is recognized as a responsible agency under CEQA. In addition, a more specific work agreement is under development between SCWA and the City to more precisely describe the terms and conditions of SMP sediment disposal at City sites. This more specific agreement may result in the need for additional CEQA review and disclosure. Such additional CEQA review will occur as needed.

1.10 Program Permitting and CEQA/NEPA Compliance

As described above in Section 1.1, prior to the development of the SMP the permitting of stream maintenance activities was conducted on a project-by-project approach for all of the individual projects in a given year. This required abundant time, effort, and cost for SCWA and the regulatory agencies, and was inefficient in that most of the maintenance activities were routine and repetitive. Additionally, conducting projects individually limited the opportunities to conserve and protect natural resources through a broader watershed approach. For these reasons the SMP sought programmatic long term permits to provide regulatory compliance. The regulatory context for the SMP and the program's permitting approach are described in Chapter 2 *Environmental Regulations and Compliance* and summarized in the paragraph below.

SCWA is seeking approval of long-term permits for routine stream maintenance activities in channels and streams under the jurisdiction of the USACE, including Waters of the United States and special aquatic sites (wetlands) pursuant to Section 404 of the CWA. An Individual Permit (IP) will grant general authorization and set conditions for routine stream maintenance activities subject to jurisdiction of the USACE for a 10 year period. In addition, SCWA and USACE is required to comply with requirements under Section 7 of the ESA for listed salmonids outside of Zone 1A and for other federally listed species not covered by the NMFS Russian River Watershed Biological Opinion. The RWQCBs issued Waste Discharge Requirements (WDRs) under Section 401 of the CWA and in compliance with Porter-Cologne Water Quality Control Act through a 5-year permit with a defined process for renewal for another 5-year term. SCWA will also replace its existing Agreement for Routine Maintenance (ARM) with CDFG with a Master Streambed Alteration Agreement for stream maintenance activities in compliance with Fish and Game Code Section 1602, the Streambed Alteration program. In addition, CDFG issued authorization for the SMP under the California Endangered Species Act (CESA). The effectiveness of the overall program will be reviewed in 5 years as part of the permit renewal process.

CEQA compliance is triggered by the issuance of permits by state regulatory agencies including the RWQCBs and CDFG. CEQA is also triggered by the discretionary action of the Sonoma County Board of Directors (SCWA's governing body) approval of the SMP via adoption of the SMP Manual, the implementation of which may result in environmental impacts. Thus, SCWA was the lead agency responsible for complying with CEQA. Compliance with CEQA was met through the development of an EIR for the SMP Manual. The EIR evaluates the environmental impacts of the maintenance activities proposed in the SMP Manual. The EIR was developed to address the needs of each regulatory agency to grant permits, as well as provide the necessary CEQA compliance to allow the Agency's Board of Directors to approve the SMP. The SMP EIR was certified by the Sonoma County Board of Directors in June 2009.

The issuance by USACE of a CWA Section 404 individual permit constitutes a federal action. Therefore, USACE must comply with NEPA. USACE was the lead agency undertaking NEPA compliance. Similar to CEQA, The SMP Manual provided the basis for developing the project description for NEPA compliance. NEPA compliance led by the USACE met environmental compliance requirements for permitting actions conducted by all federal agencies granting permits for the SMP, provided that the project description is the same for all issued permits (i.e., separate NEPA documents are not required to address USACE, USFWS or NMFS permits).

1.11 SMP Manual Organization

This SMP Manual is organized into the following chapters:

Chapter 1. Introduction and Program Summary provides an overview of the SMP including describing the program's purpose, area, channel types, maintenance activities, impact avoidance, mitigation, and permitting approaches.

Chapter 2. Environmental Regulations and Compliance describes the federal, state, and local regulations that are applicable to the SMP, reviews regulatory agencies and their permitting responsibilities for the SMP, and presents the program's compliance and permitting approach.

Chapter 3. Environmental Setting describes the physical and biological resource conditions in the Program Area that influence the SMP. This setting includes descriptions of topography, landforms, geology, hydrology, water quality, natural communities and vegetation, and wildlife in the Program Area.

Chapter 4. Channel Characterization describes the Program Area subwatersheds and provides detailed fact sheets for each of the engineered and easement engineered channels in the Program Area. For each maintenance reach key physical and biological conditions are described, photographs presented, and management needs and opportunities summarized.

Chapter 5. Pre-Maintenance Planning Approach and Impact Avoidance describes how planning measures are taken to avoid and reduce impacts are before any maintenance work occurs. This chapter presents the guiding principles and approach of the program to avoid and minimize environmental impacts.

Chapter 6. Maintenance Activities describes the primary program activities including sediment management, bank stabilization, and vegetation management activities, and secondary program activities of road maintenance, debris removal, fence repair, etc.

Chapter 7. Impact Reduction, Minimization Measures, and Best Management Practices (BMPs) presents additional measures to protect natural resources, provide good-neighbor policies, and other measures to reduce the effects of maintenance activities.

Chapter 8. Program Mitigation describes the SMP's 3-tiered mitigation approach, including the integrated watershed mitigation program to mitigate remaining impacts that were not effectively avoided or minimized.

Chapter 9. Program Management describes SMP administration and oversight including the implementation of the SMP annual work cycle, data management, regulatory agency notification and reporting, and program review.

Chapter 10. References provides a listing of the reference materials and documents used in the development of this SMP Manual and it's supporting planning studies.

Appendix A. Santa Rosa Nutrient Offset Policy – This policy describes a process for recognizing the City of Santa Rosa's nutrient reduction efforts and determining credit toward compliance with the 2011 zero net nutrient load requirement for the Laguna de Santa Rosa.

Appendix B. Sediment Sampling and Analysis Guidelines – This document describes the sediment evaluation procedures and criteria for disposal at various locations.

Appendix C. Watershed Partnerships Program Memorandum of Agreement: Sample Memorandum of Agreement and Grant Funding Application Form – This appendix provides a sample agreement between SCWA and the Sotoyome RCD to demonstrate a formalized work agreement between SCWA and a partnering agency within the Watershed Partnerships Program, that will provide watershed based mitigation for SMP activities. Appendix B also includes a sample application form that potential partners would use to apply for grant funding from SCWA.

Appendix D. Watershed Mitigation Project Descriptions – This appendix provides project descriptions for four watershed mitigation projects conducted in the interim period (2006-2008) while the SMP was in development. Project descriptions include photographs and information on the project location, partnering agencies, mitigation objectives.

Appendix E. Vegetation Management Plan – this appendix describes, in detail, the approach and procedures for vegetation management activities.

Appendix F. Outlines for Annual Reports – this appendix includes three outlines to illustrate the anticipated contents of the annual notification report (Appendix F-1), annual post-maintenance summary report (Appendix F-2), and sediment sampling report (Appendix F-3).

Chapter 2
ENVIRONMENTAL REGULATIONS AND COMPLIANCE

2.1 Background and Regulatory Guidance

This chapter describes the principal federal and state environmental regulations, policies, and local resource management plans applicable to maintenance activities of the Stream Maintenance Program (SMP). This chapter also summarizes the procedures to comply with these regulations, policies, and plans.

As introduced in Chapter 1, SMP activities generally include sediment management, vegetation management, and bank stabilization. Depending on the activity type, where the activity occurs, and how the activity is implemented, different permits or environmental compliance may be required.

To develop the SMP Manual and receive guidance on permitting approaches, the Sonoma County Water Agency (SCWA) worked with each of the member regulatory agencies of the Inter-Agency Working Group (IAWG). This group included representatives from the U.S. Army Corps of Engineers (USACE), the North Coast Regional Water Quality Control Board (North Coast RWQCB or NCRWQCB), the San Francisco Bay Regional Water Quality Control Board (San Francisco Bay RWQCB or SFBRWQCB), the California Department of Fish and Game (CDFG), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (USEPA). While the SMP Manual was under development (2006-2008), SCWA worked closely with IAWG members to review and revise the maintenance activities and impact avoidance approaches in the SMP Manual.

IAWG members provided direction on the goals and objectives of the SMP, as well as reviewed and commented on all chapters of the manual. Multiple meetings were held with focused discussion of SMP topics such as sensitive species and resources, maintenance activities, avoidance approaches, and program mitigation. Permitting approaches were also discussed at IAWG group meetings, agency-specific meetings, interim permitting activities, or during pre-submittal evaluations of programmatic permit applications.

In addition to meetings, several field tours were held to familiarize regulators with the program area, flood control channels, maintenance activities, and impact avoidance approaches.

Most of the activities and impact avoidance approaches described in this manual were demonstrated during the 2006-2008 interim period while the program was in development. During the 2006-2008 interim period, annual stream maintenance projects were permitted individually. These individual permits were necessary while the program and its programmatic permits were in development.

The remainder of this chapter presents the regulations and regulatory agency jurisdictions applicable to implementation of the SMP, and the general permitting or compliance approach of the SMP.

2.2 Clean Water Act

The Clean Water Act (CWA) is the primary federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. The CWA operates on the principle that all discharges into the nation's waters are unlawful unless specifically authorized by a permit. The following paragraphs provide details on specific sections of the CWA that are relevant for the SMP.

2.2.1 Section 404 - Fill Placement in Waters and Wetlands

CWA Section 404 regulates the discharge of dredged and fill materials into waters of the United States. "Discharge of dredged material" and "discharge of fill material" are defined at 33 CFR 323.2. "Waters of the United States" (Water of the U.S.) include all navigable waters, their tributaries and some isolated waters, as well as any adjacent wetlands to the aforementioned waters (33 CFR 328.3).

Before actions are carried out that would result in discharge of dredge or fill material to Waters of the U.S., a delineation of jurisdictional waters of the United States is usually required, following USACE protocols (Environmental Laboratory 1987). The purpose of the delineation is to determine whether the areas where these actions would take place encompass wetlands or other waters of the United States which qualify for CWA protection. These include any or all of the following:

- Areas below the ordinary high water mark (OHWM)[1] of a stream, including non-perennial streams with a defined bed and bank and any stream channel that conveys natural runoff, even if it has been realigned; and
- Seasonal and perennial wetlands, including coastal wetlands.

A stream is a long, narrow body of flowing water that occupies a channel with defined bed and bank, and moves to lower elevations under the force of gravity. The program area's engineered channels, V-ditches, and other conveyance channels are considered streams, whereas canals, aqueducts or other water transfer systems are not considered streams. A perennial stream has flowing water year-round during a typical year. The water table is located above the streambed for most of the year. During the dry season, groundwater and urban runoff are the primary sources of water for stream flow. During the rainy season, runoff from rainfall is the primary source of water for stream flow[2]. Many streams in the program area do not flow year-round, and may be categorized as intermittent or ephemeral.

[1] OHWM - Defined by USACE as that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. The USACE is the final arbitrator in determining the OHWM.
[2] Source for stream type definitions is the January 15, 2002 Federal Register; CFR 02-539.

An intermittent stream has flowing water during certain times of the year, when groundwater, rainfall, or urban runoff provides water for stream flow. During dry periods, intermittent streams may not have flowing water. An ephemeral stream, on the other hand, has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for ephemeral streams; runoff from rainfall is the primary source of water for stream flow.

Wetlands are defined for regulatory purposes as areas “inundated or saturated by surface or ground water 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” (33 CFR 328.3, 40 CFR 230.3).

Permitting Agencies and Related Regulations

The USEPA has delegated responsibilities for administering CWA Section 404 to the USACE. Therefore, project proponents must obtain a permit from the USACE for all discharges of dredged or fill material into waters of the United States, including wetlands, before proceeding with a proposed activity.

The extent of USACE jurisdiction for waters of the United States is the OHWM or, if adjacent wetlands are present, the outer limits of those wetlands. In determining its jurisdiction, USACE considers a number of factors, including existing conditions, historical alterations, normal circumstances, as well as guidance, policies and recent court decisions.

Two types of permits are issued under the CWA Section 404: general permits which cover certain classes of activities, and individual permits for activities that are not authorized under a general permit. General permits may be issued on a nationwide, state, or regional basis and exempt certain activities from individual permit requirements. Activities permitted with a general permit have minimal individual or cumulative adverse impacts on the environment.

National general permits are called nationwide permits (NWPs). As of March 12, 2007, 50 NWPs are available for permitting activities such as maintenance of previously authorized structures, bank stabilization, and maintenance of existing flood control facilities. Some NWPs require that a pre-construction notification be submitted to USACE in advance of the project. NWPs are reviewed, updated, and reissued by USACE every five years. Therefore, no activity may be permitted for over 5 years.

Regional general permits (RGPs) are similar to NWPs but may only be used in certain regions. RGPs are issued by the Division or District Engineer for activities that fall within specific parameters. Local agencies with specific, identified activities that have minimal individual or cumulative adverse impacts on the environment may work with their USACE District to develop a RGP for the agency’s activities. RGPs, like NWPs, are subject to review and re-issuance every 5 years.

Individual permits may be issued for projects that do not fit within the definition of NWPs or a local RGP. They are similar to RGPs in that they may be developed to address a suite of activities specific to a particular agency and geographic region. The permit term for individual permits is identified as a permit condition and is not subject to a mandatory 5-year review cycle as are NWPs and RGPs.

Under Section 404(b)(1) of the CWA, individual permits may be issued only for the least environmentally damaging practicable alternative. That is, authorization of a proposed discharge is prohibited if there is a practicable alternative that would have less adverse impacts and lacks other significant adverse consequences.

Compensatory Mitigation

Individual and general permits may include requirements for mitigation to account for negative impacts to waters of the United States resulting from the activities for which the permits were issued. On March 28, 2006, the USACE and USEPA published a proposed rule (71 FR 15520) revising regulations governing compensatory mitigation for activities authorized by permits issued by the USACE. The proposed regulations are intended to establish performance standards and criteria for compensatory mitigation and mitigation banks, and to improve the quality and success of compensatory mitigation projects for activities authorized by USACE permits. The proposed regulations are also intended to account for regional variations in aquatic resource types, functions, and values, and apply equivalent standards to each type of compensatory mitigation to the maximum extent practicable.

The proposed 2006 rule includes a watershed approach[3] to improve the quality and success of compensatory mitigation projects in replacing losses of aquatic resource functions, services, and values resulting from activities authorized by the USACE.

SMP Permitting Approach

The San Francisco District of the USACE has jurisdictional authority over CWA Section 404 in Sonoma County. SMP activities including, but not limited to, sediment management, bank stabilization, and other activities that result in a discharge of dredged or fill material require permit authorization under CWA Section 404 from the USACE.

During the interim permitting of stream maintenance activities conducted in 2006-2008 (prior to the programmatic permitting of the SMP), the USACE authorized coverage for maintenance activities under NWPs 3 (Maintenance), 13 (Bank Stabilization), and 33 (Temporary Construction, Access, and Dewatering). However, for the longer-term implementation of the SMP, coverage under the Nationwide Permit Program was not practical due to the programmatic nature of the SMP.

Based on discussions with USACE, SCWA applied for individual permits to cover SMP activities that have a jurisdictional nexus with USACE. Two individual permits will provide programmatic coverage for SMP maintenance activities conducted within the program area; one focusing on Flood Control Zone 1A and another focusing on Flood Control Zones 2A and

[3] The term "watershed approach" is a planning term used to describe a comprehensive regional approach to resource planning that considers physical processes and biologic conditions as they relate to ecosystem function within an integrated drainage ("watershed") unit. The term is used here to imply an approach to mitigation that goes beyond the immediate project site to consider how resources can best be protected and/or restored through an integrated approach operating at the watershed scale.

3A. The individual permits will have a 10 year coverage period. After review of the initial permitting period, the permit will be updated, including reinitiated consultations with USFWS and NMFS as necessary and updated RWQCB permits.

USACE staff provided direction to SCWA on the permitting approach and also the methods and data collection necessary to support the programmatic permits. Information supporting the permitting process included a wetland delineation report, biological assessments, and cultural resources inventory. Permitting documentation focused primarily on the SMP's main activity area of Flood Control Zones 1A, 2A, and 3A and was submitted with the final programmatic permit application.

The permits issued by the USACE providing Section 404 coverage for the SMP will be available in the program document library available at <http://www.scwa.ca.gov>.

2.2.2 Section 401 - Water Quality Certification

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of dredged and fill materials into surface waters of the United States (including wetlands) must obtain a Water Quality Certification (or Section 401 Certification) to ensure that any such discharge will comply with the applicable provisions of the CWA, including sections 301, 302, 303, 306, and 307, and state water quality standards. The Water Quality Certification is issued by the state in which the discharge would originate; or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval, such as issuance of a CWA Section 404 permit) must also comply with CWA Section 401. The goal of CWA Section 401 is to allow for evaluation of water quality when considering activities associated with dredging or placement of fill materials into waters of the United States.

Permitting Agency and Related Regulations

In California, Water Quality Certifications are issued by the State Water Resources Control Board (SWRCB or State Board) and its nine Regional Water Quality Control Boards (Regional Boards or RWQCBs). Each Regional Board is responsible for implementing Section 401 in compliance with the CWA and with each Regional Board's respective water quality control plan (also known as a basin plan). Section 2.9 below provides more detail on the Porter-Cologne Water Quality Control Act, basin plans, and SWRCB regulatory requirements for projects occurring outside of waters of the U.S. It is the policy of the Regional Boards to provide public notice of pending Section 401 Certification actions in order to gather comments from concerned agencies and the public.

SMP Permitting Approach

The USEPA, San Francisco Bay RWQCB and the North Coast RWQCB have jurisdictional authority over CWA Section 401 in Sonoma County for waters of the U.S. Within the SMP area, the North Coast RWQCB (Region 1) has jurisdiction over watersheds draining towards the Pacific Ocean, including the Russian River watershed and the Mark West Creek, Santa Rosa Creek, and Laguna de Santa Rosa subwatersheds (SCWA Zone 1A). The San Francisco

Bay RWQCB (Region 2) has jurisdiction over the Petaluma River watershed (SCWA Zone 2A) and the Sonoma Creek watershed (SCWA Zone 3A). All maintenance activities conducted under the SMP within USACE jurisdiction (federal nexus) requires CWA Section 401 Certification from the appropriate RWQCB with jurisdiction over the project area.

SCWA worked with representatives from the North Coast and San Francisco Regional Boards to develop a compliance approach for CWA Section 401. The two Regional Boards each issued a water quality certification (one from each Regional Board) for SMP maintenance activities conducted in SCWA Zones 1A, 2A, and 3A. The certifications have a five year period of coverage. The certifications and program will be reviewed annually and after the initial five year period with the potential option of a five year renewal of the certifications.

Representatives from the two Regional Boards provided guidance and direction during the development of the SMP including participation at IAWG meetings, providing review and comment on the manual drafts, participating in multiple site visits, and reviewing and permitting several interim maintenance projects while the SMP was in development. In particular, stream channel and subwatershed assessments provided in Chapters 3 and 4 were designed and developed specifically to provide the Regional Boards with baseline reach characterizations, photos, and map references for the program area.

The certifications issued by the Regional Boards providing Section 401 coverage for the SMP will be available in the program document library available at: <http://www.scwa.ca.gov>.

2.2.3 Section 402

CWA Section 402 regulates discharges to surface waters (other than dredge or fill material) through the National Pollutant Discharge Elimination System (NPDES), administered by the USEPA. The NPDES program provides for both general permits (those that cover a number of similar or related activities) and individual permits for discharges to waters of the U.S.

Permitting Agency and Related Regulations

In California, the SWRCB and its nine RWQCBs are authorized by the USEPA to oversee the NPDES program (see the related discussion in Section 2.8 *Porter-Cologne Water Quality Control Act* below). General Permits are issued by the SWRCB and overseen by the RWQCBs. The SWRCB has issued general permits for discharges from construction, industrial, and municipal activities. Individual permits are issued by the RWQCBs.

Construction Permit

Construction-related stormwater discharges to waters of the United States are regulated under the SWRCB's General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit) (California State Water Resources Control Board 2001). Projects disturbing more than 1 acre of land during construction are required to file a notice of intent (NOI) with the RWQCB in which the activity would occur in order to be covered by the Construction General Permit before the onset of construction. Construction activities resulting in soil disturbances of less than one acre are also subject to the Construction General Permit if the construction activity is part of a larger common plan of development that encompasses one or more acres of soil disturbance, or if there is significant water quality impairment from the activity.

The Construction General Permit requires the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) that must be completed before construction begins. The SWPPP must include a site map and a description of proposed construction activities, along with a demonstration of compliance with relevant local ordinances and regulations and an overview of BMPs that will be implemented to prevent soil erosion and discharge of other construction-related pollutants that could contaminate nearby water resources. Permittees are further required to conduct annual monitoring and reporting to ensure that BMPs are correctly implemented and effective in controlling the discharge of stormwater-related pollutants.

Municipal Permits

As part of the NPDES, municipalities are required to maintain NPDES permits for their stormwater discharges. The municipalities, in turn, require that individual projects within their jurisdiction comply with the requirements of these permits.

Municipal stormwater NPDES permits have been issued by the RWQCBs in two phases, referred to as Phase 1 and Phase 2 permits. Phase 1 of the NPDES stormwater program provides NPDES permit coverage for large or medium municipalities with populations of 100,000 or more. Smaller (< 100,000 population) communities and public entities that own or operate a municipal separate storm sewer system (MS4) are covered under Phase 2 of the NPDES program. Phase 1 permits are individual NPDES permits, while Phase 2 permits are covered by a statewide general NPDES permit, discussed below; the requirements associated with Phase 1 are more stringent than those associated with Phase 2.

The *General Permit for the Discharge of Storm Water from Small Municipal Separate Storm Sewer Systems* WQO No. 2003-0005-DWQ (Small MS4 General Permit), issued by the SWRCB, requires that dischargers develop and implement a Storm Water Management Program (SWMP) that describes the best management practices (BMPs), measurable goals, and schedules of implementation, as well as assigns responsibility of each task. The Small MS4 General Permit requires all permittees to develop and implement a SWMP designed to reduce the discharge of pollutants through their MS4s to the Maximum Extent Practicable (MEP). The SWMP must be available for public review and must be approved by the appropriate RWQCB prior to permit coverage commencing. The General Permit requires the SWMP to be fully implemented by the end of the permit term.

Individual or Phase 1 Permit in the SMP Area

SCWA, Sonoma County, and the City of Santa Rosa are co-permittees under a municipal NPDES permit and waste discharge requirements for MS4 discharges from Sonoma County within the North Coast RWQCB's jurisdiction (Order No. R1-2008-0106, NPDES No. CA0025024, WDID No. 1B96074SSON to be renewed in December 2008). The co-permittees have developed a SWMP) and a Standard Urban Storm Water Mitigation Plan (SUSMP) to guide construction, post-construction, industrial, commercial, and storm system operation and management operations within the permit area. The SWMP identifies SCWA's stream maintenance activities and their implementation of BMPs. One of the goals identified in the SWMP is to continue support of SCWA's trash and debris clearing activities in flood control channels.

Small MS4 General Permit Coverage in the SMP Area

SCWA and Sonoma County are co-permittees for management of stormwater discharges from the urbanizing unincorporated areas surrounding the Cities of Sonoma and Petaluma. Compliance with conditions of the general permit is overseen by the San Francisco Bay RWQCB. A SWMP has been developed that is very similar to that described under the Phase 1 Permit above and the same SUSMP requirements as the Phase 1 Permit are used.

The following seven entities in the County have submitted documentation to the appropriate RWQCB and obtained coverage under the Small MS4 General Permit: City of Cotati, Healdsburg, Community of Eldridge, Petaluma, Rohnert Park, Sebastopol, Sonoma, and Windsor. In accordance with coverage under the General Permit, each community has developed its own SWMP. In most cases, the SWMPs do not contain detailed standards for stormwater quality control that are different from the requirements of state and federal regulations. However, many of the SWMPs stipulate that a post-construction program (similar to the SUSMP described above) is to be developed in the future, and all cities must develop ordinances related to erosion/sediment control and post-construction stormwater quality.

SMP Compliance Approach

SMP maintenance activities are closely linked with the municipal NPDES permits covering the program area. In many ways, implementation of the SWMPs and the SUSMP directly control the quantity and quality of storm water received in the channels maintained by SCWA. In turn, the SMP Manual functions to ensure compliance with NPDES permits through enhancement of riparian and in-channel features that are beneficial for filtration of storm runoff to improve water quality. Additionally, SMP maintenance activities would continue to include trash and debris clearing, as identified in the SWMP. Overall compliance with CWA Section 402 for the SMP, to the extent that it is necessary, will be achieved in combination with compliance with the Porter-Cologne Water Quality Control Act, described in Section 2.9 below.

2.2.4 Regulations for Use of Pesticides

NPDES General Permit

The Statewide General National Pollutant Discharge Elimination System Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (General Permit No. CAG 990005) was issued by the SWRCB in 2004. This NPDES General Permit covers application of the following substances for the specific purpose of controlling aquatic weed growth in surface waters: 2,4-D, acrolein, copper-based pesticides, diquat, endothall, fluridone, glyphosate, and triclopyr-based compounds. Coverage under this general permit is required for use of these pesticides directly in waters of the U.S.

Key requirements of the General Permit include the following.

- Compliance with the requirements of California Toxics Rule (40 CFR Part 131) and the state's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Water Resources Control Board 2005).
- Compliance with other applicable receiving water limitations and with effluent limitations.
- The permittee must be licensed by the California Department of Pesticide Regulation or work under the supervision of someone who is licensed if the aquatic pesticide is considered a restricted material.
- Preparation of, and adherence to, an Aquatic Pesticide Application Plan.
- Compliance with specific monitoring and reporting requirements of the permit.
- Adherence to all label instructions and terms of any applicable use permits.
- Maintenance of a Pesticide Application Log.
- Compliance with Public Notice Requirements.

To obtain coverage under this General Permit, a discharger must submit a completed NOI, a vicinity map, and the first annual fee to the appropriate Regional Water Quality Control Board. These items constitute a complete application package, the submittal of which authorizes the discharge of pollutants associated with the application of aquatic pesticides in compliance with the General Permit.

Stipulated Injunction Regarding Pesticides and the California Red-Legged Frog

On October 20, 2006, the Federal District Court for the Northern District of California issued a Stipulated Injunction regarding a lawsuit brought against USEPA by the Center for Biological Diversity. The Court agreed that the USEPA failed to comply with section 7(a)(2) of the federal Endangered Species Act (ESA) by not ensuring that its registration of 66 named pesticide active ingredients will not affect the California red-legged frog.

Terms of the Stipulated Injunction require the USEPA to make determinations on the potential effects of 66 named pesticides on California red-legged frog. The injunction also establishes buffer areas around certain habitats of the California red-legged frog, and disallows use of certain pesticides within those habitats and buffer zones. The injunction addresses pesticide use only in and within 400 feet of certain geographic areas designated by the USFWS as critical habitat, and specified non-critical habitat 'sections'. Sections are defined one-square mile areas of land, based on the Meridian-Township-Range-Section geographic system. The USFWS habitat areas identified in Sonoma County are shown in Figure 3-29.

The Injunction allows a reduced buffer for localized spot treatments using handheld devices on rights-of-way, roadsides, pastures, lawns, or in forests and individual tree removal using cut stump application. The Injunction prohibits use of listed pesticides within 60 feet of aquatic breeding or non-breeding aquatic critical habitat or within 60 feet of aquatic features within the non-critical habitat sections subject to the Injunction.

The Injunction does not apply to proposed pesticide use if all of the following conditions are met:

- the pesticide is applied for the purpose of controlling state-designated invasive species and noxious weeds under a program administered by a public entity; and
- the pesticide is not applied within 15 feet of aquatic breeding critical habitat or non-breeding aquatic critical habitat, or within 15 feet of aquatic features within non-critical habitat sections subject to the injunction; and
- application is limited to localized spot treatment using hand-held devices; and
- precipitation is not occurring or forecast to occur within 24 hours; and
- the pesticide is applied by a certified applicator or working under the direct supervision of a certified applicator; and
- if using 2,4-D or triclopyr, only the amine formulations are used.

Stipulated Injunction Regarding Pesticides and the Pacific Salmionids

A citizen suit was filed under the ESA against the USEPA by a group of environmental organizations (Washington Toxics Coalition, et al. v. EPA). In response, on January 22, 2004, the United States District Court for the Western District of Washington issued an order that establishes pesticide buffer zones. Buffer zones are areas adjacent to certain streams, rivers, lakes estuaries and other water bodies, in which the court ordered that certain pesticides not be used. Generally, the buffers established by the Court are 20 yards for ground application and 100 yards for aerial application, adjacent to certain "salmon-supporting waters" in Washington, Oregon and California. In Sonoma County, these buffers apply to all streams and rivers for the 36 listed pesticides.

The injunction included a reduced one-yard buffer for localized spot treatments using hand-held, ready-to-use devices, as long as the area treated is limited to 10 percent of the treated right-of-way, roadside, pasture, lawn or forestry site, individual tree removal using cut stump applications, and basal bark applications to individual plants.

If used to control state-designated noxious weeds as part of a program administered by a public entity, no buffer is required if:

- the application is overseen by a Certified Applicator and precipitation is not occurring or forecast to occur within 24 hours.
- if using 2,4-D or Triclopyr, only the amine formulations are used.

SMP Actions and Compliance Approach

SMP maintenance activities would involve the use of pesticides for weed control on access roads, on cut tree stumps, and for blackberry control. Application of pesticides on access roads in the SMP program area is carried out by Sonoma County under an agreement with SCWA. The agreement requires that Sonoma County complies with all application regulations, including the Federal Insecticide and Fungicide Act, and that all County pesticide applicators are certified by the state. Currently, Sonoma County applies AquaMaster®, which contains glyphosate as the active ingredient, to access roads along

SCWA-maintained channels. As part of tree removal activities within maintenance channels, AquaMaster® is applied primarily on cut willow stumps by hand, as shown in Figure 6-26. Approximately 5-10 gallons of AquaMaster® are applied per month during the dry season (June-October) throughout the SMP area. SCWA may apply AquaMaster® to control problematic blackberry patches. The herbicide would be applied with a backpack sprayer after initial mechanical removal. The SMP does not include application of pesticides directly to water bodies, such as for control of invasive ludwigia.

Coverage under the NPDES General Permit is not required because pesticides would not be applied directly to water under the SMP.

As described above, court-ordered buffers have been established to protect California red-legged frog habitat. In the SMP program area, these buffers would apply in the application of AquaMaster® to maintenance roads and cut tree stumps. Within the SMP area, there are sensitive habitat areas in the Santa Rosa Creek watershed (Zone 1A), northeast of the Matanzas Reservoir; one area in the Sonoma Creek watershed (Zone 3A), at the headwaters to Chaplin Creek; and numerous in Zones 8A and 9A. Though there are no SCWA-maintained channels within the sensitive areas identified in Zones 1A, 2A, or 3A where the majority of SMP maintenance activities would occur, SCWA may conduct herbicide application activities in Zones 8A or 9A. If so, the court-ordered buffers for use of AquaMaster® near sensitive habitat would apply.

Court-ordered buffers have also been established to protect salmonid habitat. However, AquaMaster®, the herbicide used by the County on maintenance roads and cut stumps, is not listed as a pesticide requiring buffering for salmonid habitat. If SCWA or the County decided to use one of the herbicides listed in the court injunction, the mandated buffers around streams and rivers in the SMP area would apply.

2.2.5 Section 303[d] - Impaired Water Bodies and Total Maximum Daily Loads

Under CWA Section 303[d], states are required to identify "impaired water bodies," (that do not meet established water quality standards), identify the pollutants causing the impairment, establish priority rankings for waters on the list, and develop a schedule for development of control plans to improve water quality. Following listing the USEPA then approves the state's recommended list of impaired waters. The USEPA can also remove or add water bodies to the list. The Section 303[d] List must be updated every two years by each Regional Board. Water bodies on the list have no further assimilative capacity for the identified pollutant, and the Section 303[d] List identifies priorities for development of pollution control plans for each listed water body and pollutant.

The pollution control plans triggered by the CWA Section 303[d] List are called Total Maximum Daily Loads (TMDLs). The TMDL is a "pollution budget" designed to restore the health of a polluted body of water. The TMDL process provides a quantitative assessment of water quality problems, pollutant sources, and pollutant load reductions or control actions needed to restore and protect the beneficial uses of the impaired water body. More specifically, a TMDL is defined as the sum of the individual waste load allocations for point sources, load allocations for non-point sources, and natural background sources such that the capacity of the water body to assimilate pollutant loading (the loading capacity) is not exceeded (40 CFR §130.2). In other words, a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, thus ensuring the protection of beneficial uses. This calculation also includes a margin of safety and consideration of seasonal variations. The TMDL also contains the target reductions needed to meet water quality standards and allocates those reductions among the pollutant sources in the watershed.

Permitting Agency and Related Regulations

CWA Section 303 is overseen by the USEPA and administered by the SWRCB and its nine RWQCBs. Once a TMDL is developed and approved by the RWQCB, SWRCB, and USEPA, the implementation plan (if included in the TMDL) can be enacted. The TMDL implementation plan includes pollution prevention, control, and restoration actions; responsible parties; and schedules necessary to attain water quality standards. The implementation plan also identifies enforceable measures (e.g. prohibition) and triggers for Regional Board action (e.g., performance standards). One method of TMDL enforcement utilized by the State and Regional Boards is to require responsible parties to comply with pollution control actions as part of permits issued under the NPDES Program (see the CWA Section 402 discussion). If a NPDES permit signatory, or third party covered under a signatory, is found to be out of compliance with the permit requirements, including TMDL compliance requirements, penalties may be assessed by the signatory (in the case of third party lapses) or by the state in a case where a signatory is out of compliance (as determined by USEPA). At the state level, once a TMDL is incorporated into the Regional Board's Basin Plan as an amendment, the California Porter-Cologne Water Quality Control Act authorizes the agency to issue Waste Discharge Requirements (WDRs) to responsible parties named in the TMDL. Discharge requirements, whether issued under CWA or Porter-Cologne authority, may include implementation of BMPs to meet performance standards.

SMP Compliance Approach

The current (i.e., enforceable) Section 303[d] List was approved by the USEPA in 2007 and is referred to as the 2006 Section 303[d] List. The Regional Boards are currently in the process of updating this list. The 2008 Section 303[d] List is anticipated for USEPA approval in 2009. Impaired water bodies in the SMP area included in the 2006 list are shown in Table 2-1.

The USEPA, San Francisco Bay RWQCB, and North Coast RWQCB are currently developing a number of TMDLs for impaired water bodies in Sonoma County. TMDLs that have been adopted and are under development by each agency are listed in Table 2-2. A TMDL to address pathogen impairment in Sonoma Creek was finalized and approved in 2008. A TMDL to address diazinon and pesticide-related toxicity in the Petaluma River was adopted in 2005. TMDLs addressing mercury and PCBs in San Pablo Bay were adopted in 2008. While not yet approved, sediment TMDLs are under development for the Russian River, Petaluma River, Sonoma Creek, and Santa Rosa Creek. In lieu of a TMDL for nutrient enrichment in the Laguna watershed, a Waste Reduction Strategy was developed in 1995. However, in 2002, the Laguna was relisted for impairments associated with nitrogen, phosphorus, and low dissolved oxygen. TMDLs for these and other listed impairments (2006 303[d] list) are currently in development.

The SMP Manual is being developed to protect the beneficial uses identified in the basin plan and especially those which are currently listed as impaired on the 303[d] list. A particularly sensitive area of beneficial use protection in the program area is reducing the amount of sediment currently entering the Laguna de Santa Rosa and larger Russian River system, as well as the Sonoma Creek watershed which is listed as impaired by sediment. The SMP helps reduce sediment loading (in support of CWA Section 303 requirements) in two fundamental ways: through repairing bank erosion sites and in-channel sediment removal activities. These activities are described in Chapter 6 *Maintenance Activities*. The SMP will also reduce sediment loading to the Laguna de Santa Rosa through its off-site watershed mitigation program. This program funds many erosion control and sediment source reduction activities in the upper watersheds of the program area. The work is led by local Resource Conservation Districts or other local agencies or nonprofit entities. Chapter 8 *Program Mitigation* describes the watershed program in more detail.

The SMP includes many BMPs to prevent release of pollutants, including those sequestered in channel sediments during and after maintenance activities. These BMPs will ensure that maintenance activities do not contribute to existing impairments within the program area. The practices and approaches developed for the SMP considered existing and forthcoming TMDLs. The SMP is anticipated to be consistent with any TMDL updates made during the permit term of the SMP.

RWQCB's Nutrient Offset Program with City of Santa Rosa

The North Coast Regional Water Quality Control Board (NCRWQCB) issued an NPDES permit (Order No. R1-2006-0045) to the City of Santa Rosa in 2006 which includes a requirement that "in the absence of a TMDL (in 2011), the final effluent limitation for nitrogen and phosphorus will be zero, or no net loading." Since TMDL completion is not expected prior to 2011, the NCRWQCB developed the Santa Rosa Nutrient Offset Policy (Resolution No. R1-2008-0061). This policy is provided in Appendix A. This policy describes a process for recognizing the City's nutrient reduction efforts and determining credit toward compliance with the 2011 zero net nutrient load requirement. SMP implementation jointly by SCWA and the City is intended to result in nutrient source control which qualifies for nutrient reduction credits under Nutrient Offset Policy.

In support of the nutrient offset program, the City of Santa Rosa (City) has partnered with SCWA to provide sediment disposal opportunities for the SMP. The disposal of SMP sediments at suitable City sites will provide important nutrient offset benefits through reducing the volume of organic nutrients reaching the Laguna de Santa Rosa. Additional description of potential City sediment disposal sites is provided in Chapter 5, Section 5.6.4 *City of Santa Rosa Sediment Disposal Opportunities*.

2.3 Federal Endangered Species Act

The ESA was enacted in 1973 to protect plant and wildlife species determined by USFWS or NMFS to be at risk of extinction. Species are protected through listing under the ESA as either *threatened* or *endangered*. An *endangered* species is at risk of extinction throughout all or a significant portion of its range (ESA Section 3[6]). A *threatened* species is likely to become endangered within the foreseeable future (ESA Section 3[19]). Species protected under the ESA are often referred to as "federally listed."

Table 2-3 lists special status plants, fish, and wildlife that are recognized by federal and state agencies as threatened, endangered, or species of concern and are known to occur or may occur within SCWA-maintained channels.

ESA Section 9 prohibits the take of any fish or wildlife species listed under the ESA as endangered. Take of threatened species is also prohibited under ESA Section 9 unless otherwise authorized by federal regulations.[4] *Take*, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Harm* is defined as "any act that kills or injures the species, including significant habitat modification." In addition, ESA Section 9 prohibits the "removal or reduction to possession" of any listed plant species "under federal jurisdiction" (i.e., on federal land, where federal funding is provided, or where federal authorization is required).

The ESA includes three mechanisms that provide exceptions to the ESA Section 9 take prohibitions: ESA Section 7 consultation, ESA Section 10, and issuing ESA Section 4(d) rules. ESA Section 7 consultation allows for take coverage of federal actions. This will be the mechanism by which incidental take coverage is obtained for implementation of SMP activities and is discussed in greater detail below. For activities conducted outside of federal jurisdiction, ESA Section 10(a)(1)(A) provides scientific (research and monitoring) and enhancement of survival permits, and ESA Section 10(a)(1)(B) provides incidental take permits. ESA Section 10(a)(2)(A) requires that before the regulating agency can grant an ESA 10(a)(1)(B) permit for incidental take, the applicant must submit a conservation plan. Because the Agency anticipates obtaining incidental take authorization through Section 7 of the ESA, it does not anticipate the need to develop a habitat conservation plan for the SMP. Therefore, ESA Section 10 is not discussed in additional detail in this SMP Manual. ESA Section 4(d) allows the Secretary (Commerce and/or the Interior) to define rules that place limits on the take prohibitions identified in Section 9 (a)(1)(B) and 9(a)(1)(C) of the ESA for species federally listed as "threatened." This is a flexible option as these limits can be developed and approved on a program wide scale, however, since this mechanism is only available for federally threatened species (and several of the special-status species potentially occurring in the Program Area are federally listed as "endangered"), and would not provide systemic take coverage for all the federally listed species potentially affected by channel maintenance activities, it is not discussed further.

2.3.1 Section 7 - ESA Authorization for Federal Actions

ESA Section 7 provides a means for authorizing take of threatened and endangered species by federal agencies under certain circumstances. It applies to actions that are conducted, permitted, or funded by a federal agency. Under ESA Section 7, the federal agency conducting, funding, or permitting an action (the lead agency) must consult with USFWS or NMFS, as appropriate, to ensure that the proposed action will not jeopardize endangered or

[4] In some cases, exceptions may be made for threatened species under ESA Section 4[d]; in such cases, the USFWS or NMFS issues a "4[d] rule" describing protections for the threatened species and specifying the circumstances under which take is allowed.

Table 2-1: 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments in Sonoma County

RWQCB	Watershed	Subbasin	Pollutant	Potential Sources
North Coast (Region 1)	Gualala River		Temperature	Removal of riparian vegetation, streambank modification/ destabilization, channel erosion, erosion/siltation, nonpoint sources
	Russian River		Sedimentation/ Siltation (entire watershed)	Silviculture, construction/land development, disturbed sites, dam construction, flow regulation/ modification, erosion/siltation
			Temperature (entire watershed)	Hydromodification, flow regulation/ modification, habitat modification, removal of riparian vegetation, nonpoint sources
		Guerneville	Pathogens pH	Nonpoint/point source Source unknown
		Big Sulphur Creek	Specific Conductivity	Source unknown
		Laguna de Santa Rosa	Low Dissolved Oxygen, Mercury, Nitrogen, Phosphorus	Internal nutrient cycling, nonpoint source, point source, source unknown
		Santa Rosa Creek	Pathogens	Nonpoint source, point source
		Lake Sonoma	Mercury	Resource extraction, nonpoint source
San Francisco Bay (Region 2)	Petaluma River		Diazinon, Nickel, Nutrients, Pathogens, Sedimentation/ siltation	Agricultural, construction/land development, urban runoff/storm sewers
	Sonoma Creek		Nutrients, Pathogens, Sedimentation/ siltation	Agriculture, construction/land development, land development, urban runoff/storm sewers

Source: SWRCB (2006)

Table 2-2: Status of TMDLs in the SMP Area

Region	Water Body	Impairment	TMDL Status
1	Laguna de Santa Rosa	Nitrogen Phosphorus Low Dissolved Oxygen	In lieu of a TMDL for nutrient enrichment in the Laguna watershed, a Waste Reduction Strategy was developed in 1995. However, in 2002, the Laguna was relisted for impairments associated with nitrogen, phosphorus, and low dissolved oxygen. TMDLs for these and other listed impairments (2006 303d list) are currently in development.
1	Russian River	Sediment Temperature	The Russian River watershed TMDLs for sediment and temperature impairment are scheduled to begin in 2010.
	- Fifes Creek to Dutch Bill Creek - upstream of Healdsburg Memorial Beach to the Highway 101 crossing	Pathogens	Pathogen TMDLs for the two impaired segments of the Russian River are currently in development.
2	Sonoma Creek	Pathogens	A TMDL and implementation plan for pathogens in the Sonoma Creek watershed was completed in June 2006 and approved by USEPA on February 29, 2008.
		Sediment Nutrients	TMDLs for sediment and nutrient impairment are currently in development.
2	San Francisco Bay - Petaluma River	Diazinon	San Francisco Bay Area urban creeks, including the Petaluma River, exceed water quality standards for aquatic toxicity, primarily due to runoff of the common insecticide diazinon. In order to address this water quality issue, the Diazinon and Pesticide-Related Toxicity in San Francisco Bay Area Urban Creeks TMDL and supporting documents, was developed and adopted in 2005.
	- San Pablo Bay	Mercury	The San Francisco Bay Mercury TMDL was completed to examine this water quality problem and identifies sources of mercury. On February 12, 2008, the USEPA approved a Basin Plan amendment incorporating a TMDL for mercury in San Francisco Bay and an implementation plan to achieve the TMDL.
	- San Pablo Bay	PCBs	A TMDL and associated implementation plan addressing the PCB issue within the San Francisco Bay was completed, and adopted by the Regional Water Board in 2008. The PCB TMDL amendment is still awaiting approval by the SWRCB, the state Office of Administrative Law, and U.S. EPA before it can be fully incorporated into the Bay Plan.

Table 2-3. Special-Status Species with the Potential to Occur in SCWA-Maintained Channels Page 1 of 2

Species	Scientific Name	Status* State/CNPS	Status* Federal
Invertebrates			
California freshwater shrimp	*Syncaris pacifica*	SE	FE
Fish			
Central California Coastal Chinook	*Oncorhynchus tshawytscha*	—	FT
Central California Coast Coho	*Oncorhynchus kisutch*	SE	FE
Central California Coast steelhead	*Oncorhynchus mykiss*	—	FT
Russian River tule perch	*Hysterocarpus traskii pomo*	CSC	—
Pacific lamprey	*Lampetra tridentata*	--	SC
River lamprey	*Lampetra ayresi*	WL	SC
Hardhead	*Mylopharodon conocephalus*	WL	—
Amphibians and Reptiles			
California tiger salamander	*Ambystoma californiense*	CSC	FE
California red-legged frog	*Rana draytonii*	CSC	FT
Foothill yellow-legged frog	*Rana boylii*	CSC	—
Western pond turtle	*Actinemys marmorata*	CSC	—
Plants			
Baker's navarretia	*Navarretia leucocephala* ssp. *bakeri*	1B.1	—
Burke's goldfields	*Lasthenia burkei*	SE/1B.1	FE
California beaked-rush	*Rhynchospora californica*	1B.1	—
Contra Costa goldfields	*Lasthenia conjugens*	1B.1	FE
Deceiving sedge	*Carex saliniformis*	1B.2	—
Dwarf downingia	*Downingia pusilla*	2.2	—

Table 2-3. cont. Page 2 of 2

Species	Scientific Name	Status*	
		State/CNPS	Federal
Hoover's semaphore grass	*Pleuropogon hooverianus*	ST/1B.1	—
Legenere	*Legenere limosa*	1B.1	—
Many-flowered navarretia	*Navarretia leucocephala* ssp. *plieantha*	SE/1B.1	FE
Sebastopol meadowfoam	*Limnanthes vinculans*	SE/1B.1	FE
Sonoma alopecurus	*Alopecurus aequalis* var. *sonomensis*	1B.1	FE
Sonoma sunshine	*Blennosperma bakeri*	SE/1B.1	FE
Sonoma white sedge	*Carex albida*	SE/1B.1	FE
Swamp harebell	*Campanula californica*	1B.2	—
Saline clover	*Trifolium depauperatum* var. *hydrophilum*	1B.2	—

* Status Definitions

Federal

FE Federally Endangered
FT Federally Threatened
SC Federal Species of Concern

State

SE State Listed as Endangered
ST State Listed as Threatened
CSC California Species of Special Concern
WL Watch List

California Native Plant Society

1B Rare, Threatened, or Endangered in California and Elsewhere
2 Rare, Threatened, or Endangered in California, but more Common Elsewhere
0.1 Seriously Endangered in California
0.2 Fairly Endangered in California

threatened species or destroy or adversely modify designated critical habitat[5]. If a proposed project "may affect" a listed species or designated critical habitat, the lead agency is required to prepare a biological assessment (BA) evaluating the nature and severity of the expected effect. In response, USFWS or NMFS issues a biological opinion (BO), with a determination that the proposed action either:

- may jeopardize the continued existence of 1 or more listed species (*jeopardy finding*) or result in the destruction or adverse modification of critical habitat (*adverse modification finding*), or
- will not jeopardize the continued existence of any listed species (*no jeopardy finding*) or result in adverse modification of critical habitat (*no adverse modification finding*).

The BO[6] issued by USFWS or NMFS may stipulate "reasonable and prudent" conservation measures. If the project would not jeopardize a listed species, USFWS or NMFS issues an incidental take statement to authorize the proposed activity.

Permitting Agency and Related Regulations

The ESA is administered by the USFWS and NMFS. In general, NMFS is responsible for protection of ESA-listed marine species and anadromous fishes while other listed species are protected under USFWS jurisdiction. As described above, USFWS and/or NMFS are engaged in the consultation process by the lead federal agency, often the USACE, and release of a final BO represents the conclusion of the consultation.

In Sonoma County, Region 8 (California, Nevada, and Klamath Basin) of the USFWS and the NMFS Southwest Regional Office are responsible for take authorizations under the ESA. These agencies evaluate proposed actions, review BAs, and issue BOs in support of federal permitting activities.

In the program area, USFWS and NMFS have developed the Santa Rosa Plain Conservation Strategy (SRPCS) (2005a) and the Russian River Watershed BO for water supply, flood control, and channel maintenance activities (2008), respectively, to provide protection and management of certain listed species in these areas. These documents were considered in development of the SMP Manual and the program's Section 7 compliance approach, and are described below.

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[5] Critical Habitat is defined as specific geographic areas, whether occupied by listed species or not, that are determined to be essential for the conservation and management of listed species, and that have been formally described in the Federal Register.

[6] The SMP Manual has been developed to address resource issues governed by a variety of laws and regulations. In an attempt to standardize language in the SMP, there are situations when specific terms are appropriate for one resource agency working under one set of laws or regulations, but not for others. A case in point is the use of the terms "impact" and "mitigation" in the SMP. These are the terms most commonly used by the RWQCB, DFG, and the Corps, but not within Section 7 of the ESA. As such, please note that within the context of the ESA the term "impact" will refer to "affect" or "effect" and the term "mitigation" will refer to "compensation".

Santa Rosa Plain Conservation Strategy

The SRPCS was developed in 2005 by the Santa Rosa Conservation Strategy Team (Team) to provide a long-term conservation program sufficient to mitigate potential adverse effects on four federally listed species due to future development on the Santa Rosa Plain. The 2005 conservation strategy supersedes earlier planning efforts and a previous BO for select species in the region from 1998. The SPRCS study boundary extends from just north of Windsor to just south of Cotati. The study area includes the general area of the Santa Rosa Plain (see Figure 2-1). This study area includes a large portion of the Laguna de Santa Rosa Watershed, within Zone 1A of the SMP program area.

Members of the Team included the U.S. Forest Service, CDFG, USACE, USEPA, NCRWQCB, local governments, the Laguna de Santa Rosa Foundation, as well as the environmental and private landowner communities. The conservation strategy focuses on the distinct population segments of the California tiger salamander (*Ambystoma californiense*), Burke's goldfield (*Lasthenia burkei)*, Sonoma sunshine (*Blennosperma bakeri)*, Sebastopol meadowfoam (*Limnanthes vinculans),* and the many-flowered navarretia (*Navarretia leucocephala ssp. plieantha*) in Sonoma County. Due to the presence of the SRPCS, USFWS has not proposed critical habitat for any of these federally listed species within the SRPCS area.

According to the USFWS webpage (http://www.fws.gov/sacramento/es/santa_rosa_conservation.html, accessed on 8/25/08), the key components of the SRPCS are:

- Establishing preserves in the conservation area including wetland restoration and creation activities;
- Translocating listed species to suitable habitat within the Plain;
- Improving habitat through wetland creation, restoration, and enhancement of wetland and upland habitat;
- Developing preserve management plans to guide the conservation activities;
- Employing adaptive management; and
- Providing mitigation guidance for CTS, the listed plant species and seasonal wetlands, including vernal pools, in the conservation strategy.

Interim mitigation ratios provided by the SRPCS are being implemented by local jurisdictions and the implementation of the SRPCS as a whole is being carried out by USFWS and the CDFG through a programmatic BO prepared by USFWS in 2007 (National Marine Fisheries Service 2008). This BO provides incidental take coverage for activities covered under the SRPCS. Full implementation by all of the signatories will be complete once the local jurisdictions have amended their respective ordinances to reflect the vision of the SRCSP and funded the associated CEQA compliance for the new ordinances.

The SRPCS and the associated BO focus on new development and capital projects and do not explicitly cover operations and maintenance activities such as those in the SMP. The SMP activities could result in limited temporal impacts to the species covered under the SRPCS, but will not result in permanent impacts to, or significant levels of, take of federally listed species. Nonetheless, California tiger salamander and the listed plant species in the SRPCS may potentially be found in SCWA-maintained channels or V-ditches. The SRPCS provides guidance on evaluating potential impacts to these species as well as development of avoidance measures and appropriate mitigation ratios. The SRPCS guidance was incorporated into the SMP's mitigation approach as described in Chapter 8 *Program Mitigation*. The SRPCS guidance was also incorporated into the BAs developed to support additional Section 7 compliance for the SMP programmatic permits (described below).

Russian River Watershed Biological Opinion

NMFS consulted with the USACE regarding its operations of the Warm Springs Dam and Coyote Valley Dam and a suite of activities that are authorized by the USACE and undertaken by SCWA and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD). The USACE, SCWA, and MCRRFCD proposed to implement 15 years of ongoing practices and operations related to dam operations, flood control, water supply, water diversion and storage, regulation of flows on the Russian River and Dry Creek, estuary management, hydroelectric power generation, fish hatchery production, and channel maintenance in the Russian River watershed.

A BO was issued September 24, 2008 relating the proposed program activities and their effects on listed salmonid species (including California Central Coast steelhead, Chinook salmon, and coho salmon) and their habitats in the Russian River watershed. The BO summarized the consultation process and provided the following information: environmental baseline of the program area; environmental effects of the proposed actions; potential effects of the proposed actions on critical habitat and species; conclusions on the environmental effects of the program; reasonable and prudent alternatives; and an Incidental Take Statement.

The Russian River BO provides coverage for maintenance activities in tributary watersheds to the Russian River including SCWA Zone 1A. The consultation and BO provide ESA compliance and coverage for impacts on listed salmonids resulting from SMP activities in Zone 1A. Key actions, impact avoidance and minimization measures, and terms and conditions resulting from the BO were incorporated into the SMP. The implementation of the SMP will be consistent with the findings and provisions of the BO. For further detail the reader is recommended to review the entire contents of the BO document at <http://www.sonomacountywater.org/projects/documents/Signed-RussianRiverFinalBO9-24-08.pdf>.

It is useful to note that the 2008 BO was developed over several years with much of the information describing maintenance activities being developed prior to the development of the SMP. While there is general agreement between the description of maintenance activities in the BO and in this SMP Manual, the description of activities in this manual is more current and extensive.

Key provisions for the amount or extent of take provided by the Incidental Take Statement are summarized in Table 2-4. This table includes the authorized amount of disturbed habitat to be maintained according to linear feet of creek length and the frequency of maintenance of the 15 year BO period. Reasonable and Prudent Measure 5 from the

Incidental Take Statement of the BO provides guidance on measures to reduce harm and mortality to listed salmonids from channel maintenance activities (including activities in Zone 1A). These measures are relevant to the SMP and were incorporated directly into the impact avoidance measures and BMPs of Table 7-1.

SMP Permitting Approach

In accordance with issuance of CWA Section 404 permits by the USACE for SMP activities, ESA Section 7 consultations with the USFWS and NMFS are required. As described above, the USFWS' SRPCS will not cover SMP activities in the Santa Rosa Plain area, but does currently provide guidance and approaches to avoid and minimize impacts to listed species. Thus, a BA was prepared to address the entire SMP area and all listed species and designated critical habitat under jurisdiction of the USFWS (Table 2-3). This BA includes the guidance and approaches recommended in the SRPCS that are relevant for SMP activities. After review, the USFWS will then issue a BO for SMP actions.

In terms of salmonids, the SMP activities and this manual were reviewed and updated carefully to comply with the terms and conditions of the Russian River Watershed BO issued by NMFS (September 24, 2008). As described above, this BO only covers SMP activities in Zone 1A. To support USACE consultation and permitting for all SMP activities, a BO for activities conducted in areas outside of Zone 1A (outside of the Russian River watershed) will be issued from NMFS. This BO will address the potential for incidental take of California Central Coast steelhead, Chinook salmon, and coho salmon in the Petaluma (Zone 2A) and Sonoma River (Zone 3A) watersheds.

In summary, three BOs (one from USFWS for the entire SMP program area, the NMFS Russian River BO for salmonids in Zone 1A, and one from NMFS for salmonids in Zones 2A/3A) will provide Section 7 ESA compliance for the SMP.

2.4 Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a national program to manage and conserve the fisheries of the United States through the development of Federal Fishery Management Plans (FMPs), and the Federal regulation of domestic fisheries under those FMPs, within the 200-mile U.S. Exclusive Economic Zone (16 USC §1801 *et seq*). To ensure habitat considerations receive increased attention for the conservation and management of fishery resources, the amended Magnuson-Stevens Act required each existing, and any new, FMP to "describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 1855(b)(1)(A) of this title, minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat." (16 USC §1853(a)(7)). Essential Fish Habitat (EFH) is defined in the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC §1802(10)). The components of this definition are interpreted at 50 CFR §600.10 as follows: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological

Table 2-4: Terms and Conditions for Maintenance Activities in Zone 1A

Creek	Maintenance Type	Area of Maintenance (feet)	Frequency/per 15 years
Mark West Creek and Tributaries	No coverage		
Laguna de Santa Rosa	Sediment Removal	2,400	3 times between 2008-2023
	Vegetation Removal	12,000	Annually
Copeland Creek	Sediment Removal	3,270	6 times between 2008-2023
	Vegetation Removal	9,625	Annually
Santa Rosa Creek	Sediment Removal	4,000	3 times between 2008-2023
	Vegetation Removal	12,100	Annually
Windsor Creek	Sediment Removal	500	2 times between 2008-2023
	Vegetation Removal	3,000	Annually

Source: NMFS 2008.

communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Pursuant to the Magnuson-Stevens Act, each Federal agency is mandated to consult with NOAA's NMFS with respect to any action authorized, funded, or undertaken, or proposed to be, by such agency that may adversely affect any EFH under this Act (16 USC §1855(b)(2)). Further, where NMFS receives information from a Fishery Management Council, or Federal or state agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be, by any Federal or state agency would adversely affect any EFH identified under this Act, NMFS has an obligation to recommend to such agency measures that can be taken to conserve EFH.

2.4.1 Permitting Agency and Related Regulations

The Magnuson-Stevens Act is administered by NMFS. As part of the CWA Section 404 permitting process, the USACE will initiate consultation with NMFS regarding the SMP and its potential effects on marine resources. The SMP Area occurs within EFH for various fish species federally managed under FMPs.

2.4.2 SMP Compliance Approach

Potential adverse effects to EFH due to SMP activities conducted in the Russian River watershed (Zone 1A) were evaluated by NMFS as part of the Russian River BO. To avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH, NMFS provided seven EFH conservation recommendations (Page 364 of NMFS 2008) to protect EFH within the Russian River estuary, modify flood control operations to improve salmonid habitat, and implement restoration projects within the watershed.

The USACE has initiated consultation with NMFS regarding potential adverse effects of SMP activities on EFH within the Petaluma River and Sonoma Creek watersheds (Zones 2A and 3A, respectively) through the CWA Section 404 permitting process. Issuance of a BO from NMFS is anticipated by the end of 2009.

2.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 USC 703-712), administered by the U.S. Fish and Wildlife Service, implements four treaties between the United States and Canada, Mexico, Japan and Russia, respectively, to manage and conserve migratory birds that cross national borders. The MBTA makes it unlawful in any manner, unless expressly authorized by permit pursuant to federal regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export at any time, or in any manner, any migratory bird, or any part, nest, or egg of any such bird. The definition of "take" is defined as any act to "pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture or collect." This includes most actions, direct and indirect, that could result in "take" or possession, whether it is temporary or permanent, of any protected species. Although harassment and habitat modification do not constitute a take in themselves under the MBTA or the California Fish and Game Code, such actions that result in direct loss of birds, nests or eggs including nest abandonment or failure are considered take under such regulations. A list of migratory birds protected under the MBTA, available in Section 10.13 of Title 50 of the Code of Federal Regulation, excludes nonnative species that have not been introduced into the U.S. or its territories, and species that belong to the families not listed in any of the four treaties underlying the MBTA, such as wrentit (*Chamaea fasciata*), European starling (*Sturnus vulgaris*), California quail (*Callipepla californica*), Ring-necked Pheasant (*Phasianus colchicus*) and Chukar (*Alectoris chukar),* among other species less common in California.

On December 8, 2004 the U.S. Congress passed the Migratory Bird Treaty Reform Act (Division E, Title I, Section 143 of the Consolidated Appropriations Act, 2005, PL 108–447; MBTRA), which excludes all migratory birds that are nonnative or have been human introduced to the U.S. or its territories. It defines a native migratory bird as a species present within the U.S. and its territories as a result of natural biological or ecological processes. The USFWS published a list of the bird species excluded from the MBTA on March 15, 2005 (70 FR 12710), which included two species commonly observed in the U.S., the rock pigeon (*Columba livia*) and domestic goose (*Anser anser 'domesticus'*).

2.5.1 Permitting Agency and Related Regulations

The MBTA is administered by the USFWS. USFWS sets seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703, 50 CFR 21, 50 CFR 10). Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of the MBTA. Compliance with the MBTA is determined as part of USFWS's issuance of biological opinions.

2.5.2 SMP Compliance Approach

SMP activities, such as vegetation management, may require the removal of trees or snags where migratory birds are nesting. Compliance with this regulation is met through the implementation of bird habitat avoidance measures and BMPs during program activities so that take of migratory birds is avoided. These measures are discussed in Chapter 7.

2.6 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires federal agencies (or agencies to which they provide funding or issue permits) to take into account the effects of their actions on cultural resources, including historic properties and historic and prehistoric archaeological sites. In addition, NHPA Section 106 requires lead agencies to:

- provide review and comment opportunities on actions that may affect cultural resources to the Advisory Council on Historic Preservation (an independent federal agency responsible for advising the president and Congress on historic preservation), and to

- coordinate with the State Historic Preservation Officer (SHPO) in the state where the proposed action will take place.

Federal review of projects is normally referred to as the Section 106 process. The Section 106 review process normally involves the following four-step procedure described in detail in the implementing regulations (36 CFR Part 800):

- identify and evaluate historic properties in consultation with the SHPO and interested parties;
- assess the effects of the undertaking on properties that are eligible for inclusion in the NRHP;
- consult with the SHPO, other agencies, and interested parties to develop an agreement that addresses the treatment of historic properties and notify the Advisory Council on Historic Preservation; and
- proceed with the project according to the conditions of the agreement.

2.6.1 Permitting Agency and Related Regulations

The SHPO has jurisdictional authority over NHPA Section 106 in California. Any federal action, such as issuance of project permits, must gain approval by the SHPO for compliance with NHPA Section 106. Compliance with NHPA Section 106 may be met through the development of a Programmatic Agreement, a Memorandum of Agreement, or a project-by-project evaluation. Compliance under each pathway generally involves completion of a cultural resources inventory, evaluation of resources, and implementation of avoidance and mitigation measures for projects that may have an impact on cultural resources.

2.6.2 SMP Compliance Approach

All earth-moving activities, such as bank stabilization and sediment removal projects, conducted under the SMP within USACE jurisdiction (federal nexus) requires compliance with NHPA Section 106. As such, the Agency submitted a report documenting cultural resources, including historic properties and historic and prehistoric archaeological sites, in the SMP area to the USACE for use in consulting with the SHPO.

Compliance with the NHPA Section 106 will be met through the implementation of avoidance measures and BMPs during implementation of SMP activities so that harm to cultural resources is avoided.

2.7 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to include in their decision-making process appropriate and careful consideration of all environmental effects of a proposed action and of possible alternatives. Documentation of the environmental impact analysis and efforts to avoid or minimize the adverse effects of proposed actions must be made available for public notice and review. This analysis is documented in either an environmental assessment (EA) or an environmental impact statement (EIS). Project proponents must disclose in these documents whether their proposed action will adversely affect the human or natural environment. NEPA's requirements are primarily procedural rather than substantive in that NEPA requires disclosure of environmental effects and mitigation possibilities but includes no requirement to mitigate.

2.7.1 Lead Agency

The issuance by the USACE of a CWA Section 404 individual permit constitutes a federal action. Therefore, the USACE must comply with NEPA. The USACE would be the lead agency undertaking NEPA compliance. The USACE may conduct NEPA compliance under its own purview, or it may utilize an environmental assessment or environmental impact statement provided in draft form by the entity requesting the permit.

2.7.2 SMP Compliance Approach

Because individual permits were developed as part of programmatic permitting of the SMP, NEPA compliance was required as part of the federal action of the USACE. NEPA compliance was led by the USACE and met the environmental compliance requirements for permitting actions conducted by all federal agencies granting permits for the SMP. The project description was the same for all issued permits (i.e., separate NEPA documents were not required to address USACE, USFWS or NMFS permits). The SMP Manual provided the basis for developing the project description for NEPA compliance.

2.8 Federal Regulation of Floodplains

Congress passed the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 to manage costs and improve precautions for emergency flooding and disaster relief. The intent of these acts was to reduce the need for large, publicly funded flood control structures and disaster relief by restricting development on floodplains.

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP) to provide subsidized flood insurance to communities that comply with FEMA regulations limiting development in floodplains. A key requirement is the adoption of a local floodplain management ordinance restricting development within the mapped floodplain. FEMA issues flood insurance rate maps (FIRMs) for communities participating in the NFIP. These maps delineate flood hazard zones in the community. The locations of FEMA-designated floodplains in the SMP area are illustrated in Figure 3-16.

Levee standards are often included in building design requirements. Areas of concern often include embankment protection, embankment and foundation stability, settlement, and maintenance plans and criteria.

Executive Order 11988 (Floodplain Management) addresses floodplain issues related to public safety, conservation, and economics. It generally requires federal agencies constructing, funding, or permitting projects in a floodplain to:

- Avoid incompatible floodplain development,
- Be consistent with the standards and criteria of the NFIP, and

- Restore and preserve natural and beneficial floodplain values.

2.8.1 Permitting Agency and Related Regulations

In Sonoma County, assistance for FEMA compliance is provided by the County's Community Development Department. The County administers a Flood Elevation Mitigation Program to assist property owners in avoiding hazardous conditions in areas subject to flooding. The County's program provides grant funding to property owners and coordinates with FEMA.

2.8.2 SMP Relevance

The primary objective of the maintenance activities of the SMP is to reduce the potential for flooding associated with the channels that SCWA has maintenance authority for. The cumulative result of the sediment removal, bank stabilization, vegetation management, and other activities described in this manual is to lessen the flood hazard.

2.9 Porter-Cologne Water Quality Control Act

The California Porter-Cologne Water Quality Control Act (Porter-Cologne Act) was passed in 1969 and together with the federal CWA, provides regulatory guidance to protect water quality and water resources. The Porter-Cologne Act established the SWRCB and divided California into nine regions, each overseen by a RWQCB. The Porter-Cologne Act established regulatory authority over "waters of the state," which are defined as "any surface water or groundwater, including saline waters, within the boundaries of the state" (California Water Code, Division 7, § 13050). More specifically, the SWRCB and its nine RWQCBs have jurisdiction over the bed and banks of a stream channel, its riparian corridor, and its beneficial uses.

The Porter-Cologne Act also assigns responsibility for implementing CWA Sections 303, 401, and 402 to the SWRCB and RWQCBs. Under Section 303, the RWQCBs, in conjunction with USEPA, are responsible for developing and implementing TMDLs to address water quality impairments.

The Porter-Cologne Act requires the development and periodic review of water quality control plans (Basin Plans) for the protection of water quality in each of the state's nine regions. A Basin Plan is unique to each region and must identify beneficial uses, establish water quality objectives for the reasonable protection of the beneficial uses, and establish a program of implementation for achieving the water quality objectives. To ensure currency, Basin Plans must be updated every 3 years. The Basin Plans must also comply with Section 303 of the federal CWA, which requires states to establish their own water quality standards. Basin Plans provide the technical basis for the RWQCBs to determine waste discharge requirements (WDRs), take enforcement actions, and evaluate grant proposals.

As described above in the discussion of CWA Section 401, regulatory compliance for projects occurring within waters of the U.S. is met through a Water Quality Certification granted by the RWQCBs. For projects occurring within Porter-Cologne Act jurisdiction (i.e., State jurisdiction) but outside of waters of the U.S. (in streams this is the area above the OHWM, or "isolated" waters such as wetlands), WDRs or Waiver of WDRs are required.

WDRs are issued by the RWQCB that has jurisdiction over the region in which the project occurs.

2.9.1 Permitting Agency and Related Regulations

The SWRCB is the primary state agency responsible for protecting the quality of the state's surface and groundwater supplies, but much of its daily implementation authority is delegated to the nine RWQCBs. In general, the SWRCB manages water rights and regulates statewide water quality, while the RWQCBs focus on water quality within their respective regions. For projects that cross more than one region, the SWRCB is responsible for overseeing water quality protection.

As discussed above, each Regional Board is required to develop a Basin Plan to guide management and protection of resources. However, each region may also develop and implement its own policies beyond what is required by the state. Currently, the North Coast RWQCB and San Francisco Bay RWQCB are developing a Stream and Wetlands System Protection Policy to enhance protection of streams and wetlands within their respective regions. This new policy will amended to each region's basin plan. A discussion of this amendment is provided below.

Additionally, in compliance with CWA Section 303, the RWQCBs identify water bodies whose beneficial uses are impaired by pollutants and develop TMDLs to restore those beneficial uses. This process is described above under CWA Section 303.

Stream and Wetlands System Protection Policy

Since October 2005, the North Coast RWQCB and San Francisco RWQCB have been developing draft Basin Plan amendments to protect stream and wetlands systems, including stream channels, wetlands, floodplains, and riparian areas. These proposed amendments are anticipated to be adopted during the permit term of the SMP. The proposed policy is very relevant to the SMP and therefore is described in detail below.

The goals of the proposed Stream and Wetlands System Protection Policy (Stream Policy) are as follows.

- To achieve water quality standards and protect beneficial uses of waters of the state;
- To protect drinking water through natural water quality enhancement and protection of groundwater recharge zones;
- To restore habitat and protect aquatic species and wildlife;
- To enhance flood protection through natural functions of stream and wetlands systems;
- To restore the associated recreational opportunities, green spaces and neighborhood amenities that water resources provide;
- To protect property values and community welfare by protecting natural environments;

- To encourage local watershed planning and support local oversight of water resources; and
- To improve Regional Water Board permitting and program efficiency.

This new policy recognizes the need to protect and restore the physical characteristics of stream and wetland systems in order to achieve water quality standards and protections of beneficial uses identified in each basin plan. This policy will be based on sound scientific principles and will guide the use of reasonable methods to protect water quality. The policy will promote regulatory efficiency by linking existing programs, including CWA Section 401 water quality certifications, timber harvesting plans, WDRs, WDR waivers, and urban runoff NPDES permits. The policy will also provide incentives for local jurisdictions to develop watershed management plans that can be used by project applicants to offset impacts to stream and wetlands functions when on-site avoidance of impacts is impossible. The Stream and Wetlands System Protection Policy and associated Basin Plan Amendments will be proposed for adoption in both the North Coast and San Francisco RWQCB Basin Plans to improve regulatory consistency.

For the San Francisco RWQCB, the policy proposes adoption of two new beneficial uses to their Basin Plan: Flood Peak Attenuation/Flood Water Storage (FLD) and Water Quality Enhancement (WQE). In 2003, the North Coast RWQCB adopted three new beneficial uses to their Basin Plan including Flood Peak Attenuation/Flood Water Storage (FLD), Water Quality Enhancement (WQE), and Wetland Habitat (WET). However, the RWQCB did not adopt water quality objectives or an implementation plan to protect them. As a result, new water quality objectives are being developed for potential amendment to both Regional Board's Basin Plans as part of the policy. To assess compliance with these new water quality objectives, narrative and numeric performance criteria may be developed. The draft water quality objectives under development include:

- **Hydrologic Connectivity:** Protect and maintain levels of hydrologic connectivity (e.g., upstream-downstream, channel-floodplain, and surface water-groundwater connectivity) within individual waterbodies and within watersheds as a whole in such a manner as to produce the seasonal pattern and range of flows necessary to support beneficial uses.
- **Stream Equilibrium:** Protect and maintain the dynamic balance, or equilibrium, between sediment loads and surface water discharges, such as by protecting and maintaining the characteristics of streams in equilibrium, including their flows, channel shapes, slopes, planforms, and floodplain areas. This objective will prevent system imbalances, which result in excessive erosion or deposit
- **Wetland and Riparian Area Integrity:** Protect and maintain controllable water quality factors in wetlands and riparian areas, including the levels of vegetation and the extent of floodplains, to support stream and wetland systems and their associated water quality functions and beneficial uses.

To implement the new policy, an Implementation Plan will be proposed as an amendment to the Basin Plan. The specifics of this plan are currently under development. However, the plan will include guidance on policy application to streams, wetlands, and riparian areas that provide water quality functions to protect beneficial uses (e.g., definitions and identification methodology), regulatory mechanisms for implementation (e.g., waste discharge prohibitions, alternative regulatory approaches, non-regulatory approaches, and additional NPDES permit or Water Quality Certification conditions), permit performance criteria, mitigation requirements, monitoring and adaptive management requirements, and local watershed planning support.

2.9.2 SMP Compliance Approach

The North Coast RWQCB and the San Francisco RWQCB have jurisdictional authority to implement the Porter-Cologne Act in Sonoma County. All projects conducted under the SMP which occur in waters of the State require WDRs under the Porter-Cologne Act. In practice, WDRs are combined with NPDES permitting requirements and the CWA Section 401 Water Quality Certification. WDRs require compliance with all current Basin Plan policies including the proposed Stream and Wetlands System Protection Policy and Implementation Plan, once it is adopted.

The North Coast RWQCB issued WDRs and 401 Water Quality Certification for SMP areas draining to the Russian River and Pacific Ocean on July 23, 2009 (Order No. R1-2009-0049). The San Francisco Bay RWQCB issued WDRs and 401 Water Quality Certification for SMP areas draining to the San Francisco Bay on December 9, 2009.

The SMP was developed in accordance, and is consistent with, the proposed Stream and Wetlands System Protection Policy and Implementation Plan. The SMP is a multi-objective approach to protection of the North Coast RWQCB's and San Francisco RWQCB's new and existing beneficial uses through compliance with water quality objectives, including the proposed new water quality objectives. These new objectives were reviewed and integrated into the impact avoidance planning approaches described in Chapters 5 and 7 of this manual.

When the final Stream and Wetlands System Protection Policy is developed and adopted in the North Coast and San Francisco RWQCB's respective Basin Plans, the SMP Manual will be reviewed for consistency with the final plan and adjusted in collaboration with the Regional Boards accordingly.

2.10 California Endangered Species Act

The California Endangered Species Act (CESA) was established in the California Fish and Game Code (F&G Code), Sections 2050-2116. CESA was originally enacted in 1970 to designate wildlife, fish and plants as "endangered" or "rare". In 1984, CESA was amended and species were reclassified as "endangered" or "threatened". As of January 1985, all "rare" wildlife species were reclassified as "threatened" and the term rare was dropped from the code. For plants however, the classification of "rare" was maintained for plants listed under the California Native Plant Protection Act (Sections 1900-1913), but those plants are only subject to the protections of that act and not CESA.

The CESA states that all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation will be protected or preserved. The CESA sets forth procedures by which individuals, organizations, or the CDFG can submit petitions to the Fish and Game Commission requesting that a species, subspecies, or variety of plant or animal be added to, deleted from, or changed in status on the State lists of threatened or endangered species.

The CDFG maintains two key species lists for CESA listed species; (1) State and Federally Listed Endangered, Threatened and Rare Plants of California[7] Listed Endangered and Threatened Animals of California[8]. These lists are updated two times per year. The CDFG also maintains other lists of species with a range of protections through the California Fish and Game Code. These include California Species of Special Concern lists (CSC or SSC) for fish, reptiles, amphibians, birds and mammals. A species of special concern is a species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria:

- is extirpated from the State or, in the case of birds, in its primary seasonal or breeding role;
- is listed as Federally-, but not State-, threatened or endangered; meets the State definition of threatened or endangered but has not formally been listed;
- is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status; and
- has naturally small populations exhibiting high susceptibility to risk from any factor(s) that if realized, could lead to declines that would qualify it for State threatened or endangered status.

In addition to these CSC species, the California Fish and Game Code provides protections for other species such as California Fully Protected Species and Special Plant Species. It is important to note that only species classified by the state as “threatened” or “endangered” fall under the protections of CESA. Such other special status species are generally protected through either F&G Code Sections 1602 (Streambed or Lakebed Alteration Agreement Program), California Fully Protected Species regulations or through the California Environmental Quality Act (CEQA) discussed elsewhere in this chapter.

Like ESA, CESA also allows for incidental take of listed species. *Take* is defined under the California Fish and Game Code as any action or attempt to “hunt, pursue, catch, capture, or kill.” The incidental take permit process is outlined in CESA (F&G Code Sections 2081 and 2080.1).

CESA (F&G Code Section 2081[b]) provides a means by which agencies or individuals may obtain authorization for incidental take of state-listed species. Take must be incidental to, and not the purpose of, an otherwise lawful activity. Requirements for a F&G Code Section 2081[b] permit include: the identification of impacts on listed species; development of mitigation measures that minimize and fully mitigate impacts; development of a monitoring plan; and assurance of funding to implement mitigation and monitoring.

[7] http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEPlants.pdf
[8] http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf

For state-listed species that are also federally listed under the ESA, CESA (F&G Code Section 2080.1) allows for incidental take issued through ESA Section 7 or Section 10 to potentially provide incidental take coverage under CESA, assuming CDFG believes the protection and mitigation prescribed under the ESA consultation are sufficient. This is known as a "consistency determination." Under F&G Code Section 2080.1, CDFG issues a letter of concurrence with the federal take authorization, along with any mitigation and monitoring measures. In some cases, DFG may find partial consistency but require additional or different mitigation or monitoring measures.

2.10.1 Permitting Agency and Related Regulations

CDFG and the Fish and Game Commission are the primary entities whom implement and enforce provisions of the CESA, including the state species lists and F&G Code Sections 2080.1 and 2081. CDFG conducts CESA consistency determinations and issues permits and letters of concurrence.

2.10.2 SMP Compliance Approach

Implementation of SMP activities may require compliance with CESA due to the possibility that state-listed species may be negatively impacted. The California freshwater shrimp and Central California Coastal coho salmon are the two state-listed species (both endangered) that occur within SCWA's geography and in aquatic habitats potentially affected by SMP activities. It should be noted that all streams known to support coho salmon have been removed from the SMP due to the sensitivity of this species and the desire to avoid implementation of SMP activities that could result in "take" of this species. In addition, there is only one stream in the SMP that is known to support California freshwater shrimp, Sonoma Creek, and maintenance activities in this creek are focused on three small areas.

In addition to the CESA species, four CSC have the potential to be impacted by SMP activities. These CSC species include California red-legged frog, California tiger salamander, foothill yellow-legged frog, and western pond turtle. Other state species with various levels of protections could be impacted by SMP activities, and protections for these species will be addressed through either F&G Code Section 1602 or CEQA.

It is unclear whether "take" meeting the CESA definition would happen under the SMP. Depending upon the conclusion, one of several pathways will be pursued: a CESA incidental take permit, a consistency determination with the BOs issued by USFWS and NMFS for the SMP, or no CESA compliance at all.

2.11 California Fish and Game Code 3503 and 3503.5 (Bird Nests and Birds of Prey)

Section 3503 of the F&G Code makes it unlawful to take, possess or needlessly destroy the nests or eggs of any bird. F&G Code Section 3503.5 makes it unlawful to take, possess or needlessly destroy birds of prey or the nests or eggs of a bird of prey; §3503.5 prohibits the take, possession, or needless destruction of any nests, eggs or birds in the orders Falconiformes (new world vultures, hawks, eagles, ospreys and falcons, among others)or Strigiformes (owls); §3511 prohibits the take or possession of fully protected birds; and

§3513 prohibits the take or possession of any migratory nongame bird or part thereof as designated in the Migratory Bird Treaty Act.

2.11.1 Permitting Agency and Related Regulations

F&G Code Section 3503 and Section 3503.5 are administered by the CDFG and the Fish and Game Commission. These regulations are enforced under CDFG's CEQA environmental process and issuance of species take permits under CESA.

2.11.2 SMP Compliance Approach

SMP activities, such as vegetation management, may require the removal of trees or snags where birds are nesting. Compliance with this regulation is met through the implementation of avoidance measures and BMPs so that take of birds is avoided. The SMP contains conservation measures to avoid such take in order to comply with F&G Code Section 3503 and 3503.5.

2.12 California Fish and Game Code Section 1602 - Lake and Streambed Alteration Agreement Program

Under the F&G Code Section 1602, CDFG regulates projects that affect the flow, channel, or banks of rivers, streams, and lakes. F&G Code Section 1602 requires public agencies and private individuals to notify and enter into a streambed or lakebed alteration agreement with CDFG prior to construction of a project that will:

- substantially divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake;
- substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake; or
- result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake.

F&G Code Section 1602 may apply to any work undertaken within the 100-year floodplain of any body of water or its tributaries, including perennial, intermittent, and ephemeral rivers, streams, or lakes in the state. In general, however, it is construed as applying to work within the active floodplain and/or associated riparian habitat of a wash, stream, or lake that provides benefit to fish and wildlife. F&G Code Section 1602 typically does not apply to drainages that lack a defined bed and banks, such as swales, or to wetlands such as vernal pools.

2.12.1 Permitting Agency and Related Regulations

The CDFG has regulatory jurisdiction over the bed, bank, or channel of a stream, lake, or pond, as stated in F&G Code Sections 1600-1616. Under F&G Code Section 1602, the CDFG administers the Lake and Streambed Alteration Program and may issue a Streambed Alteration Agreement (SAA) for proposed projects within their jurisdiction. SAAs are typically issued through an application process (submittal of a notification package) and include restrictions on construction periods and locations and avoidance, minimization, and mitigation measures for potential impacts on habitat associated with waters of the state. Because the CDFG has discretionary approval authority, it is a responsible agency under the CEQA (see further discussion of CEQA below). As such, proposed projects must fully comply with CEQA before CDFG can finalize a SAA. An Agreement for Routine Maintenance (ARM) can also be used between the CDFG and an applicant to provide more broad or program-wide coverage for similar and routine maintenance activities across a common program area.

2.12.2 SMP Permitting Approach

The CDFG Bay Delta Region has jurisdiction over streambed alteration activities occurring in Sonoma County. Bank stabilization and sediment removal activities, as well as some vegetation management activities, implemented through the SMP require a streambed alteration agreement from CDFG.

In 2006 SCWA and CDFG entered into an ARM to provide permitting coverage for the interim maintenance activities (except from sediment removal activities) while the SMP was under development. The ARM provided guidance, terms, and conditions for the implementation of vegetation management and bank stabilization maintenance activities, required impact avoidance and minimization approaches, monitoring requirements, notification responsibilities, and other terms. This ARM was subsequently updated in 2009, and has served as the permitting method for F&G Code Section 1602 compliance for all of SCWA routine vegetation management and bank stabilization efforts (and as of 2009, localized sediment removal projects) within the SMP area.

With the finalization of the SMP Manual and its other associated permitting efforts, a Master Streambed Alteration Agreement (MSAA) will be drafted in collaboration with CDFG to replace the ARM and provide F&G Code Section 1602 compliance for all SMP activities. The MSAA will include all SMP activities, is anticipated to have a 10-year permit term, and will be available for review and a 5-year renewal following the initial 10-year period.

2.13 California Environmental Quality Act

CEQA (Public Resource Code 21000 et seq.) is the cornerstone of environmental law and policy in California. CEQA requires public agencies to assess and publicly disclose the environmental implications of proposed actions through the preparation of appropriate documents. The primary objectives of CEQA include:

- ensuring that the potential environmental impacts of proposed projects are disclosed to decision makers and the public;
- ensuring that environmental damage is avoided, reduced, or compensated for by the implementation of carefully designed mitigation measures;
- making the public aware of the reasons for an agency's approval of a project with significant, unavoidable, and unmitigable environmental impacts;
- fostering cooperation between agencies in the review of projects; and

- enhancing public involvement in the planning and review of projects that may impact local communities and their natural environment.

CEQA applies to discretionary activities proposed, implemented, or approved by California public agencies, including state, regional, county, and local agencies. The public agency which has the principal responsibility for carrying out or approving a project which may have a significant effect upon the environment is the *lead agency* for CEQA compliance and is responsible for preparing the environmental documentation for the proposed project.

Several types of documents may be used to comply with CEQA. Some types of actions are categorically exempt from the assessment and disclosure of impacts required by CEQA, and for such actions, a categorical exemption is filed. For most projects, the first step in CEQA compliance is preparation of an initial study (IS) to determine whether a proposed project is likely to result in a significant adverse impact on the environment. If the IS shows that no significant impact is likely, the lead agency files a negative declaration; if project impacts can be reduced below the level of significance by the implementation of one or more mitigation measures, the lead agency may file a mitigated negative declaration. However, if the IS shows that the proposed project is likely to result in one or more significant adverse impacts that cannot be adequately reduced by mitigation, the lead agency must complete an environmental impact report (EIR). The EIR must evaluate the likely environmental impacts of the proposed project and a reasonable range of feasible alternatives that would accomplish the same goals, and is required to identify the environmentally superior alternative.

2.13.1 SMP Compliance Approach

CEQA is triggered by the issuance of permits by state regulatory agencies including the RWQCB and CDFG. CEQA is also triggered by the discretionary action of SCWA in adopting the SMP Manual and approving the SMP program, the implementation of which may result in a significant adverse impact on the environment. As the agency with principal responsibility for carrying out the SMP, SCWA was the lead agency responsible for complying with CEQA.

Compliance with CEQA was met through the development of an EIR for the SMP Manual. The EIR evaluated the environmental impacts of the channel maintenance activities proposed in the SMP Manual. The EIR was crafted to address the needs of each regulatory agencies to grant permits, as well as provide the necessary CEQA compliance to allow the SCWA Board of Directors to approve the SMP. The EIR was certified by the Sonoma County Board of Directors on June 23, 2009. The Draft and Final EIR are available for review at: <http://www.scwa.gov>.

2.14 Local Stream and Watershed Plans

Applicable local plans, such as general plans, are discussed in detail in the EIR which accompanies the SMP Manual. The Santa Rosa Citywide Creek Master Plan and the Laguna de Santa Rosa Restoration and Management Plan are relevant stream and watershed management plans in the SMP program area. These plans share many common goals with the SMP. These plans are summarized below.

2.14.1 Santa Rosa Citywide Creek Master Plan

The City of Santa Rosa adopted the *Santa Rosa Citywide Creek Master Plan* in March 2007 (City of Santa Rosa 2007). The master plan presents a set of creek-related policies and recommendations for site-specific improvements on streams in the City of Santa Rosa. The plan defines and describes 11 goals for holistic creek protection and management. The goals are to:

- preserve, enhance, and restore local creeks and riparian corridors as habitat for fish, birds, mammals, and other wildlife;
- enable waterways to carry stormwater runoff and surface water;
- enhance the economic value of areas adjacent to creeks;
- enhance the urban environment with natural and open space features;
- provide trail corridors and other recreational opportunities along some waterways;
- provide educational opportunities along some waterways;
- enhance aesthetic qualities of creeks;
- protect and enhance water quality of creeks;
- respect private property rights;
- protect public health and safety; and
- protect cultural and archaeological resources.

In addition, the master plan contains a subset of affiliated objectives and policies for each goal.

The Citywide Creek Master Plan addresses the approximately ninety miles of creeks that flow through Santa Rosa. This master plan supersedes both the Santa Rosa Creek Master Plan (1993) and the Santa Rosa Waterways Plan (1996), and includes portions of the Laguna de Santa Rosa watershed that are within the 45.5 square-mile Urban Growth Boundary surrounding the City of Santa Rosa.

The master planning process included a Natural Resources Assessment with a series of geo-referenced maps depicting creek channel type (natural, modified, culverted, and restored), public lands, existing infrastructure (roads, trails, bikeways), access points, and proposed trails and connections. Data includes stream temperature, benthic macro-invertebrates survey data, biological monitoring scores, bioassay survival results for first flush and representative storms, special status plant species, special status animal species, fish capture results, fish passage barriers, and bird survey observations. The plan's implementation strategy also includes proposed site-specific projects with cost estimates.

The Santa Rosa Creek Master Plan describes recommendations for habitat preservation, enhancement, restoration, and management actions on specific reaches of Santa Rosa Creek and its tributaries. "Enhancement" implies invasive species removal and replanting with natives for understory and canopy growth. "Restoration" denotes physical channel change, including removal of hardscape elements, channel recontouring, and/or installation of structures.

In terms of linkages to the SMP, information provided in the Citywide Creek Master Plan was referenced in development of the SMP Manual's environmental setting (Chapter 3) and reach sheets (Chapter 4). In particular, the consideration of management opportunities at reaches was compared to the master plan for relevant creeks. Looking ahead, projects identified by the master plan for potential implementation will be coordinated with the SMP actions to ensure consistency of maintenance and flood protection activities, as well as consideration of habitat needs.

2.14.2 Laguna de Santa Rosa Restoration and Management Plan

In 2003, the Laguna de Santa Rosa Foundation began convening stakeholder meetings to accumulate knowledge on the Laguna (its natural and biological resources as well as impairments), collaborate with agencies charged with the Laguna's management, and develop a collective long-term vision for the Laguna. The final product - *Enhancing and Caring for the Laguna de Santa Rosa: A Plan for Restoring and Managing the Laguna de Santa Rosa Watershed* (Laguna Plan), identifies the species at risk, which habitats are most affected, and what specific opportunities exist for immediate restoration. The Laguna Plan serves the fourteen mile long wetland complex that drains the Laguna's 254-square mile watershed and encompasses most of the Santa Rosa Plain.

The Laguna Plan includes a detailed description of physical and biological processes occurring in the Laguna watershed, as well as important management and restoration considerations based on this understanding. These resources informed the SMP Manual's *Environmental Setting* (Chapter 3), reach sheets (Chapter 4), and the maintenance approach and programmatic avoidance and minimization measures discussed in Chapters 5 through 7.

A central issue to both the Laguna's management plan and the SMP is the role of sediment transported through SCWA flood control channels that is eventually deposited in the Laguna. According to the Laguna Plan, abundant sediment deposition from upstream watershed sources impacts habitat conditions and stream integrity (Honton and Sears 2006). In Chapter 4 of the Laguna Plan, sediment removal from flood control channels is described as a solution towards downstream natural resource protection. Another related document, the Copeland Creek Watershed Assessment (Laurel Marcus and Associates 2004) provides a similar assessment and recommendation of the benefit of removing sediment in flood control channels such as Copeland Creek prior to sediment being delivered to the Laguna downstream. Mitigation approaches described in Chapter 8 of this SMP Manual consider these opportunities to reduce sedimentation to the Laguna and preserve and enhance its habitats.

The Laguna Plan also includes many useful and informative appendices including an invasive species plan that identifies the highest priority exotic plants and their respective locations; a list of special status flora/fauna species, their habitat requirements and occurrence potential; existing and potential beneficial uses associated with the Laguna de Santa Rosa hydrologic unit; a Ludwigia management plan; a description of geophysical regions in the watershed along with their size, topography, climate, impervious surface, and land uses; and map resources.

Current initiatives described in the Laguna Plan are the implementation of a Ludwigia Control Project in the worst affected areas of the Laguna and an extensive habitat restoration effort in the middle reach of the Laguna, which began in April 2007. The effort includes reestablishing native riparian vegetation, seasonal wetlands, and oak woodlands in a project area extending along nearly two miles of the channel.

The Laguna Plan also emphasizes the need for collaborative and streamlined permitting to promote successful restoration and management of the Laguna system (Honton and Sears 2006). The Laguna de Santa Rosa Foundation, the lead organization on the Laguna management plan, is a partner in SCWA's off-site watershed mitigation program. Restoration activities described within the Laguna Plan can support mitigation approaches and opportunities described in Chapter 8 of this Manual.

2.14.3 Water Clarity Ordinance of the County of Sonoma - Ordinance No. 3836R

Ordinance No. 3836R is an initiative measure adopted by the electorate of Sonoma County on June 7, 1988. The Ordinance requires that a roiling permit be issued prior to performing work that may decrease the clarity of the waters of the river or stream. The ordinance requires a roiling permit prior to conducting work that involves protection of riparian property adjacent to a river or stream; construction of recreational dams, construction work on riparian property, ; or construction of temporary bridges, dikes, dams, and settling ponds in connection with mining operations or for agricultural uses. The permit can only be issued upon a four-fifths vote of the Sonoma County Board of Supervisors and only for a maximum period of 30 days. The Board designated the Permit and Resource Management Department (PRMD) as the administering agency of this Ordinance. Roiling permit applications are filed at PRMD and are subject to CEQA. The PRMD has issued a programmatic roiling permit to SCWA for maintenance activities conducted within riparian corridors throughout the county.

Chapter 3
ENVIRONMENTAL SETTING

3.1 Introduction

This chapter presents the environmental setting focusing on the physical and biological conditions of the Stream Maintenance Program (SMP) Program Area. This information provides the foundation for developing stream characterizations in Chapter 4, framing the maintenance approach of Chapter 5, and drafting the description of program activities and implementation in Chapters 6 and 7 through 9. Because the majority of the Sonoma County Water Agency (SCWA) work is conducted in Flood Control Zones 1A, 2A, and 3A, this setting is generally focused on these three zones.

The resource setting also provides an important basis for environmental compliance. Physical and biological resources have been considered and described at three general scales to address the regulatory requirements of the federal Endangered Species Act (ESA), California Endangered Species Act (CESA), Clean Water Act (CWA) Sections 401 and 404, the Porter-Cologne Water Quality Control Act, and California Fish and Game Code Section 1600 et seq. The three scales include the regional or large watershed scale (e.g., Laguna de Santa Rosa watershed), the subbasin scale (e.g., Copeland Creek watershed), and the natural community or habitat scale (e.g., areas of Copeland Creek supporting emergent wetland marsh vegetation, etc.). The stream characterizations of Chapter 4 carry this scaled approach to the next level of detail in providing general descriptions at the reach scale.

This chapter is organized as follows:

- Section 3.2 – Topography and Landforms
- Section 3.3 – Watersheds, Creeks, and Land Use
- Section 3.4 – Geology and Soils
- Section 3.5 – Climate and Precipitation
- Section 3.6 – Surface Water
- Section 3.7 – Groundwater
- Section 3.8 – Water Quality
- Section 3.9 – Natural Communities and Channel Land Cover
- Section 3.10 – Special Status Plants, Wildlife, and Fish

The Laguna de Santa Rosa is referenced in this chapter as three different, yet related, features. The Laguna de Santa Rosa is described as being a watershed, a stream channel within the watershed, and also the namesake lagoon/marsh system near Sebastopol in the lower watershed. To provide clarity and consistency to these references, the watershed is referred to as the "Laguna de Santa Rosa watershed"; the stream channel is identified as the channel or called the "Upper Laguna" in its upper extent and into Rohnert Park; and the lagoon/marsh is identified simply as the "Laguna."

3.2 Topography and Landforms

As described in Chapter 1, Section 1.4 *Program Area and Channel Types*, the SMP Program Area includes all of Sonoma County but is focused on the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watersheds of the southern County. The physiography of southern Sonoma County is generally defined by a sequence of northwest to southeast aligned valleys and ridgelines which follow the regional tectonic and geologic structure. The principal landforms in the Program Area are shown in Figure 3-1. Figure 3-2 includes topographic profiles across central Zone 1A, southern Zone 1A, and central Zones 2A and 3A.

Sources used to map and describe the physical setting of the Program Area included U.S. Geological Survey (USGS) data on topography and hydrology; geologic maps of the area (California Department of Conservation 1990; U.S. Geological Survey 1994; Sloan 2006); soil survey information (USDA 1972); and other published information (Hickman 1993; Alt and Hyndman 2000). Topography, hydrology, geology, and soil data were downloaded from agency web sites and imported into a GIS database, where files were clipped and converted into the projection for the Program Area.

3.2.1 Mountains, Fans, and Plains

The Mayacamas Mountains separate Sonoma and Napa counties. The westward draining slopes of the Mayacamas Mountains provide headwater drainage areas to the northern Laguna de Santa Rosa and eastern Sonoma Creek watershed areas. The Sonoma Mountains separate the southern Laguna de Santa Rosa, northern Petaluma River, and western Sonoma Creek watershed areas.

The elevation profiles in Figure 3-2 illustrate how the Mayacamas Mountains and Sonoma Mountains provide the headwater source areas for runoff and sediment to the SMP area streams to the west and east. Steep canyons and mountain streams carry flows and sediment to the valley floors building characteristic alluvial fans. The watersheds of the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek drain with different orientations. As shown in Figure 3-2 the Laguna de Santa Rosa watershed has mountains in the east and plains to the west. The slopes of the Petaluma River watershed have a more northeast-southwest alignment descending to the Petaluma River at the base of the watershed that flows southeasterly to the Bay. The Sonoma Creek watershed is more elongated and symmetrical than either the Laguna or Petaluma basins. In the Sonoma Creek system, canyon tributaries descend from both the Mayacamas in the east and Sonoma Mountains in the west on to the valley floor where Sonoma Creek leads southward to the Bay.

The alluvial fans noted above are found at the base of mountains in each of the three focus watersheds. The fans represent the accumulation of sediment over many centuries. In some places the fans have coalesced into a combined fan surface (known as an apron or *bajada*) such as along Windsor and Mark West creeks in the Laguna de Santa Rosa watershed, where the Mayacamas Mountains transition to the alluvial fan surface east of

Highway 101. Similarly, in the Rohnert Park area the alluvial fans of Copeland, Hinebaugh, Crane, and Five creeks merge into an alluvial apron at the base of the Sonoma Mountains along Petaluma Hill Road. For other streams, such as Pruit or Pool creeks in the Windsor Creek subbasin, the individual fan surface may be more independent from neighboring stream.

Historically, these alluvial fans functioned as depositional areas that stored sediments in the topographic transition between the higher and steeper mountains to the east and the lower and more gently sloping plains to the west (Laurel Marcus and Associates 2004). Streams historically migrated across these alluvial fan surfaces (swinging in a snake-like fashion over time) through braided channels and distributed sediments evenly across the surface. Over time fans prograded downstream onto the lower plain surface depending upon sediment sources, climatic conditions, and tectonic activity (discussed below). In the Laguna de Santa Rosa watershed the alluvial fan surfaces give way to the broader and more gently sloping Santa Rosa Plain and eventually the Laguna itself. Beside the alluvial fans, older historic sediments are also stored in relict stream terraces in the Program Area. Most notably, on the Santa Rosa Plain west of Highway 101 moving toward the Laguna, the Mark West Creek and Santa Rosa Creek systems both have sediments stored in historic terrace deposits.

Identifying the degree of slope (or gradient) across the typical profiles shown in Figure 3-2 is important in understanding the energy available to move water and sediment as well as the general distribution of coarser sediments upstream and the fining of sediments downstream. For example in the Sonoma Mountains headwaters, slopes drop about 1 foot (ft) in elevation for every 50 ft of horizontal movement, a ratio of about 1:50 or a slope of about 0.02 (Honton and Sears 2006). Moving downstream on to the alluvial fan surface of Copeland, Hinebaugh and Crane creeks (near the Snyder Lane crossings) the gradient drops to about 1:120. Slope lessens to 1:300 by the Highway 101 crossing in Rohnert Park, and flattens to about 1:1,000 toward the Laguna lowlands further west of Highway 101 (Honton and Sears 2006).

The topographic transition between mountain, fan, and plain is particularly important in considering maintenance needs for the engineered channel systems of the SMP. In Flood Control Zones 1A and 2A many of the engineered channels begin in the historic alluvial fan zone, most often in the lower fan areas (Figures 1-2 and 1-3, respectively). Historically these were reaches that received abundant sediment from upstream sources. Over time these reaches variably stored this sediment, distributed and deposited it along the fan surface, or carried some of it downstream depending upon the location of the active stream channel on the fan. Under existing conditions with developed land uses adjacent to the creek either for residential, educational, commercial, transportation, or other uses; the streams have been channelized and are now operated and maintained for flood control purposes (see Chapter 1, Section 1.1 *Program Background and Need*). Streams that previously migrated and deposited their materials across a broad fan or plain surface are now contained in generally linear channels with gradients that are typically governed by hardened road crossings.

The result of the current engineered channel system is that sediments that historically would have been deposited and spread across the larger plain and alluvial fan area now accumulate inside the engineered channels. Identifying, managing, and sometimes removing this sediment is a key aspect of the SMP. Recognizing the historical conditions and physical processes under which this sediment system operated helps in developing maintenance approaches that are physically appropriate, environmentally sensitive, and sustainable (see Chapter 5 Section 5.2 *Maintenance Principles*).

3.2.2 Lowlands and the Laguna

The Program Area's lowlands are formed near the outlet of the Laguna de Santa Rosa watershed. Similarly, lowlands of the Petaluma River and Sonoma creek watersheds are found in the floodplains, marshes, and tidal areas near to the edge of the San Francisco Bay. These lowlands and baylands are part of important regional ecosystems that include many sensitive habitats. In particular, the Laguna is a key hydrologic feature and ecologic resource in the Program Area as it supports a mosaic of channels, oxbows, ponds, and wetlands. As shown in Figure 3-1, the Laguna extends nearly 12 miles from its northern confluence with the Russian River to its southern origin with the creeks of the Rohnert Park and Cotati area. The Laguna is nearly a mile wide at its downstream end, is generally about three-quarters to one-half mile wide through most of its length, and tapers to a few hundred yards towards its southern limit.

In the winter, a natural basin at the confluence of the Laguna and Mark West Creek receives surplus (or carryover) storm flows from the Russian River. This inflow from the Russian River causes a hydraulic backwatering and detainment of other Laguna watershed flows providing flood storage and peak attenuation benefits for the lower Russian River valley. The Laguna can detain and store 80,000 acre-feet of water that would otherwise flow directly to the lower Russian River (PWA 2004; Sonoma County Flood Control and Water Conservation Improvement District 1965). Although this natural flood storage is advantageous for managing flood waters in the lower Russian River watershed, the backwatering effects upstream areas and impacts flood conveyance in many of its tributaries.

A fuller description of the Laguna de Santa Rosa watershed is found in a recent management plan titled *Enhancing and Caring for the Laguna: A Plan for Restoring and Managing the Laguna Watershed* developed by the Laguna de Santa Rosa Foundation (Laguna Foundation) (Honton and Sears 2006). This plan includes sections describing ways to manage and restore the Laguna as well as sustain its water resources. An important connection between the goals of SMP and the Laguna Foundation's management plan is that both strive to find ways to reduce sediment deposition in the Laguna and reduce the impacts to habitat quality associated with sedimentation. Water quality issues affecting the Laguna, including sediment, are discussed below.

3.3 Watersheds, Creeks, and Land Use

3.3.1 Laguna de Santa Rosa Watershed

The Laguna de Santa Rosa watershed encompasses 253 square miles (sq. mi.) and is the largest southern tributary to the Russian River. The highest elevation in the watershed is 2,463 feet (ft.) above mean sea level (MSL) along the eastern mountains. Elevations at the confluence with Mark West Creek are 50 ft. above MSL. As described above, several steep, high-gradient creeks originate in the Mayacamas and Sonoma Mountains of the upper watershed. These smaller tributaries combine and collect into primary subbasin creeks that then flow west across the alluvial fans and Santa Rosa Plain, eventually meeting the Laguna main channel that flows north joining the Russian River. The primary subbasins of the Laguna de Santa Rosa watershed are shown in Figure 3-3 and include: Windsor Creek, Mark West Creek, Santa Rosa Creek (which includes Piner, Matanzas, Spring, Brush, and Oakmont creeks); Roseland Creek; Colgan Creek; Bellevue-Wilfred creeks; and the creeks of the upper Laguna subbasin including Gossage, Upper Laguna, Copeland, and Hinebaugh creeks. These subbasins and their engineered channels are described in greater detail in Chapter 4.

Land uses in the Laguna de Santa Rosa watershed are mixed and include high density urban development, rural residential uses, public recreational areas, varying degrees of agricultural uses, and some rangeland. The distribution of these land uses is shown in Figure 3-4. Areas of higher elevations on the east side of the watershed are encompassed by public lands, rural residential, agriculture (vineyards), and open ranchlands and woodlands. As the elevation levels towards the west, residential and commercial land uses intensifies, particularly at the urban areas of Santa Rosa and Rohnert Park. Land use shifts to rural residential and more intensive agriculture use moving further west across the watershed.

For the purposes of the SMP, it is important to recognize the influence of land use on surface hydrology and sediment transport throughout the watershed. Urban land uses typically have more impervious land surfaces leading to increased surface runoff, higher runoff peaks, and shorter lag times to reach peak runoff. Urbanized areas also typically have higher summertime low flow conditions resulting from irrigation and other urban inputs. Some creeks that would typically be dry in the summer are often perennialized through urbanization.

Agricultural land uses once supported a variety of orchard, row, and feed crops. However, today the valley floor and gentle sloping plains largely support vineyards, dairy, and livestock operations (California Department of Food and Agriculture 2007). These types of agricultural land uses result in a range of runoff, erosion and sediment yield, and water quality conditions. In general, the hydrologic and sediment related impacts from these agricultural land uses primarily depend upon the intensity of the activity, the degree of vegetated land cover, the degree of soil disturbance, the slope of the land surface, the rural road network and its influence on drainage patterns, and the local precipitation and water balance conditions.

3.3.2 Petaluma River Watershed

The Petaluma River watershed (146 sq. mi.) lies in both Sonoma County (112 sq. mi. of the watershed) and Marin County (34 sq. mi. of the watershed). The highest elevation in the watershed is Sonoma Mountain (2,295 ft. above MSL) and the lowest elevation is sea level at San Pablo Bay. The northern watershed divide with the Laguna de Santa Rosa basin is subtle and mildly perceptible. Historically the boundary between the two watersheds would have migrated variably north and south with changes in alluvial fan and stream locations in the area. Also, tectonic uplift, subsidence, or compression along the Rodgers Creek Fault may have altered the basin divide between the watersheds.

In the northeastern Petaluma River watershed, tributaries flow southwest out of the Sonoma Mountains to the Petaluma River and then flow southeast to San Pablo Bay. The Petaluma Valley in the central watershed forms a wide basin with characteristic rolling hills and grasslands that stretches from Cotati southeast to San Pablo Bay. Primary tributaries to the Petaluma River include Willow Brook, Lichau, Lynch, Washington, Adobe, Ellis, Liberty, Marin, and San Antonio creeks. These creeks that include engineered channels are described in greater detail in Chapter 4.

The Petaluma River experiences tidal fluctuations from San Pablo Bay in the south to 14 miles upstream past downtown Petaluma (Sonoma County 2006). The lower Petaluma River has been modified to enable commercial traffic and is dredged every four years to maintain navigability. Flooding along the Petaluma River and its lower tributaries is exacerbated during high tide events when river base levels are elevated and flows in low-lying storm drains and channels are detained. This tidal condition has maintenance implications for some of the channels maintained by SCWA including lower Washington and Lynch creeks. In these channels, accumulated sediment and debris conditions that might reduce flood conveyance capacity pose an increased flood concern when combined with the potential influence of high-tide backwatering.

Predominant land uses in the Petaluma River watershed are comprised of agriculture, rural residential, and the urban center of Petaluma. As Figure 3-4 shows, the urban area of Petaluma sits squarely in the middle of the watershed surrounded by almost exclusive agricultural lands to the east and a buffer of rural residential to the west before agricultural lands begin again. As shown in Figure 3-1, the town of Petaluma is also situated at the low point of the watershed.

3.3.3 Sonoma Creek Watershed

The Sonoma Creek watershed (170 sq. mi.) is located east of the Petaluma River watershed and west of the Napa River watershed of Napa County. As described above, the Sonoma Creek valley is generally symmetrical with dendritic tributaries (small tributaries that feed a single, large tributary) descending from the Mayacamas Mountains to the east and the Sonoma Mountains to the west. Elevations in the watershed range from about 2,500 ft. above MSL at Bald Mountain to sea level at San Pablo Bay. Key tributaries in the watershed include Calabazas, Hooker, Carriger, Fryer, Nathanson, Schell, Rodgers, and Fowler creeks. This watershed contains few SCWA-maintained engineered channels, with Fryer Creek containing most of SMP relevant channel segments. Maintained reaches of Fryer Creek under the SMP are described in greater detail in Chapter 4.

Flooding issues in the watershed affect agricultural and rural residential areas in the lower watershed, particularly near Schellville. Tidal action from San Pablo Bay influences Sonoma Creek north of Highway 37 and south of Highway 121. This tidal influence affects flooding conditions in the lower watershed, but does not reach as far upstream into the watershed compared to the Petaluma River.

Land uses in the Sonoma Creek watershed are mixed, but contain a high percentage of both agriculture and ranchland/woodland land uses. The town of Sonoma forms the main urban center and is located at the lower end of Flood Control Zone 3A. The most problematic areas for flooding in the Sonoma Creek watershed are located south of Highway 121 within the marshy margin of San Pablo Bay.

3.4 Geology and Soils

3.4.1 Regional Tectonism and Older Rocks

The geology and structure of the Program Area in southern Sonoma County has been shaped through a dynamic history of tectonism along the San Andreas Fault Zone. The northwest-southeast alignment of this fault zone with its characteristic right-lateral strike-slip tensional movement is reflected in the alignment and orientation of the region's ridgelines and valleys (see landform discussion above). Movement along the fault zone was not only lateral, but also included compression resulting in the mountain building of the Coast Ranges in the Program Area (Nilsen 1987). In geologic terms, this combination of lateral-tension plus compression is known as transpression. In Sonoma County, the main artery of the San Andreas Fault roughly follows Highway 1 near the coast. In the focus area of the SMP (Zones 1A, 2A, and 3A) the Healdsburg-Roger's Creek and Mayacama faults represent more interior arms of the San Andreas system, sharing its same orientation (Figure 3-5).

The San Andreas Fault has been relatively quiet in Sonoma County since the historic 1906 earthquake (magnitude 8.3). The Healdsburg-Rogers Creek and Mayacama faults are considered active faults with known activity during the Holocene period (last 10,000 years). Of recent note, in 1969 two moderate earthquakes (magnitudes 5.6 and 5.7) along the Rogers Creek Fault caused moderate damage in Santa Rosa.

As shown in Figure 3-5, the distribution and sequence of rock types in the Program Area reflect the area's geologic history (Norris and Webb 1990). The oldest rocks include the Great Valley Complex with its tilted marine sedimentary layers, mostly sandstones and shales. The Great Valley Complex underlays much of the project, but clearer exposures are found to the west and east. A bit more prevalent in the Program Area are rocks of the Franciscan Complex, a mixture of chert, basalt, shale, metamorphic rocks, and mélange created by subduction zone processes. Franciscan rocks are seen in the upper Mark West and Santa Rosa creek watersheds, in the southern Petaluma watershed, and a few outcrops west of the Laguna.

However, the rocks that best define the crests and slopes of the upper watersheds in the Program Area belong to the Sonoma Volcanics (Sloan 2006). This rock grouping includes lavas, mudflows, and tuffs that erupted or spread in the Miocene epoch between about nine and three million years ago. Compared to some of the sedimentary rocks in the region, these volcanics are more resilient and durable, which explains their prominence along ridgelines. Sonoma volcanics are observed in the headwaters for several of the Program Area's streams in the Mayacamas and Sonoma ranges (Figure 3-5). Around the time of the Sonoma volcanism (five million years ago), but further to the west, sandy sediments were deposited in a shallow marine environment. Now lithified, these rocks are seen today as the sandstones of the Gold Ridge Hills south and west of Sebastopol, Cotati, and Petaluma.

The history of tectonism, volcanism, and their various mountain uplifting and basin subsidence processes are important to consider as background for the SMP. These past processes provided the basic earth materials which are now eroded and carried in today's channels. Of even more relevance to the SMP is the geologic history of the last two million years, known as the Quaternary period, which is comprised of the Pleistocene epoch (two million years to 10,000 years ago) and the Holocene (the last 10,000 years).

3.4.2 Quaternary and Surficial Geology

The large majority of engineered channels in the SMP Program Area are located in Quaternary and surficial geologic materials (Figure 3-6). The explanation for this parallels the landform discussion above which described how most channels of the SMP are found in depositional areas of alluvial fans, plains, or other lowlands where sediments have historically collected for many thousands of years.

Building on the landform discussion above, the distribution and patterns of materials shown in Figure 3-6 reveal much about the geomorphic processes which led to their deposition. For example, the Rohnert Park area demonstrates the fining sequence of alluvium from coarse-grained, to medium-grained, to fine-grained moving west from the Sonoma Mountains down into the alluvial fan. The Santa Rosa area shows the concentration of coarse grained materials along the pathways of the current channels and historic creeks, whereas the wider Santa Rosa plain consists of older Pleistocene alluvium. In the Laguna, the texture of sediments also becomes finer, moving north from the Sebastopol area where stream cobbles and coarse sediments transition to medium textured materials. Further north into the more still depositional basin of the Laguna south of the Mark West Creek confluence, finer alluvium is found.

In the Petaluma River watershed, many of the channels of the SMP are built onto medium-textured alluvium of the Petaluma plain. In the Sonoma Creek watershed, the main arm of Sonoma Creek flows south along the coarser sediments of the valley floor. Several older Pleistocene terraces also run throughout the valley, but are located further from the creek. Interestingly, the east side of Sonoma Valley includes abundant colluvium. Colluvium is sediment or rock that is deposited at the base of a slope by gravity or sheetwash, but it is not transported by channelized flow like in the case of alluvium. Though dependent on specific site and land use conditions, colluvium is typically highly erosive and can often enter neighboring streams.

An important feature of Figure 3-6 are several of the known and mapped larger landslides of the Program Area. These landslides are significant sediment sources for the streams and channels downstream. Landslides are prominent in the headwaters to Copeland, Crane, Five, and Hinebaugh creeks in the Rohnert Park area. Not shown on this map, but observed in the field, are additional landslides and gullies in the headwaters of Cook and Coleman creeks that have exacerbated downstream sedimentation. The Cook Creek landslide in particular has led to abundant downstream sedimentation in the past and has required specialized erosion control techniques at the toe of the slide, as well as multiple maintenance clearings at the Cook Creek sediment basin just downstream of the landslide. In the Petaluma River watershed a large landslide at the common headwater areas to Lichau, Willow Brook, Lynch, Washington, and Adobe creeks also supplies the creeks with eroded materials.

Understanding the causes and remedies of an individual landslide is often complex. Causes may begin with geologic conditions that favor instability, yet often the triggers for sliding are climatic, hydrologic, or land use conditions which move forces beyond a threshold. A central component of the SMP, both in terms of the program's approach towards sustainability and its goal of effective sediment management is the concern and attention towards reducing headwater area erosion sources. As described in Chapter 8 *Program Mitigation* the SMP seeks to work with local landowners and erosion specialists to reduce erosion “hot spots” such as at Cook Creek through improved management and applied erosion control techniques.

3.4.3 Soils

Soils in the Program Area are varied, derived from diverse landform, geologic, climatic, and biologic conditions. The Soil Survey of Sonoma County (U.S. Department of Agriculture 1990) includes 15 soil associations. At the association level, soils are generally distinguished according to their geomorphic and topographic setting; whether they are located in basins, tidal flats, floodplains, terraces, alluvial fans, high terraces, foothills, uplands, and mountains. In general, the soils in the lowland basins, floodplains, and alluvial fans range from gravelly sandy loams to clays; most often composed of clays and clay loams that formed in alluvium from sedimentary and volcanic material. These soils vary in drainage capacity from poor to excessive, with the more clay-textured soils draining more poorly. The soils on the high terraces, foothills, uplands, and mountains consist of gravelly to stony sandy loams to clay loams and range in drainage capacity from moderate to excessive, with the coarser textured soils draining better. The Soil Survey of Sonoma County can be used to identify more specific site or parcel soil series, types, and conditions.

Soils are mapped for their runoff potential according to their Hydrologic Soil Group, where: A soils have high infiltration rates and low runoff potential, B soils have moderate infiltration, C soils have slow infiltration, and D soils have very slow infiltration rates and high runoff potential. Hydrologic Soil Groups for the Program Area are mapped in Figure 3-7a. The vulnerability of natural soil types to erosion (erodibility) was mapped by the Natural Resources Conservation Service (2007) and is available through the Soil Survey Geographic Database (SSURGO). While inherent erodibility is important in considering a soil’s potential erosion, often it is the slope, type of land use, and intensity of land practices which are the more important determinants of potential erosion. Figure 3-7b maps soil erodibility in the Program Area according to the Soil Erodibility Factor K(f) used in the Revised Universal Soil Loss Equation (RUSLE). As shown in Figure 3-7b, most of the headwater source regions in the SMP Program Area have high erosion potential.

3.5 Climate and Precipitation

Climate of the Program Area is characterized as two-season Mediterranean with cool wet winters and warm dry summers. Annual and seasonal variability in temperatures and rainfall are high. For the period 1931 – 2006 average maximum temperatures for the area ranged between low 80s (F) in the summer to high 50s in the winter; while average minimum temperatures ranged between low 50s in the summer to upper 30s in the winter (Western Regional Climate Center 2007). Average monthly temperature and precipitation conditions for Santa Rosa are shown in Figure 3-8.

In the Laguna de Santa Rosa watershed, average daily maximum summer temperatures in Santa Rosa are in the low 80s, while winter average daily minimum temperatures are in the high 30s (Western Regional Climate Center 2007). Spring and summer prevailing southwesterly-westerly winds in the Laguna de Santa Rosa watershed area are influenced by marine air channeled northeast through the Petaluma Gap, a lowland gap in the Coastal Range (the Estero Lowlands) at the southwestern end of Petaluma Valley.

Air temperatures in the Petaluma River watershed tend to be a bit warmer than the Laguna de Santa Rosa watershed. Summer average daily maximum temperatures in the Petaluma Valley are in the low-mid 80s, while winter average daily minimum temperatures are in the high 30s to low 40s (Western Regional Climate Center 2007). Prevailing winds in Petaluma Valley are westerly through the Petaluma Gap. Marine air and winds arriving through the Petaluma Gap descend across the Petaluma Valley and can flow north toward the Santa Rosa Plain or south toward San Pablo Bay.

Prevailing winds in Sonoma Valley tend to be from the south during the day when warming conditions create an up-valley flow. At night the pattern is reversed where cooler air in the northern Sonoma Valley and from the side valley canyons descends to the valley floor and flows southward down valley. Further east and insulated from the maritime coastal air, Sonoma Valley is warmer than the Petaluma or Laguna de Santa Rosa watershed areas and experiences average summer temperatures in the high 80s. Average daily winter minimum temperatures are in the high 30s.

Precipitation primarily falls between November and March and varies across the Program Area from 22 inches annually at the mouth of Sonoma Creek in the south to 50 inches at Sonoma Mountain (2,295 ft. above MSL). Figure 3-8 shows the record of annual precipitation at Santa Rosa since 1931. Santa Rosa has an average annual rainfall of 30 inches. Average annual precipitation amounts for the Program Area are shown by isoheytal contours in Figure 3-9. As shown in Figure 3-9, topographic conditions influence rainfall patterns, winds, sunlight and evaporation and create a range of local microclimates. Winter storm fronts typically arrive from the west, but this can range from the south-southwest to northwest directions. Fronts experience orographic lifting and increased precipitation in crossing the Mayacamas and Sonoma Mountains. The lee side of these ranges typically experiences a rain-shadow effect and reduction in precipitation. Some storms approach from a more direct southerly direction beginning at San Pablo Bay and moving their way northward up the Petaluma and Sonoma valleys and Santa Rosa plain.

In general, precipitation patterns in the Laguna de Santa Rosa watershed are strongly correlated with elevation. Rainfall increases from south to north and as elevation increases. Along the Santa Rosa Plain, average annual rainfall in Rohnert Park is 29 inches, increasing to 30 inches in Santa Rosa, and 35 inches in Windsor. The mountains on the east and west sides of the plain receive 40-50 inches of rainfall annually. Average annual rainfall contours (isoheytal) are illustrated in Figure 3-9. Average annual rainfall in the Petaluma Valley is 26 inches with the surrounding higher slopes in the watershed receiving 28-30 inches. Rainfall amounts in Sonoma Valley gradually increase from south to north, with 22 inches at the San Pablo Bay margin increasing to 40 inches to the northern valley. Rainfall amounts also increase up to 50 inches with elevation in the mountains west of the valley floor as shown in Figure 3-9.

3.6 Surface Water

The hydrologic cycle describes the movement and storage of water across the atmosphere, the land surface, the subsurface, and the ocean basins (Figure 3-10). Surface water hydrology represents the portion of the hydrologic cycle that is in movement or storage across the land surface and is typically thought of as runoff and streamflow. Runoff is a broad category and includes a range of flows progressing from sheetwash or overland flow, to initial collection of flows in small rills and land creases. Streamflow identifies the larger concentration of flows in natural creeks or engineered channels.

The amount and timing of runoff and streamflow over a given time period (storm event, season, or year) reflect a region's and watershed's climate, topography, geology, and soil conditions. Steeper surfaces shed runoff more quickly than flatter surfaces. Soil attributes of porosity and permeability influence how precipitated water on the land surface will infiltrate the ground to be either stored as soil water, travel through the soil towards a creek as interflow or throughflow, or infiltrate deeper to groundwater depending upon geologic conditions.

Surface water that is not infiltrated, evaporated, or transpired (taken up by plants) is available as runoff to streams. In the Program Area streams may be ephemeral (conveying flows only immediately after a storm event); intermittent (conveying flows seasonally and supported by shallow groundwater); or perennial (flowing year round and supported through deeper groundwater sources or human sources such as reservoirs, release of imported flows, urban runoff, or irrigation).

Within the Program Area first-order and second-order stream headwater tributaries vary in their flow conditions from ephemeral to perennial. Surface hydrology in these upper watershed streams is a function of watershed size, underlying geology, recent precipitation conditions, and land use. Medium sized tributaries (third and fourth-order streams) that collect flows out of the primary upper headwater canyons are generally intermittent but may be perennial. The larger named creeks that emerge from the upland canyons and alluvial fans and carry enough flows to cross the valley floors and plains without losing all their flows to percolation are typically perennial. Flow characterizations for creeks, particularly the seasonal duration of intermittent flow, varies according to climatic conditions and how wet or dry the current and past one or two years have been. Additionally, while some channels may not flow perennially, they may sustain cold-water pools throughout the year (particularly where substrate, shading, and groundwater conditions are favorable) that can provide important habitat for many species.

The urban, suburban, agricultural, or commercial development of the land surface directly affects the hydrologic cycle and infiltration and runoff conditions. In developed areas with higher proportions of impervious surfaces, infiltration is greatly reduced and storm runoff increased. Urbanized areas typically have engineered stormdrain systems to convey runoff to local streams. As described in Chapter 1 Section 1.4 *Program Area and Channel Types,* the engineered channels and engineered easement channels of the Program Area were designed and constructed to provide stormflow conveyance and reduce the threat of flooding in the Program Area. The maintenance of these channels to keep them free of accumulated debris and sediment enables them to convey runoff as designed. Urbanized areas with summer irrigation also typically show an increase in summer low flows, including the perennialization of creeks that were previously intermittent.

The hydrograph portrays flows over time and is the fundamental graphic used to describe streamflow for a particular creek. Hydrographs portray peak flow rates or flow volumes for single events, seasons, or many years. Unfortunately many of the Program Area's stream gages in the Laguna de Santa Rosa, Petaluma Creek, and Sonoma Creek watersheds do not provide long-term continuous or uninterrupted records. Figure 3-11 shows annual peak volumes for Sonoma Creek at Agua Caliente for many, but not all, years between 1956 and 2005. Wet years such as 1956 and 1974 show almost 15 times the flow as drier years such as 1972 or 1976. Figure 3-11 also depicts annual peak flows for Santa Rosa Creek at 8,190 cubic feet per second (cfs) and Colgan Creek at 934 cfs for available years of record.

For more recent years, many of the gages in the Program Area do provide good records of flow conditions. Figure 3-12 and Figure 3-13 show average daily flow records during the 2005-2006 and 2006-2007 winter seasons for gages on Santa Rosa Creek and Colgan Creek, respectively. Comparison of flows at two locations on Santa Rosa Creek (Figure 3-12) illustrates how downstream reaches maintain higher flows as the size of the drainage basin (area of a stream's watershed draining to a specific point) increases. This results in larger peaks and higher flows while the overall shape of the hydrograph remains consistent. The hydrographs from Santa Rosa Creek also indicate the rapid increase (or flashiness) of flows with the onset of a storm event (late December 2005 or early March 2006) and the recession of flows following the storm event. Also revealed in the flow records from Santa Rosa Creek, and also Colgan Creek, is that baseflows following a storm event are gradually lowered over time and spring rains in March/April 2006 were effective in maintaining higher baseflows through the spring season. The hydrographs from Matanzas Creek and Copeland Creek, tributary creeks to Santa Rosa Creek and the upper Laguna, respectively, in 2006-2007 – shown in Figure 3-14 – depict just how flashy some of the smaller creek systems can be. The highest 2007 daily average flows in Matanzas Creek and Copeland Creek were approximately 330 cfs and 100 cfs, respectively. Note that the highest 2006-2007 daily average flow in Colgan Creek of 90 cfs (Figure 3-13), is far less than the highest annual peak flow observed in the gaged record of 934 cfs in 2006 (Figure 3-14), thus reflecting 2007 as being a dry winter with generally low flow conditions in the Program Area creeks.

For the context of the SMP it is useful to consider how flow magnitude relates to water elevation in the channel, potential flooding threats to adjacent lands, and the depositional or erosional processes that may occur in channels with varying flows. Figure 3-15 provides channel cross sections for Santa Rosa Creek and Copeland Creek with estimated water levels for the 100-yr, 25-yr, 10-yr, and 2-yr sized events.

As shown on Figure 3-15 a fair degree of in-channel sedimentation has reduced the available channel capacity to convey flows. Another important feature of the cross section of Figure 3-15 is the identification of a “low flow” channel that conveys flows smaller than the approximate bankfull elevation (flows of approximately the 1.5 to 2-yr return frequency). As observed in several channels of the SMP Program Area, a low flow channel of proper size and slope can be a very effective means to transport fine sediments down through the system. Where flat bottom channels occur with little slope and without a low flow conveyance channel inset in their bed, they often accumulate fine sediments under the slow velocity, diffuse, and shallow flows conditions that favor deposition. SMP channels with and without low flow channels are described and shown in the many reach descriptions of Chapter 4.

In addition to known flooding hazards, the Federal Emergency Management Agency (FEMA) produces maps showing where flooding may occur throughout the country. Figure 3-16 shows the FEMA-designated floodplains for 100-year flood hazard in the Program Area. Most of the FEMA 100-year zones occur in and around the Laguna de Santa Rosa extending up along the floodplains of several tributaries to the Laguna including Windsor Creek, Mark West Creek, Santa Rosa Creek, and Irwin Creek. In the Upper Laguna area, designated FEMA flood zones occur at the lower Bellevue-Wilfred channel, along portions of the floodplains of Copeland and Hinebaugh creeks in Rohnert Park, and along portions of the Upper Laguna channel and Cotati Creek in Cotati. In the Petaluma River Watershed (Zone 2A) flood zones are observed along Marin and Hill creeks and along the Petaluma River upstream toward Lichau Creek. In Zone 3A of the Sonoma Creek Watershed, flood zones are seen in the northern watershed along Kenwood, Sonoma, and Lawndale creeks (Figure 3-16).

3.7 Groundwater

As described above in reference to the hydrologic cycle, groundwater originates from rainfall that infiltrates and percolates through the soil layer into subsurface rock materials that can hold water. When saturated these subsurface rock materials can act as reservoirs that are known locally as aquifers or more regionally as groundwater basins. Aquifers tend to be associated with porous and permeable sedimentary rocks or alluvium that have higher water-bearing capacities, but groundwater can also be held in less porous igneous or metamorphic rocks that have permeability through large joints or fractures. Faults can provide another avenue for subsurface water to collect and migrate.

In the Program Area, groundwater is an important water supply resource supporting municipal and agricultural uses in the Sonoma and Petaluma valleys and in the Laguna de Santa Rosa watershed. The primary regional groundwater basins in the SMP Program Area are the Santa Rosa Valley, Petaluma Valley, and Napa and Sonoma Valley basins. These basins contain smaller groundwater subbasins including the Santa Rosa Plain (125 sq. mi.), Rincon Valley (9 sq. mi.), and Sonoma Valley (70 sq. mi.) subbasins in the Program Area Figure 3-17.

Groundwater sources in the Program Area include fractures in the Sonoma Volcanics in the eastern watersheds, the sedimentary sandstones of the Wilson Grove Formation beneath the Santa Rosa Plain and in the Gold Ridge Hills west of the Laguna, and the coarse fluvial deposits of the Glen Ellen Formation in the Rincon and Sonoma valleys (U.S. Geological

Survey 1958). In addition to these rock unit source areas, the abundant alluvium in the Program Area supports groundwater.

Of particular importance in relation to the purposes of the SMP, many of the channels of the SMP Program Area are important recharge corridors directly to aquifers below. The earthen beds of SMP channels, often comprised of coarse-grained sands, gravels, and cobble provide excellent recharge capacity. Lower Mark West Creek, lower Santa Rosa Creek, the Laguna, and Petaluma River alluvial plains were identified as key recharge streams (Sonoma County 2006) but many additional earthen bed creeks across the alluvial plains and fans of the Program Area provide similar functions.

Sediment deposition in the engineered flood control channels can reduce the channels' ability to support groundwater recharge. Deposition of fine sediments such as mud and silt can reduce or block soil pores and reduce infiltration rates at the channel bed. The aggradation of in-channel bars can heighten much of the bed surface area such that lower and medium sized flows no longer infiltrate across the channel bed. Though it is not an expressed goal of the SMP to enhance groundwater resources, the maintenance of channel bed and bar features to heights appropriate for flood management purposes also provides the added benefit of enhanced groundwater recharge.

3.8 Water Quality

This section presents an overview of water quality conditions related to sediment, temperature, nutrients, and pathogens in the SMP Program Area.

3.8.1 Erosion and Sediment

Watersheds are nested systems where a range of sedimentary processes naturally occur as materials move from higher to lower locations. Sediments can be stored in place, eroded (i.e., initiated into movement downslope or downstream), transported, or deposited. A standard, though simplified, geomorphic approach classifies watersheds into three general zones: (1) a source zone of sediment production, (2) a transport zone where sediments are generally carried, and (3) a depositional zone typically downstream in the basin where sediments are more likely to come to rest. This three-part classification generally works well for the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watersheds of the Program Area. As described above in Section 3.2 *Topography and Landforms*, in general the surrounding mountains act as source areas, the canyons and upper alluvial fans serve as transport zones, and the lower alluvial fans, plains, and valley bottoms operate as depositional zones. While generally true, the simplified three-part classification can obscure several of the erosive, transport, or depositional possibilities observed at more local scales throughout the watershed. Looking at processes in closer detail, sediments can be variably eroded, stored, or transported throughout the entire system, whether in the farthest upstream tributaries, mid-watershed fans and plains watershed plains, or the lower watershed Laguna, marshes, or estuaries.

As introduced above, there are several physical and biological conditions that influence erosion and sediment processes in a watershed, including: geologic structure, tectonism, and properties; topography and slope; climate and precipitation; soils and vegetation; and the hydrologic conditions of infiltration, runoff, and streamflow.

On top of these physical influences, land use practices, history, and structures further influence erosion and sediment processes. The intensification of land uses through agriculture, grazing, fire management, mining, recreation, or residential and commercial development in the Program Area has resulted in increased erosion. Under urbanization, the cause and effect between land use and erosion can be direct as in the following sequence: development reduces infiltration, increases runoff and streamflow, increases sediment delivery to streams, increases in-channel bed/bank erosion and transport, increasing sediment yield downstream. Or, with more agricultural land uses, increases in erosion and sediment delivery may occur without the large increases in streamflows observed with urbanization. In such a case, increased erosion may lead to net channel aggradation, at least locally, because there is not adequate streamflow to carry the material downstream.

SMP Area Regulatory Sediment Issues

Mark West Creek, Laguna de Santa Rosa, Santa Rosa Creek, Petaluma River, and Sonoma Creek are currently identified by federal and state regulatory agencies as being impaired by excessive sediment (State Water Resources Control Board 2006). Degradation of these water bodies has been attributed to agricultural practices (grazing, crop production, and dairies are the primary sources) and land development activities (including residential/commercial development resulting in hydromodification, stream channelization, and reduced floodplain connectivity). The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) is currently developing a Total Maximum Daily Load (TMDL) and implementation plan to address sediment impact in the Sonoma Creek watershed. As described in Chapter 2, the San Francisco Bay and North Coast RWQCBs are also developing a Stream and Wetland Protection Policy to achieve water quality standards and protect beneficial uses.

A serious concern in the Program Area is the degree and rate of sedimentation in the Laguna and how this sedimentation has impacted beneficial uses, particularly impacts to aquatic habitats (Honton and Sears 2006). The United States Army Corps of Engineers (USACE) also sponsored a study of historical sedimentation in the Laguna (PWA 2004). This study arose from an interest at USACE in understanding how the Laguna's ability to provide backwatering storage capacity to Russian River flows has been reduced through sedimentation in the Laguna. The study found that about 1.5 ft. of sediment had been deposited on average across the extent of the Laguna between the years 1946 and 2002. This trend was forecast to continue into the future. Excessive sedimentation can lead to further water quality degradation, as indicated by the 2006 Section 303(d) impairment listings for the Laguna due to excess levels of nitrogen, phosphorus, suspended sediment, elevated water temperature, and low dissolved oxygen (State Water Resources Control Board 2006).

The maintenance activities of the SMP, particularly in regard to in-channel sediment management and removal provide a benefit to the Laguna as a downstream resource that is currently impacted for sediment. Additionally, the SMP's off-site watershed mitigation program (as described in Chapter 8 Section 8.7.3) provides a direct funding mechanism for erosion control and sediment reduction projects in the immediate headwater sediment source areas of the Program Area.

3.8.2 Temperature

Parameters that influence stream temperature include ambient air temperature, humidity, riparian vegetation, topography, surrounding land use, and flow conditions. Additionally, cold water seeps and groundwater inputs contribute to moderating and lowering stream water temperatures. Among these parameters, direct solar radiation on the water surface is perhaps the most influential factor in raising water temperature. Consequently, shade provided by riparian vegetation often controls water temperature. Water temperature influences a number of chemical processes within water bodies. Dissolved oxygen capacity is inversely related to water temperature. As water temperature rises, the maximum potential concentration of dissolved oxygen reduces. This affects the growth and decay rate of aquatic species that rely on high dissolved oxygen concentrations for survival.

Streams in Mediterranean climates, such as Sonoma County, experience seasonally reduced flows in summer, resulting in higher water temperatures. Additionally, land development often results in removal of riparian shading, reduced cold-water inputs (i.e., altered groundwater supplies), increased sediment deposition due to channel modifications, and increased surface runoff. All of these factors alter channel geomorphology, which in turn create conditions that can cause water temperatures to rise to levels that degrade habitats for cold water species. While shading creeks may help decrease water temperatures, it is important to note that runoff received from urbanized areas may exhibit relatively high water temperatures compared to runoff received from non-urbanized areas. Additionally, summer air temperatures in Sonoma County are capable of exceeding 90 degrees F. Under such conditions, given the narrow width of the riparian corridor, shading of the creek may only modestly reduce creek water temperatures. It is also important to note that streams flowing across the valley floor often naturally have relatively warm water temperatures. These conditions are not necessarily indicative of poor water quality and can provide important habitat opportunities for native warm water fish assemblages.

Water temperature is a key constituent for assessing the quality of habitat within areas that support anadromous fish. Steelhead trout (*Oncorhynchus mykiss*), coho (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*) are highly sensitive to temperature and require cold water throughout the majority of their life stages. As stated in Moyle (2002), optimal water temperatures for growth and survival of steelhead trout are 59°–64°F (15°–18°Celcius (C)) and mortality occurs at 73°–81°F (23°–27°C) (Moyle 2002). Optimal temperatures for growth and survival of Chinook salmon are 55°–64°F (13°–18°C) and mortality occurs at temperatures of 72°–73°F (22°–23°C). Optimal water temperature for growth and survival of coho salmon are 54°–57°F (12°–14°C) and mortality occurs at 77°–79°F (25°–26°C) (Moyle 2002). Though not specific to the creeks within the SMP area, these thresholds are generally accepted for assessing optimal habitat conditions for steelhead, coho and Chinook salmon.

Habitat for cold-water anadromous fish species, including steelhead trout and coho and Chinook salmon is present in the SMP Program Area. However, the majority of the cold-water and prime rearing habitat is located outside of the SMP area, particularly for Chinook and coho. Some of the SMP Program Area channels are used by salmonids for migration to upper watershed spawning areas.

SMP Area Temperature Issues

The Laguna de Santa Rosa, Mark West Creek, and Santa Rosa Creek, as part of the Russian River watershed, are identified by federal and state regulatory agencies as being impaired by high temperatures (State Water Resources Control Board 2006). SCWA channels primarily serve as migratory corridors for anadromous fish passing from the Russian River to spawning and rearing areas higher in the tributary watershed. Proper maintenance of creekside vegetation and new plantings along SCWA-maintained channels will help shade the channel, which is anticipated to reduce water temperatures.

3.8.3 Nutrients

Nutrients, specifically nitrogen and phosphorus, are essential for life and play a primary role in ecosystem functions. Nitrogen and phosphorus are naturally occurring inorganic ions present within the atmosphere and in fixed forms within organic matter, such as plants and soils. In addition to naturally present concentrations, nutrients are introduced to water bodies through human or animal waste disposal or agricultural application of fertilizers.

Nutrients are commonly the limiting factor for growth in aquatic systems. In freshwater streams of the Bay Area, nitrogen is the limiting nutrient (Krottje and Whyte 2003). Many types of activities, such as agriculture, land development, and urban runoff, can result in excessive loading of nutrients to water bodies. Excessive nutrient loading in streams can produce toxic or eutrophic conditions, both of which impair aquatic life. Eutrophication also can lead to increased algal growth and reduced oxygen levels in the water, thus reducing aesthetic quality and habitat value. Sediments contain nutrients that stimulate growth of invasive aquatic weeds. Nutrients can leach from sediments and cause eutrophication in water. Sediments can also deplete oxygen from water. Ammonia is a plant growth nutrient that is also toxic to aquatic life under elevated pH conditions associated with eutrophication.

The nutrient content of sediment in some streams in the SMP area has been studied and found to be elevated in some cases. In the Laguna de Santa Rosa in particular, sediments have been found to contain as much as 2,400 milligrams per kilogram (mg/kg) and 4,600 mg/kg of total phosphorus and total nitrogen, respectively (see *The Altered Laguna: a Conceptual Model For Watershed Stewardship*, Laguna de Santa Rosa Foundation 2007). The quantity of nutrients in sediment within the SMP area is large and is considered a major factor contributing to eutrophication in the Laguna de Santa Rosa.

SMP Area Nutrient Issues

The Laguna de Santa Rosa, Petaluma River, and Sonoma Creek are identified by federal and state regulatory agencies as being impaired by excessive nutrients (State Water Resources Control Board 2006). The San Francisco Bay RWQCB is currently developing a TMDL and implementation plan to address nutrient impacts in the Sonoma Creek watershed.

Excess nutrients in these water bodies often encourage excessive vegetation growth. For example, the Laguna is currently impacted throughout much of its length and may be a factor in the spread of ludwigia, or water primrose (*Ludwigia peploides montevidensis*). As the species also occurs in low nutrient areas such as gravel bars in the upper Russian River, nutrients may not be the only causal factor in the spread of this species. The Laguna Foundation, with funding assistance from SCWA and other supporters, has conducted regular ludwigia control activities to better manage impacted channels and improve ecosystem function. In addition to impacting streams (i.e., filling a channel to capacity), vegetation can also trap sediment and reduce flow capacity of the channel.

3.8.4 Pathogens

Pathogens are microorganisms that cause diseases in other organisms. Bacteria are the primary indicator organisms of pathogens, particularly for the detection of waterborne diseases. Waterborne diseases threaten the health of recreational users of waters and wildlife. Pathogenic bacteria contained within fecal waste are the common source of waterborne diseases. Fecal contamination can be detected by bacterial indicators, such as total coliforms, fecal coliforms, *Escherichia coli* (*E. coli*), and fecal *enterococci*. High concentrations of these indicator bacteria – resulting from poor waste management and disposal, and sometimes from homeless encampments along the creek banks – can degrade water quality for human consumption, recreation, and wildlife use.

SMP Area Pathogen Issues

Santa Rosa Creek, Petaluma River, Sonoma Creek have been identified by federal and state agencies as being impaired by pathogens (State Water Resources Control Board 2006). A TMDL and implementation plan to address the pathogen impairment in Sonoma Creek was adopted by the San Francisco Bay RWQCB in 2006. These basin plan amendments were adopted by the State Water Resources Control Board and approved by the U.S. Environmental Protection Agency (USEPA) in 2008.

Accumulated trash and homeless encampments can foster favorable conditions for pathogens. The SMP maintenance activities would remove or reduce opportunities for pathogens by maintaining channels free of trash and encouraging better flow conditions in SCWA maintained channels.

3.9 Natural Communities and Channel Land Cover

This section presents a description of natural communities and channel land cover types in the Program Area. Land cover and natural communities occurring in the Program Area were categorized into eight primary types, as follows:

- Willow Scrub
- Riparian Forest and Woodland
- Mixed Riparian Scrub
- Emergent Wetlands
- Blackberry Scrub

- Ruderal
- Developed
- Aquatic

Invasive species are common in these natural communities in the Program Area and are commonly characteristic of the surrounding residential and agricultural areas. Seeds and vegetative fragments from these invasive species are carried into the Program Area by tributary flows, wind, animals, and by residents using the Program Area for recreation. Monitoring and controlling invasive species is an important ongoing maintenance activity that is necessary to maintain and enhance habitat value and flood control in the Program Area.

The channels and associated natural communities in the Program Area provide valuable habitat for many common and special status plant and animal species. Many of the common and special status species with potential to occur in the SMP channels are discussed together with the natural communities in which they are found. A more detailed discussion of the special status species with potential to occur in SMP channels is provided in Section 3.10 *Special Status Plants, Wildlife, and Fish*.

3.9.1 Willow Scrub

Willow scrub in the Program Area is typically located on the banks and sandbars of perennial drainages. Within the SMP area stands of willow scrub, riparian trees and shrubs would be best characterized as Central Coast Riparian Scrub. As described by Holland (1986) Central Coast Riparian Scrub is a scrubby streamside thicket, varying from open to impenetrable, dominated by any of several willow species. This early seral community may succeed to any of several riparian woodland or forest types in the absence of severe flooding disturbance. This community occurs on relatively fine-grained sand and gravel bars adjacent to river channels and therefore close to groundwater.

Willow scrub within the SMP area is dominated by dense growths of a number of willow species, including red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), and Pacific willow (*Salix lucida lasiandra*). Typical willow scrub in the Program Area is shown in the photographs of Figure 3-18. Box elder (*Acer negundo*) and California black walnut (*Juglans californica*) are frequently minor components of willow scrub, as well. Sandbar willow (*Salix exigua*) is also common in willow scrub, particularly in areas that are recently disturbed. The herbaceous layer within willow scrub is typically sparse. Openings in willow scrub are commonly dominated by non-native herbaceous species, such as various brome grasses (*Bromus sp.),* Italian rye (*Lolium multiflorum*), wild oat (*Avena sativa, A. barbata*), Harding grass (*Phalaris aquatica*), hemlock (*Conium maculatum*), teasel (*Dipsacus fullonum*), and bristly ox-tongue (*Picris echioides*).

Several common wildlife species can be associated with willow scrub, including amphibians such as Pacific treefrog (*Pseudacris regilla*) and western toad (*Bufo boreas*). Ring-necked snake (*Diadophus punctatus*), common garter snake (*Thamnophis sirtalis*), and western terrestrial garter snake (*Thamnophis elegans*) are also found in scrub and forest in or along streams. Common birds such as California thrasher (*Toxostoma redivivum*) and Western scrub jay (*Aphelocoma californica*) use willow scrub habitats for nesting. It is common for mammals to use these riparian areas for corridors during dispersal and while foraging.

Special Status Species

Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*) (federally endangered [FE], California Native Plant Society [CNPS] List 1B) has potential to occur in willow scrub in the Program Area.

Willow scrub in river channels can provide breeding and summer habitat for the federally threatened California red-legged frog (*Rana draytonii*), which may utilize this vegetation for cover, and may attach egg masses to submerged roots or other vegetation.

Several migratory songbirds nest in willow riparian scrub including song sparrow (*Melospiza melodia*), red-winged blackbird (*Agelaius phoeniceus*), loggerhead shrike (*Lanius ludovicianus*), common yellowthroat (*Geothlypis trichas*), and yellow warbler (*Dendroica petechia*). Other migratory songbirds may utilize willow scrub as stopover sites during migration.

Ecosystem Functions

The primary ecosystem functions provided by willow scrub are:

- stabilization of streambanks;
- shading of water;
- maintenance of water quality by filtering out sediment and nutrients;
- providing movement areas for wildlife; and
- providing wildlife refugia habitat and forage through the input of detritus and insects into streams and rivers.

Response to Disturbance

Willow scrub responds to minor disturbance by rapidly resprouting. Where bank failure occurs or sandbars are removed by flooding or mechanical means, abundant wind- and water-dispersed seeds allow willow species to rapidly colonize once substrate is available. However, disturbance may allow invasive species such as giant reed (*Arundo donax*), pampas grass (*Cotaderia selloana*, and *C. jubata*), various species of eucalyptus, Indian bean (*Catalpa bignonioides*), or tree of heaven (*Ailanthus altissima*) to become established and prevent willow scrub from regenerating. Disturbed areas should be monitored in order to allow removal of invasive populations before they become well established.

Stream Maintenance Considerations

The presence of willow scrub vegetation can be compatible with flood control, particularly when it forms a band along the edge of an active channel. When willow scrub is present along the channel banks, it helps to stabilize banks and overhanging vegetation shades water in the channel, enhancing aquatic habitat and reducing the growth of dense emergent vegetation. In some areas where willow scrub occupies much of the channel, it may be necessary to reduce or remove it in order to maintain flood control capacity. Where possible, consistent with flood control needs, areas of willow scrub that are particularly valuable for habitat or water quality will be preserved. For example, a patch of willow scrub located at the mouth of a drainage ditch may be particularly valuable for filtering out sediment and nutrients. Willow scrub adjacent to deep pools may provide California red-legged frog breeding habitat.

3.9.2 Riparian Forest and Woodland

Riparian forest and woodland in the Program Area is found on the banks of perennial drainages between the Ordinary High Water Mark (OHWM) and top-of-bank (TOB). This community may include many non-native tree species performing a riparian function. On intermittent drainages, such as Peterson Creek in Zone 1A, riparian forest and woodland is typically found at the top of bank. This community is also found adjacent to the TOB for both perennial and intermittent drainages. Typical riparian forest and woodland in the Program Area is shown in the photographs of Figure 3-19.

Riparian forest and woodland in the Program Area is dominated by a variety of tree species. Coast live oak (*Quercus agrifolia*) and valley oak (*Quercus lobata*) are the most common species in riparian woodland in the Program Area. Other common species include Oregon ash (*Fraxinus latifolia*), California black walnut, Fremont cottonwood (*Populus fremontii*), white alder (*Alnus rhombifolia*), and cork oak (*Quercus suber*). Larger trees are commonly found at the TOB, while shorter willows or alders may be found growing near the OHWM (see description of willow scrub above). The herbaceous understory of riparian woodland along the flood control channels is typically dominated by non-native species that are also dominant in ruderal areas, such as brome grasses, Italian ryegrass, English and Algerian ivy (*Hedera helix, H. canariensis*), periwinkle (*Vinca major*), Himalayan blackberry, Harding grass, bristly ox-tongue, and sweet fennel (*Foeniculum vulgare*).

The non-native blackberry scrub and periwinkle (*Vinca* spp.) are frequently interspersed with riparian woodland or present as an understory along the banks in reaches where mature trees are present at the top of the bank.

Riparian forest and woodland was classified into four sub-categories based on the degree of canopy closure over the stream channel. Areas with greater canopy closure provide more shading of the streams, enhancing habitat for fish and other wildlife species and reducing the growth of wetland vegetation in the channel. Greater canopy closure is therefore typically associated with higher quality aquatic habitat for many fish and wildlife species. Riparian habitat quality is also enhanced by more mature trees with greater canopy closure. However, riparian habitat quality also depends on the degree of development of herbaceous, shrub and subcanopy layers. In some cases, riparian woodland with a high degree of canopy closure may consist of one or two rows of mature trees at the top of the bank, without a shrub or subcanopy layer.

Despite the constraints on wildlife habitat in the watershed, a well-developed riparian woodland overstory and dense vegetative cover in the understory provide habitat for species that can tolerate chronic human disturbance. Several species of nesting songbirds utilize riparian forest and woodland. Several commensal species of mammals, including raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), and striped skunks (*Mephitis mephitis*) flourish in riparian forests that are in close proximity to human disturbance. Additionally, many bird species associated with oak woodland habitats, such as oak titmouse (*Baeolophus inoratus*) and acorn woodpecker (*Melanerpes formicivorus*), are also found in riparian woodlands.

Madrone Audubon Society surveys of Santa Rosa's creeks have documented many year round residents, including but not limited to, acorn woodpecker, Anna's hummingbird (*Calypte anna*), black phoebe (*Sayornis nigricans*), California towhee (*Pipilo crissalis*), and belted kingfisher (*Ceryle alcyon*). California Swainson's thrush (*Catharus ustulatus oedicus*) is a summer resident of riparian forests in the Program Area.

Western toad, Pacific treefrog, ring-necked snake, common garter snake, and western terrestrial garter snake, discussed above under willow scrub, may also be found in riparian forest and woodland. California giant salamanders (*Dicamptodon ensatus*) may utilize riparian forest along small streams relatively high in the watersheds of the Program Area. Riparian forest and woodland also provide habitat for species such as black-tailed deer (*Odocoileus hemionus*).

Wildlife habitat is greatly enhanced by riparian vegetation, which provides shade, food, and nutrients for algae and aquatic invertebrates that form the basis of the food chain. Coarse woody debris from riparian trees and shrubs is also an important feature of in-stream habitat, forming scour pools and log jams used by amphibians, insects, and fish. Riparian forests and woodland may be the most important habitat for California bird species, providing breeding and over wintering habitat, migration stopover areas, and movement corridors (Riparian Habitat Joint Venture 2004). The quality of riparian wildlife habitat is enhanced by multilayered, structurally complex vegetation, including canopy trees and a shrub layer, and food sources such as berries and insects.

Special Status Species

California bottlebrush grass (*Elymus californicus*) (CNPS List 4) may occur in riparian woodland and forests in the vicinity of the SMP area. Riparian woodland provides nesting habitat for several raptor and migratory bird species some of which are special status bird species, such as white-tailed kite (*Elanus leucurus*) and yellow-breasted chat (*Icteria virens*). Other migratory birds such as yellow warbler and protected subspecies of common yellowthroat and song sparrow may also nest in riparian habitats throughout the SMP area. Bald eagles have been observed in the vicinity of SCWA's flood control channels and creeks in the California Department of Fish and Game (CDFG) Wildlife Area north of Occidental Road (Laguna de Santa Rosa Foundation 2006). California freshwater shrimp (*Syncaris pacifica*) may be found along creek reaches with riparian woodland or forest, utilizing exposed live tree roots of undercut banks and feeding on detrital material from overhanging vegetation.

Like other communities adjacent to creeks, this habitat provides movement corridors and short-term refugia for California red-legged frog. Where adequate cover is available and human disturbance is relatively low, riparian forest and woodland provides potential egg laying sites for western pond turtle (*Actinemys marmorata*), which has been documented in several tributaries in the Program Area. California tiger salamander (*Ambystoma* *californiense*) has been documented in the vicinity of the Program Area, and may utilize woodland, if grasses dominate the understory and suitable burrows for aestivation are present. Special status bats, such as the long-eared myotis (*Myotis evotis*), Townsend's big-eared bat (*Corynorhinus townsendii townsendii*), Western red bat (*Lasiurus blossevillii*) and pallid bat (*Antrozous pallidus*), may utilize mature trees in riparian forest or woodland for temporary roosting sites while foraging and day roost sites. In general, riparian corridors are important foraging areas for bats.

Ecosystem Functions

The primary ecosystem functions provided by riparian forest and woodland are:

- stabilization of streambanks;
- shading of water;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintenance of stream flows during summer by promoting groundwater recharge and storing water;
- providing movement areas for wildlife; and
- providing wildlife refugia and breeding habitat and forage through the input of coarse woody debris and detritus into streams and rivers.

Response to Disturbance

Disturbance, whether natural or human-induced, affects different plant species in various ways. Some mature tree species in riparian woodland, such as black walnut, Fremont's cottonwood, and coast live oak, can resprout if they are damaged by flooding or mechanical disturbance. Others, such as valley oak, may be capable of resprouting as seedlings or saplings but lose this ability when mature. In general, mature riparian trees do not resprout as vigorously as riparian scrub species and require longer periods than scrub species or invasive species to recolonize by seed. Therefore, as areas recover from disturbance, they are likely to be dominated initially by herbaceous vegetation, followed by willow scrub and possibly larger willows. Ultimately, in the absence of disturbance, mature riparian woodland and/or forest will develop.

Disturbance of riparian woodlands may lead to increases in the relative cover of invasive exotic species including sweet fennel, bristly ox-tongue, English ivy (*Hedera helix*), French broom (*Genista monspessularia*), Himalaya blackberry (*Rubus discolor*), and periwinkle. These species are currently spreading in riparian areas and displacing native vegetation. This shift in riparian species composition can reduce native species diversity and habitat value, and may alter creek hydrology.

Stream Maintenance Considerations

Riparian forest and woodland enhances flood control functions by discouraging the growth of dense emergent vegetation that could otherwise reduce channel conveyance capacity. As described above, it also enhances habitat value. The SMP approach encourages riparian forest and woodland in the Program Area by planting riparian trees at the top of bank and, depending on channel capacity, at the toe of the slope. Riparian forest and woodland in the Program Area consists of a mixture of native trees, such as coast live oak, and non-native trees, such as cork oak. Planting native species and controlling invasive shrubs in the understory will enhance the habitat value of this community.

3.9.3 Mixed Riparian Scrub

Mixed riparian scrub occurs between TOB and the OHWM of some perennial and intermittent drainages, as well as adjacent to and outside of TOB. Typical mixed riparian scrub in the Program Area is shown in the photographs of Figure 3-20. Mixed riparian scrub is characterized by a shrub layer dominated by Himalaya blackberry, coyotebrush (*Baccharis pilularis*), and saplings of valley oak, California black walnut, and arroyo willow. An herbaceous layer is present in between patches of shrubs, dominated by Harding grass, Fuller's teasel, bristly ox-tongue, wild oats (*Avena* spp.), and Mediterranean mustard (*Hirschfeldia incana*).

Commensal species discussed above, such as striped skunk, opossum, and raccoon, may use mixed riparian scrub. Western toad, Pacific treefrog, common garter snake, and western terrestrial garter snake, also discussed above, may too be found in mixed riparian scrub. Other previously discussed species—red-winged blackbird, common yellowthroat, and song sparrow–will also use these habitats for nesting. Deer and wild turkey may use mixed riparian scrub for movement corridors, foraging, and daytime loafing.

Special Status Species

Sonoma alopecurus, white-tailed kite, and loggerhead shrike, discussed above, have potential to occur in mixed riparian scrub in the Program Area.

Ecosystem Functions

The primary ecosystem functions provided by mixed riparian scrub are:

- stabilization of streambanks;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintenance of stream flows into summer by promoting groundwater recharge and storing water;
- providing movement areas for wildlife; and
- providing wildlife breeding and refugia habitat and forage through the input of coarse woody debris and detritus into streams and rivers.

Response to Disturbance

Mixed riparian scrub responds to minor disturbance by rapid regrowth. Shrubs may regenerate from the roots or from remnant aboveground material, while saplings will resprout. Disturbance may lead to increased dominance by more invasive species in this community, such as Himalaya blackberry. Increased cover of Himalaya blackberry may improve habitat quality for some species, particularly bird species. However, habitat quality for other species will be reduced by the reduced diversity of the vegetation community. In addition, increased cover of Himalaya blackberry may reduce conveyance capacity of the flood control channel. Disturbed areas should be monitored in order to allow control of invasive populations before they become well established.

Stream Maintenance Considerations

The SMP approach will encourage the growth of riparian forest and woodland where large areas of mixed riparian forest and scrub occur, in order to achieve the flood control and habitat benefits that riparian forest provides. However, properly situated patches of mixed riparian scrub within a matrix of riparian forest are desirable, because they are compatible with flood control and increase overall habitat complexity. In locations where it is difficult to establish riparian woodland, mixed riparian scrub may be encouraged in place of ruderal communities on channel banks because of the bank stabilization benefits and habitat that it provides.

3.9.4 Emergent Wetlands

Emergent wetlands in the Program Area occur as a narrow fringe along the margins of some drainages, or as patches or dense stands in other drainages. Photographs of representative emergent wetland in the Program Area are shown in Figure 3-21. Many creek reaches in the Program Area are characterized by dense stands of cattail (*Typha* spp.), with bulrush or tule (*Scirpus* spp.) as a significant but less common component. *Ludwigia peploides montevidensis* (ludwigia), a non-native floating emergent species, is a problem species in emergent wetlands in many creeks in the Program Area.

The narrow strips and small patches of emergent wetland found along the margins of creek channels in the Program Area are dominated by a variety of species, including rice cutgrass (*Leersia oryzoides*), giant bur-reed (*Sparganium eurycarpum*), common water plantain (*Alisma plantago-aquatica*), common threesquare (*Scirpus pungens*), river bulrush (*Scirpus fluviatilis*), hardstem bulrush (*Scirpus acutus*), torrent sedge (*Carex nudata),* and cyperus species, including red-rooted cyperus (*Cyperus erythrorhizos*). Associated species include mint (*Mentha* spp.), willowherb (*Epilobium ciliatum*), and smartweeds such as waterpepper (*Polygonum hydropiperioides*).

Pacific treefrog and western toad, discussed above, may also be associated with emergent wetland vegetation. Birds such as red-winged black birds, Virginia rails (*Rallus limicola*), and soras (*Porzana carolina*) may utilize dense freshwater marsh vegetation. Cattail wetlands are utilized extensively by muskrats (*Ondotra zibethica*). Where muskrat populations are large, foraging may be an important factor in maintaining open water areas. In addition, cattail fruits are utilized by terrestrial birds for nesting material, and their stems may be used by aquatic birds (Motivans and Apfelbaum 2005).

Special Status Species

Special status plants that may occur in freshwater marsh in the Program Area include Sonoma alopecurus, swamp harebell (*Campanula californica*) (CNPS List 1B), Sonoma white sedge (*Carex albida*) (FE, state endangered (SE), CNPS List 1B) and California beaked-rush (*Rhynchospora californica*) (CNPS List 1B).

California red-legged frog may utilize emergent wetland vegetation for cover and breeding habitat. Emergent wetlands in creek channels provide suitable habitat for western pond turtle. Red-winged blackbird, common yellowthroat and song sparrow may utilize freshwater marsh vegetation for nesting.

Ecosystem Functions

The primary ecosystem functions provided by emergent wetland are:

- maintenance of water quality through filtration of sediment and nutrients;
- recharging of groundwater by slowing surface flows;
- prevention of flooding by storing floodwaters; and
- providing wildlife habitat directly.

Response to Disturbance

Emergent wetland vegetation responds to disturbance by rapid regrowth from rhizomes or recolonization from seed sources upstream. Habitat quality typically decreases while emergent wetlands recover from disturbance. Lack of disturbance and accumulation of sediment may lead to conversion of emergent wetlands to willow scrub communities.

Stream Maintenance Considerations

In some cases, emergent wetland in and along channels in the Program Area is compatible with flood control needs. A fringe of emergent wetland vegetation along the channel banks or relatively sparse patches of vegetation within the channel typically does not lower channel conveyance capacity below safe thresholds. Emergent wetland vegetation of this sort is encouraged in the SMP because of the habitat and water quality benefits it provides. However, dense emergent wetland vegetation (often composed of cattails and ludwigia) is found in many channels in the Program Area. These stands are incompatible with flood control because of their association with increased sedimentation rates. In the short term, vegetation and sediment removal is necessary to maintain conveyance capacity in these channels. Additionally, from an ecological viewpoint, excessive buildup of sediment in Program Area channels causes a succession of the instream habitat toward monocultural stands of cattail marsh. Removing the sediment has the beneficial effect of providing a varied habitat that supports a more diverse species mix until increasing aggradation triggers the need for sediment to be removed again. In the long term, SCWA is encouraging the development of riparian woodland along these channels to reduce the growth of emergent wetland vegetation. Much of the emergent wetland vegetation in the Program Area is of low habitat value for many species, because it consists of dense monocultures of cattails or ludwigia.

Where vegetation removal is necessary to increase conveyance capacity, patches of emergent wetland or a wetland fringe may be maintained when feasible. Wetland patches or a wetland fringe will provide habitat and enhance water quality, as well as preserving the diversity of vegetation communities along the reach.

Reducing the proportion of emergent wetlands characterized by dense monocultures of cattails would enhance habitat heterogeneity and conveyance capacity. Planting of trees just above the toe of slope in the channel and at the top of bank may be necessary to help control cattails in the long term. These trees will mature and create a canopy over the active channel, providing shade and discouraging cattail growth. Cattails may also be controlled by completely removing the plant and root structure. This is achieved through sediment removal (removing cattails along with the sediment) in reaches where sediment has settled in the channel and been populated by cattails combined with the strategic planting of potential competitors to reduce available habitat.

3.9.5 Blackberry Scrub

Blackberry scrub is located on the banks of some intermittent and perennial drainages in the Program Area. Photographs of representative blackberry scrub in the Program Area are shown in Figure 3-22. In a few cases, such as in some reaches of Cotati Creek, blackberry scrub fills drainage channels. In some cases, blackberry scrub forms the understory in open riparian woodlands. It is characterized by a dense growth of Himalaya blackberry, which is native to Eurasia.

As noted in the discussion of mixed riparian scrub above, areas with dense blackberry patches often attract species such as red-winged blackbird, common yellowthroat and song sparrow. Also, this habitat is favored by Norway rats (*Rattus norvegicus*) for food and shelter.

Special Status Species

Tricolored blackbird (*Agelaius tricolor*) has been documented using blackberry scrub in the central valley (Hamilton 2004), though there are no documented cases of this occurring in Sonoma County.

Ecosystem Functions

The primary ecosystem functions provided by blackberry scrub are:

- Stabilization of streambanks;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintenance of stream flows into summer by promoting groundwater recharge and storing water; and
- providing wildlife refugia and foraging habitat.

Response to Disturbance

Blackberry scrub responds to minor disturbance by rapid regrowth. Himalaya blackberry is effective at expanding into disturbed areas. While increased cover of Himalaya blackberry may improve habitat quality for some species, particularly bird species, habitat quality for other species will be reduced by the reduced diversity of the community. In addition, increased cover of Himalaya blackberry may reduce conveyance capacity of the flood control channel.

Stream Maintenance Considerations

To the extent possible, SCWA will endeavor to control the spread of blackberry scrub in the Program Area in order to encourage greater cover of native species and to prevent loss of flood control functions. Encouraging the development of riparian forest and woodland is anticipated to reduce the overall cover contributed by Himalayan blackberry, which is observed to generally be intolerant of shade. In the short term, vegetation removal will be necessary to maintain channel conveyance capacity in some areas where Himalaya blackberry has occupied the channel.

3.9.6 Ruderal

Ruderal vegetation in the Program Area is found in the channels of smaller intermittent drainages, and on and above the banks of many intermittent and perennial drainages. Ruderal vegetation is an assemblage of plants, often a mixture of both native and non-native weed species that thrive in waste areas, heavily grazed pastures, cultivated and fallow fields, roadsides, parking lots, footpaths, residences and similar disturbed sites in towns and cities and along rural roadways. In areas of frequent human disturbance, typical of the SMP area, the majority of wild plants are often introduced weeds rather than natives. However, ruderal species may at times be integrated into other communities (Holland and Keil 1995). Within the SMP, ruderal vegetation frequently forms the understory of riparian woodland in the Program Area. Photographs of representative ruderal vegetation in the Program Area are shown in Figure 3-23. Ruderal vegetation in the Program Area varies depending on the site hydrology. In more mesic areas, such as the creek banks of perennial drainages, ruderal vegetation is dominated by Harding grass, Italian rye grass, various brome grasses, wild oat, star thistle (*Centaurea solstitialis*), Italian thistle (*Carduus pycnocephalus*), hemlock, Bermuda grass (*Cynodon dactylon*), bristly ox-tongue, velvet grass (*Holcus lanatus*), and Fuller's teasel. In drier areas, adjacent to intermittent drainages or on the outer edges of access roads, ruderal vegetation is dominated by species such as sweet fennel, wild oats, Mediterranean mustard, and wild radish (*Raphanus sativus*).

Ruderal vegetation may be used for movement and foraging by wildlife species discussed above that are tolerant of chronic human disturbance. In addition, ruderal areas may provide foraging areas for raptors. Openings in the riparian forest or woodland canopy in the Program Area are typically characterized by ruderal vegetation or mixed riparian scrub. Maintaining some open areas in riparian woodland enhances habitat function by increasing structural heterogeneity and providing foraging and basking areas for some wildlife species.

Special Status Species

Burrowing owl (*Athene cunicularia*) may use ruderal areas where ground squirrel activity is sufficient to provide burrows, though Klute, et al. (2003) listed the species as nearly extirpated as a breeding species in Sonoma County. Western pond turtle may use ruderal areas adjacent to water for egg-laying sites. California tiger salamander has been documented in the vicinity of SCWA-maintained channels, and may utilize ruderal areas if suitable burrows for aestivation are present. All of these species could move through ruderal areas during local or long distance migration.

Ecosystem Functions

The primary ecosystem functions provided by ruderal vegetation are:

- stabilization of streambanks;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from runoff;
- maintenance of stream flows during summer by promoting groundwater recharge and storing water; and
- prevention of flooding and minimization of channel erosion by slowing surface runoff.

Ruderal areas provide lower amounts of functions than mixed riparian scrub and riparian woodland and forest.

Response to Disturbance

Ruderal areas respond to disturbance such as mowing or flooding by rapid colonization and regrowth.

Stream Maintenance Considerations

The SMP will generally encourage the growth of perennial grassland, willow scrub, riparian forest and woodland in the place of ruderal vegetation. Where ruderal areas are present as small openings within a matrix of riparian woodland, they may provide valuable foraging or basking areas for native wildlife. Native herbaceous species could be planted in these areas, maintaining them as open areas.

3.9.7 Developed

Developed portions of the Program Area include access roads, v-ditches, in-channel structures including culverts, bicycle trails, and supporting infrastructure located adjacent to drainages. These areas are largely unvegetated, although some canopy from trees lining the road may be present. Along many reaches some landscaping may also be present. V-ditches may be bare, but are also sometimes support ruderal grasses. Developed land covers provide low quality habitat for species that are adapted to chronic human disturbance. Photographs of representative developed land covers adjacent to streams in the Program Area are shown in Figure 3-24.

Stream Maintenance Considerations

The main maintenance consideration for developed land covers is the need to keep roads and v-ditches clear of woody vegetation so that maintenance vehicles have access to channels. Access roads may be treated with herbicides to prevent vegetation from growing.

V-ditches must also be kept clear of excessive vegetation and sediment so that the drainage function is maintained.

3.9.8 Aquatic

Aquatic communities are discussed in terms of intermittent and perennial drainages. The many hydrologic and geomorphic processes that influence streamflow and sediment conditions in the aquatic environment are discussed above in Sections 3.2 through 3.8. A key process for understanding aquatic environments in the Program Area is the relationship between in-channel sedimentation and the growth of marsh or willow scrub vegetation. In areas of abundant in-channel sedimentation, particularly areas with medium and finer sediments (finer than coarse sands), cattail marsh or willow vegetation will often colonize. This typically happens in locations where the channel gradient has lessened (perhaps just upstream or downstream of a crossing or in-channel structure) and sediments collect either as in-channel bars, or as a broad depositional wedge across the entire channel width. Under such depositional conditions, and especially when there is little shade and the area is very sunny, the marsh and willow vegetation establish quickly. The positive feedback between low gradient reaches creating a depositional environment, which then attracts and fosters aquatic vegetation, which in turn traps more sediment, has several management implications. This feedback process is also described in Chapter 5, Section 5.2 *Maintenance Principal 6: Integrate Maintenance Activities Towards Sustainability*.

Intermittent Drainages

Smaller intermittent drainages with lower flows, such as Ducker Creek and Forestview Creek, support primarily ruderal vegetation in their channels and along their banks. Larger intermittent drainages, such as Austin Creek, support in-channel emergent wetland vegetation. Emergent wetlands in intermittent drainages with little or no canopy cover, such as Airport Creek, may be dominated by dense stands of cattails. The location and extent of in-channel vegetation in intermittent drainages varies depending on the nature of the channel and the nature and timing of vegetation management activities in the channel. In-channel vegetation may be limited to a narrow fringe of wetland vegetation along the low-flow channel, or it may form a dense to open stand filling the channel. The upper banks of larger intermittent channels support blackberry scrub or ruderal vegetation. Vegetation communities at and adjacent to the TOB in intermittent drainages include ruderal vegetation, riparian woodland, and mixed riparian scrub.

Perennial Drainages

As is the case in intermittent drainages, the location and extent of vegetation within the channels of perennial drainages vary. In channels with steeper gradients, more rapid flows and more scour, vegetation may be limited to a narrow fringe of wetland vegetation along the low-flow channel. This is generally also the case for channels in which recent maintenance activity has removed vegetation. In channels with gentler gradients, vegetation often forms a dense stand that fills the channel.

Smaller perennial drainages, such as Abramson Creek, and upper reaches of larger perennial drainages, such as the east fork of Windsor Creek, are characterized by low flows at the end of the dry season. Vegetation in and along these channels is similar to the vegetation described above in larger intermittent drainages.

Many large perennial drainages lack significant in-channel vegetation. In-channel vegetation in some perennial drainages, such as Colgan Creek, consists of stands of cattails or water plantain. In other drainages, such as lower Santa Rosa Creek and Spring Creek, sand and gravel bars have formed. These features support a variety of vegetation communities. Recently established gravel bars support ruderal vegetation, much of which is not hydrophytic, dominated by species such as white sweetclover (*Melilotus alba*). Older sand and gravel bars are typically characterized by willow scrub. Many large perennial drainages, such as Windsor Creek, support a band of willow scrub located at and above the OHWM and often have a good compliment of riparian forest trees. Other perennial drainages, such as lower Santa Rosa Creek, support riparian forest on their banks. Riparian forest in these drainages shades a portion of the open channel, reducing the growth of in-channel vegetation.

Sediment Basins

The Program Area has two sedimentation basins at Cook Creek and Adobe Creek. The Cook Creek sedimentation basin is located on Cook Creek just east of Petaluma Hill Road and consists of open water with a narrow fringe of emergent wetland (Figures 4-30 and 4-35). The Adobe Creek basin is found in the Petaluma River watershed on Adobe Creek, just upstream of South McDowell Boulevard (Figures 4-42 and 4-46). Periodic maintenance of these basins, including removal of sediment and any vegetation that has established in the sediment, is necessary to maintain the sedimentation basin's function.

Special Status Species

Special status species that may be found in aquatic habitats include California freshwater shrimp, California red-legged frog, foothill yellow-legged frog, western pond turtle, steelhead, Chinook salmon, and coho salmon. Although perennial and intermittent drainages typically do not support breeding California tiger salamanders due to high velocities and the presence of predators, cracks or burrows in the upper banks and adjacent uplands of these drainages could provide underground refugia for salamanders during the non-breeding season. Each of these species is discussed in detail in Section 3.10 *Special-Status Plants, Wildlife, and Fish*. At the Cook Creek basin there are no documented occurrences of special status species, but the emergent wetland fringe could provide marginal habitat for California red-legged frog and western pond turtle. At the Adobe Creek basin, there are known occurrences of steelhead, which use the reach as a migratory corridor, and there is potential habitat for California red-legged frog.

Ecosystem Functions

The primary ecosystem functions and functions of drainages in the Program Area are the following:

- prevent flooding by storing floodwaters;
- maintain surface and groundwater quality through filtration and decomposition of pollutants;

- recharge the groundwater aquifers;
- service floodplain fertility by flooding and deposition of fine sediments;
- provide water for human, animal, and wildlife use; and
- provide wildlife habitat.

The key characteristics of streams that contribute to these functions are intact wetland or riparian vegetation, connectivity with their floodplains, a lack of barriers to wildlife passage, and a natural hydrologic regime.

Stream Maintenance Considerations

Maintenance considerations for vegetation communities in the Program Areas were discussed above. These maintenance considerations also apply to the drainages where these communities are found. As noted above, SCWA generally encourages the growth of riparian forest and woodland along the channels in the Program Area. Riparian trees at the top-of-bank and just above the toe-of-slope stabilize the bank and are anticipated to discourage the growth of dense in-channel vegetation.

In addition, SCWA encourages channel form complexity where this is compatible with flood control. For example, a low-flow channel with an angled bed provides both habitat and flood control benefits. Such a channel profile provides greater diversity in water depth. Deep water areas may provide habitat for some species, and also discourage the growth of floating emergent species such as the non-native ludwigia or marsh species like cattails, which thrives in warm, stagnant conditions.

3.10 Special Status Plants, Wildlife, and Fish

A list of federally endangered and threatened species that may be affected by activities within the Cazadero, Cotati, Geyserville, Glen Ellen, Guerneville, Healdsburg, Jimtown, Kenwood, Petaluma, Petaluma River, Santa Rosa, Sebastopol, Sonoma, and Two Rock U.S. Geological Survey (USGS) 7-1/2-minute Quadrangles (quadrangles) was obtained online from the U.S. Fish and Wildlife (USFWS) website (CDFG 2008), and is contained in the Biological Assessment prepared for the SMP. The California Natural Diversity Database (CNDDB) and the CNPS electronic inventory were also queried for the 14 quadrangles and a 1-mile buffer around these quadrangles. Figures 3-25 and 3-26 depict all CNDDB occurrences within the SMP area (CDFG 2008). The CNDDB, CNPS, and the USFWS search results for the SMP Program Area and surrounding area are included in the Biological Resources section of the SMP EIR. The EIR special status species tables also include information pertaining to each species' habitat requirements and the likelihood that those habitats are present within the limits of the SMP area. In evaluating the occurrence potential of special status plant and wildlife species in the SMP area, relevant literature, knowledge of regional biota, and observations made during the field investigations were applied as analysis criteria.

3.10.1 Special Status Plants

Sonoma County's streams and floodplains host and provide habitat for a diversity of plant species, both common and rare. Several special status plant species have the potential to occur in the Program Area. It should be noted that habitats of some of these listed plant species have existed historically in the SMP or only exist in isolated areas of adjacent quadrangles. Much of the historical habitat no longer exists in the SMP due to agricultural, residential and commercial development, infrastructure and road development. It should also be noted that reaches and their access roads within the SMP area have, in most cases, been altered due to flood control management. This alteration along with the prevalence of weedy native and non-native plant species may reduce the potential for special status plant species to occur in the SMP area. However, in some locations, small areas of suitable habitat for listed plants do persist adjacent to SCWA rights-of-way.

Generally, SMP activities are not anticipated to affect these species as most work is accomplished during the dry season. Focused surveys for these species have failed to reveal their presence along SCWA channels.

Baker's Navarretia

Baker's navarretia (*Navarretia leucocephala* ssp. *Bakeri*) is a spiny annual herb that is on CNPS's List 1B for rare, threatened, or endangered plants in California and elsewhere. It is in the phlox (*Polemoniaceae*) family. This plant can be either branched or not and grows from 1-4 inches in height. Stems are white with purple streaks. Tiny flowers occur in clusters and are white or pale blue.

Natural History

Habitat for this plant includes mesic areas in cismontane woodland, lower montane coniferous forest, meadows and seeps, valley and foothill grassland, and vernal pools. Elevation range for the species is typically between 5 and 1,740 meters (m) above MSL and the blooming period is from April through July.

Occurrence in the Program Area

In Sonoma County, 17 occurrences have been documented with 13 presumed extant (CDFG 2008). Some sightings were in the Laguna de Santa Rosa watershed, including in Mark West Creek and Santa Rosa Creek watersheds.

Stream Maintenance Considerations

Within the SMP area, it is not likely that program-related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support potential habitat for Baker's navarretia. However, there are areas where SMP reaches bisect vernal pool complexes or Santa Rosa Plain Conservation Strategy (SRPCS) Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations.

Burke's Goldfields

Burke's goldfields (*Lasthenia burkei*), was listed as endangered under ESA on December 2, 1991. This species was also listed as endangered under the CESA in September of 1979. Burke's goldfields is also designated as a CNPS List 1B.1 species (CNPS 2008). The USFWS determined that it was not prudent to designate critical habitat for this species because published maps and a critical habitat description would make the plant more vulnerable to incidents of vandalism or attractive to rare plant collectors, which could contribute to the decline of these species (USFWS 1991). However, this species is included in the SRPCS.

Natural History

Burke's goldfields is an annual species of the sunflower (*Asteraceae*) family. Burke's goldfields grow to a height of 12 inches (30 centimeters) and have erect distally branched, hairy stems. Burke's goldfields is supported by mesic meadows and seeps as well as vernal pools on nearly level to slightly sloping loams, clay loams, and clays between 49 and 1,969 ft. above MSL (15 to 600 meters above MSL) in elevation. Huichica loam is the predominant soil Burke's goldfields is found on in the northern part of the Plain (USFWS 2007a). In the southern part of the plain this species occurs on mostly on Clear Lake clay or Wright loam. Historically, this taxon extended north from Cotati Valley to Napa, Mendocino, and Lake Counties. Currently it is known from Sonoma, Napa, and Lake Counties with most occurrences occurring within Laguna de Santa Rosa and the Windsor area (CNPS 2008). According to the USFWS (1991), the only Mendocino County occurrence, the type locality for this taxon, is no longer considered extant as it has been the target of unsuccessful focused surveys. This species has a blooming period from April through June; however a majority of the herbarium specimens have been collected during the month of May (CCH 2008).

Occurrence in the Program Area

In the SMP area, Burke's goldfields has been recorded from 39 sites in Cotati Valley (Laguna de Santa Rosa) (USFWS 1991). A total of 24 occurrences are represented in the CNDDB, of which 88 percent are considered extant. These occurrences are located in grassland swales and vernal pools and coincide with Zones 1A and 4A. The Laguna Foundation also has population information for a number of sites that are not represented in the CNDDB. However, none of these occurrences are located within SMP channels. The nearest record to an SMP reach is a specific occurrence (EONDX # 4769) located south of Saunders Avenue and east of Sonoma County Airport, approximately 0.15 miles west of Airport Creek (reach Airport 2).

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations. Specific reaches where potential Burke's goldfields habitat is present include Roseland 1 and 3, Colgan 2, Fryer 1, Laguna 1, Peterson 2, and Bellevue-Wilfred 1. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of Burke's goldfields is possible but considered low.

California Beaked-Rush

California beaked-rush (*Rhynchospora californica*) occurs on CNPS List 1B for plants rare, threatened, or endangered in California and elsewhere. It is a rhizomatous herb in the sedge family (*Cyperaceae*). It bears long, thin stems topped with dense inflorescences of dark brown flowers enfolding grainlike fruits that have white-fuzzy tubercles. Its range is in the southern part of northwestern California, the northern and central Sierra Nevada foothills, and northern San Francisco Bay area.

Natural History

California beaked-rush grows in bogs and fens, lower montane coniferous forest, meadows and seeps, and freshwater marshes and swamps. Its elevation range is 45 to 1,010 m above MSL, with a blooming period from May to July (California Native Plant Society 2008).

Occurrence in the Program Area

California beaked-rush has been documented in three locations in Sonoma County, of which two populations are considered extant.

Stream Maintenance Considerations

Within the SMP area, potential habitat is present in select reaches where emergent wetlands are present. It is possible that any reach along the SMP channels with emergent wetland vegetation may support undiscovered populations of this species. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of California beaked rush is considered possible but low.

Deceiving Sedge

Deceiving Sedge (*Carex saliniformis*) occurs on the CNPS List 1B for plants rare, threatened, or endangered in California and elsewhere. It is a rhizomatous herb in the sedge family (*Cyperaceae*).

Natural History

Deceiving Sedge grows coastal prairie, coastal scrub, meadows and seeps, and marshes and swamps. Its range includes the northern California coast in Humboldt, Mendocino, and Sonoma Counties. Populations may also exist in Santa Cruz County. Its elevation range is from 3 to 230 m above MSL, with a blooming period in June and occasionally into July (California Native Plant Society 2008).

Occurrence in the Program Area

CNDDB identifies one occurrence of deceiving sedge in Zone 7A, north of the mouth of the Russian River (California Department of Fish and Game 2008). Current threats may include grazing.

Stream Maintenance Considerations

There are no suitable vegetation associations for deceiving sedge present in SMP work areas. Program related maintenance activities will not impact potential habitat or known populations of this species.

Dwarf Downingia

Dwarf downingia (*Downingia pusilla*) occurs on CNPS List 2.2, which classifies the species as fairly endangered in California, but more common elsewhere. The species is an annual herb in the bellflower family (*Campanulaceae*), 3 to 8 cm tall, with small linear leaves. Its small, radially symmetric flowers are less than 1 cm across, in contrast to all other *Downingia* species, which have larger, showy, asymmetric flowers. The flowers, borne at the ends of branches, are white or blue with two small yellow spots near the throat (Hickman 1993). It is a rhizomatous herb in the sedge family (*Cyperaceae*). Dwarf downingia's range is the Inner North Coast Ranges, southern Sacramento Valley, and northern and central San Joaquin Valley. Sonoma County is the only coastal county known to support this species (CNPS 2008).

Natural History

Its habitat includes mesic areas in valley and foothill grassland and vernal pools, usually below 445 m above MSL in elevation. Dwarf downingia's blooming period is from March to May (California Native Plant Society 2008).

Occurrence in the Program Area

Fourteen occurrences have been documented in Sonoma County, and 11 of those are considered extant.

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations.

Legenere

Legenere (*Legenere limosa*) is designated a CNPS List 1B.1 species indicating it is rare, threatened, or endangered in California and elsewhere and is seriously endangered in California (CNPS 2008). An annual species of the bellflower family (*Campanulaceae*), it is entirely hairless and has a reclining stem that can grow up to 30 centimeters. It has lateral branches that are erect, slender, stiff, and sometimes fleshy. The inflorescence is a terminal raceme with a zig-zag axis and one a leaf like bract per flower. The flowers are white and two-lipped, with the upper lip 2-lobed and the lower lip is 3-lobed. Leaves are cauline, narrowly triangular, entire, sessile, and early deciduous. It is the only species of Legenere in California (Morin in Hickman 1993).

Natural History

Legenere occurs in vernal pools. It is known from Alameda, Lake, Napa, Placer, Sacramento, Santa Clara, Shasta, San Joaquin, San Mateo, Solano, Sonoma, Tehama, and Yuba counties from between 1 to 880 m above MSL. It is presumed extirpated from Mendocino and Santa Barbara counties (CNPS 2008). Many historical occurrences extirpated. Currently this species threatened by grazing, road widening, non-native invasive weeds, agricultural conversion, and development (CNPS 2008). This species is included in the Draft Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2004). Legenere flowers from April to June (CNPS 2008).

Occurrence in the Program Area

Two populations have been documented in Sonoma County with one considered extant. Threats have included historic agriculture production and grazing, and invasive plant species.

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zone 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations.

Many-flowered Navarretia

Many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha*) was listed as endangered under ESA on June 18, 1997. This species was also listed as endangered under the CESA in November of 1979, but under the name of *N. plieantha*. This taxon is also designated as a CNPS List 1.B.2, indicating it is rare, threatened, or endangered in California and elsewhere and is fairly endangered in California (CNPS 2008). The USFWS determined that it was not prudent to designate critical habitat for this species because published maps and a critical habitat description would make the plant more vulnerable to incidents of vandalism or attractive to rare plant collectors, which could contribute to the decline of these species (USFWS 1997). However, this species is included in the SRPCS.

Natural History

Many-flowered navarretia is a spiny annual species of the phlox (*Polemoniaceae*) family. This plant forms small mats that can range from 2-8 inches wide. The leaves are about 1 inch long, linear and have a few lobes. The flowers are clustered in a head at the end of stems composed of 20-50 white to blue flowers. Many-flowered navarretia is supported by volcanic ash flow vernal pools between 98 and 3,117 ft. above MSL (30 to 950 m above MSL) in elevation. Historically, this taxon is known from Lake and Sonoma counties. According to the Draft Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2004) three of the occurrences in the Santa Rosa area consist of plants intermediate between *N. leucocephala* ssp. *plieantha* and *N. leucocephala* ssp. *bakeri*. Currently, the occurrences from Sonoma County are considered possibly extirpated while the Lake County occurrences are all considered extant (USFWS 2004). This species has a blooming period from May through June; however a majority of the herbarium specimens have been collected during the month of June (CCH 2008).

Occurrence in the Program Area

In the SMP area, many-flowered navarretia has been recorded from three sites: Bennett Mountain Lake; the northeast corner of Sonoma County Airport; Shiloh Ranch near Santa Rosa; and two miles southwest of Windsor (Best, et al. 1996). A total of two occurrences are represented in the CNDDB, of which 100 percent are considered extant, although the aforementioned information indicates Sonoma County sites are possibly extirpated. These two CNDDB occurrences are located in swales and vernal pools that coincide with Zone 1A. However, neither of these occurrences is located within SMP channels. The nearest record to an SMP reach is a specific occurrence (EONDX # 4676) located south of Saunders Avenue and east of Sonoma County Airport, approximately 500 ft. west of Airport Creek (reach Airport 2).

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zone 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations. Specific reaches where potential many-flowered navarretia habitat is present include Windsor 1 and Airport 2. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of many-flowered navarretia is possible but considered low.

Sebastopol Meadowfoam

Sebastopol meadowfoam (*Limnanthes vinculans*) was listed as endangered under ESA on December 2, 1991. This species was also listed as endangered under the CESA in November of 1979. Sebastopol meadowfoam is designated as a CNPS List 1B.1 species (CNPS 2008). The USFWS determined that it was not prudent to designate critical habitat for this species because published maps and a critical habitat description would make the plant more vulnerable to incidents of vandalism or attractive to rare plant collectors, which could contribute to the decline of these species (USFWS 1991). However, this species is included in the SRPCS.

Natural History

Sebastopol meadowfoam is a small (up to 12-inch tall), multi-stemmed annual species of the meadowfoam (Limnanthaceae) family. Although the first leaves are narrow and undivided, leaves on the mature plant have three to five undivided leaflets along each side of a long stalk (petiole). The shape of the leaves distinguishes Sebastopol meadowfoam from other members of the Limnanthes genus. Small, bowl-shaped, white flowers appear April through May. The white flowers are born singly at the end of stems. Sebastopol meadowfoam is supported on vernally mesic sites in meadows and seeps, grasslands, and vernal pools between 49 and 1,000 ft. above MSL (15 to 305 m above MSL) in elevation. Soils confirmed as supporting this species include Clear Lake clay and Wright loam (USFWS 2007a). Both historic and current distributions include Laguna de Santa Rosa (Cotati Valley) and the area near Graton. Two outlying populations have also been recorded in Knights Valley in Lake County and at the Yountville Ecological Reserve in Napa County (CDFG 2008). This species has a blooming period from April through May; however a majority of the herbarium specimens have been collected during the month of May (CCH 2008).

Occurrence in the Program Area

In the SMP area, Sebastopol meadowfoam has been recorded from two sites in Cotati Valley (Laguna de Santa Rosa) (USFWS 1991). A total of 38 occurrences are represented in the CNDDB of which 82 percent are considered extant. These occurrences are located in ditches, vernally wet meadows, marshy creek margins, grassland swales, and vernal pools which coincide with Zones 1A, 4A, and 5A. The Laguna Foundation also has population information for a number of sites that are not represented in the CNDDB. However, none of these occurrences are located within SMP channels. The nearest record to an SMP reach is a specific occurrence (Laguna Foundation) located within the Santa Rosa Air Center approximately 100 ft. east of Roseland Creek (reach Roseland 3).

Stream Maintenance Considerations

Within the SMP area it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may also provide marginally suitable habitat conditions for this species if adjacent to extant populations. Specific reaches where potential Sebastopol meadowfoam habitat is present include Roseland 1 and 3, Colgan 2, Fryer 1, Laguna 1, Peterson 2, and Bellevue-Wilfred 1. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of Sebastopol meadowfoam is possible but considered low.

Sonoma Alopecurus

Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), also known as Sonoma shortawn foxtail, was listed as endangered under the authority of the ESA on October 22, 1997. This taxon is also designated as a CNPS List 1B.1 species, indicating that is rare or endangered in California (CNPS 2008). It is recognized as *A. aequalis* in the Jepson Manual (Hickman 1993) and is mentioned as not clearly distinct in Best et al. (1996). The USFWS determined that it was not prudent to designate critical habitat for this species because doing so would increase the degree of threat to this species (USFWS 1997).

Natural History

Sonoma alopecurus is a perennial herbaceous species of the grass (*Poaceae*) family. The plant reaches 12 to 30 inches in height. Leaf blades are up to 0.3 inch wide and the stems are mostly straight or weakly bent near the base. Spikelets are usually violet-gray near the tip. The awn (bristle-like part) is straight, and exceeds the lemma (the bracts that enclose the awn) by 0.04 to 0.1 inch. Panicles (branching flower clusters) are 1 to 3.5 inches long and 0.1 to 0.3 inch wide. Sonoma alopecurus may be difficult to distinguish from other varieties of the species. It is distinguished from *Alopecurus aequalis* var. *aequalis* by the violet-gray spikes, more upright appearance and generally wider panicle. Sonoma alopecurus occurs in moist soils in permanent freshwater marshes between 20 and 680 ft. above MSL (6 and 210 m above MSL) in elevation. Historically, this taxon extended north from the Point Reyes Peninsula to Guerneville and east to Cunningham Marsh. Currently it is known from Marin and Sonoma counties from fewer than ten occurrences (CNPS 2008). This species has a blooming period from May through July however a majority of the herbarium specimens have been collected during the month of May (CCH 2008).

Occurrence in the Program Area

In the SMP area, Sonoma alopecurus has been recorded from Duncan Mills Marsh, Guerneville Marsh, Occidental Marsh, Freestone Marsh, Ross Marsh, Pitkin Marsh, Cunningham Marsh, near Bloomfield, near Llano Road, and at Bennett Mountain Lake (Best, et al. 1996). A total of 13 occurrences are represented in the CNDDB, of which 92 percent are considered extant. These occurrences are located on the edges of lake margins and in moist areas of low fields, and coincide with Zones 1A, 3A, 5A, and 8A. However, none of these occurrences are located within SMP channels. The nearest record to an SMP reach is a non-specific occurrence (EONDX #22479) near Llano Road and Highway 116 northwest of Cotati, approximately 0.5 miles southwest of Laguna de Santa Rosa (reach Laguna 1).

Stream Maintenance Considerations

Within the SMP area, potential habitat is present in Zones 1A, 3A, 5A, and 8A where reaches support willow scrub, mixed riparian scrub, and emergent wetlands. Since Pitkin Marsh is essentially associated with tributaries of Atascadero Creek, potential habitat for this species is considered to occupy the aforementioned vegetation associations of Atascadero Creek proper. The occurrence nearby Laguna de Santa Rosa is considered extant; therefore it is possible that any reach along the creek with appropriate vegetation may support undiscovered populations of this species. Additionally, there is a historic collection near Bloomfield that may still be extant. Therefore suitable habitat may be present along Bloomfield Creek (reach Bloomfield 1). Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of Sonoma alopecurus is considered possible but low.

Sonoma Sunshine

Sonoma sunshine (*Blennosperma bakeri*), also known as Baker's stickyseed, was listed as endangered under the ESA on December 2, 1991. This species was also listed as endangered under the California Endangered Species Act (CESA) in February of 1992. Sonoma sunshine is also designated as a CNPS List 1B.1 (CNPS 2008).

Natural History

Sonoma sunshine is a small (up to 12 inches) annual species of the sunflower (*Asteraceae*) family. The plant has alternate, narrow, hairless leaves, 2 to 6 inches long. The upper ones have 1 to 3 lobes, the lower ones none. The species produces yellow daisy-like flowers. The yellow disk flowers have white pollen and stigmas. Sterile ray flowers, which are yellow or sometimes white, have red stigmas. The lobe pattern of the leaves and the color of ray stigmas separate this species from other in the genus. Sonoma sunshine occurs in mesic grasslands and vernal pools between 33 and 360 ft. above MSL (10 and 110 m above MSL) in elevation. Both historic and current distribution includes Laguna de Santa Rosa (Cotati Valley) and Sonoma Valley. According to CNPS (2008), it is known only from Sonoma County. This species has a blooming period from March through May; however a majority of the herbarium specimens have been collected during the month of March (CCH 2008).

Occurrence in the Program Area

In the SMP area, Sonoma sunshine has been recorded from 35 sites in Cotati Valley and seven sites in Sonoma Valley (USFWS 1991). A total of 26 occurrences are represented in the CNDBB, of which 85 percent are considered extant. These occurrences are located in grassland swales, vernal pools, the margin of shallow creeks, and in flat open fields that coincide with Zones 1A and 3A. The Laguna Foundation also has population information for a number of sites that are not represented in the CNDDB. However, none of these occurrences are located within SMP channels. The nearest record to an SMP reach is a specific occurrence (EONDX #5298) located north of Four Corners and South of Newcomb Street approximately 0.15 miles east of Fryer Creek (reach Fryer 1).

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may provide marginally suitable habitat conditions for this species if adjacent to extant populations. Specific reaches where potential Sonoma sunshine habitat is present include Roseland 1 and 3, Colgan 2, Fryer 1, Laguna 1, Peterson 2, and Bellevue-Wilfred 1. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of Sonoma sunshine is possible but considered low.

Sonoma White Sedge

Sonoma white sedge (*Carex albida*), also known as white sedge, was listed as endangered under the ESA on October 22, 1997. This species was also listed as endangered under the CESA in November of 1979. Sonoma white sedge is also designated as a CNPS List 1B.1 species (CNPS 2008). The USFWS determined that it was not prudent to designate critical habitat for this species because doing so would increase the degree of threat to this species (USFWS 1997).

Natural History

Sonoma white sedge is a rhizomatous herb species of the sedge (*Cyperaceae*) family. The triangular stems are 1.3 to 2 feet tall, and longer than the leaves. The leaves are flat, 1 to 2 inches wide, and have closed sheaths. The inflorescence consists of 4 to 7 oval to oblong spikelets that are 0.3 to 0.7 inches long. The fruits are three-sided when mature. The Flora of North America (Flora of North America Editorial Committee 1993) gives the habitat for this species as occurring in Sphagnum bogs less than 295 ft. above MSL (90 m above MSL) in elevation and is currently known from only one station in Sonoma County, Pitkin Marsh. The only other habitat type this species has been recorded as occupying is swamps of Santa Rosa Creek from a 1977 Rubtzoff collection. This location is now considered extirpated because the marsh habitat has been destroyed (CDFG 2008). Historically this Sonoma white sedge was also known from Perry Marsh (CCH 2008). This species has a blooming period from May through July, however a majority of the herbarium specimens have been collected during the months of May and June (CCH 2008).

Occurrence in the Program Area

In the SMP area, Sonoma white sedge has been recorded from Perry Marsh, Pitkin Marsh, and Santa Rosa Creek (CDFG 2008). A total of four occurrences are represented in the CNDDB, of which 50 percent are considered extant. These occurrences are located at upper and lower Pitkin Marsh (EONDX #4603 & 4610) in wet meadows and quaking bog areas and coincide with Zone 5A. An occurrence considered extirpated (EONDX #47272) was located in Santa Rosa Creek within Zone 1A. This section of Santa Rosa Creek was apparently destroyed in the 1960's by channelization and other alterations to Santa Rosa Creek (USFWS 1997). This extirpated occurrence is the nearest record to an SMP reach and is a non-specific occurrence located southeast of the intersection of College Avenue and Wright Road approximately 0.10 miles southwest of the confluence of Santa Rosa Creek (reach Santa Rosa 3) and College Creek (reach College 1).

Stream Maintenance Considerations

Within the SMP area, potential habitat is present in select reaches in Zones 1A and 5A where emergent wetlands are present. Since Pitkin and Perry's marshes are essentially associated with tributaries of Atascadero Creek, potential habitat for this species is considered to occupy emergent wetlands of Atascadero Creek proper. Although the occurrence on Santa Rosa Creek is considered extirpated, it is possible that any reach along the creek with emergent wetland vegetation may support undiscovered populations of this species. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of Sonoma white sedge is considered possible but low.

Swamp Harebell

Swamp harebell (*Campanula californica*) is a rhizomatous herb on CNPS List 1B.2 for plants rare, threatened, or endangered in California but more common elsewhere. It is in the bellflower family (*Campanulaceae*). The species is a slender stemmed sparingly branched perennial with nearly sessile, scalloped, alternately borne leaves. The plant bears pale blue bell-shaped flowers.

Natural History

Generally, this species grows in mesic areas in bogs and fens, closed-cone coniferous forest, coastal prairie, meadows and seeps, freshwater marshes and swamps, and North Coast coniferous forest. The typical elevation range is from 1 to 405 m above MSL, and the blooming period is from June to October.

Occurrence in the Program Area

Swamp harebell has been documented in 21 Sonoma locations, with 17 of those populations presumed extant. Most of those observances occurred along or near the northern Sonoma coast in Flood Control Zone 7A. Threats to the species are competition, grazing, development, marsh habitat loss, logging, road maintenance, and trampling.

Stream Maintenance Considerations

Within the SMP area, potential habitat is present in select reaches in Zones 7A where emergent wetlands are present. It is possible that any reach along the SMP channels with emergent wetland vegetation may support undiscovered populations of this species. Based on habitat quality and the SMP's proximity to extant occurrences, potential for occurrence of swamp harebell is considered possible but low.

Saline Clover

Saline clover (*Trifolium depauperatum* var. *hydrophilum*) is an annual herb on CNPS List 1B.2 for plants rare, threatened, or endangered in California but more common elsewhere. It is in the legume family (*Fabaceae*). The small, often fleshy plant has typical "clover-leaves"; each of the three leaflets is 0.5 to 2 cm long. The stipules of the upper leaves are tipped with bristles. The white-tipped, pink-purple flowers are 6.5 to 9 mm long and clustered in small heads that are 0.5 to 1.5 cm in diameter. The banner, or upper petal, becomes inflated and encloses the 2 to 3 mm long fruit (legume) as it ripens. Its range includes Sacramento Valley and central western California.

Natural History

Saline clover's typical habitats include marshes and swamps, mesic and alkaline areas in valley and foothill grassland, and vernal pools, usually below 300 m above MSL in elevation. This plant's blooming period is from April to June (California Native Plant Society 2008).

Occurrence in the Program Area

Of the five population documented in Sonoma County, three are considered extant.

Stream Maintenance Considerations

Within the SMP area, it is not likely that program related activities will impact potential habitat for this species as the areas confined within the fenced rights-of-way do not support vernal pools or grassland swales. However, there are areas where SMP reaches bisect vernal pool complexes or SRPCS Plant Conservation Areas in Zones 1A and 3A. Additionally, some earthen v-ditches may provide marginally suitable habitat conditions for this species if adjacent to extant populations.

3.10.2 Special Status Wildlife

California Freshwater Shrimp

California freshwater shrimp (*Syncaris pacifica*) (CFWS) is a federal and state endangered species assumed to have been historically common in low-elevation, perennial freshwater streams within Marin, Sonoma, and Napa counties. The current understanding of the historical distribution of this species is based on its current distribution, local topography and watershed boundaries, and patterns in geologic activity and climatic changes that may have isolated populations by severing freshwater connections between streams. A recovery plan for the species was released in July 1998 (USFWS 1998). The USFWS 5-year review for this species was released in December 2007 (USFWS 2007b).

Natural History

CFWS are adapted to freshwater and have not been found in brackish or estuarine environments. While seemingly restricted to low-elevation and low-gradient perennial streams, relatively little is known about the shrimp's habitat requirements. Previous studies have shown that CFWS are typically found in streams 12 to 36 inches in depth (30.5

to 91.4 centimeters) with exposed live roots along completely submerged undercut banks greater than 6 inches (15 centimeters) and overhanging woody debris/vegetation (USFWS 1998). These areas provide refuge from swift currents as well as protection from heavy sediment loads associated with high stream flows.

No data are currently available for defining the optimum temperature and stream flow regime for the CFWS or the minimum and maximum limits it can tolerate. CFWS seem to have evolved to survive a broad range of hydrologic and temperature fluctuations characteristic of the small, perennial streams they inhabit. While relatively sedentary and slow-moving, CFWS do move around within their microhabitat based on seasonal variations and preferences in response to water currents, water temperature, and food supply.

The habitat preferences of the shrimp change between the winter and late-spring/summer months, with shrimp living beneath undercut banks in the winter months and resting/feeding on submerged leafy branches in the spring and summer. While downstream migration of less than 9 miles (15 kilometers) has been observed, upstream migration is also believed to occur, but has not been documented. CFWS are typically found attached to/feeding on decaying plant material and debris which provides both cover from predators and fine particulate organic matter which the shrimps feed on. CFWS are most likely to be found in low gradient portions of the active stream channel, particularly in areas where cover is provided by undercut banks, woody debris, root structures, or stream vegetation.

Occurrence in the Program Area

The CNDDB contains 12 localities for this species (Figure 3-27) (CDFG 2008). This species is currently known from 23 stream segments in Napa, Marin, and Sonoma Counties that can be separated into four general drainage units, including several tributary streams in the lower Russian River drainage (Austin Creek [different from the Austin Creek that is a tributary to Brush Creek in Zone 1A]) and the southward flowing streams that empty into northern San Pablo Bay, including Napa River and Sonoma Creek. In Sonoma County, CFWS are known from Sonoma, Green Valley, Blucher, Jonive, Salmon, Austin, Ebabias, and Redwood creeks (CDFG 2008 and USFWS 2007b).

CFWS are known to occur in the Sonoma Creek watershed in SCWA Flood Control Zone 3A (CDFG 2008), and in Blucher Creek, a tributary of the upper Laguna in Zone 1A (Martini-Lamb 2007). There are also records for tributaries of the Russian River (Big Austin, East Austin, Green Valley, Ebabias, and Jonive Creeks) within Zone 5A, as well as in Salmon Creek in Zone 8A (CDFG 2008; Martini-Lamb 2007). Now extirpated, this species also historically occurred in the Santa Rosa Creek (Zone 1A) (Figure 3-27).

The recovery plan for this species recommends a watershed management plan that incorporates restoration of freshwater shrimp habitat in Santa Rosa Creek (USFWS 1998). Based on this information, a subset of the natural channels has been removed from the SMP area due to resource sensitivity, specifically presence of suitable habitat for CFWS and coho salmon (Figure 1-12). SCWA has removed the following natural channels from all SMP activities: Blucher Creek (Zone 1A), Willow Creek (Zone 5A), Sheephouse Creek (Zone 5A), Dutch Bill Creek (Zone 5A), Green Valley Creek (Zone 5A), Jonive Creek (Zone 5A), and Salmon Creek (Zone 8A). In addition, SCWA maintenance activities for the Russian River (mainstem) and Dry Creek (mainstem) are not covered under the SMP, as actions in these systems are governed by existing agreements between SCWA and USACE.

The only stream maintained under the SMP that supports CFWS is Sonoma Creek. This creek has natural and modified channel reaches along its length, and does not have any engineered channels. A reach-by-reach habitat assessment for CFWS is provided in Martini-Lamb (2007).

Stream Maintenance Considerations

Natural channels provide the highest quality habitat for CFWS. These channels typically have in-channel vegetation and slow moving, backwater areas that provide microhabitat features essential for this species. This does not preclude CFWS from occurring in engineered or modified channels, but the overall habitat quality is lower in those channels since there is generally less in-stream structure and flows are faster than in natural channels. Overall the likelihood of occurrence is less.

As described in Chapter 1, several natural and/or modified channels in the Program Area support CFWS. During development of the SMP, and through guidance from USFWS regulatory staff, all of these channels with the exception of Sonoma Creek were removed from the SMP so that potential impacts to CFWS were reduced. Figures 1-2 through 1-9 and 1-12 show these removed channels as green dashed lines.

As discussed in Chapter 1 *Introduction and Program Summary* and in proceeding chapters, maintenance activities in modified and natural channels will be conducted in a manner to reduce the likelihood that shrimp or shrimp habitat is adversely affected.

California Tiger Salamander

The California tiger salamander (*Ambystoma californiense*), a species endemic to California, is a federal endangered species and a California species of special concern in Sonoma County. Historically, the California tiger salamander occurred in lowland grassland habitats throughout much of central California. Although this species still occurs within much of its range, it has been extirpated from several areas it once occupied (Fisher and Shaffer 1996, Stebbins 1985). The loss of California tiger salamander populations has been due primarily to habitat loss within their historic range (Fisher and Shaffer 1996). Based on genetic analysis, there are six populations of California tiger salamanders, of which one is distinct to the Santa Rosa area of Sonoma County (Shaffer and Trenham 2005). Though critical habitat has been designated for this species, there is no critical habitat designated in Sonoma County (70 FR 74137-74163). This is due in large part to the adoption of the SRPCS in 2005.

Most populations occur at elevations below 1,500 ft. above MSL, but California tiger salamanders have been recorded at elevations up to 4,500 ft. above MSL. Although populations have declined, the species continues to breed at a large number of locations within its current range (59 FR 18353–18354). At most historic breeding sites below 200 ft. above MSL, ponds remain present but no longer support California tiger salamanders. These sites are typically occupied by non-native species (Fisher and Shaffer 1996).

Natural History

California tiger salamanders require two major habitat components: aquatic breeding sites and terrestrial aestivation or refuge sites. California tiger salamanders inhabit valley and foothill grasslands and the grassy understory of open woodlands, usually within one mile of water (Jennings and Hayes 1994). The California tiger salamander is terrestrial as an adult and spends most of its time underground in subterranean refuge sites, or refugia. Underground retreats are usually California ground squirrel (*Spermophilus beecheyi*) or pocket gopher (*Thomomys* sp.) burrows and, occasionally, cracks in the ground or human-made structures.

Adult California tiger salamanders migrate to and congregate at aquatic breeding sites during warm rains, primarily between November and February (Shaffer and Fisher 1991, Barry and Shaffer 1994). California tiger salamanders are rarely observed except during this period (Loredo et al. 1996). During the winter rains, California tiger salamanders breed and lay eggs primarily in vernal pools and other shallow, ephemeral ponds that fill during the wet season and often dry by summer (Loredo et al. 1996). This species also uses permanent human-made ponds (without predatory fish) for reproduction but streams and reservoirs are rarely used. Breeding usually occurs within a few days after migration, and adults probably leave the breeding sites at night soon after spawning (Barry and Shaffer 1994 citing Storer 1925).

California tiger salamander larvae and embryos are susceptible to predation by fish (Stebbins 1972; Zeiner, et al. 1988; Shaffer, et al. 1994), and California tiger salamander larvae are rarely found in aquatic sites that support predatory fish (Shaffer and Fisher 1991; Shaffer and Stanley 1992; Shaffer et al. 1994). Aquatic larvae are taken by herons and egrets and possibly garter snakes (Zeiner, et al. 1988). Shaffer, et al. (1993) also found a negative correlation between the occurrence of California tiger salamanders and the presence of bullfrogs; however, this relationship was detected only in unvegetated ponds. This suggests that vegetation structure in aquatic breeding sites may be important for survival.

Occurrence in the Program Area

There are 69 extant CNDDB occurrences (and four presumed extirpated occurrences) of California tiger salamander located in Zone 1A of the SMP area, including a 1-mile buffer (CDFG 2008, Figure 3-28). Most of these occurrences are of breeding pool clusters or individual pools and road observations of migrating adults near Laguna de Santa Rosa and its tributaries. These occurrences are primarily located west of Santa Rosa, Rohnert Park, and Cotati, and south of Cotati. There are no known reports of California tiger salamander within the Program Area channels, although nearly all of the known California tiger salamander occurrences are in ponds, vernal pools, or other wetlands, within 1.3 miles of Program Area channels (Cook 2008a; Cook 2008b). Approximately 56 miles of SCWA's 200-plus miles of maintenance channels are located within the potential range of California tiger salamander (Cook 2008b). For a detailed analysis of the potential for California tiger salamander to occur in the Program Area see Cook (2008b).

Most of the aquatic habitats in the Program Area consist of channelized creeks that do not provide potential California tiger salamander breeding habitat. These channels typically have high winter flood flows, contain fish and other aquatic predators, such as bullfrog and crayfish, and are degraded (Cook 2008b). Upland habitats that occur along the channel banks and along access road shoulders vary from dense riparian to grassland/ruderal. The probability of adult California tiger salamander occupying upland habitats within the project area range from unlikely in areas that are greater than 1.3 miles and isolated from known California tiger salamander breeding sites by development to moderate-high probability where grasslands or other undeveloped lands are adjacent to SCWA maintained channels and are within close proximity to known breeding sites (Cook 2008b).

Stream Maintenance Considerations

Since California tiger salamanders do not typically occur in stream channels, in-channel maintenance activities will have little direct effect on this species. Road mortality of migrating California tiger salamanders can be a concern during early winter rains if breeding pools are near high-volume roadways (Cook 2008d). However, SCWA maintenance activities are unlikely to affect salamanders because migration occurs also exclusively at night during rainfall and SCWA crews work during daylight hours due to safety concerns.

During the dry season (summer months) California tiger salamanders are typically underground and may be affected by maintenance activities that result in ground disturbance (i.e., excavation, grading). If ground disturbance along the shoulders of access roads or banks adjacent to engineered or modified channels occurs, there is the potential for individuals to be crushed in burrows or excavated out of burrows. During any time of year excavation of ground squirrel or pocket gopher burrows could impact upland habitat for this species. As such, specific avoidance and minimization practices will be conducted during maintenance activities that could directly impact suitable subsurface habitat. Similarly, rodent control on levees or along engineered channels could have a cumulative effect on the amount of refugia habitat that is available over the long term.

Scheduling ground disturbing maintenance activities outside of the rainy season, when possible, will reduce the chance of encountering above-ground California tiger salamanders. Additionally, avoidance of adjacent wetlands or temporary pools along roadways or along natural channel will reduce impacts on breeding California tiger salamanders.

California Red-legged Frog

The California red-legged frog (*Rana draytoni*) is a federal threatened species and a California species of special concern. The historical range of the California red-legged frog extended from the California coast in the vicinity of Point Reyes National Seashore, Marin County, inland to Redding, Shasta County, and southward to northwestern Baja California, Mexico (Jennings and Hayes 1985, Hayes and Krempels 1986). However, recent genetic studies indicate that this specie's coastal range extends as far north as southern Mendocino County (Shaffer, et al. 2004). Prior to April 13, 2006, federal ESA protections only extended to California red-legged frogs in Sonoma County for watersheds that drain to the San Francisco Bay, which include Petaluma Creek and Sonoma Creek watersheds. As of the 2006 Critical Habitat Rule (71 FR 19244), federal protection has been extended to cover all individuals and populations of California red-legged frogs throughout the species' range. Currently there is no critical habitat designated for this species in Sonoma County (71 FR 19244-19346). However, on July 20, 2007, the USFWS announced their intent to reconsider the critical habitat designation, and on September 16, 2008, a proposed critical habitat map was published (USFWS 2008). Figure 3-29 depicts the three proposed critical habitat areas within Sonoma County, which do not intersect with any of the SMP channels. Figure 3-29 also depicts general critical habitat areas designated by the USEPA as restricted for uses of certain pesticides (USEPA 2007). As a result of a court-ordered injunction, USEPA has in identified certain critical habitat areas for California red-legged frog whereby use of certain pesticides is disallowed or allowed with use restrictions, such as no-use buffers.

Natural History

Within their range, California red-legged frogs occur from sea level to about 5,000 ft. above MSL (USFWS 2002). Almost all of the documented occurrences of this species, however, are located below 3,500 ft. above MSL. The species may use upland habitat adjacent to aquatic habitat for foraging, cover, dispersal, and temporary aestivation. California red-legged frogs may also use temporary pools in ditches along the side of access roads.

Breeding sites include a variety of aquatic habitats—tadpoles and metamorphs use streams, deep pools, backwaters within streams, ponds, marshes, sag ponds, dune ponds, and lagoons. Breeding adults are commonly found in deep (more than 2 ft.) still or slow-moving water with dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988). Adult frogs have also been observed in shallow sections of streams that are not shrouded by riparian vegetation. Generally, streams with high flows and cold temperatures in spring are unsuitable for eggs and tadpoles. Stock ponds are frequently used by this species if the ponds are managed to provide suitable hydroperiod, pond structure, vegetative cover, and control of nonnative predators.

During summer, California red-legged frogs often disperse from their breeding habitat to forage and seek summer habitat if water is not available (USFWS 2002). This habitat may include shelter under boulders, rocks, logs, industrial debris, agricultural drains, watering troughs, abandoned sheds, or hayricks. The frogs will also use small mammal burrows, incised streamed channels, or areas with moist leaf litter (Jennings and Hayes 1994; USFWS 1996; USFWS 2002).

California red-legged frogs breed from November through April (Storer 1925; USFWS 2002), but in Sonoma County they typically breed in January and February (Cook 2008, pers. comm.). Females lay egg masses containing about 2,000 to 5,000 eggs, those eggs hatch into tadpoles and then metamorphose in 3.5 to 7 months, typically between July and September (Storer 1925; Wright and Wright 1949; USFWS 2002).

California red-legged frogs may move over 2 miles up or down drainages from breeding sites and have been observed using adjacent riparian woodlands up to 100 feet from the water (Rathbun, et al. 1993). Generally speaking, red-legged frogs will use the extent of a riparian corridor no matter how narrow or wide it is. The primary features driving the use of this habitat are cool moist soil under shrubs or other vegetation where frogs can find refuge for short periods before returning to the water.

Occurrence in the Program Area

In 2008 SCWA completed the *California Red-legged Frog Site Assessment for the Stream Maintenance Program*, an assessment of documented California red-legged frog occurrences as well as a summary of a detailed habitat assessment conducted at 188 sites (105 unique streams) within the SMP Area (Cook 2008a).

There are 30 CNDDB occurrences of California red-legged frog within the SMP area (CDFG 2008) (Figure 3-29). California red-legged frogs have been documented in upper Sonoma Creek watershed (Zone 3A), lower Petaluma Creek watershed (Zone 2A), Santa Rosa Creek and Copeland Creek watersheds (Zone 1A), as well as in Salmon Creek, American Creek, and Stemple Creek watersheds (Zone 8A) and Willow Creek (Zone 5A). Salmon Creek and Willow Creek have been removed from the SMP. No maintenance activities would occur in these creeks.

Most California red-legged frog occurrences are located in the Petaluma River and Sonoma Creek watersheds. Many of these occurrences are in the upper reaches of the tributaries to Petaluma River, on both the east and west side of the valley. A cluster of California red-legged frog occurrences are located near creeks west of Petaluma including on Wiggins Hill, Wilson, and Thompson creeks on which SCWA has easements to maintain hydraulic capacity. Wiggins, Hill, and Wilson creeks are not engineered channels, and therefore maintenance activities would be very limited. The section of Thompson Creek that is maintained resides in a relatively wide channel easement where historic maintenance has been infrequent (see Thompson Creek, Reach 1 on Figure 4-47).

To date, no California red-legged frogs have been documented in natural channels maintained by SCWA. Ellis Creek, a modified channel where SCWA has an easement to maintain hydraulic capacity located southeast of downtown Petaluma, is the only SMP channel where the California red-legged frog is known to occur (Cook 2008a; Figure 3-29).

Although habitat quality is generally low in SCWA's engineered, modified and many of the SMP area's natural channels, these systems could provide aquatic habitat for this species during the summer months and at times may be the only perennial source(s) of aquatic habitat due to their modified nature and the fact that these channels often receive additional summer flows from urban runoff.

Stream Maintenance Considerations

Natural channels potentially provide the highest quality habitat for California red-legged frogs in the Program Area. These channels typically have in-channel vegetation and slow moving, backwater areas that provide microhabitat features essential for this species. This does not preclude California red-legged frogs from occurring in engineered or modified channels. For example, occurrences of California red-legged frog have been recorded in Arroyo Las Positas, a straightened and channelized urban creek in Livermore, California (van Hattem and Paterson 2004). Nonetheless, the overall habitat quality is lower in those channels since they often do not contain the complexity necessary to support the frog's life history. SCWA may conduct maintenance activities in natural, modified, and engineered channels within the range of this species. To date, no California red-legged frogs have been documented in natural channels maintained by SCWA (California Department of Fish and Game 2008). Although habitat quality is generally low in SCWA's engineered and modified channels, these systems could provide aquatic habitat for this species during the summer months and at times may be the only perennial source(s) of aquatic habitat due to their modified nature and the fact that these channels often receive additional summer flows from urban runoff.

Stream maintenance activities will incorporate measures to reduce potential impacts to aquatic environments and special status species that use such environments, including California red-legged frogs. To the extent feasible given flood control requirements, vegetation removal activities will avoid complete removal of instream vegetation and woody debris. Removal of instream vegetation could indirectly impact this species by reducing the amount of available habitat for securing egg masses and providing refugia for tadpoles and adults. Bank stabilization through revegetation will be encouraged (to reduce erosion) but will be implemented with native species only. This also includes avoiding using mulch, which often contains non-native seeds. Reduction in sediment loading to creeks would improve habitat conditions for the California red-legged frog. Well-vegetated riparian corridors may act as a filter by trapping and reducing sediment. However, this may have a cumulative negative effect on this species since in-stream vegetation typically establishes on built-up sediment in engineered and modified channels. Without sediment deposition in these channels, in-stream vegetation will be reduced.

Foothill yellow-legged frog

The foothill yellow-legged frog (*Rana boylii*) is a California species of concern. Historically, foothill yellow-legged frogs occurred from west of the crest of the Cascade mountains in Oregon south to the Transverse ranges in Los Angeles County, and in the Sierra Nevada foothills south to Kern County (Zweifel 1955; Stebbins 1985). The known elevation range of the species extends from near sea level to approximately 6,695 ft. above MSL (Stebbins 1985). The current range excludes coastal areas south of northern San Luis Obispo County and foothill areas south of Fresno County, where the species is apparently extirpated (Jennings and Hayes 1994).

Natural History

Foothill yellow-legged frogs are a highly aquatic amphibian, spending most or all of their life in or near streams, though foothill yellow-legged frogs have been documented underground and beneath surface objects more than 165 ft. from water (Nussbaum et al. 1983). Adult foothill yellow-legged frogs have high site fidelity and typically occupy small home ranges. Normal home ranges are probably less than 33 ft. in the longest dimension, with occasional long distance movements of 165 ft. during periods with high water conditions (Morey 2005). During the breeding season, March through June, adults and subadults may move several hundred yards or more to congregate at breeding sites (Ibis Environmental, Inc. 2003).

Foothill yellow-legged frogs require shallow, flowing water in small to moderate-sized streams with at least some cobble-sized substrate (Hayes and Jennings 1988; Jennings 1988). This habitat is believed to favor oviposition (Storer 1925; Fitch 1936;, Zweifel 1955) and refuge habitat for larvae and postmetamorphs (Hayes and Jennings 1988; Jennings 1988). Adults are often found in pools with submerged cover. This species has been found in streams without cobble (Fitch 1938; Zweifel 1955), but it is not clear whether these habitats are regularly used (Hayes and Jennings 1988; Jennings and Hayes 1994). The species deposits its egg masses on the downstream side of cobbles and boulders over which a relatively thin, gentle flow of water exists generally between March and early June (Storer 1925; Fitch 1936; Zweifel 1955; Kupferberg 1996).

Occurrence in the Program Area

In 2008, SCWA completed the *Foothill Yellow-legged Frog and Western Pond Turtle Habitat Evaluation for the Stream Maintenance Program*, an assessment of documented foothill yellow-legged frog occurrences as well as a summary of a detailed habitat assessment conducted at 189 sites (102 unique streams) within the SMP Area (Cook 2008c). Approximately 89 of these creeks were channelized and usually located within urban areas. The remaining 100 creeks were natural and are generally located in rural, undeveloped areas. A brief summary of the report is provided below.

A search of the CNDDB provided 47 reported occurrences of foothill yellow-legged frog in Sonoma County (Cook 2008c) (Figure 3-30). There is occurrence data for Laguna de Santa Rosa watershed (Zone 1A), Petaluma River watershed (Zone 2A), Sonoma Creek watershed (Zone 3A), Russian River watershed (Zones 4A and 5A), and scattered occurrences in Zones 7A and 8A. Foothill yellow-legged frogs are likely distributed throughout the county in natural foothill and mountain streams with moderate gradient and permanent or semi-permanent water. Throughout these zones foothill yellow-legged frog is dependent on perennial streams with coarse cobblestone substrate and stream side riparian vegetation for cover. Natural channels provide the highest quality habitat year-round for this species though the species could occur in modified channels. Engineered channels provide little habitat for this species unless pools with cover are present. Breeding opportunities in modified and engineered channels are limited. There are no reports of foothill yellow-legged frogs occurring in degraded, channelized creeks (Cook 2008c).

Stream Maintenance Considerations

The potential impact on the foothill yellow-legged frog, although present, is low due to the geographic separation of this frog and most SCWA maintenance activities. Foothill yellow-legged frog occurs primarily in natural moderate-gradient streams in mountainous areas, while SCWA activities are usually in low-gradient channels in lowland urban areas. However, vegetation management and sediment removal in natural moderate-gradient channels have the potential to affect foothill yellow-legged frogs. Since yellow-legged frogs have high site fidelity and are sometimes reluctant to move far, stream maintenance activities have the potential to impact individuals. Deposited eggs and tadpoles could be lost during in-channel work that requires excavation of sediment, and adults and juveniles could be lost during in-stream dredging or vegetation clearing activities. Overall the temporary or permanent removal of vegetative cover and in-stream cobblestone sediment will reduce the habitat quality for this species in reaches where maintenance activities occur.

Stream maintenance activities will incorporate measures to reduce potential impacts to foothill yellow-legged frog. Vegetation removal activities will allow for a percentage of in-stream vegetation to remain in the stream channel and riparian zone in areas with potential frog habitat. Reductions in fine sediment as a result of maintenance activities will likely improve habitat conditions for the foothill yellow-legged frog. Further, in-stream excavation that will remove larger rocks or gravel bars will not occur between March and June 15th. This is typically the season when foothill yellow-legged frogs attach egg masses to the downstream side of rocks or gravel bars and excavation could remove them. If this activity is unavoidable, pre-excavation surveys will be conducted to identify eggs, tadpoles, juveniles, and adults to reduce the impact from maintenance activities.

Western Pond Turtle

The western pond turtle (*Actinemys marmorata*) is a California species of special concern. Historically, the western pond turtle had a relatively continuous distribution in most Pacific slope drainages from Klickitat County, Washington, along the Columbia River (Slater 1962) to Arroyo Santo Domingo, northern Baja California, Mexico. In California, it was historically present in most Pacific slope drainages between the Oregon and Mexican borders (Jones & Stokes 2004). The area of the Central Valley of California between the American River drainage and the Transverse ranges is considered a zone of intergradation between the two subspecies (Seeliger 1945;, U.S. Fish and Wildlife Service 1999), although based on genetic evidence the current subspecies split is not warranted (Spinks and Shaffer 2005).

Natural History

Western pond turtles occur in a variety of aquatic habitats from sea level to elevations of 6,500 ft. above MSL. They are found in rivers, streams, lakes, ponds, wetlands, reservoirs, and brackish estuarine waters (Holland 1994; Jennings and Hayes 1994). Western pond turtles will utilize various components of a stream. They may often be observed using large logs and other woody debris within the stream channel and riparian zone for basking. They may also be found basking on open portions of a stream bank. This species will seek underwater refugia within the active channel or bed of the stream.

The species has been observed to avoid areas of open water lacking these habitat features (Holland 1994). Both adult and juvenile turtles favor aquatic habitats with access to areas of deep, slow water with underwater refugia. Hatchlings are relatively poor swimmers and tend to seek areas with shallow, warm water, free of predatory aquatic vertebrates, with at least some aquatic vegetation (Reese 1996; Holland 1994; Jones & Stokes 2004).

Western pond turtles overwinter in both aquatic and terrestrial habitats. Aquatic refugia consist of rocks, logs, mud, submerged vegetation, and undercut areas along banks. Terrestrial overwintering habitat consists of burrows in leaf litter or soil. The presence of a duff layer seems to be a general characteristic of overwintering habitat (Jones & Stokes 2004; Holland 1994).

Upland habitats are used for nesting. Nesting has been reported to occur up to 1,390 feet from water (Jennings and Hayes 1994) but is usually closer, averaging 92 feet from aquatic habitat (Rathbun et al. 2002). Western pond turtles generally utilize friable soils, although nests have been observed in many soil types from sandy to highly compacted (California Department of Fish and Game 2005). This species also often requires an open canopy and southern exposures to warm the soil and eggs. Nest predation rates are high, and complete failure of nests is common.

Occurrence in the Program Area

In 2008, SCWA completed the *Foothill Yellow-legged Frog and Western Pond Turtle Habitat Evaluation for the Stream Maintenance Program*, an assessment of documented western pond turtle occurrences as well as a summary of a detailed habitat assessment conducted at 189 sites (102 unique streams) within the SMP Area (Cook 2008c). Approximately 89 of these creeks were channelized and usually located within urban areas. The remaining 100 creeks were natural and are generally located in rural, undeveloped areas. A brief summary of the report is provided below.

Western pond turtle records are widely distributed throughout Sonoma County. A search of the CNDDB provided 53 reported occurrences of western pond turtle in Sonoma County (see Figure 3-31). There is occurrence data for Santa Rosa Creek and Laguna de Santa Rosa watersheds (Zone 1A), Petaluma River watershed (Zone 2A), Sonoma Creek watershed (Zone 3A), Russian River watershed (Zones 4A and 5A), and a tributary of Salmon Creek (Zone 8A). Documented aquatic habitats include small and large creeks, constructed ponds and lakes, flood control channels, marshes, wastewater treatment ponds, and tidal sloughs and estuaries.

In all cases western pond turtles use many habitat features of the creeks. In-channel vegetation or woody debris provides refugia and basking sites, while sparsely vegetated upland areas provide suitable nesting sites. Natural channels provide the highest quality foraging and basking habitat for this species, though modified and engineered channels may also provide a combination of aquatic refugia and upland basking and nesting habitat. This explains the wide distribution of this species in the Program Area.

Stream Maintenance Considerations

Vegetation management and sediment removal activities have the potential to affect western pond turtles in Sonoma County. Typically turtles will move out of harm's way by avoiding areas where work is occurring, but during more sedentary life history stages (e.g., nesting), individuals are more vulnerable. Although the chance of encountering a nest is very low, nests could be lost during near-channel work that requires mobilizing equipment off-road. Overall the temporary or permanent removal of vegetative cover or in-channel woody debris could reduce the habitat quality for this species by removing basking sites and escape cover in reaches where maintenance activities occur. Western pond turtles may benefit from sediment removal in high sediment-loaded urban creeks where deep, open water habitat is limited. However, sediment removal activities may also temporarily alter or remove underwater refugia.

Stream maintenance activities will incorporate measures to reduce potential impacts to western pond turtle. Vegetation removal activities will allow for a percentage of instream vegetation and woody debris to remain in the stream channel and riparian zone.

Migratory Birds and Raptors

The Migratory Bird Treaty Act and California Fish and Game Code (F&G Code) Section 3503 protect migratory birds, their nests and eggs from disturbance and destruction. F&G Code Section 3503 prohibits the take, possession, or needless destruction of the nest or eggs of any bird; §3503.5 prohibits the take, possession, or needless destruction of any nests, eggs or birds in the orders Falconiformes (new world vultures, hawks, eagles, ospreys and falcons, among others) or Strigiformes (owls); §3511 prohibits the take or possession of fully protected birds; and §3513 prohibits the take or possession of any migratory nongame bird or part thereof as designated in the Migratory Bird Treaty Act.

Migratory birds utilize any and all habitats for nesting during the spring and early summer months. These habitats can range from natural (e.g., grasslands, riparian forest) to man-made (e.g., bridges, buildings), so the likelihood that migratory bird nesting habitat is present within SCWA flood control channels is high. Many bird species that are associated with particular habitat types are discussed above, under *Natural Communities and Channel Land Cover*.

Occurrence in the Program Area

During 2006 and 2007 SCWA flood control facilities within each of the Agency's flood control zones (Zones 1A, 2A, 3A, 4A, 5A, 6A, and 8A) were surveyed for nesting migratory bird species and potential habitats that may support nesting special status bird species (Martini-Lamb 2007). Further, data on species and habitats present collected during pre-construction nest searches of flood control channels from 2002 to 2003 was also used to determine habitats for special status bird species. Pre-construction nest searches were performed on foot and all species observed were recorded. Approximately 80 bird species were observed including four special-status species: double-crested cormorant (*Phalacrocorax auritus*), Vaux's swift (*Chaetura vauxi*), white-tailed kite (*Elanus leucurus*), and yellow warbler (*Dendroica petechia brewsteri*). No signs of these species nesting in the channels were observed. A more detailed account of the surveys and the results, including a species list and a characterization of migratory bird nesting habitat along each reach, can be found in Martini-Lamb (2007).

Stream Maintenance Considerations

Most stream maintenance activities, if conducted during the breeding season, have the potential to impact nesting migratory birds. This is due to the widespread nature of migratory bird breeding habitat. Any activities that require ground excavation or vegetation removal have the potential to remove or disturb migratory bird nests during the breeding season. Other activities, particularly those that require mobilizing large equipment, have the potential to disturb nesting birds due to excessive noise.

SCWA has been working to avoid impacts to nesting birds during stream maintenance activities by providing training to employees, scheduling maintenance activities outside of the nesting season (typically March to July) whenever possible, performing pre-construction surveys for active nests during the nesting season, and establishing procedures to avoid impacts to active nests (Martini-Lamb 2007). One tool that has been helpful in training staff is a brochure developed by SCWA containing useful information on how to survey for nests and what to do if a nest is encountered. These procedures will continue under the SMP.

3.10.3 Special Status Fish

Some of the channels within the SMP area are known to support the federally threatened Central California Coast steelhead trout (*Oncorhynchus mykiss*) and federally threatened California Coastal Chinook salmon (*Oncorhynchus tshawytscha*) (NOAA 2004). After careful consideration and discussion with the National Marine Fisheries Service (NMFS), SCWA removed all creeks and/or creek reaches from the SMP area known to support the federally endangered Central California Coast coho salmon (*Oncorhynchus kisutch*) (Figure 1-12). The Russian River has been designated critical habitat for these three species, though the Laguna de Santa Rosa subwatershed was excluded from the final critical habitat designation for the Central California Coast Steelhead Distinct Population Segment (USFWS 2005b). Figures 3-32, 3-33, and 3-34 depict critical habitat for steelhead trout, Chinook salmon, and coho salmon, respectively. These three special status fish are described in detail below, as well as other fish species of special concern which are present in the Program Area.

Central California Coast Steelhead

Central California Coast steelhead is a federal threatened species. The historical range of Central California Coast steelhead includes coastal streams from the Russian River south to and including Soquel Creek in Santa Cruz County. This includes the stream tributaries of the San Francisco Bay and San Pablo Bay basins. Central California Coast steelhead are still present in most of the coastal streams in their historic range, though abundance may be reduced and distribution may be restricted.

Natural History

Smith (1999) describes two different habitat types used by Central California Coast steelhead and resident trout. The primary habitat consists of shaded pools of small, cool, low-flow upstream reaches typical of the original steelhead habitat in the region. However, steelhead have also been found to use less than optimal habitat including warm water areas below dams or pipeline outfalls and areas where summer releases provide high summer flows and fast water feeding habitat, provided that environmental conditions are still acceptable to the steelhead. Trout rely heavily on insect drift for food, and drift increases with flow velocity.

Upper lethal temperatures for adult Pacific salmonids are in the range of 75°F to 77°F (24°C to 25°C) for continuous long-term exposure (Brett, et al. 1982). Optimal temperatures for growth and survival vary between species, as mentioned previously in Section 3.8 *Water Quality*. Preferred temperatures for steelhead parr range from 54°F to 64°F (12°C to 18°C), although optimum growth rates may occur at slightly higher temperatures if food is abundant. Temperatures also influence the smoltification process. In some studies, steelhead have exhibited decreased migratory behavior and decreased seawater survival at temperature in excess of 55°F (13°C) (Zaugg and Wagner 1973; Adams, et al. 1975).

Steelhead along the central California coast enter freshwater to spawn when winter rains have been sufficient to raise streamflows and breach the sandbars that form at the mouths of many streams during the summer. Increased streamflow during runoff events also appears to provide cues that stimulate migration and allows better conditions for fish to pass obstructions and shallow areas on their way upstream (Moyle 2002). The season for upstream migration of Central California Coast steelhead adults typically occurs from December through March (depending on rainfall) with peak migration occurring in January and February (Moyle 2002). At the Warm Springs Fish Hatchery, most adults return from January to April.

Steelhead select spawning sites with gravel substrate and sufficient flow velocity to maintain circulation through the gravel. This provides a clean, well-oxygenated environment for incubating eggs. After emergence from the gravel, fry inhabit low velocity areas along the stream margins. As they feed and grow, they gradually move to deeper and faster water. In the Russian River, steelhead typically rear for two years in freshwater before emigrating to the ocean (Chase 2008, pers. comm.).

In the Russian River, smolt emigration occurs primarily from March through May, extending at low levels through June. In addition, some movement (both upstream and downstream) of young-of-year fish (less than a year old) likely occurs throughout the year. This movement is related to natural dispersal mechanisms, and is an adjustment of fish based on densities and habitat availability.

Occurrence in the Program Area

Historical data show that steelhead were widespread in the Russian River watershed, occupying all of the major tributaries and most of the smaller ones, including creeks in Zone 1A. Currently, steelhead occupy habitat in Zones 2A, 3A, 8A, and 9A. Figure 3-32 depicts critical habitat for steelhead in these four SCWA maintained Zones.

The lower sections of many of the streams within the SMP project area are low gradient, lack deep pools and gravel beds, and therefore generally do not support either spawning or rearing habitat preferred by steelhead. These stream sections are dominated (naturally) by warm water fisheries such as cyprinids (minnows) and catastomids (suckers).

There is general agreement that the steelhead population has declined in the last 30 years (CDFG 1984; CDFG 1991), but limited quantitative data are available to support this assumption. In 2005 and 2006, SCWA conducted fish surveys in several creeks throughout Zone 1A. Surveys documented fairly large numbers of steelhead in Santa Rosa Creek, and low numbers of steelhead in Brush Creek, Matanzas Creek, Spring Creek, Piner Creek, Paulin Creek, Windsor Creek, and Copeland Creek (Chase 2006, pers. comm.).

There are no recent population estimates for steelhead in the Russian River. However, during snorkel surveys conducted by SCWA in 2002, rearing steelhead were observed in the upper mainstem of the Russian River, mostly between Hopland and Cloverdale, but also as far south as Healdsburg (Cook 2003b). Young-of-the-year steelhead are captured annually at the Mirabel inflatable dam during spring sampling; however, few are captured during electrofishing surveys later in the summer. The data indicates that steelhead rear at low numbers in the mainstem near the Mirabel Inflatable Dam (Chase, et al. 2005).

There has been substantial planting of hatchery-reared steelhead within the Russian River basin, which may have affected the genetic constitution of the remaining natural population. Almost all steelhead planted prior to 1980 were from out-of-basin stocks (Steiner 1996). Since 1982, stocking of hatchery-reared steelhead has been limited to progeny of fish returning to the Don Clausen Fish Hatchery (DCFH) (also known as Warm Springs Fish Hatchery) and the Coyote Valley Fish Facility (CVFF).

Stream Maintenance Considerations

Stream maintenance activities that have the potential to directly and indirectly impact steelhead include sediment removal, vegetation clearing, and bank stabilization. Low gradient streams, such as those that make up the majority of the channels maintained under the SMP, tend to provide little spawning and rearing habitat, and are more important for fish passage and migration.

When performing any type of work that necessitates work within the active channel, effective sediment control practices, such as minimizing disturbance to the stream bank and dewatering the channel, will be utilized. Increases in turbidity and sediment input may cause stress to steelhead due to displacement. In-stream maintenance activities may also inflict direct injury or mortality from equipment. In some cases, fish may need to be removed from the site during dewatering and temporarily excluded from the work area to prevent direct injury or mortality. In-stream work (i.e., work within the active channel) will be conducted during the dry season (between June 15 and October 31) to avoid affecting fish during migration.

Another concern is loss of instream cover such as rocks and vegetation that provide refugia for migrating adults and over-summering juveniles. To the extent feasible given flood control requirements, such cover should be allowed to remain in place. In situations where flood control requirements allow for it, habitat elements may be added to the system as a part of maintenance activities (e.g., meandering low flow channels, riparian plantings, etc). Channel clearing and removal of large woody debris should be avoided when possible.

Removal of riparian vegetation has the potential to reduce cover, increase water temperatures, and reduce the amount of aquatic invertebrates, which are the primary food source for these fish species. As much canopy cover needs to be retained as possible. Improper application of herbicides for vegetation removal could result in potential injury to fish or other aquatic species. However, targeted and controlled application can be affective without harming aquatic environments.

Central California Coast Coho

Central California Coast coho salmon is a federal and state endangered species. Data describing the historic range of coho salmon in Sonoma County are limited. However, CDFG has compiled and reviewed salmonid presence data collected between 1920 and 2000 for streams in the Russian River watershed.

Natural History

Freshwater habitat requirements for coho salmon rearing include adequate cover, food supply, and suitable water temperatures. Primary habitat for coho salmon includes pools with extensive cover. The factors most limiting to juvenile coho salmon production are not completely understood, but may include high water temperatures, poor summer and winter habitat quality, and predation.

Coho salmon spawn and rear in tributaries to the Russian River. Emigrating smolts and adults migrating upstream use the mainstem Russian River primarily for migration to and from spawning and nursery areas in the tributaries. There are no data indicating that coho salmon spawn or rear in the mainstem (ENTRIX, Inc. 2004).

Most coho salmon enter the Russian River in November and December and spawn in December and January. After spawning adult coho salmon die. Young coho spend approximately one year in fresh water after hatching, occupying pool and backwater habitats with adequate cover, food supply, and lower water temperatures. Because of the time spent rearing in fresh water, their distribution throughout the Russian River basin is generally limited by water temperature and hydrology (Garza 2003).

The coho salmon life history is quite rigid, with a relatively fixed 3-year lifecycle. Outmigration of juvenile coho salmon takes place in late winter and spring. Coho salmon live in the ocean for a year and a half, return as 3-year-olds to spawn, and then die.

Occurrence in the Program Area

Historic distribution of coho salmon is believed to have included numerous tributaries in the lower and upper Russian River as far north as Corral Creek. Presence-absence data for coho salmon presented in the status review update (National Marine Fisheries Service 1996) and CDFG surveys (B. Cox 2008, pers. comm.) identify streams within the entire Russian River basin for which coho salmon presence has been noted since 1989. Data have been prioritized to indicate streams for which: (1) the most recent survey recorded coho salmon presence; (2) the most recent survey recorded coho salmon absence but which had an equal or greater number of surveys noting coho salmon presence; (3) the most recent and the majority of surveys recorded coho salmon absence.

According to the latest status review, estimates of spawner abundance (considered to be “best-guesses" because data are limited) have shown a decrease within the Russian River from approximately 5,000 fish in 1963 to 255 in 1991 (Good, et al. 2005). It is believed that these numbers have continued to decline. Only three of 26 historic coho streams are currently known to support juvenile wild coho salmon (Conrad, et al. 2006), and this only occurs during intermittent years. No coho salmon have been observed during survey efforts conducted in 2002 on Mark West Creek and between 1999 and 2001 on Santa Rosa and Millington creeks for SCWA’s Russian River Basin Steelhead and Coho Salmon Monitoring Program (Pilot Study). However, CDFG reports coho salmon present in Mark West Creek in 2001 (B. Coey 2001, pers. comm.). It is unlikely that any of the engineered or modified channels within the SMP Program Area support coho salmon.

The Don Clausen Fish Hatchery on Dry Creek at Warm Springs Dam produced and released an average of approximately 70,000 Age 1+ coho salmon each year, from 1980 to 1998. The DCFH coho hatchery was shut down in 1999 due to concerns about genetic impacts on remnant native coho populations. As an interim measure, SCWA, working with NMFS, CDFG, USACE and others, has implemented an experiment Coho Salmon Captive Broodstock (CSCB) Program. The primary goal of the CSCB Program is to reestablish self-sustaining runs of coho salmon in historic habitat within the Russian River watershed. The program planted the first juveniles in the fall of 2004. Plantings were done in Mill Creek, Sheephouse Creek, and Ward Creek.

No coho observed in the watershed occur in the current project area. Coho salmon are considered to be substantially less widespread and less abundant than either Chinook salmon or steelhead in the Russian River basin.

Stream Maintenance Considerations

A subset of the natural channels, of which SCWA holds maintenance easements, has been removed from the SMP area due to presence of habitat for California Coast coho salmon. Under the SMP, SCWA will not remove debris or clear vegetation in the following natural channels: Blucher Creek (Zone 1A), Willow Creek (Zone 5A), Sheephouse Creek (Zone 5A), Dutch Bill Creek (Zone 5A), Green Valley Creek (Zone 5A), Jonive Creek (Zone 5A), and Salmon Creek (Zone 8A). In addition, SCWA maintenance activities for the Russian River (mainstem) and Dry Creek (mainstem) would not be covered under the SMP, as actions in these systems are governed by existing agreements between SCWA and USACE. Figure 1-12 shows these removed channels as green dashed lines. Additionally, the conditions of the Biological Opinion issued by NMFS on the Russian River watershed include restrictions on SMP activities in the upper Mark West Creek watershed, upstream of the Laguna.

California Coastal Chinook

California Coastal Chinook salmon is a federal threatened species. There are over a thousand spawning populations of Chinook salmon on the North American coast from southeastern Alaska to California (Healey 1991). Chinook salmon is one of the most abundant salmon species in North America.

Natural History

Adult Chinook salmon migrate upstream to their spawning habitat, located primarily in the mainstem Russian River above Asti and in selected tributaries such as Dry Creek (ENTRIX, Inc. 2004) between late September and early November. As such, Chinook salmon are the first salmonids to arrive in the system during a given water year. Young Chinook salmon begin their outmigration soon after emerging from the gravel. This is a critical life history difference between Chinook salmon and the other salmonids because juvenile Chinook salmon are out of the system prior to commencement of the in-channel maintenance season (July-October). Moreover, unlike steelhead and coho, adult Chinook salmon could be present in the system during the end of the in-channel maintenance season. However, this scenario is highly unlikely as adult Chinook salmon require fairly substantial rains to provide adequate flows to allow for migration. Flows of this magnitude are uncommon prior to October 31 (the end of SCWA's in channel work window) and such flows would also likely inhibit any in channel work from being conducted.

Ocean residence can be from 1 to 7 years, but most Chinook salmon return to the Russian River as 2- to 4-year-old adults. Adult Chinook salmon begin returning to the Russian River as early as late August, but most upstream migration occurs in late-October and early-November (Chase et al. 2005). Chinook salmon may continue to enter the river through December and spawn into January. Freshwater residence in coastal California stocks, including outmigration, usually ranges from 2 to 4 months. Juvenile Chinook salmon in the Russian River emigrate as smolts from late February through June.

Chinook salmon are dependent upon suitable water temperature and substrate for successful spawning and incubation. Although the suitability of gravel substrates for spawning depends largely on the fish size, generally Chinook salmon require substrates of approximately 0.1–5.9 inches (Bjornn and Reiser 1991). The quality of spawning habitat is also correlated with intra-gravel flow. Low intra-gravel flow may lead to insufficient dissolved oxygen, contribute to the growth of fungus and bacteria, and result in high levels of metabolic waste. A high percentage of fine sediment in gravel substrates can substantially limit intra-gravel flow, affecting the amount of spawning gravel available in the river (Healey 1991). Aelvins of Chinook salmon, steelhead, and coho salmon have been observed in laboratory studies to have difficulty emerging when gravels exceeded 30–40 percent fine sediments (Phillips et al. 1975 in Bjornn and Reiser 1991;, Waters 1995).

Rearing habitat quality for salmonids is defined by environmental conditions such as water temperature, dissolved oxygen, turbidity, substrate, area, water velocity, water depth, and cover (Bjornn and Reiser 1991; Healey 1991; Jackson 1992). Environmental conditions and interactions among individuals, predators, competitors, and food sources determine habitat quantity and quality and the productivity of the stream (Bjornn and Reiser 1991). Rearing habitat for juvenile Chinook salmon includes riffles, runs, pools, and inundated floodplains.

Survival of juvenile Chinook salmon declines as water temperatures increase from 64.4°F to 75.2°F (18°C to 24°C). Juveniles require cooler water temperature to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation deteriorates at temperatures of 62.6°F to 73.4°F (17°C to 23°C) (Myrick and Cech 2001). At the Mirable rubber dam, healthy Chinook salmon smolts were captured at maximum daily surface water temperatures greater than 23°C (Chase, et al. 2005).

Occurrence in the Program Area

Several reports and correspondences suggest there were few, if any, Chinook salmon in the Russian River historically (Shapovalov 1946, 1947, 1955; Murphy 1945, 1947; Pintler and Johnson 1958; Fry 1979 cited in Steiner 1996). Stocking records from the United States Commission of Fish and Fisheries (USCFF) documented planting of Chinook salmon between 1881 and 1907. Snyder (1908) described Chinook salmon in the Russian River and cannery records from before 1890, but suggested that most of the salmon harvested were too small (less than 20 pounds) to be Chinook salmon. There is no information on the presence or absence of Chinook salmon in the Russian River watershed prior to the first stocking records (USCFF 1892 in Chase, et al. 2007).

Research by SCWA and CDFG reveal an abundant and widely distributed population of Chinook salmon in the Russian River today. CDFG compiled and reviewed salmonid presence data collected between 1920 and 2000 for streams in the Russian River watershed; this confirmed a Chinook salmon presence in the mainstem Russian River, the East Fork Russian River, and Dry Creek (ENTRIX, Inc. 2004). SCWA monitored the entire Chinook salmon run for the first time in 2000 at the Mirabel inflatable dam, and counted approximately 1,500 Chinook salmon in 2000 and at least that many in 2001 (Chase, et al. 2001, 2002). A total of 6,103 Chinook salmon adults were observed in 2002 (Chase, et al. 2003). Of the 31 Chinook salmon trapped, only 2 were larger than 20 pounds (Chase, et al. 2003). The latter study indicates that fish size may be a poor indicator of species, and

Chinook salmon may, therefore, have been historically present in the watershed at some level.

SCWA continued monitoring fish migration through the Mirabel Dam from 2000 to 2004 using video counts. Results from those surveys ranged from 1,383 Chinook salmon in 2001 to 6,081 in 2003 (Chase, et al. 2007). SCWA also counted redds along a 100-km reach of the mainstem from Ukiah to Windsor annually from 2002 to 2004. Adult Chinook salmon were the only fish observed on spawning gravels, and up to 1,044 were observed in a single year (Chase, et al. 2007). Results from migrant trapping downstream of Mirabel dam ranged from 1,361 in 2000 to 19,319 in 2002 (Chase, et al. 2007).

Chase et al. (2007) reported the results of Chinook salmon monitoring on Russian River tributaries as well as other Sonoma County streams. During spawning surveys between 2002 and 2004, SCWA observed Chinook salmon on Dry Creek, four other tributaries to the Russian River, and Santa Rosa Creek. NOAA Fisheries captured juveniles on Austin Creek[1] in 2003 and 2004. Finally, CDFG observed redds and carcasses on Forsythe Creek in 1999.

Stream Maintenance Considerations

Zone 1A falls within the Evolutionary Significant Unit for California Coastal Chinook salmon. As discussed in Chapter 2, the Russian River Biological Opinion addresses the potential for California Coastal Chinook salmon to occur in the Russian River and its tributaries. The Laguna de Santa Rosa is a tributary to the Russian River and, therefore, may also support populations of Chinook salmon.

Maintenance activities are unlikely to impact Chinook salmon in the SMP project area. Juvenile Chinook salmon are not present in the project area during the dry months (July through October) when instream activities occur. Some adults may begin their upstream migration in late August, but most upstream migration occurs in late-October and early-November (Chase, et al. 2005). In the unlikely event that Chinook salmon are present at project sites, implementation of avoidance measures for the other salmonids (e.g., exclusion netting, silt fencing, fish removal during dewatering, etc.) will reduce any direct impacts to migrating adults. It should be noted that although unlikely, stream activities that include dewatering could temporarily prevent upstream migration of Chinook salmon. Please refer to the steelhead section for a more detailed discussion of impacts and avoidance measures.

Fish Species of Special Concern

Hardhead

Hardhead (*Mylopharodon conocephalus*) is listed as a species of special concern by the Department of Fish and Game. Hardhead are generally found in clear, deep pools and runs with sand, gravel, and boulder substrates and slow velocities. Most steams in which they occur have summer temperatures in excess of 20^{0}C (Moyle 2002). Hardhead are widely

[1] There are two Austin creeks in the Russian River watershed. The Austin Creek noted here as providing Chinook salmon habitat is located in the lower Russian River and is not a SCWA-maintained channel. There is also an Austin Creek tributary to Brush Creek/Santa Rosa Creek (seen east of Santa Rosa on Figure 1-2) that is a maintained engineered channel. The engineered Austin Creek east of Santa Rosa does not support sensitive fish habitat.

distributed in low to medium elevation streams within Sacramento-San Joaquin drainage and are also know from a number of other drainages including the Russian River. This species is occasionally captured in low numbers with in the SMP Area (Chase 2008, pers. comm.).

Pacific lamprey

Pacific lamprey (*Lampetra tridentat*) is listed as a species of concern by the U.S. Fish and Wildlife Service. Pacific lamprey are anadromous an adults generally move into spawning streams between March and June and are known to migrate in freshwater for up to a year prior to spawning. Migrations of 500-600 km are thought to have been normal prior to habitat loss and barriers. Lamprey need cool water (12-18^{0}C) to spawn and, like salmon, use riffles with clean gravel/cobble substrates. Young lampreys, called ammocoetes, generally require cold water (~15^{0}C) to emerge. After emerging from gravels, ammocoetes move to muddy or silty slack water areas to feed on detritus and spend up to seven years in freshwater before undergoing metamorphosis that allows them to survive in the ocean (Moyle 2002). Pacific lamprey are the most common and largest lamprey in California and are found in coastal rivers and stream throughout the state as well as in the Sacramento-San Joaquin drainages. In the Russian River watershed, Pacific lamprey have been found in the mainstem, as well as in Santa Rosa Creek (Chase 2008, pers. comm.).

River lamprey

River lamprey (*Lampetra ayresi*) is listed as a watch list species by the Department of Fish and Game and a species of concern by the U.S. Fish and Wildlife Service. The biology of river lamprey has not been well studied in California and most information about their habitat requirements has been gleaned from research in British Columbia. This species is anadromous with lamprey spawning in freshwater riffles. Young lampreys, called ammocoetes, feed on detritus, algae and microorganisms in slack water environments for 3-5 years before undergoing a 9-10 month metamorphosis that allows them to survive in the ocean. Timing of outmigration and adult spawning is not well known in California, but it is thought to occur between February and May (Moyle 2002). River Lamprey are know from as far north as Alaska to the southern extent of their known range in the SF Bay. Most California populations are known from the lower Sacramento and San Joaquin Rivers and their tributaries. Populations are also known from the Russian River, Sonoma Creek, Napa River, and Alameda Creek (Moyle 2002). Within the SMP Area river lamprey have been identified in Mark West Creek, are considered likely occur in Santa Rosa Creek and occur in Sonoma Creek (Chase 2008, pers. comm.).

Russian River tule perch

Russian River tule perch (*Hysterocarpus traskii pomo*) is listed as a species of special concern by the Department of Fish and Game. The Russian River tule perch iInhabits low elevation streams of the Russian River system. It requires clear, flowing water with abundant cover, and deep runs or pools (>0.5m). Tule perch are rarely found in streams warmer than 25^{0}C for extended periods and generally are known to prefer temperatures below 22^{0}C (Moyle, 2002). Cover is especially important for near-term females and young because it serves as refuge from predators. Key types of cover include tule beds, other dense instream vegetation beds, and/or submerged branches. The subspecies is known from a number of locations along the mainstem Russian River and potentially occurs in low elevation tributaries that support habitat requirements such as lower Santa Rosa Creek where the species has been observed by SCWA biologists (Chase 2008, pers. comm.).

Chapter 4
CHANNEL CHARACTERIZATION

4.1 Purpose and Overview

This chapter presents watershed information and stream channel characterizations for the SMP Program Area. This chapter builds on the environmental setting presented in Chapter 3, but provides more specific and detailed information for the engineered flood control channels of the maintenance program.

The resource information and channel system understanding developed for this chapter provided the basis to develop the maintenance approaches and environmental measures described in Chapters 5, 6, and 7 in this manual. Besides providing the fundamental system understanding on which to develop the Program's approach, the channel characterizations in this chapter also directly support the program's permitting, implementation, and operation.

The following key elements of the program are directly supported or guided by the channel characterizations in this chapter:

- The environmental planning and impact avoidance approaches described in Chapter 5 *Pre-Maintenance Planning Approach and Impact Avoidance* were developed based on observations of stream conditions and processes.
- The program activities of Chapter 6 *Maintenance Activities* were developed based on understanding the resources and processes in different stream segments and their location in the watershed.
- The impact reduction and minimization measures presented in Chapter 7 were also developed based on knowing the Program Area's resources and stream characteristics.
- The Program's mitigation approach (Chapter 8) was based on an understanding of the Program Area's resources and how to enhance, improve, or restore the resources (as observed and documented through the stream characterization) that may be impacted through program activities.
- The Program's data management system (SMP Tracker), discussed in Chapter 9, was developed in part to track and monitor the resources identified in this chapter.

Finally, the channel characterizations provided in this chapter will provide the SMP program manager and regulatory agency staff a common resource inventory and atlas for the program area. The channel characterizations provided in this chapter are anticipated to be updated over time through program activities and resource inventories.

This chapter is organized geographically by watershed, by subwatershed, and then by specific stream reach. The maps, figures, and reach sheets presented at these different scales are used iteratively to characterize and describe the program's channels. SMP channel reaches are defined according to SCWA's Facility Guide (SCWA 2007b). In general, a reach can be thought of as a continuous channel segment. Reaches are typically defined at their upstream and downstream ends by road crossings, railroad lines, or other structures.

The chapter is divided according to the principal watersheds within SCWA maintenance zones including the Laguna de Santa Rosa watershed (Zone 1A), the Petaluma River watershed (Zone 2A), and the Sonoma Creek watershed (Zone 3A). Overview descriptions for these three primary watersheds are provided in Chapter 3. In this chapter more specific information is provided for the subwatersheds in Zone 1A including: Windsor Creek, Mark West Creek, Santa Rosa Creek, Roseland Creek, Colgan Creek, and Upper Laguna de Santa Rosa Creek.

For each subwatershed area in Zone 1A an index map is provided followed by a sequence of maps that locate and name the engineered channel reaches. These reach maps include an aerial photo base map and the primary vegetation classifications within the reach. Following the reach maps, the channel characterizations (reach sheets) are provided. For Zones 2A and 3A, the index maps are provided in Figures 4-42 and 4-48. The reach maps and reach sheets for the Petaluma and Sonoma watershed areas follow the index maps for those areas.

Table 4-1 lists the reach and vegetation maps for the subwatersheds and reaches maintained within Zones 1A, 2A, and 3A. Note that the vegetation maps and reach description sheets are provided only for the engineered flood control channels of Zones 1A, 2A, and 3A (mapped as orange and red reaches in the subwatershed maps, and the program area maps in Chapter 1, Figures 1-1 through 1-9). Maintenance activities in Modified and Natural channels (mapped as blue and green reaches in the Chapter 1 maps) only occur on an as needed basis as described in Chapter 6.

While this chapter presents an overview of the unique characteristics of each creek, the figures and reach sheets are meant for use in project-scale assessments and to document the SMP's progress. The reach sheets are an integral part of the SMP tracking database which houses data related to SMP activities.

The reach sheets were developed with the objective of providing SCWA maintenance managers and regulatory agency staff a common resource inventory of the program area. Through the Inter Agency Working Group (IAWG), regulatory agency staff requested that the reach sheets of the Program Area include a description and representative photographs. Regulatory agency staff wanted to have a clear description of the reaches in the event that staff could not visit each reach in the field. The resulting reach sheets provide a snapshot of conditions to guide management options, assist the design of project features, or identify sensitive environmental concerns.

The reach sheets contain four groups of information: (1) general setting information; (2) physical conditions; (3) biological conditions; and (4) management considerations and opportunities. The general setting section includes information on jurisdiction, location, adjacent land use, reach length, and channel width. The section on physical conditions includes description of the watershed/reach physical setting, active flow channel width, channel bank structure and composition, water quality, and channel geomorphic processes. The biological conditions section describes instream habitats, riparian corridor conditions, vegetation composition, and wildlife habitat and listed species. The management considerations and opportunities section includes relevant maintenance history, current maintenance priorities at the site, and recommendations on opportunities to enhance or protect natural resources while also achieving maintenance objectives. Over time, as maintenance is conducted the "maintenance history" section of the reach sheets will be updated.

To develop the reach sheets, each of the reaches were visited by an experienced and qualified hydrologist, geomorphologist, ecologist, or botanist. The aim was for specialists in stream physical processes and biological processes to visit each reach. Typically the reaches were walked from upstream to downstream, with observations, notes, and photographs taken. Following the first pass downstream, the reach was generally reviewed again on an upstream pass to confirm initial observations. Draft reach sheets were developed based on the initial site visit and additional references including channel auto-CAD files, SCWA GIS data, and various other available natural resource information including relevant information on plants and wildlife in the Program Area. Draft reach sheets were reviewed by SCWA field managers familiar with the Program Area for accuracy. For most of the Program Area the reaches were visited a second time to confirm/verify initial observations.

The text sections below are presented prior to the reach sheets to introduce subwatershed conditions. Similar to the individual reach sheets, the following subjects are described for the subwatershed areas: watershed and geomorphic context, sediment transport functioning, biological resources, maintenance issues, and resource potential.

4.2 Laguna de Santa Rosa Watershed (Zone 1A)

The primary subwatersheds of the Laguna de Santa Rosa (Laguna) watershed are the Windsor Creek, Mark West Creek, Santa Rosa Creek, Upper Laguna, Roseland, and Colgan Creek subwatersheds. In the descriptions below, subwatershed and subbasin are used synonymously as smaller drainage areas within a larger watershed. The Laguna de Santa Rosa watershed is shown in Figure 1-2 in Chapter 1.

4.2.1 Windsor Creek Subwatershed

The Windsor Creek subwatershed, shown in Figure 4-1, encompasses approximately 26 square miles. Windsor Creek is a tributary to Mark West Creek and the Russian River. Elevations in the subbasin range from 50 feet mean sea level (MSL) near the confluence with Mark West Creek to nearly 1,000 feet MSL in the Mayacamas Mountains to the east. Major creeks and tributaries in the subbasin include Windsor Creek, Starr Creek, Faught Creek, and Airport Creek. Similar to many of the subwatersheds in the Laguna de Santa Rosa, the creek systems of the Windsor subwatershed can generally be classified between the more mountainous headwaters to the east (east of Highway 101) and the more gently sloping lands of the alluvial Santa Rosa Plain to the west. During larger winter stormflows, backwatering of flows from the Russian River can inundate the floodplains along the Windsor Creek and Mark West Creek confluence. The gentler gradients of the lower watershed encourage sediment deposition. In terms of land use, areas of cropland and pasture are found throughout the Santa Rosa Plain portion of the subbasin with urbanized areas in and around the town of Windsor. A number of headwater tributaries, east of Windsor are dammed creating small local reservoirs.

SMP engineered channels in this subwatershed are generally located in the urban areas around Windsor (Figure 4-1). Maintenance reaches include Starr Creek (Figure 4-2), Windsor Creek (Figures 4-2, 4-3), Faught Creek (Figure 4-4), and Airport Creek (Figure 4-5). Vegetation types in these reaches vary from riparian woodland to willow scrub to ruderal, as shown in the figures listed above and described in the following reach sheets. Sensitive habitat for western pond turtle is present in all the maintenance reaches in the Windsor subbasin. Known migratory and rearing habitat for steelhead trout is present in the *Windsor 1* reach. Steelhead habitat is not considered present in reaches upstream of Highway 101 (Bill Cox, CDFG pers. comm., 2008).

Starr Tributary merges with Starr Creek at Windsor River Road. As seen in the *Starr Trib 1* reach sheet, this reach has a low flow channel with ponded stagnant water. While this reach has good canopy cover, cattails and blackberry thickets are the dominant vegetation in the lower portions of the reach.

Airport Creek reaches 1 and 2 receive runoff from the industrial area surrounding the Sonoma County airport. As shown in the *Airport Creek 1 and 2* reach sheet, the channel is straight and trapezoidal with little riparian cover and abundant cattail growth. Removal of sediment and cattails at the the two Airport Creek reaches has been the most recurring maintenance issue in this subbasin. The culvert at Airport Creek and Skylane Boulevard (see photo in the reach sheet) was cleared in the summer of 2008.

Additional details of the channels of the Windsor Creek subwatershed are provided in the reach sheets that follow. Maintenance reaches in this subbasin are listed in Table 4-1.

4.2.2 Mark West Creek Subwatershed

The Mark West Creek subwatershed (60 square miles) is a tributary to the Russian River. Elevations in the subbasin range from 50 feet MSL (above mean sea level) near the confluence with the Russian River to over 2,000 feet MSL near Diamond Mountain in the Mayacamas range to the east. The major creeks and tributaries in the subbasin include Mark West Creek, Wikiup Creek, and Fulton Creek. As seen in Figure 4-6, the subwatershed is elongated between its western lowlands and its eastern headwaters where creeks flow through deep canyons cut into the Mayacamas Mountains. As described for Windsor Creek above, the winter backwatering of flows from the Russian River can inundate the floodplains along the Windsor Creek and Mark West Creek confluence. The gentler gradients of the lower watershed encourage sediment deposition in those locations.

The headwaters in the eastern subbasin are densely vegetated by oak woodland and some Douglas fir forest. The upper watershed includes rural to low density development and Mark West Springs Road which follows the south bank of Mark West Creek. As shown in the reach sheet for Wikiup Creek (*Wikiup 1*) located at the base of the Mayacamas Mtns., storm flows have the erosive power to scour banks and create meanders. In contrast, the gently sloping areas in the western half of the subbasin are generally grasslands with scattered oaks. In addition, there are some areas of cropland and pasture, with vineyards located on the Santa Rosa Plain and the nearby hillsides and valleys to the east. Urban development is focused in northern Santa Rosa along the Highway 101 corridor.

SMP engineered maintenance reaches in this subbasin include Wikiup Creek (Figure 4-7) and Fulton Creek (Figure 4-8). The dominant vegetation type in both reaches is riparian woodland, which provides 75% or greater canopy cover over the channel. As shown in Chapter 7, Table 7-3, Wikiup Reach 1 supports potential habitat for Foothill yellow-legged frog and Western pond turtle and Fulton Reach 1 potentially supports habitat for Western pond turtle.

As described in the Russian River BO (NMFS 2008), the Mark West Creek subwatershed supports habitat for steelhead and Chinook and coho salmon. The Russian River BO specifies that maintenance activities in this portion of the Mark West Creek subbasin, upstream of the confluence with the Laguna de Santa Rosa, are not covered by the 2008 BO. Historically, maintenance requirements for Wikiup and Fulton Creek have been limited to infrequent culvert clearing. If maintenance is required at these reaches, SCWA would conduct a separate consultation with the USACE and NMFS prior to proceeding with maintenance activities. Maintenance on modified and natural channels in this subbasin is very rare and would only occur when requested by private property owners.

Additional details of the channels of the Mark West Creek subwatershed are provided in the reach sheets that follow. Maintenance reaches in this subbasin are listed in Table 4-1.

4.2.3 Santa Rosa Creek Subwatershed

Elevations in the Santa Rosa subbasin (77 square miles) range from approximately 2,000 feet MSL in the Mayacama Mountains to the east to roughly 50 feet MSL at the Laguna de Santa Rosa at the western watershed limit (Figure 4-9). Major streams and tributaries in the subbasin include Santa Rosa Creek, Spring Creek, Brush Creek, Matanzas Creek, Colgan Creek, and Piner Creek.

This subwatershed can be divided into four topographic subregions: the eastern headwaters in the highest portion of the watershed; the central foothills and valleys west of the eastern highlands (including lower Oakmont Valley, Brush Creek); the southern Matanzas Creek tributary; and the low lying Santa Rosa plain to the west. Much of the eastern headwaters area is protected from development in the Hood Mountain Regional Park. These steep lands are covered mostly in Douglas fir forest. The southern arm of the upper watershed drains the eastern “backside” of Taylor Mountain and the northern edge of Sonoma Mountain into Matanzas Creek. Matanzas Creek flows north toward Bennett Valley which is flanked by Annadel State Park to the east and Taylor Mountain to the west. Oak woodland is the dominant vegetation type in this part of the watershed. The Matanzas Reservoir and Spring Lake, located in this area, are managed for water supply and flood control.

The upper subbasin creeks (upper Santa Rosa Creek, Matanzas Creek, Spring Creek, and Brush Creek) join the main Santa Rosa Creek in town east of Highway 101. Further downstream, west of Highway 101, Santa Rosa Creek becomes larger and wider to accommodate flows from the larger watershed area and stormwater from the urban areas around Santa Rosa. In the lower subbasin, Piner Creek is the principal tributary. Piner Creek includes Russell Creek, Paulin Creek, and Steele Creek all of which drain mostly urban portions of Santa Rosa and flow westerly. College, Peterson, and Abramson creeks are smaller more local tributaries that directly merge with lower Santa Rosa Creek.

Approximately 35% of the watershed is urbanized. Urbanization influences the hydrology and stream functioning, particularly in the lower subbasin, downstream of the urban Santa Rosa areas. Urbanization has also encroached east into Bennett Valley, portions of Brush Creek, and sections in the upper watershed along Highway 12. Urbanization has negatively impacted water quality in the subwatershed. Santa Rosa Creek is listed as impaired by pathogens (Table 2-1).

Some channels in the watershed support habitat for salmonids and other federal and state-listed species. As such, maintenance activities in the subbasin must be conducted according to the terms and conditions of the BOs issued by NMFS or USFWS, which cover SMP-related impacts on habitat for salmonids, California tiger salamander, California red-legged frog, and endangered plants. Habitat for state-listed western pond turtle and Foothill yellow-legged frog are also present in this subbasin. Specific reaches where federal or state-listed species are potentially present in the watershed are shown in Table 7-3 in Chapter 7.

Additional description of the major tributaries in the subbasin and their resources is provided below and in the reach sheets that follow. Maintenance reaches in this subbasin are listed in Table 4-1.

Upper Santa Rosa Creek

In upper Santa Rosa Creek, SMP maintenance activities in Bennett Valley focus at Spring Lake, the Spring Lake Diversion Structure, the Matanzas Reservoir, Sierra Park Creek, Lorna Dell Creek, and Spring Creek. This portion of the Santa Rosa Creek watershed is influenced by low to medium density residential development, the Bennett Valley Golf Course, flood and water storage modifications, and Highway 12.

The Spring Lake diversion structure shown in Figure 4-12 controls flood flows and diverts water from Upper Santa Rosa Creek to Spring Lake. The diversion structure was designed to also contain sediment moving downstream. The diversion structure is typically cleared of sediment every 3-4 years. The Matanzas Reservoir, shown in Figure 4-9, provides flood control for Bennett Valley and helps reduce flows downstream. Sediment at this reservoir is also periodically removed, approximately two times every 10 years. Lorna Dell Creek (Figure 4-15), Sierra Park Creek (Figure 4-14), and Spring Creek (Figure 4-13) are intermittent creeks in wetter years and ephemeral in drier years, with water retained in some pools throughout the year. Lorna Dell creek has concrete-lined banks in its maintenance reach (*Lorna Dell 1*). Areas of sensitive California red-legged frog habitat are present near Matanzas Creek, east of the Matanzas Reservoir, as shown in Figure 3-26. Western pond turtle habitat is present in locations with standing water. Steelhead are known to inhabit areas near the Santa Rosa Creek diversion. Foothill yellow-legged frog habitat is present in some reaches of Spring Creek.

Brush Creek

The Brush Creek tributary drainage area is located in the upper Santa Rosa Creek watershed. This drainage flows through Rincon Valley (east of Highway 101 and north of Highway 12). Located at the foot of steep slopes and higher stream velocities of the Mayacamas Mountains, creeks in this subbasin are relatively sensitive to in-channel facilities such as box culverts, hardened banks, and grade control structures (*Austin 2*). There are several points of erosion and bank destabilization noted in the reach sheets for this subbasin. Runoff from Brush Creek's headwaters is controlled by the Brush Creek Middle Fork Reservoir, an earthen dam constructed for flood protection. The reservoir has altered flow and sediment transport functioning downstream, with channel erosion and aggradation observed in downstream reaches (see reach sheets for *Brush 2* and *Ducker 2*). The box culvert at Ducker Creek and Benicia Drive was cleared in the summer of 2008. Riparian woodland vegetation along Brush, Ducker, and Austin creeks has been maintained by SCWA and provides 75% to full canopy cover through the majority of the drainage area (see Figures 4-10 and 4-11). This canopy provides high quality wildlife habitat as well as improved flow passage by discouraging growth of cattails (see reach sheet for *Austin 3*). As shown in Table 7-3, steelhead migratory and rearing habitat and western pond turtle habitat is present in Austin and Brush creeks.

College Creek

Only the lower half mile of College Creek, west of Ridley Avenue, flows above ground (see Figure 4-9). Reach assessments conducted on College Creek Reaches 1, 2, and 3 indicate some bank instability at Reach 3 and significant deposition in Reaches 1 and 2, particularly at the W. College Ave. crossing (see photos on reach sheets). As shown in Figure 4-20, the riparian canopy at these reaches varies between 25 and 75% closure which restricts growth of emergent vegetation like cattails. In reaches 1 and 2, habitat quality is somewhat degraded by channel modifications such as hardened banks, invasive plant species such as blackberry, and accumulated sediment in bars and box culverts. A barrier to fish passage exists at the confluence with Santa Rosa Creek. However, College Creek supports habitat for western pond turtle, as shown in Table 7-3.

Piner Creek

The headwaters of Piner Creek are located in the northern portion of the City of Santa Rosa limits, including Fountain Grove Lake along Fountain Grove Parkway (Figure 4-9). The creek then flows southwest from Highway 101 and merges with Santa Rosa Creek just west of Fulton Road. Major tributaries to Piner Creek include Coffey, Russell, Paulin, and Steele creeks. Paulin Creek includes an in-line flood control reservoir (known as Piner Reservoir – despite it being located on Paulin Creek), approximately 1 mile upstream of Highway 101 (and downstream of County Farm Rd.). A large portion of the City of Santa Rosa is located in the Piner Creek subbasin; including industrial, commercial, residential, schools, and park land uses located adjacent to SMP channels.

Because of the highly developed land uses in this subbasin, the creeks now receive a relatively larger proportion of stormwater runoff compared to pre-development times. Many of the stream banks of this area, particularly along Piner and Paulin creeks have been armored (see reach sheet *Paulin 3* as an example). Reaches in this subbasin have numerous culverts which influences discharge and water quality functions. Along with stormwater, the reaches collect trash and fine sediments washed from streets as shown in reach sheet photos for *Paulin 5*. In terms of recent maintenance, the culvert at Steele Creek and Gamay Street was cleared in the summer of 2008.

The upper reaches of Piner, Russell, Paulin, and Steele creeks tend to be narrow and widen moving downstream to their mid-basin locations (compare the reach sheets for *Steele 5* and *Paulin* 6 with downstream reaches *Steele 1* and *Paulin 1*). Riparian woodland vegetation in some reaches provide patches of 75% canopy cover, particularly along Paulin Creek (Figure 4-17), but the majority of vegetation along the banks of the reaches in this subbasin provide 25% or less canopy cover (see Figures 4-16 and 4-18). Cattails dominate the channel in reaches lacking canopy cover, including Steele reaches 3, 4, and 5. In terms of biological resources, habitat within the urban areas is limited and not diverse, as indicated in the reach sheets for Piner and Paulin creeks. Migratory and rearing habitat for steelhead is present in the lower reaches of Piner Creek (*Piner 1, 2, 3, and 4*) and throughout Paulin Creek (see Table 7-3). If salmonid habitat is present on Steele Creek, as shown in the reach sheet for *Steele 1*, there is a significant barrier to fish passage at the confluence of Steele and Piner creeks (see reach sheet *Piner 2*). California tiger salamander and western pond turtle habitat is supported by many of the reaches in this subbasin (see Table 7-3).

Lower Santa Rosa Creek

Lower Santa Rosa Creek (Reach *Santa Rosa 6* and reaches west of Highway 101), is a wide, nearly uniform trapezoidal channel, which widens moving further downstream. The width of the channel provides opportunities for low-flow channels and gravel bars to develop. East of Fulton Road, the creek flows through primarily residential neighborhoods with some patches of commercial and industrial areas. West of Fulton Road and downstream of the confluence with Piner Creek, the creek flows through agricultural fields in a straight channel for nearly four miles leading to the Laguna de Santa Rosa. At the downstream end of Santa Rosa Creek (Reach 1), just upstream of the Laguna de Santa Rosa confluence, the Santa Rosa Reservoir is found just south of the creek. The reservoir has large earthen berms around its perimeter.

In terms of vegetation, Reach 4, from West 3rd Street to Stony Point Road, contains dense riparian habitat which provides full canopy cover over the creek channel (Figure 4-19). In other reaches, ruderal vegetation dominates both stream banks, with patches of willow and riparian scrub (see vegetation types in Figures 4-19, 4-20, 4-21, 4-22). Reaches 5 and 6 were modified in recent years, including the *Prince Memorial Parkway Project* in Reach 6 to stabilize the stream banks and provide improved flow and sediment conveyance through the channel. As indicated in the reach sheets, enhancement of biological resources is not strongly observed in these recent creek upgrades.

As listed on Table 7-3, Santa Rosa Creek Watershed supports habitat for steelhead trout and Chinook salmon (on rare occasions), as well as California tiger salamander, western pond turtle, and special status plants. Because of resource sensitivity, maintenance activities are restricted by the regulations discussed in Chapter 2. Forestview, Peterson, and Abramson creeks are situated at lower elevations of the Santa Rosa Plain, before entering the Laguna (Figure 4-9). As noted on the reach sheets, sediment accumulates in bars, particularly along

Peterson 2 and Abramson creek. Sediment transport, water quality, and riparian vegetation along Peterson and Abramson creeks are influenced by surrounding agriculture, compared to creeks higher in the watershed which are more influenced by urban development.

4.2.4 Roseland and Colgan Creek Subwatershed

Roseland and Colgan Creeks are located south of Santa Rosa Creek and drain the middle portion of the Laguna de Santa Rosa subbasin (Figure 4-23). The two creeks flow parallel to each other from the southwest area of Santa Rosa to the Laguna, south of Sebastopol. Colgan Creek encompasses approximately 7 square miles is located approximately one mile south of Roseland Creek. Elevations in the drainage areas range from nearly 75 ft. above MSL at the Laguna to 1,400 feet above MSL at Taylor Mountain. The upper portion of these catchment basins are mostly urbanized within the Santa Rosa city limits. The headwaters of Colgan Creeks include smaller tributaries that drain the north side of Taylor Mountain. Both Colgan and Roseland creeks flow through residential and industrial areas and Colgan Creek is directed under Highway 101 through culverts. The lower portions of both drainages flow through agricultural fields until they meet the Laguna. The primary land use in the lower portion of the subwatershed is cattle grazing.

Roseland Creek has a slightly larger drainage area (7.8 square miles) compared to Colgan Creek. The creek's middle reaches have been straightened between Burbank and Ludwig avenues. Further downstream (at reach *Roseland 1*), the creek exhibits a more natural meandering form. Vegetation is primarily ruderal with little to no riparian canopy over the channel (see Figures 4-24, 4-25, and 4-27). The majority of Roseland Creek flows through agricultural lands which can strongly influence habitat and water quality in the channel. For example, in Reach *Roseland 1*, cattle allowed to graze in the channel may affect water quality and sediment inputs to the Laguna. In 2008, three cattle crossings (low flow access roads built over culverts) were replaced to improve creek flow and sediment transport conditions in the creek and fencing was replaced to keep cattle out of the water. As listed in Table 7-3, western pond turtle habitat is supported along lower Roseland Creek and this region of the Laguna watershed supports a sensitive population of California tiger salamander.

The headwaters of Colgan Creek are found at Kawana Springs Creek (Figure 4-24). Kawana Creek flows from the foothills of Taylor Mountain and merges with Colgan Creek at Highway 101. Reach *Kawana 1* extends from Petaluma Hill Road west to Santa Rosa Avenue. The gentle gradient, linear trapezoidal channel, hardened stream banks, and lack of riparian canopy along much of the length of Colgan Creek have encouraged growth of invasive vegetation and sediment deposition. Vegetation along Colgan Creek varies from ruderal with patches of blackberry scrub in the middle of the watershed to more riparian woodland in the lower reaches of the watershed (see Figures 4-26, 4-28, and 4-29). Significant accumulation of sediment and poor water quality is noted on the reach sheets for Colgan Creek, particularly for reach *Colgan 4, 5, and 6*. These conditions are created or exacerbated by abundant invasive plants such as cattails and blackberry. A box culvert at Colgan Creek and Hearn Avenue (reaches *Colgan 5/6*) was cleared during 2008 maintenance activities. The channel in the lower reaches of Colgan Creek (reaches *Colgan 1/2*) is surrounded by agricultural fields and is widened to accommodate backwatering from the Laguna during high flows. The low topography encourages sediment deposition and the wide channel with little riparian canopy combine to encourage growth of cattails. California tiger salamander and western pond turtle habitat are supported by Colgan Creek.

Additional description of the Roseland Creek and Colgan Creek channels is provided in the reach sheets that follow. Maintenance reaches in this subbasin are listed in Table 4-1.

4.2.5 Upper Laguna de Santa Rosa Subwatershed

The upper Laguna subbasin is the southernmost drainage area of the Russian River watershed and forms the divide between the Russian and Petaluma river watersheds (Figure 4-30). The upper Laguna drainage area encompasses 42 square miles, including the cities of Cotati and Rohnert Park. The downstream border of the subbasin ends at the City of Santa Rosa's Laguna Wastewater Treatment Plant on Llano Road, near the confluence with Colgan Creek.

Land use in the subbasin transition from undeveloped Douglas fir forest high on Sonoma Mountain (at the headwaters of Copeland Creek), to oak woodland and grasslands in the mid- to lower Sonoma Mountain area, to suburban residential neighborhoods in Rohnert Park and Cotati, to then rural residential and agricultural uses in the subwatershed toward the Laguna proper.

Primary drainages in the subbasin include the Bellevue-Wilfred Channel system including Todd, Hunter, Wilfred, Coleman, and Cook creeks (Figures 4-31, 4-32, 4-33, 4-34, 4-35, and 4-37); Hinebaugh Creek system including Crane and Five creeks (Figures 4-37 and 4-38); and Copeland Creek (Figures 4-39 and 4-40). The Bellevue-Wilfred drainage area exhibits drier ruderal and mixed riparian scrub vegetation, while the Hinebaugh and Copeland drainage areas support dense riparian woodland which provides 75% to full canopy cover in the most of the channel reaches.

The headwater tributaries of Copeland, Hinebaugh, Crane, and Cook creek descend from Sonoma Mountain. The elevation contours in Figure 4-30 illustrate the decrease in land gradients from the mountain front, to the alluvial fan zone, to the lower alluvial plain of the Laguna. The changes in gradient are important for in terms of stream maintenance and habitat conditions. In the alluvial fan zone, near Petaluma Hill Rd. and Snyder Ln. the steeper stream gradients of the upper mountainous zone become gentler. When this happens, many of the streams become more depositional in nature, dropping their coarser sediment load. This situation is particularly observed at many of the crossings at Petaluma Hill Rd. and Snyder Ln. where culverts are often blocked with accumulated sediment and debris. Because of this situation, several of the upper Laguna channels of Rohnert Park and Cotati require the most frequent and routine maintenance of any channels in the SMP Program Area. Also of note in this subbasin is the substantial influence of backwatering from the Laguna system. This effect may extend as far east as Highway 101.

Additional description of the major tributaries in the Upper Laguna subbasin and their resources is provided below and in the reach sheets that follow. Maintenance reaches in this subbasin are listed in Table 4-1.

Todd Creek

Todd Creek is the northern most tributary within the Upper Laguna system. Todd Creek is somewhat unusual in the Upper Laguna subwatershed for its north-south alignment. Historically, this channel pattern may have been more northwest/southeast oriented along the general slope of the alluvial plain.

As described in the reach sheets, Todd Creek is noted for its gentle gradient, stagnant flow and poor water quality conditions, and accumulation of sediment at road crossings. Abundant fine sediment was removed from Todd Creek Reach 5 during 2008 interim maintenance activities. Field observations suggest that various maintenance activities are needed in most Todd Creek reaches. Downstream of Reach 5, Todd Creek continues as a very linear south flowing channel in Reach 4 until its confluence with Hunter Creek, whereby it then flows due west, increasing in size to accommodate the larger flow capacity. West of Highway 101, Todd Creek remains as an earthen channel except for the confluence with Wilfred Creek where the channel is entirely concrete. The lower reaches of Todd Creek (*Todd 1 and 2*) are located within sensitive California tiger salamander habitat.

Todd Creek does not flow through a particularly urbanized area, but fine sediment-producing activities in its upper watershed (row crops and light grazing) are the largest influence on the quality of habitat in Todd Creek, aside from channel modifications. As opposed to other creeks in the watershed, Todd Creek functions more akin to an agricultural drainage ditch where fine sediment mobilized from upstream accumulates in the gentle sloping channel instead of transporting to areas downstream. Historic modifications to Todd Creek's alignment may also have cut off its coarser headwater sediment source area. Cobbles and gravels from headwaters east of Petaluma Hill Road no longer reach the channel. However, these coarser sediments are delivered by Hunter Creek.

Hunter Creek

Hunter Creek flows easterly from Petaluma Hill Road west to Santa Rosa Avenue where it joins Todd Creek. It is likely that the current channel is located fairly close to the original stream position prior to being confined in a trapezoidal channel. As shown in Figures 4-32 and 4-33, the dominant vegetation type is ruderal with some patches of riparian woodland. Unlike Todd Creek, Hunter Creek is still connected to headwater sediment source areas and it transports a bedload of sand, gravel, and cobbles. Additionally, the channel does not exhibit aggradation from deposited sediment or dense thickets of cattails as noted in Todd Creek. However, stagnant pools and bank sloughing are common in the lower reaches of the creek, as shown in the *Hunter 1 and 2* reach sheet. Maintenance activities in this channel have been infrequent in the past. However, future land use changes in the upper watershed could result in significant alteration to channel functioning and maintenance needs.

Coleman and Cook Creeks

Coleman Creek is located in the geomorphic transition from alluvial fan to alluvial plain west of Petaluma Hill Road where sediment is prone to depositing in the flood control channel (Figure 4-30). As shown on Figure 4-35, Cook Creek is a tributary to Coleman Creek. Though not immediately evident in the figure, Cook Creek flows from its headwaters on Sonoma Mountain to the Cook Creek Sediment Basin near Petaluma Hill Road (reach sheet *Cook 2*), then the creek flows underground in a culvert (the Cook Creek Conduit) and daylights again in Golis Park west of Snyder Lane (reach sheet *Cook 1*). The Cook 1 reach flows north along the west edge of the park for approximately 800 feet before merging with Coleman Creek. Downstream of Snyder Lane, Coleman Creek passes through the Foxtail Golf Club and then joins the Wilfred Extension channel (reach *Wilfred Extension 1*) which then joins the mainstem of Wilfred Creek (Figure 4-34). As noted in Table 7-3, potential habitat for western pond turtle occurs in the subbasin but it is unlikely that habitat for other special-status species is present.

While the combined headwater catchment area for Coleman and Cook Creeks is relatively small, their headwater areas are very erosive and contribute high sediment yields downstream. Particularly in upper Cook Creek, mass movement, landslides, and severe streambank erosion have led to abundant sediment yields. These conditions prompted the 2006 and 2008 Cook Creek erosion control projects (see Appendices C-1 and C-4 for more information on those projects). East of Petaluma Hill Road, a sedimentation basin on Cook Creek captures materials discharged from the headwaters and foothills. In the past, this basin was frequently cleared of sediment, but since completion of the erosion control projects in the headwaters upstream, the basin has not required maintenance as frequently. This is an example of successful implementation of the SMP's Maintenance Principles (discussed in Chapter 5) and the mitigation program (discussed in Chapter 8).

As noted in the reach sheets, sediment deposition and channel aggradation occurs in the Cook and Coleman creek reaches. Considering the erosion control efforts conducted in the headwaters and the maintenance activities conducted on Coleman Reach 2 during 2008, improved channel maintenance and habitat conditions should result. These improvements will also benefit the creek reach that flows through the Foxtail golf course and to Wilfred Creek.

Wilfred Creek and Bellevue Wilfred Channel

Wilfred Creek, like Todd Creeks, may have once been more directly connected to headwater source areas east of Petaluma Hill Road. However, development in the area including agricultural use, residential housing, and a golf course resulted in the realignment and straightening of the creek channel and disconnection from their upper watershed (Figures 4-34 and 4-35). Wilfred Creek has a smaller headwater area than Hunter or Cook creeks, with its primary source of sediment and flow likely originating from runoff from the agricultural fields along the northern half of the drainage area.

The reach sheets for *Wilfred 1* and the *Wilfred Extension*, characterize channel conditions with abundant sediment accumulation, limited riparian vegetation, and lack of channel complexity. Maintenance activities along these reaches consist of culvert clearing at Snyder Land and Santa Rosa Avenue and bank stabilization. The *Wilfred Extension* channel conveys runoff from Coleman Creek and the Foxtail Golf Club (Figure 4-34). As noted in the *Wilfred Extension* reach sheet, sediment detention basins within the golf course noticeably improve the quality of water discharged to the *Wilfred Extension* and Wilfred Creek channels, particularly for reduction of suspended sediment (i.e., turbidity). The lower portion of the *Wilfred Extension* and *Wilfred Reach 1* channels border a vernal pool wetland preserve where sensitive habitat for many plant and wildlife species is protected. Any maintenance activities along Wilfred Channel near the preserve must considerate the habitat sensitivity of the area.

The *Bellevue-Wilfred Channel* is the receiving stream for the Todd, Hunter, Cook, Coleman, and Wilfred channels discussed above. A photo showing the confluence of Todd and Wilfred creeks is shown on the reach sheet for *Bellevue-Wilfred Reach 4*. Numerous sediment depositional bars with cattail growth and flow impedance are noted on the reach sheets as a result of the modified nature of the channel and receiving waters. The Bellevue-Wilfred channel gradually widens moving downstream from Reach 4, through Reaches 3 and 2, eventually leading to Reach 1 at the Laguna de Santa Rosa. The widened channel and backwatering from the Laguna encourages sediment deposition throughout the lower Bellevue-Wilfred channel. Though deep pools are observed in Reach 4, the downstream reaches exhibit little channel complexity. Ruderal vegetation dominates the banks and there is little to no riparian canopy over the channel (Figures 4-34 and 4-37).

As a result, conditions for invasive plants such as ludwigia and cattails are supported by the existing Bellevue-Wilfred channel conditions. As indicated in Table 7-3, there is a high likelihood of presence of California tiger salamander habitat in the area, probably due to the surrounding agricultural fields and earthen banks where rodent burrows offer retreats for salamanders. Opportunities to improve habitat and sediment transport functioning within the Bellevue-Wilfred channel may include installation of targeted sediment capture areas (sediment basins) or low-flow channels within the banks to prevent transfer of sediment to the Laguna and migration of invasive species (ludwigia) from the Laguna to the channel. As noted on the sheets for reaches *Bellevue-Wilfred 1, 2, and 3*, large areas of ludwigia were removed from the channel in 2007.

Hinebaugh Creek

The Hinebaugh Creek drainage area extends far in to Sonoma Mountain to the east (Figure 4-30). Crane Creek is the primary tributary in the system, followed by Five Creek and Hinebaugh Creek. As shown in Figure 4-30, Five Creek flows into Crane Creek, which flows into Hinebaugh Creek and then to the Laguna de Santa Rosa. East of Snyder Lane, the three creeks flow through agricultural fields which support grazing and grain production. Rural residences and ranches are located in the upper watershed lands. Patches of oak and Douglas fir trees are found along the stream channels in the upper watershed. As the creeks flow west onto the alluvial plain, the streams transition to engineered channels and the diversity of riparian species reduces while invasive species such as cattail increase. Additionally, sediment texture transitions from the coarser gravels and sands found in the upper watershed to finer sands and silts moving downstream to reaches *Hinebaugh 1 and 2*. Vegetation in the reaches varies from ruderal to riparian woodland with nearly 75% canopy cover (see Figures 4-37 and 4-38).

Many of these finer sediments are transported to the lower reaches of Hinebaugh Creek downstream of Highway 101 where they are deposited. This zone between Highway 101 and the Laguna confluence downstream reflects a transition from a fluvial, low gradient system (observed in the upper portion of Hinebaugh Reach 2 and Reach 3) to a very low gradient, lagoon type environment that experiences backwatering from the Laguna system (as observed in the lower portion of Hinebaugh Reach 2 and Reach 1). Depending upon flood conditions, backwatering effects from the Laguna continue upstream to the Highway 101 crossing, as observed during flow events in the fall of 2007. Backwatering from the Laguna causes sediment deposition in the lower reaches of Hinebaugh Creek (see reach sheets for *Hinebaugh 1, 2, and 3*). Bars within the channel and sections with little riparian canopy creates conditions where cattails thrive. The cattails encourage additional entrapment of fine sediment and impede flow through the channel. Many of the reach sheet photos for Hinebaugh Creek illustrate this problem. Two large reach-scale sediment removal projects were conducted at Hinebaugh Creek Reaches 1 and 2 in 2007 and 2008. The channel was cleared of deposited sediment and cattails and a low-flow channel was excavated.

Suitable spawning habitat for steelhead may exist in the upper tributaries to Hinebaugh Creek, such as Crane Creek. However, to date no steelhead have been observed in the upper reaches during SCWA surveys although other cold water fish such as sculpin have been observed. As shown in Table 7-3, reaches of Hinebaugh and Crane creeks are identified as supporting migratory habitat for steelhead. The subbasin also supports habitat for California tiger salamander.

Copeland Creek

The headwaters of the Copeland Creek subbasin (5.1 sq. mi.) extend to the east beyond the city limits of Rohnert Park and rise up the slopes of Sonoma Mountain to a peak elevation of 2,463 ft. This headwater area provides the source areas for runoff, groundwater recharge, and sediment yields transported downstream. West of Petaluma Hill Road, were elevations and slope decrease across the alluvial plain, Copeland Creek becomes a straightened engineered flood control channel (Figure 4-30). Snyder Lane marks a shift toward a more depositional channel environment with cobbles and pebbles being deposited upstream of Snyder Lane and finer sand and silt materials depositing downstream of Snyder Lane.

Sediment deposition is observed throughout Copeland Reaches 1-5. In Reach 5, near the Snyder Lane crossing, sediments consist primarily of gravels (course sands, pebbles, and small cobbles). These coarser sediments are organized into longitudinal bar features, with narrow low flow channels between the bars. Of note, the sediment bars near the Snyder Lane Bridge aggraded over 1 ft. in height during the storm events of early January 2008. Moving downstream to Reach 4, sediment texture transitions to finer materials including medium sands and finer silts. As this occurs, the depositional patterns change from the defined gravel bars upstream to a more homogonous filling of the entire channel width. SCWA conducted a reach scale sediment removal project (including excavation of a low-flow channel) at Copeland Creek Reach 4 during 2008.

Downstream of Reach 4, SCWA had previously excavated a low-flow channel during previous sediment maintenance activities at Reach 3 in 2003. As described in the reach sheets for *Copeland 1, 2, and 3* benches and bars have established adjacent to the low-flow channel. In conjunction with the riparian corridor of lower Copeland Creek, these features provide channel complexity, habitat improvement, and an important migratory corridor for fish that pass through the engineered Copeland Creek reaches toward upstream spawning sites. Upper Copeland Creek supports spawning and rearing habitat for steelhead in its upper reaches (Table 7-3). The Copeland Creek channel provides important migratory corridor from the Russian River and Laguna, to the upper Copeland Creek headwaters. The low-flow channel features will improve sediment transport functioning and improve channel complexity for the benefit of juvenile salmonids. Vegetation within Copeland Creek is dense, ranging from riparian forest in Reach *Copeland 2* (Figure 4-40) to riparian woodland providing 75% canopy coverage in reaches Copeland 4 and 5.

South Fork Copeland Creek (Figure 4-40) primarily conveys runoff from surrounding residential neighborhoods and joins Copeland Creek at Reach Copeland 3. As noted in the reach sheet, this drainage channel is likely a borrow ditch from construction of the adjacent railroad berm. Poor water quality in the channel, such as highly turbid water and floating oils, indicate the influence of the surrounding development on habitat quality. This channel may provide an important water quality and sediment filter for runoff from drainage areas south of Copeland Creek and between Snyder Lane and Highway 101.

Upper Laguna Channel

The Upper Laguna drainage area forms the southernmost divide between the Russian River and Petaluma River watersheds. The Upper Laguna channel daylights from a culvert at Liman Way and Myrtle Avenue in Cotati. Headwater areas further upstream of the daylighted culvert are disconnected due to development, but flows contained in the uppermost reaches (Reaches 6 and 7) are still supplied by underflow through the alluvial plain and urban surface runoff. Sediment clearing in reaches *Laguna 6 and 7*, as described in the reach sheets, has improved flow conditions and provided opportunities for community involvement in riparian plantings, such as organized by the Cotati Creek Critters organization for example. The Cotati Creek Critters organization is one of the Watershed Partners who participated in SCWA's watershed mitigation and grant funding program in 2008 (see Chapter 8 *Program Mitigation*). The continued nurturing and planting of the riparian corridor in these upper reaches will hopefully reduce the need for additional cattail removal and bank stabilization projects.

In Reaches 4 and 5, the channel is wider and more sinuous than Reaches 6 and 7 (Figure 4-41). The increased available width in the channel encourages establishment of a low flow channel and a riparian overstory. Approaching Highway 101 at the lower end of Reach 4, the channel is concrete lined with vertical walls. Patches of riparian vegetation on the banks and in the channel (cattails) provide varying levels of habitat.

The channel gradually widens as it continues to flow downstream, most noticeably at Reach 3, west of Highway 101. The channel is slightly wider than the reach upstream and a low flow channel and pools have established throughout the reach. Fine sediments are abundant and because of limited shading and the gentle channel gradient (see Figure 4-39), cattail growth is widespread. During moderate storm events the Laguna routinely backwaters upstream into Reach 3.

Washoe and Copeland creeks enter at the lower end of Reach 3. The reach of Washoe Creek maintained by SCWA is likely a remnant of the original channel's alignment. Headwater flows to Washoe Creek are redirected to Gossage Creek at Derby Lane, north of Highway 116. The remnant channel reach (*Washoe 1*) primarily functions to convey runoff from agricultural activities surrounding the area. Backwatering influences from the Laguna are felt in this reach as well.

In Laguna Reach 2 the channel transitions from riverine processes to a more still water or lagoonal environment. This reach of channel was designed with the capacity to convey flow from the upper drainage area, as well as the Copeland, Gossage, and Hinebaugh drainage areas. The channel widens even further at Reach 1 where the Bellevue-Wilfred flows are received. Water is dispersed widely across the channel and the bed is layered with silts and clays. Ludwigia occurs commonly throughout the lower portions of the Upper Laguna channel. In some locations, riparian cover over the channel assists in suppressing growth of ludwigia and cattails.

The Upper Laguna channel supports habitat for steelhead (migratory corridor), California tiger salamander, western pond turtle, and some special-status plants. Unlike most of the major tributaries to the Upper Laguna system which flow from the east, the Gossage Creek tributary joins the Upper Laguna system, flowing from the south and west. Gossage Creek also supports migratory habitat for steelhead. Gossage Creek has experienced ludwigia encroachment in its lower reaches. Improved riparian corridor management to prevent growth and distribution of cattails and ludwigia would ensure this habitat is protected and improved in the future. Gossage Creek has also had two bank stabilization projects conducted by SCWA in recent years (2006-2008).

4.3 Petaluma River Watershed (Zone 2A)

The Petaluma River watershed is located in southern Sonoma and northern Marin Counties. Approximately 112 square miles of the 146 square mile watershed are located in Sonoma County. The City of Petaluma and the unincorporated community of Penngrove, as well as, a portion of the Town of Novato and outlying unincorporated areas are located in the Petaluma River watershed.

Elevations in the watershed range from sea level at San Pablo Bay to about 3,000 feet MSL at Sonoma Mountain. Major tributaries to the Petaluma River in Sonoma County include Lichau Creek, Wiggins Hill Creek, Corona Creek, Capri Creek, Lynch Creek, Washington Creek, McDowell Creek, Thompson Creek, Adobe Creek, Ellis Creek, and San Antonio Creek, which forms the border with Marin County (Figure 4-42). The lower 12 miles of the Petaluma River flow through the Petaluma Marsh. The river ultimately empties into the northwest portion of San Pablo Bay. Tidal influence extends approximately 14 miles upstream of San Pablo Bay, to near the confluence of Lynch Creek above downtown Petaluma. The Petaluma River is one of the few remaining rivers in California that continue to support commercial river traffic.

The majority of the Petaluma River watershed is in non-intensive agricultural production, including oat hay production and dairy cattle and sheep grazing lands. Vineyard development has occurred throughout the watershed from the 1990’s to the present, including on Sonoma Mountain and along Lakeville Highway. Urban runoff from the City of Petaluma, which covers approximately 14 square miles, is directed to the lower Petaluma watershed.

SCWA conducts maintenance activities on the lower sections of the following tributary creeks: Lichau (Figure 4-43), Corona (Figure 4-44), Capri (Figure 4-44), Washington (Figure 4-45), McDowell (Figure 4-46), Adobe (Figure 4-46), and Thompson (Figure 4-47) creeks. SCWA does not conduct maintenance activities in the Petaluma River itself.

Three reaches of Lichau Creek are maintained by SCWA between Old Redwood Highway and Stony Point Road (Figure 4-43) toward the confluence with the Petaluma River. Land uses draining to Lichau Creek are primarily agriculture (grazing) with some patches of low-density development, and more commercial uses near the Highway 101 corridor. Channel vegetation cover is over 75% in Reach 3 near Old Redwood Highway and declines to 5% cover in Reach 2 near Highway 101. Reaches 2 and 3 contain a developed riparian corridor which provides shade over in-channel pools, while Reach 1 is gentler in gradient and supports emergent vegetation (cattails) in over 70% of the channel width. Lichau Creek supports spawning and rearing habitat for steelhead in the upper watershed. Thus, Reaches 1, 2, and 3 are the migratory gateway for steelhead moving up the Petaluma River and into Lichau Creek. Maintenance activities in these reaches primarily consist of sediment and vegetation removal.

Corona and Capri creeks are small tributaries originating in the foothills of Sonoma Mountain west of Petaluma. The majority of both drainage areas have been developed for residential housing with headwater areas occupied by rural residential and agricultural land uses. The seven reaches of Corona support an abundance of emergent vegetation (duckweed and cattails) which impedes flow and encourages sediment deposition. As noted in the reach sheets, vegetation removal and riparian corridor enhancement are recommended maintenance activities. Reach *Corona 1* diverts flows from Corona Creek to Capri Creek west of Highway 101. Prior to construction of Highway 101, Corona Creek flowed west directly toward the Petaluma River. Capri Creek is similar to Corona Creek, but the drainage area and creek sizes are smaller. The upper Capri Creek watershed is rural agricultural grasslands at the base of Sonoma Mountain. Moving downstream, Capri Creek becomes a landscape feature through a neighborhood park. As seen in the reach sheets, lower Capri Creek enjoys a wide easement upstream of Old Redwood Highway. This lower reach provides a good opportunity for additional planting and canopy development, and removing existing cattail stands. Toward the Petaluma River, the riparian canopy cover increases (Figure 4-44).

A short reach of Jessie Lane Creek, located on the west side of the Petaluma River, directly across from Capri Creek, is heavily impacted by stands of blackberry and surrounding land uses (Figure 4-44). Compared to Capri Creek, Jessie Lane Creek is more ephemeral than intermittent.

Lynch Creek is one of the larger tributaries to the Petaluma River from the Sonoma Mountain side of the watershed. Steelhead spawning habitat is located in the upper watershed. The reach maintained by the Agency (*Lynch 1*) therefore provides an important migratory pathway to these spawning grounds. This reach includes a coarse sediment bed with pebbles and sands. As described on the reach sheet, patches of duckweed and cattails fill the channel and the banks lack riparian vegetation tall enough to provide channel shading (see Figure 4-45).

Similar to the other tributaries described above, Washington Creek flows from Sonoma Mountain west to the Petaluma River and is one of the larger drainage areas in the Petaluma subwatershed. The Petaluma Municipal Airport and Rooster Run Golf Course bisect Washington Creek and its parallel tributary, East Washington Creek requiring underground culverts. The upper drainage area is mostly oak woodland and grasslands, while the lower drainage area is urbanized. Patches of riparian woodland and willow scrub are found along both the Washington and East Washington creek reachess. In some places the riparian vegetation provides full canopy cover (Figure 4-45). Unlike Lichau, Lynch, and Adobe creeks, Washington Creek does not support steelhead habitat. The lowermost reaches of Washington Creek (Washington 1, 2, and 3) are influenced by tidal activity.

Upper Washington Creek, Reach 7 is an ephemeral reach with a nearly entirely sandy channel bed. Moving downstream, Washington Creek (Reaches 6, 5) becomes a roadside adjacent channel to Washington Ave. In these locations the channel is linear and homogonous with steep banks, typically hardened with secrete, and is flanked by Eucalyptus and other non-native species. Washington Creek Reach 4 has previously flooded into the adjacent shopping area near the “Big 5”. This reach has been maintained by SCWA to reduce the flooding potential, and remains on SCWA’s watch list for additional maintenance. A box culvert on Washington Creek (Reach 2) was cleared as part of interim maintenance activities in 2008. Lower Washington Creek, particularly Reach 1, has been upgraded by the USACE to provide increased flood protection. This reach that joins the Petaluma River is tidal and experiences bi-directional flows. SCWA and the USACE coordinate their maintenance in the lower Washington Creek reaches near the Petaluma River.

East Washington Creek is maintained by SCWA in five reaches extending from the airport to the confluence with Washington Creek (Figure 4-45). As mentioned in the reach sheets, the wide gently sloping channel banks of Reaches 4 and 5 provide the space to install low flow channels and in channel sediment basins. Reaches 1, 2, and 3 are narrower than the upstream reaches and also experience abundant deposition. Areas of bank slumping are observed in Reach 3 and in channel vegetation hinder flow conveyance in Reaches 1 and 2. Existing patches of riparian vegetation throughout the creek could be enhanced to improve channel shading and reduce growth of cattails. East Washington Creek Reach 1 was cleared of sediment during the 2007 maintenance season.

The original channel of McDowell Creek is barely distinguishable today due to the intense development in this portion of the watershed. McDowell Reach 1 is directly connected to the Petaluma River and no SCWA maintenance occurs there. Tidal gates at the upstream end of Reach 1 at Lakeville Road reduce tidal influences from entering reaches *McDowell 2 and 3* and *East Fork McDowell 1*. The reaches maintained by the Agency have been heavily modified for flood control and conveyance of stormwater runoff from surrounding development and highways. Numerous stormdrain outfalls require that a large portion of the stream banks are armored. The riparian corridor is dense enough in some locations to provide some shading over the channel, but the corridor is sparse or non-existent in most portions of the *McDowell 2 and 3* (Figure 4-46). The primary maintenance needs in the reaches are vegetation management and some sediment removal.

Similar to Washington Creek, the drainage area for Adobe Creek extends to the peak of Sonoma Mountain. The creek descends quickly from approximately 2,000 ft MSL at Sonoma Mountain to approximately 200 ft MSL at Old Adobe Road. The creek flows through the Adobe Creek Golf Course, residential housing, and to the Petaluma River, south of McDowell Boulevard. The lower portions of Adobe Creek (Reaches 1-4) are maintained by SCWA. Reaches 4 and 3 represents the transition from the alluvial fan into the gentler alluvial plain section and are characterized by their sand and cobble stream bed which encourages infiltration. The stream channels narrows moving downstream through Reaches 4 and 3. The channel in Reaches 3 and 4 contains a narrow, but intact remnant riparian corridor. As shown the reach sheet photos, the gravel and cobble streambed materials store flows subsurface except where deep pools have formed. In channel pools provide important habitat for special-status species such as Foothill yellow-legged frogs and steelhead which have been observed in these reaches. Downstream of Lakeville Road, the channel is wider and nearly completely covered by a dense riparian over story (Figure 4-46). Many of the sediments transported from the upper watershed and through reaches 3 and 4 are deposited in Reach 2. Reach 2 has retained some connection to adjacent floodplain areas. Reaches 2 and 1 are tidally influenced from the nearby Petaluma River.

In 2008, SCWA removed sediment from the Adobe Channel and instream sediment basin located in Reach 2, just upstream of McDowell Blvd. This instream sediment basin effectively captures sediments transported and deposited from upstream. Reach 1 is tidally influenced through the majority of the reach. The Agency does not conduct maintenance activities in the tidal portions of the reach. Adobe Creek supports the most intact spawning and rearing habitat for steelhead in the Petaluma River watershed. It also provides important habitat for foothill yellow-legged frogs, which were observed during field work for the reach sheets, as listed in Table 7-3.

Thompson Creek is located on the southwest side of the lower Petaluma River watershed (Figure 4-42). Thompson Creek provides a narrow corridor of riparian vegetation that becomes thicker towards the lower end of the maintenance reach. This ephemeral reach supports stands of blackberry and some stagnant pools. Though the reach is immediately surrounded by development, the channel easement is wide located in a neighborhood parkway. The maintenance reach is in close to upland habitat for California red-legged frogs. Maintenance activities within this reach typically involve vegetation removal.

4.4 Sonoma Creek Watershed (Zone 3A)

The Sonoma Creek watershed is located in the southeastern corner of Sonoma County. The watershed encompasses approximately 170 square miles. Elevations in the watershed range from sea level at San Pablo Bay to approximately 2,500 feet MSL at Bald Mountain (Figure 4-48).

Approximately 54 percent of the watershed is in agricultural use, 30 percent is rural and about 11 percent is recreational. Urbanized areas are located in the center of the watershed, within the alluvial plain area. Where not converted with vineyards, the hillslopes surrounding the valley contain oak woodland and Douglas fir forests, with some areas of brush.

There are many creek reaches in the watershed that are identified as modified or natural channels. These reaches are very rarely maintained by SCWA (see Chapter 6 discussion of maintenance activities in modified and natural channels). As discussed in Chapters 2 and 3, habitat for California freshwater shrimp is present in the Sonoma Creek watershed. As such, maintenance activities are restricted to avoid or minimize potential impacts to the species or their habitat.

In terms of potential maintenance activities, the only engineered channels maintained by SCWA are Fryer Creek, a tributary to Nathanson and Schell creeks, and the Nathanson Creek bypass (Figure 4-48). The five reaches of Fryer Creek maintained by the Agency are located in the lower alluvial plain portion of the Sonoma Creek watershed, just upstream from tidal marsh areas (Figure 4-49). Fryer Creek flows north to south through the southern edge of downtown Sonoma and then through the residential neighborhoods south of downtown. The Fryer Creek system appears to be heavily engineered with *Fryer 1, 2, 3, and 4* straightened and flows through a trapezoidal cross-section. The East Fork of Fryer Creek still retains some sinuosity and maintains some semblance of a low flow channel with a shallow bench and gentler bank slopes. The Fryer Creek system appears to be completely disconnected from any larger, upstream watershed, as upstream of Reach 4 the channel quickly turns to a small swale and then ends at W. Napa Street. Flows into this swale appear to be completely dependent on runoff from downtown Sonoma.

Table 4-1: SMP Reaches and Figure Numbers Page 1 of 4

Subbasin Name	Creek Name	Reach Name	Figure Number
Zone 1A – Laguna de Santa Rosa Watershed			
Windsor			**4-1**
	Airport Creek	Airport1	4-5
		Airport2	4-5
	Faught Creek	Faught1	4-4
	Starr Creek	Starr1	4-2
		Starr2	4-2
	Starr Creek Tributary	Star Trib1	4-2
	Windsor Creek	Windsor1	4-3
		Windsor3	4-2
		Windsor4	4-2
Mark West			**4-6**
	Fulton Creek	Fulton1	4-8
	Wikiup Creek	Wikiup1	4-7
Santa Rosa			**4-9**
	Abramson Creek	Abramson1	4-21
		Abramson2	4-21
	Austin Creek	Austin1	4-11
		Austin2	4-11
		Austin3	4-11
	Brush Creek	Brush1	4-13
		Brush2	4-10, 4-11
	Coffey Creek	Coffey1	4-17
	College Creek	College1	4-20
		College2	4-20
		College3	4-20
	Ducker Creek	Ducker1	4-10
		Ducker2	4-10
	Forestview Creek	Forestview1	4-21
		Forestview2	4-21
		Forestview3	4-21
	Lorna Dell Creek	Lornadell1	4-15
	Middle Fork Brush Creek	MiddleBrush1	4-10, 4-11
		MiddleBrush2	4-10, 4-11
	Paulin Creek	Paulin1	4-17
		Paulin2	4-17
		Paulin3	4-17
		Paulin4	4-17
		Paulin5	4-17
		Paulin6	4-17
	Peterson Creek	Peterson1	4-21
		Peterson2	4-21
	Piner Creek	Piner1	4-20
		Piner2	4-20
		Piner3	4-17

Table 4-1: Cont.

Page 2 of 4

Subbasin Name	**Creek Name**	**Reach Name**	**Figure Number**
		Piner4	4-17
		Piner5	4-17
		Piner6	4-16
		Piner7	4-16
	Russell Creek	Russell1	4-16
		Russell2	4-16
	Santa Rosa Creek	Santa Rosa1	4-22
		Santa Rosa2	4-20, 4-21, 4-22
		Santa Rosa3	4-20
		Santa Rosa4	4-19
		Santa Rosa5	4-19
		Santa Rosa6	4-19
	Santa Rosa Creek Diversion	Santa Rosa Div.1	4-12
	Sierra Park Creek	Sierra Park1	4-14
		Sierra Park2	4-14
		Sierra Park3	4-14
	Spring Creek	Spring1	4-13
		Spring2	4-13, 4-14
		Spring3	4-13, 4-14
	Steele Creek	Steele1	4-18
		Steele2	4-18
		Steele3	4-18
		Steele5	4-18
Roseland and Colgan			**4-23**
	Colgan Creek	Colgan1	4-29
		Colgan2	4-29
		Colgan3	4-28
		Colgan4	4-28
		Colgan5	4-26
		Colgan6	4-24
		Colgan7	4-24
	Kawana Springs Creek	Kawana1	4-24
	Roseland Creek	Roseland1	4-27
		Roseland2	4-25
		Roseland3	4-25
		Roseland4	4-24
		Roseland5	4-24
		Roseland6	4-24
Upper Laguna			**4-30**
	Bellevue Wilfred Channel	BellWil1	4-37
		BellWil2	4-34
		BellWil3	4-34
		BellWil4	4-34
	Coleman Creek	Coleman1	4-35
		Coleman2	4-35
	Cook Creek	Cook1	4-35

Table 4-1: Cont. Page 3 of 4

Subbasin Name	Creek Name	Reach Name	Figure Number
		Cook2 (sediment basin)	4-35
	Copeland Creek	Copeland1	4-39
		Copeland2	4-40
		Copeland3	4-40
		Copeland4	4-40
		Copeland5	4-40
	Cotati Creek	Cotati1	4-41
		Cotati2	4-41
	Crane Creek	Crane1	4-38
		Crane2	4-38
	Five Creek	Five1	4-38
	Gossage Creek	Gossage1	4-39
		Gossage2	4-39
		Gossage3	4-39
	Hinebaugh Creek	Hinebaugh1	4-37
		Hinebaugh2	4-37
		Hinebaugh3	4-37, 4-38
		Hinebaugh4	4-37, 4-38
		Hinebaugh5	4-38
		Hinebaugh6	4-38
		Hinebaugh7	4-38
	Hunter Creek	Hunter1	4-32
		Hunter2	4-32
		Hunter3	4-33
	Laguna de Santa Rosa	Laguna1	4-36
		Laguna2	4-37
		Laguna3	4-38, 4-39
		Laguna4	4-38, 4-41
		Laguna5	4-38, 4-41
		Laguna6	4-38, 4-41
		Laguna7	4-38, 4-41
	South Fork Copeland Creek	SFCope1	4-40
		SFCope2	4-40
	Todd Creek	Todd1	4-32, 4-34
		Todd2	4-32
		Todd3	4-32
		Todd4	4-32
		Todd5	4-31, 4-32
	Washoe Creek	Washoe1	4-39
	Wilfred Creek	Wilfred1	4-34, 4-35
	Wilfred Extension	Wilfred Ext.1	4-34
Zone 2A – Petaluma River Watershed			
Petaluma			**4-42**
	Adobe Creek	Adobe1	4-46
		Adobe2	4-46
		Adobe3	4-46

Table 4-1: Cont. Page 4 of 4

Subbasin Name	Creek Name	Reach Name	Figure Number
		Adobe4	4-46
	Capri Creek	Capri1	4-44
		Capri2	4-44
		Capri3	4-44
		Capri4	4-44
	Corona Creek	Corona1	4-44
		Corona2	4-44
		Corona3	4-44
		Corona4	4-44
		Corona5	4-44
	East Fork McDowell Creek	East Fork McDowell1	4-46
	East Washington Creek	East Washington1	4-45
		East Washington2	4-45
		East Washington3	4-45
		East Washington4	4-45
		East Washington5	4-45
	Jessie Lane Creek	Jessie Lane1	4-44
	Lichau Creek	Lichau1	4-43
		Lichau2	4-43
		Lichau3	4-43
	Lynch Creek	Lynch1	4-45
	McDowell Creek	McDowell1	4-46
		McDowell2	4-46
		McDowell3	4-46
	Thompson Creek	Thompson1	4-47
	Washington Creek	Washington1	4-45
		Washington2	4-45
		Washington3	4-45
		Washington4	4-45
		Wathington5	4-45
		Washington6	4-45
Zone 3A – Sonoma Creek Watershed			
Sonoma			**4-48**
	Fryer Creek	Fryer1	4-49
		Fryer2	
		Fryer3	
		Fryer4	
	Lower East Fork Fryer Creek	Lower East Fork Fryer1	4-49

Chapter 5
PRE-MAINTENANCE PLANNING APPROACH AND IMPACT AVOIDANCE

5.1 Introduction

This chapter describes the planning steps taken prior to conducting maintenance work to ensure that the work is effective and also avoids and minimizes potential environmental impacts. As such, this chapter describes the program's planning approach. In contrast, Chapter 6 describes the maintenance activities in more specific detail. Following the description of program activities in Chapter 6, Chapter 7 presents the program's additional impact-reducing measures and BMPs that occur beyond the planning measures described here in Chapter 5.

In this chapter, the maintenance planning and impact avoidance approach for the SMP is presented as a series of resource planning steps. These planning steps occur prior to the actual maintenance work to ensure that the work is targeted, effective, and avoids foreseeable environmental impacts.

The maintenance planning approach is a four-step process that begins with broad level activity planning and focuses down to the details informing maintenance at a specific project site. At the broadest scale, Maintenance Principles are used to provide overarching guidance for maintenance activities. Framing Considerations build on the Maintenance Principles and frame the extent of the SMP's three primary activities: Sediment Management, Vegetation Management, and Bank Stabilization. Framing Considerations guide the maintenance activities to effectively work in alignment with natural processes and thereby avoid or reduce potential impacts. Following the Framing Considerations, Maintenance Goals are used to set the desired outcomes of the program. The fourth and final planning scale describes Maintenance Triggers. These are events that initiate the need for maintenance activities to occur. In sum, the maintenance approach follows a sequence of four planning steps that operate at different scales as follows:

1. **Maintenance Principles:** provide overarching guidance for SMP activities including impact avoidance and minimization approaches;
2. **Framing Considerations:** provide more specific context for the three primary SMP activities (sediment management, vegetation management, and bank stabilization) while considering stream functions;
3. **Goals:** describe desired outcomes for maintenance activities; and
4. **Triggers**: define the need and timing for maintenance activities.

5.2 Maintenance Principles

The following Maintenance Principles were chartered to guide the SMP:

1. No Unnecessary Intervention
2. Understand the System and its Processes
3. Consider Adjacent Land Uses
4. Apply System Understanding to Maintenance Activities
5. Manage for Incremental Ecologic Improvement (Lift)
6. Integrate Maintenance Activities Towards Sustainability (reduced frequency of maintenance)

5.2.1 Maintenance Principle 1: No Unnecessary Intervention

This basic principle is foundational to the SMP; that no unnecessary intervention in stream processes should occur and that maintenance is restricted to necessary and appropriate activities. The following questions help guide implementation of Principle 1.

- Has overbank flooding occurred at the reach threatening or causing damage to property or resulted in the area being designated as a flood hazard zone[1]?
- Is observed flooding due to the reduction in channel conveyance capacity caused by in-channel sedimentation, excessive vegetation growth, or bank failure?
- Compared to prior surveys and reach sheet descriptions, have channel bed, bank, or vegetation conditions changed at the reach such that flooding in the coming rainy season, and associated safety hazards and property damage, are now more likely under typical or average annual flow conditions?
- Is there a clear and specific flow impediment (e.g., trees or shrubs blocking culvert, or a downed tree diverting flow directly into a streambank causing bank erosion, etc.) that will increase or likely cause a flooding hazard under typical or average annual flow conditions?
- Has streambank erosion or a bank failure occurred that has led to (or may lead to) the loss of adjacent structures such as bridges, roads, or homes?
- Has streambank erosion or a bank failure occurred that reduces the strength and integrity of adjacent streambank areas and increases potential flood hazard?
- Has streambank erosion or bank failure occurred that leads to increased sediment yields into the channel and downstream receiving waters?

[1] The Federal Emergency Management Agency defines "flood" as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source (Federal Emergency Management Agency 2008).

If answers to any these questions are “yes” then maintenance may be necessary. For example, during the recent 2006 annual stream reconnaissance SCWA identified three sites in potential need of bank stabilization and repair. However, additional site review to prepare a treatment design revealed that the bank conditions, while not ideal, did not warrant immediate repair action in 2007. As a result, rather than pursuing maintenance in 2007, SCWA is now observing these sites yearly to determine if repair will be necessary. Such monitoring and prudence prior to pursuing in-channel maintenance work is fundamental to supporting Maintenance Principle 1.

5.2.2 Maintenance Principle 2: Understand the System and its Processes

If maintenance is necessary, then prior to selecting sediment, vegetation, or bank stabilization treatments, the channel system and its formative processes must be understood to know why the reach functions as it does. From this functional understanding, appropriate treatments can be selected. The following questions help illustrate Principle 2.

- What are the governing hydraulic and geomorphic conditions at the reach? Is the reach primarily depositional or erosional? Are there observed depositional features such as mid-channel bars, point bars, or other deposits? Are there observed erosional features such as undercut banks or a channel incision? Does the channel slope represent a significant change from either upstream or downstream conditions? Are hardened structures such as channel crossings, bank protection, or drop structures present that strongly influence channel conditions?
- Do the existing channel cross section form, in-channel features (such as bars, benches, back channels, etc.), and reach slope indicate a channel in dynamic equilibrium (a graded stream); where the channel form reflects a relative balance of erosional and depositional forces as appropriate for the reach’s location in the watershed? Or, is the reach strongly depositional or erosional, thus suggesting a non-equilibrium condition?
- What is the relationship between this reach and upstream and downstream conditions? In particular, what are upstream sediment inputs to this reach and how are those inputs either stored in the reach or transported further downstream?
- Have historic maintenance activities at this reach strongly influenced its current functioning? Do such influences affect conditions either upstream or downstream?
- Has maintenance at this reach been on-going in past or recent years indicating a chronic issue?
- What ecological succession stage is this reach in? How will ecologic succession operate in this reach? In the absence of maintenance what is the foreseeable ecological progression or climax in this reach. Which stage should be managed for in this reach?

This principle of understanding the stream system and its processes is demonstrated in the channel characterization sheets, or reach sheets, included in Chapter 4. The above questions (and others) were asked of each of SCWA’s owned in fee-engineered channels and easement engineered channels through detailed field observations during the development of the program. The resulting sheets provide a watershed- and reach-specific foundation to implement suitable and reach appropriate maintenance activities. As discussed in Chapter 4, reach sheets were not completed for modified and natural channels as maintenance in those reaches is limited and more infrequent than activities in the engineered channels.

In addition to the field observations used to develop the channel characterization sheets, other relevant stream information can be referenced to understand reach processes. Where available, channel as-built designs, streamflow records, historic maps and cross sections, photographs, and hydraulic modeling results may all be used to address the above questions during the annual channel maintenance assessment process (see Chapter 9). Additionally, as part of developing the SMP, SCWA has developed a channel maintenance and environmental resource data management system ("SMP Tracker") to track and inventory past maintenance activities. Having the reach's past maintenance record available within a database helps determine whether a reach has chronic maintenance needs.

As part of its natural resources management program, SCWA conducts annual monitoring and surveying of salmonids, western pond turtle, and a variety of birds and wildlife (see Cook 2008a, 2008b, 2008c). These species surveys provide additional resource information and context to better understand the species issues in the Program Area. This information will be integrated with the SMP Tracker so that information on resource conditions can be evaluated together with monitoring requirements, sediment disposal sites, and impact avoidance measures and BMPs. Using this information in an integrated way provides an excellent tool to help manage maintenance operations. The SMP Tracker is further described in Chapter 9.

The information gathered through this step is applied under Maintenance Principle 4, below.

5.2.3 Maintenance Principle 3: Consider Adjacent Land Uses

Where channels are bordered by developed land uses, flood protection requirements may constrain stream management options. The needs of adjacent land uses will define the types of activities that can or should be conducted within the actively managed stream corridor. For instance, the width of the managed channel corridor has several implications including the sensitivity or risk to flood hazard, the ease of access for maintenance activities, and the potential to manage for ecologic enhancement (as shown in Figure 5-1 and discussed in Maintenance Principle 5). Similarly, how narrow a channel corridor is in relation to its adjacent land uses may constrain the maintenance activities or treatments, access, or ecological improvements that are possible. As a result, each reach presents certain management needs, based on current channel functioning and the habitat and aesthetic values it provides. In parallel, each reach also presents constraints, with consideration of adjacent land uses and their sensitivity and risk to flooding being a major consideration.

For example, Washington Creek at McDowell Boulevard in Petaluma overtopped its banks during the New Year flood of December 31, 2005 to January 1, 2006 and flooded a portion of a shopping area to the north. This reach is located in the alluvial plain and has a low gradient which encourages sediment deposition. This reach is also tightly constrained, being bound on the north by the mall development and to the south by E. Washington Boulevard. Upstream is a concrete lined channel which delivers flows rapidly to the site, and downstream is the Hwy 101 crossing. While the preferred approach for stream maintenance is to use a minimal intervention (or light touch) whenever possible, this reach has the potential to cause (and in fact did cause) substantial flood damage when flow capacity is exceeded. In cases such as Washington Creek at McDowell Boulevard, a more aggressive maintenance approach was necessary to alleviate the potential flood risk. This reach was also more limited in the natural functions and ecologic benefits it provided. In contrast, other reaches such as the Bellevue-Wilfred channel are mostly adjacent to open agricultural lands. In such cases, the potential hazard or damage to property from a flood may be less severe.

For each reach, the adjacent land use needs and constraints will be considered to identify the suitable maintenance approach.

5.2.4 Maintenance Principle 4: Apply System Understanding to Maintenance Actions

Once it is determined that maintenance work is necessary (Maintenance Principle 1), the natural function of the system is understood (Maintenance Principle 2), and localized physical constraints are identified (Maintenance Principle 3), maintenance activities at the reach scale can be identified based on best available information. Applying this information to channel maintenance actions may be as simple as determining that sediment removal and vegetation management are necessary to prevent flooding in a reach where flooding occurred the previous year.

As described above, implementation of the SMP will include development of a channel maintenance database (SMP Tracker) chronicling past maintenance activities, flooding events, and natural resource conditions. Understanding the stream system can also lead to a more comprehensive and longer-term maintenance approach at the reach scale. For example, Santa Rosa Creek downstream of the Piner Creek confluence is characterized by almost a mile of in-channel gravel bars. These bars are fed by headwater erosion and sediments fall out in this reach because of the wide cross section and low channel gradient. These bars also reduce the flow capacity of the channel and create a flooding concern. While overtopping has not been observed recently, the creek was flowing at full capacity during the 2005/2006 winter storms. Instead of removing sediment from this stretch all at one time, sediment removal can be phased over several years so that only a portion of the reach is disturbed at any one time. In this way, understanding of the system enables a phased maintenance approach that minimizes annual impacts while satisfying long-term maintenance needs over time.

Another important application of understanding the overall sediment delivery system is relating how flood control channels convey sediment to downstream natural resources. In

Zones 1A, 2A, and 3A of the Program Area, flood control channels deliver sediment to the Laguna de Santa Rosa, the Petaluma River and marsh, and Sonoma Creek and marsh, respectively. These important downstream ecological resources may be impacted by abundant sediment loads from upstream sources. The reduction of upstream erosion sources and the removal of aggraded in-channel sediment can help reduce downstream sediment loading and protect and enhance downstream resources.

5.2.5 Maintenance Principle 5: Manage for Incremental Ecologic Improvement (Lift)

The vision for SCWA's engineered channels is to provide a balance between flood protection management and habitat support whereby over time, channels provide both functions with reduced maintenance needs. The management approach to achieve this vision recognizes each reach's existing functional condition, but also looks forward toward improving each reach's ecologic condition.

The following questions help integrate Maintenance Principles 5 and 4 into the program and are included in the stream assessment and restoration development protocols that guide the program (see Chapter 9).

- What are the existing natural habitats and aquatic resources at the reach?
- Are particular in-channel features such as large woody debris (LWD) or gravel bars present that provide valuable habitat?
- Do the presence of these features or resources influence how, where, and when maintenance activities might occur?
- Which habitat features and functions can be preserved in the context of hydraulic capacity?
- Are there known occurrences of threatened or endangered species at the reach?
- Can habitat conditions at the reach be improved to support additional species or enhanced to improve the quality of existing habitat?
- What would be the best way to preserve habitat function and advance succession toward a desired climax community?

Figure 5-1 illustrates this process of managing the channel toward reaching an improved ecologic condition. Figure 5-1 shows current channel conditions at several sample reaches in the Program Area and presents a spectrum of habitat conditions. Some reaches are relatively poor in habitat quality (toward Reach A) while other reaches provide healthy functioning creek corridors (toward Reach G). Depending on existing conditions, restoration options can be applied to improve a reach, even if only incrementally, due to other constraints. This principle emphasizes gradual adjustment of maintenance actions through adaptive management. Creek management in this way provides incremental improvement, or ecologic "lift," that moves the treated reach incrementally toward a longer-term vision.

For example, Reach A of Figure 5-1 is a straight channel with little channel complexity, some sediment accumulation along its bed, and no significant riparian vegetation along its bed or banks. Using SMP approaches, management activities at Reach A would include removing some bed sediment to create a sinuous low-flow (two stage) channel within the overall channel cross section and planting riparian trees along the top of bank (and some along the lower bank) to shade the channel. Enhancing the channel form and planting trees can lift Reach A toward sample Reach C or D in Figure 5-1, where channel complexity and riparian canopy are greatly improved. For Reaches C, D, or E in the mid-spectrum of Figure 5-1, actions would be taken to enhance channel conditions toward Reaches F or G including increased riffle/pool structures, increased mature canopy, fewer invasive or exotic species, etc.

The SMP program includes follow-up monitoring of all restoration and mitigation activities. Program monitoring is more specifically described in Chapter 8 *Program Mitigation*. For the program's reaches monitoring will be used to evaluate the effectiveness of the gradual stepwise ecological improvement approach described above.

5.2.6 Maintenance Principle 6: Integrate Maintenance Activities toward Sustainability

The approach for channel maintenance should integrate effective activities that in time will reduce the overall need for continued maintenance support. As an example, a feedback cycle can develop where (1) the accumulation of fine sediments are favored by emergent vegetation such as cattails, that (2) in turn encourages additional sediment trapping, which (3) ultimately reduces habitat quality and flood conveyance capacity. Preventing or breaking this cycle through reducing fine sediment loading is desired versus the continual removal of accumulated sediment and emergent vegetation. As another example, erosion control practices in headwater and upper watershed areas can reduce the sediment delivery and loading into the flood control channels downstream. Reducing upstream sediment loading reduces the need for in-channel maintenance activities in general. Watershed erosion control and off-site mitigation efforts are an important strategy of the SMP and are discussed in more detail in Chapter 8 *Program Mitigation*.

Although beyond the scope of the SMP, capital projects implemented by SCWA may consider measures to reduce in-channel maintenance needs, particularly for sediment management. One approach is to develop more sediment collection basins, similar to the Cook Creek basin. Such basins, when located appropriately (typically at the base of the foothills and upstream of the alluvial plain) can be very effective in capturing sediment before it enters SCWA's maintenance channels downstream. Similarly, developing focused sediment removal areas (within the "as-built" channel) can help reduce the frequency and intensity of sediment removal activities along several program reaches.

5.2.7 Conclusion

The Maintenance Principles collectively guide the SMP's integrated maintenance approach while considering a variety of parameters including existing conditions, natural processes, and ecological health. Figure 5-2 provides a diagram outlining how this process is applied at the reach scale. According to the Maintenance Principles discussed above, opportunities for reach enhancement will be identified based on the existing conditions, constraints, and maintenance needs. This approach then feeds into evaluation of the ecologic lift potential, as illustrated in Figure 5-1, and long-term sustainability. The questions used in this chapter to illustrate the Maintenance Principles are incorporated into the annual Stream Assessment process described in Chapter 9 *Program Management*.

5.3 Sediment Management Approach

5.3.1 Framing Considerations

Five key considerations frame the context and approach for sediment management activities.

- **The natural function of streams is to convey sediment from headwater source areas (or upstream in-channel source areas) to downstream reaches, lowlands, or basins where the sediment ultimately deposits.** In all streams, sediments are variably eroded, transported, or deposited. The movement of sediment along the stream system represents a beneficial natural function. Chapter 3 describes geomorphic and sediment transport processes in the Program Area. However, it is also recognized that natural sediment transport processes are strongly affected by historic and current land use conditions, urban development, past engineering and alterations to the channel network, and other modifications. As a result of these influences, sediment transport processes and loadings may be augmented or depleted depending upon the reach. In a system already largely impacted through such conditions, additional maintenance is required to manage sediment and ensure the protection of streamside land uses.
- **Sediment transport is an inherently dynamic process.** Because of this dynamism, target conditions for sediment transport should not be stable or static, but should reflect some degree of variability and include the possibility of episodic high-magnitude events. For sediment management, target outcomes should reflect an acceptable range of conditions rather than a static prescribed form.
- **Sediment loading and vegetation growth are intimately related in a feedback loop.** Sediment supports the growth of vegetation within and along the channel, and vegetation in turn benefits habitat quality by shading the channel, reducing water temperatures, and improve oxygen exchange in the water column (NMFS, 2008). However, excessive vegetation growth can reduce flood conveyance capacity; contribute to elevated nutrient loading, ultimately decreasing water quality; increase sediment deposition rates; and reduce habitat quality and complexity by creating shallow, diffuse flow conditions across the channel bottom.
- **Sediment accumulation can reduce the channel's ability to convey floodwaters.** This poses a particular challenge where streams that were historically broad, or part of a braided multi-channel system, are now confined into a single channel. Historically, such systems deposited their sediments across wide

floodplains. Now, such confined systems may be inherently depositional, depending on channel hydraulics and the balance of slope vs. cross sectional area. In engineered systems, sediment is likely to deposit in reaches with relatively gentler gradients or where the channel cross section is wider than necessary to convey expected loads. SMP stream managers recognize that some degrees of sedimentation or erosion will occur in a healthy stream—what is essential for stream management is to identify and address reaches where deposition or erosion are excessive. Sediment management triggers described below provide guidance on when sediment management should be initiated.

- **Accumulated sediment can obstruct infrastructure such as culverts and bridge underpasses.** This can lead to backwater conditions that further reduce transport, alter habitat, contribute to flooding, and potentially cause damage to instream and channel bank structures.

5.3.2 Sediment Management Goals

Consistent with the Maintenance Principles and Framing Considerations described above, the goals of sediment management for the SMP are to:

- understand the way each reach functions as a sediment conduit within its stream, its subwatershed, and its land use context;
- identify an appropriate maintenance target condition that balances flood protection needs, economizes maintenance activities, and avoids and minimizes environmental impacts for that reach;
- contribute to improvement of water quality conditions through nutrients removal, invasive plants removal, and hydraulic improvement; and
- implement treatments that will enhance the stream's function toward the desired condition while minimizing the need for repeat maintenance.

Target conditions for each reach will be identified according to management needs, reach functioning, and other opportunities and constraints. The reach and its host stream will be managed to maintain and enhance sediment conveyance, water quality, and habitat.

Sediment will be managed for the following specific outcomes.

- a general balance between channel aggradation and channel erosion;
- adequate flood conveyance capacity;
- preservation and enhancement of beneficial instream bed forms and habitat features (including LWD) that support in-channel complexity, diverse cover, and local/micro habitats to the extent feasible;
- development and preservation of the desired vegetation condition for the reach.

To achieve these goals without impacting stream function, sediment management will be implemented incrementally. This will prevent sudden, drastic alterations in sediment load within individual reaches, which could accelerate further aggradation or incision. Incremental implementation also allows time for monitoring, evaluating channel conditions, and adaptively adjusting the maintenance approach as needed. The incremental maintenance approach has a spatial component and a time component, in that activities will occur in focused reaches at a given time and not throughout an entire stream system in any given year. Therefore, stream maintenance activities for particular reaches will be prioritized annually with only the reaches in most need being treated.

5.3.3 Sediment Management Triggers

In general, sediment management or removal activities are appropriate when any of the following conditions applies.

- The channel is systemically aggrading such that channel capacity is at risk. The degree to which channel capacity has been reduced is determined based on visual assessment (during dry season and wet season conditions), cross section comparisons to the as-built channel condition, and any past record of flooding conditions.
- Accumulated sediment is covering culvert outfalls, drop-inlets in V-ditches, or filling box culverts, threatening to cause flooding.
- Sediment is accumulating in a way that supports excessive vegetation growth, threatening channel capacity or creating undue roughness.
- Sediment accumulation is impeding fish passage.
- Significant bed erosion is occurring, particularly where a migrating nickpoint reflects headward incision.[2]
- Instream structures designed to direct flows for flood management are causing excessive sediment deposition or bed or bank erosion.
- Bar surfaces that would support groundwater recharge have aggraded to the point that they can no longer be effectively inundated for a sufficient duration to recharge underlying groundwater stores. The grading down of bar surfaces would occur in consideration of the presence of an existing low-flow channel and what is the width, depth, and orientation of such a low-flow channel.
- Instream hardscape requires sediment removal to maintain as-built functions.

[2] In reaches with significant bed erosion, particularly those where a migrating nickpoint and headward incision occur, grade control may be needed in addition to, or instead of, sediment management. In some cases, it may be possible to reduce bed erosion by removing excess sediment. The key to selecting the appropriate treatment will be to identify the cause of the erosion. The need for grade control is most likely to be indicated when bed erosion results from consistently excessive flow volume or velocity, which is typically associated with changes in upstream land use patterns. Grade control may also be an appropriate treatment for erosion resulting from turbulence downstream of flow-constricting infrastructure such as bridges or culverts. Grade control installation is typically outside the scope of normal maintenance activities, and is not included in this SMP Manual.

The need for sediment management action is unlikely if none of these trigger conditions are present.

5.3.4 Design Guidance for Sediment Removal Projects

The guiding questions and assessments described above are used to understand the channel's function and design an appropriate sediment removal project that achieves flood management and ecosystem objectives while minimizing impacts. The additional issues and questions below are used to refine the maintenance project approach and provide design guidance. The following issues will be recognized and addressed to clarify the key processes and help guide the design process:

- Did the reach in question historically function as a depositional zone? Or, was the reach historically more of a transport zone and only recently has it become more depositional? Comparison of past channel cross sections, photos, and recorded observations (as available) should be used to describe the historical condition. Based on the historic trend of the reach, the extent of sediment removal can be targeted for the project.
- Is sediment accumulating throughout the reach, depositing broadly across the entire channel cross section as a homogenous sediment wedge? Based on the situation, the need and size for an instream low-flow channel can be refined.
- Is sediment collecting in particular locations along the longitudinal profile such as the upstream and downstream ends of crossings and culverts? Are such culverts undersized or otherwise designed in a way to encourage sediment deposition instead of transport? Known collection spots are used to target sediment removal locations.
- Is sediment being deposited in particular features within the channel such as mid-channel bars, sediment benches and wedges along the edge of the channel, or in sinuous alternating bars along the longitudinal axis? Understanding these situations allows the sediment removal project to work with natural processes and to preserve natural forms as much as possible.
- What is the dominant texture of the sediment accumulating in the reach and is there a pattern observed? Sediment patterns indicate the depositional environment and can be used to refine the extent and location of sediment removal activities.
- What is the net rate of sedimentation at the reach (either measured as a depth or a volume over a certain period of time)? Understanding the sediment rate will inform how frequent sediment removal activities shall occur.
- Is there an existing low-flow channel operating within the wider channel cross section?
- If a low-flow channel is present, is this channel adequately transporting sediment under medium and lower flow conditions through the reach? Monitoring the existing low-flow channel is useful if adjustments are necessary to either enlarge or deepen the low-flow channel.

The planning considerations described in the sections above for sediment removal projects are illustrated by recent sedimentation events and maintenance activities at Copeland Creek (Figure 5-3). Storm events during 2005-2008 deposited abundant sediment at the Snyder Lane crossing of Copeland Creek. This was punctuated by a storm in January 2008 that raised the bed with 1.5 ft of sediment and further reduced the culvert capacity beneath Snyder Lane in a single event. The reduction in channel capacity increased overbank flooding potential during the remainder of the 2008 season.

This reach of Copeland Creek is a known migration corridor that allows steelhead to access potential spawning habitat further upstream in the watershed (NMFS, 2008). However, the heavy deposition that reduced the crossing at Snyder lane and filled the channel with sediment also created an aggraded bed with diffuse flow and very low water elevations which reduced the reach's functioning as a migration corridor. This situation of reduced migration capacity due to abundant sediments and shallow/diffuse flows at Copeland Creek is also described in the recent Russian River Watershed BO (NMFS, 2008).

The maintenance project undertaken in the fall of 2008 removed sediment from the reduced crossing and impacted channel, as shown in photo (d) of Figure 5-3. The maintenance project also included the creation of a low-flow channel to maintain an active channel that could support fish migration and the transport of fine sediments under lower flow conditions. The 2008 maintenance project at Copeland Creek nicely demonstrates all of the SMP Maintenance Principles. The work was necessary in light of increased flooding. System dynamics, adjacent land uses, and the reaches environmental resources were all considered in designing an appropriate (and not excessive) project that achieved flood management goals while also enhancing habitat conditions.

5.3.5 Approach to Avoid and Minimize Repeat Sediment Removal Activities

SCWA shall generally only conduct reach-scale sediment removal once within a given reach over a general period of 5 years. However, if and when large stream discharges occur (e.g. equaling or exceeding the 10-year magnitude flow event), SCWA may review reaches to evaluate the need for additional reach-scale sediment removal activities. Large magnitude events may cause significant sediment accumulation that reduces flow conveyance capacity. As such, large events may result in the need to review and consider reach-scale sediment removal even for reaches where sediment removal activities had occurred within the past 5 years. Under these situations following a significant depositional event, SCWA will evaluate the reach in question carefully for reduced conveyance capacity. If sediment removal activities are required to maintain flood conveyance capacity, SCWA will provide demonstrated evidence to the pertinent regulatory agencies overseeing the SMP to demonstrate that channel capacity has been significantly diminished. Evidence of diminished channel capacity may include channel cross-sections, photographs, modeling, and/or other field-based evidence or observance of a heightened flood risk.

5.4 Vegetation Management Approach

5.4.1 Framing Considerations

Five key considerations frame the context and approach for vegetation management activities.

- **Riparian vegetation provides physical stabilization for bank and terrace surfaces through the growth of root structure.** In addition to the structural benefits provided by roots, vegetation also contributes to bank stability by helping remove excess soil moisture, which can contribute to slumping and other types of bank failure. This represents an important nexus between vegetation management and bank stabilization efforts.
- **Riparian vegetation benefits instream habitat by shading the channel, drawing subsurface water up, lowering water temperatures, limiting in-channel emergent vegetation, and providing LWD.** Cooler water temperatures are preferable for cold water species, such as salmonids (NMFS 2008). Shading of the channel can also hinder the growth of instream emergent vegetation, in turn reducing the need for future instream vegetation management. Riparian vegetation pulls subsurface moisture up via the transpirational stream, in some cases, keeping water in the channel. It also provides cover, forage, and breeding habitat for a variety of birds and other wildlife that use the streambank area.
- **Invasive species may limit the success of native, slower-growing vegetation and can degrade habitat quality over time.** Because many invasive species (both native and non-native) grow quickly, they often out-compete non-invasive native species. This may occur to the point that entire channels are filled with fast-growing, invasive vegetation further degrading habitat quality.
- **Excessive vegetation growth can decrease a channel's flood conveyance capacity.** This occurs in three ways. First, excess growth of instream and bank vegetation can obstruct the channel by reducing its cross section and conveyance capacity of the floodway as a whole. Second, vegetation increases bed and bank friction or hydraulic roughness, resulting in energy losses, turbulence, decreased capacity, and leads to an increased threat of flooding. Third, increases in hydraulic roughness can encourage further sediment deposition as flow velocities slow. This effect is illustrated in photos in Figure 6-12 and 6-14 through 6-16.
- **Establishing adequate flood protection may require aggressive vegetation management.** In areas where creeks are closely bordered by developed land uses or agriculture, the increased risk of flooding created by excess vegetation growth may be unacceptable, and it will be important to identify the threshold at which vegetation must be managed in each reach to provide adequate flood protection and ensure the safety of the community.

5.4.2 Vegetation Management Goals

Consistent with the framing considerations presented above, the goals of vegetation management are to:

- ensure that adequate flood conveyance capacity is maintained; and
- develop a mature and complex riparian canopy and corridor that offers substantial habitat, shading of the creek, and aesthetic value while minimizing future understory maintenance requirements.

In most channels, meeting these goals will require a balance between habitat and flood protection needs. Although it is possible to identify an ideal vegetation configuration, it may not be possible to achieve this condition in all reaches of all channels. As described in Chapter 3 *Environmental Setting*, a range of channel vegetation conditions is observed in the SMP Program Area. Figure 5-1 synthesizes this range of conditions into a spectrum of channel characteristics, each with varying ecologic and habitat quality.

Figure 5-1 provides a basis for establishing a realistic target for incremental vegetation and habitat improvement for each reach. For example, Reach C in Figure 5-1 has some riparian vegetation but almost no canopy. Reach C could be managed or restored toward the conditions of Reaches D or E (more large trees and some canopy) with the right management activities. However, it is unrealistic to expect that Reach A could become like Reach G. In other words, the vegetation maintenance target for each reach is informed by an understanding of what potential conditions can be achieved. Vegetation should be managed to bring the reach as close as possible to its target condition. Over the longer term, management approaches will actively explore ways of improving the target condition of each reach, and to keep improving along the vegetation and habitat spectrum.

Within this context, vegetation will be managed for the following outcomes as appropriate for reach specific conditions:

- to develop riparian woodland/forest canopy closure;
- to encourage native vegetation and discourage nonnative vegetation, particularly invasive species;
- to control emergent vegetation in the channel;
- to minimize flow obstructions; and
- to improve bank stability.

Table 5-1 presents summary information for riparian canopy cover conditions for the engineered flood control channels in the Program Area. This summary is based on detailed vegetation mapping conducted for the SMP during 2006-2008. Channels with less than 25% canopy cover are most common and represent the largest amount of stream length. Channels with more than 75% canopy cover are least common. The table indicates that a good opportunity presents itself for SCWA to continue with its vegetation planting program, and selective pruning techniques to increase the degree of canopy cover over a greater portion of the engineered flood control channels.

Table 5-1. Summary of Program Area Canopy Cover Conditions

% Canopy Cover	Number of Reaches	Length (mi)
up to 25%	84	27.2
25 to 75%	69	17.4
75 to 100%	3	0.28
totals	156	44.9

Note - 44.9 mi total stream length only includes reach segments in engineered and easement-engineered channels that have some riparian forest vegetation. Total stream length for all engineered channels is more than 76 miles. About 31 miles of engineered channels have no measurable riparian cover.

5.4.3 Vegetation Management Triggers

In general, vegetation management is appropriate when any of the following conditions occur:

- Vegetation growth is significantly decreasing flood conveyance capacity, particularly where infrastructure or adjacent properties are at risk (photos in Figures 6-12 and 6-14 through 6-16 illustrate channels with diminished conveyance capacity due to excessive vegetation growth);
- Vegetation growth is significant and obstructs access to channels and facilities or threatens SCWA facilities or neighboring property;
- Invasive nonnative plants are reducing the success of native vegetation; or
- Vegetation management offers good opportunities to improve habitat value for fish and wildlife.

The decision to remove, thin, or preserve individual trees will be made in the field by SMP field staff familiar with regional and wetland ecology. Consideration for individual tree removal or thinning will be based on several factors including:

- What is the degree of blockage across the channel and where is the tree located in the channel?
- What is the type and age of the tree? Are there a lot of these trees already in the channel reach? Are there better trees to preserve?
- Can the individual tree be pruned or thinned (before consideration of removal) to provide the necessary conveyance capacity?
- Does the tree under consideration provide shade or other habitat benefits?
- Does the tree under question provide longer-term canopy development or riparian corridor benefits?

The rationale to either thin, prune, or remove trees will be based on addressing these questions above. Answering these questions requires the oversight and guidance of a biologist or arborist that is familiar with the Program Area's vegetation and knowledgeable of channel botanical conditions. Additional details on the vegetation management rationale and decision making process are included in Appendix E: *Vegetation Management Plan*.

The planning considerations described in the sections above for vegetation management projects are illustrated through comparative photographs from Santa Rosa Creek (Figure 5-4). Photo (a) from Figure 5-4 shows Santa Rosa Creek in 1997 before the SMP vegetation management approaches were used. Up to that time, the reach was managed to keep bank and bed vegetation to a relative minimum to preserve an open trapezoidal channel shape without much hydraulic roughness from bank vegetation. In contrast, photo (b) from Figure 5-4 shows the same reach on Santa Rosa Creek in 2007. Over the course of 10 years, and with a more habitat sensitive approach to vegetation management as described in this manual, vegetation was selectively preserved in Santa Rosa Creek. Arroyo willows were removed and the taller alders were naturally recruited and pruned to provide a riparian canopy. Additional recruitment of aquatic plants including sedges and grasses have contributed to the understory development. The 2007 condition shown in photo (b) of Figure 5-4 represents a channel that balances flood management needs with improved natural resource conditions, a central objective of the SMP. Additional details on the SMP's vegetation management activities are provided in Chapter 6, Section 6.4. Additional photos of Santa Rosa Creek are shown in Figure 6-11.

Design guidance for the SMP's vegetation planting program is provided in Chapter 8 *Program Mitigation* as it is related to the program's mitigation and restoration approach.

5.5 Bank Stabilization Approach

5.5.1 Framing Considerations

The following five considerations frame the context and need for bank stabilization activities.

- **Bank failure is a natural occurrence**. Stream channels are dynamic environments whereby existing stream banks fail and collapse and new banks are formed through erosional and depositional processes. However, while bank failure happens quickly, stream bank formation takes a long time.
- **Human changes to the landscape affects floodplain functioning.** Under natural conditions, a stream's active channel or channels migrate laterally across the floodplain through a process of erosion and bank failure, through erosional avulsion and overtopping, or some combination of the two. Human intervention has historically attempted to control and constrain the sometimes erratic and unpredictable nature of streams. These attempts have been largely effective, but streams may continue to behave opportunistically, overtopping their banks and once again moving across the floodplain. For example, this occurred when upper Copeland Creek (upstream of reach Copeland 5) jumped its banks and flowed into an adjacent creek system during the 2005/2006 New Year's flood. As described in Chapter 3, the engineered channels of the Program Area generally represent

constrained systems that have replaced natural streams that would have meandered and migrated across their floodplains.

- **Destabilized banks may restabilize naturally over time, but this is generally not feasible in urbanized areas.** The natural geomorphic recovery of eroded banks to reconstituted banks can occur through natural processes of vegetation recruitment and in-filling of sediment, but this can take several decades to occur (Wolman and Gerson 1978). The flood protection, land use, infrastructure, and water quality concerns in the Program Area require more immediate corrective actions on failing streambanks. If bank failures occur in areas with homes or other infrastructure adjacent to the channel, this presents a risk. In addition, eroding sediment from failing banks leads to increased sediment loading downstream. For natural resources like the Laguna de Santa Rosa, upstream bank stabilization actions are desirable to reduce sediment loading in the Laguna.
- **Equilibrium can be restored or adjusted through intervention.** Under natural conditions, a stream's invert elevation, gradient, and shape self-adjust to balance discharge and sediment loading. This balance is dynamic, and to the extent that it is altered by human activities (including land uses in upper watershed and floodplain areas) intervention may be needed to restore balance, or guide a stream's response to disturbance.
- **Sonoma County channel streambanks are mostly earthen.** Most of the streambanks in the Program Area are earthen and not hardened. This is a different condition than more urban regions where flood control channels will typically be hardened. While several locations in the Program Area do have rip-rap banks or concrete, these typically occur at crossings or other structures. The presence of mostly earthen banks provides the SMP with greater management and resource enhancement flexibility; though it does also increase the potential for bank instability, slumping, or erosion.

5.5.2 Bank Stabilization Goals

Consistent with the informed management approach described above, the goal of bank stabilization projects is to identify the cause or causes of instability in the affected reach, and implement the most appropriate solution based on that understanding.

In general, bank protection will be designed to achieve one or more of the following related outcomes.

- Increased channel and/or bank stability.
- Decreased need for repeat maintenance of banks.
- Reduced loading of eroded sediment into the channel and to downstream reaches; reduced need for sediment management.
- Improved support for vegetation, facilitating increased habitat value.

Note that because improved bank stability reduces sediment input into the channel and supports development of mature riparian vegetation, bank stabilization can be used as a coordinated treatment with sediment and vegetation activities. In this way, bank stabilization activities can provide several benefits to the overall health and function of the channel.

5.5.3 Bank Stabilization Triggers

In general, bank stabilization is likely to be needed in reaches where one or more of the following conditions apply:

- Bank failure has occurred and the bank must be repaired to re-establish the banks of a flood control channel, preserve riparian vegetation, prevent additional sediment input to the channel, and/or protect the channel's flood conveyance capacity (Photo a in Figures 5-5 through 5-7 illustrate the need for bank stabilization activities).
- Chronic bank erosion is occurring, leading to excess sediment loading and/or damage to riparian vegetation.
- Bank erosion or failure poses a threat to existing infrastructure or adjacent land uses.[3]

5.5.4 Design Guidelines for Bank Stabilization Projects

As illustrated by the above considerations, channel and bank erosion are natural processes, and stream maintenance activities should focus on sites where the erosion is problematic to the extent that the bank erosion directly threatens property or infrastructure, or can lead to larger bank failures that further reduce conveyance capacity or flood protection for adjacent properties.

Bank stabilization will be designed and implemented in consideration of the overall function of the reach, and of the reach within the larger stream and subwatershed context. The use of hardscape will be restricted as much as possible, and the use of extensive hardscape will only be considered a last resort. If biotechnical engineering can effectively stabilize a bank, this is the preferred approach. Hardscape will only be used where no effective alternative is feasible due to the magnitude of the hydraulic forces involved, the need to protect infrastructure, or an adjacent land use constraint.

Most often for the reaches in the Program Area, biotechnical stabilization is preferable to hardscape engineering approaches because it offers substantial environmental advantages in terms of improved habitat value for fish and wildlife, as well as improved aesthetics. In addition, biotechnical measures are often less expensive to install than conventional engineered solutions, and because they rely on live plant materials, many are self-repairing

[3] As identified in the *Sediment Management* section above, reaches with significant bed erosion, particularly those where a migrating nickpoint indicates headward incision, may require grade control. Grade control is most likely to be indicated for erosion resulting from consistently excessive flow volume or velocity, and for erosion due to turbulence downstream of flow constricting infrastructure such as bridges or culverts. Grade control installation is typically outside the scope of normal maintenance activities, and is not included in this SMP.

if damaged. With this in mind, bank stabilization designs, including those that include hardscape, will include a planting component. Use of rock in specific capacities, such as at the toe of slope, in combination with other biotechnical measures and plantings on the higher bank can be a very effective approach for stabilizing a bank.

Figures 5-5, 5-6, and 5-7 illustrate standard bank stabilization treatment designs that have been developed for the SMP channels in recent years. These designs use bioengineering techniques including engineered back-filled soils and erosion control fabric. These approaches also emphasize the planting of native riparian trees at the top-of-bank and the toe-of-slope and understory shrubs in the mid slope to provide additional bank stability and increase the riparian canopy of the channel. Where soil compaction, erosion control fabrics, and revegetation are not adequate in providing a stable slope on their own, other bioengineered solutions would be prioritized over the use of hardscape installations.

Hardscape will only be used in cases where other alternatives would not result in a sufficiently stabilized slope. A typical condition where a hardscape solution may be expected to be used is to stabilize an emerging culvert outlet to prevent reoccurring erosion (Figure 5-7). In such cases, rock will be used only beneath and below the culvert outfall, as well as on the sides to ensure stability of the culvert. Rock sizes are typically 1 foot in diameter or less (sized accordingly for culvert size). If riprap must be used for other bank slope stabilization purposes, it will consist of rock typically between 1 and 2 ft. in diameter. During recent years, use of rock or other hardscape bank stabilization materials has been significantly reduced at SCWA in favor of more integrated bioengineering approaches.

Note that in some cases, bank stabilization may not offer the most effective (or the most cost-effective) solution over the long term. Where there is extensive bank and channel failure or where reliable bank protection cannot be provided, or where heavily engineered solutions would be the only option for reliable armoring, it may be preferable to remove or re-contour the channel bed or to realign a short segment of the channel. Such channel reshaping or grading approaches may provide a more effective, longer-term solution that supports overall stream health and function compared to more traditional bank stabilization approaches. Activities requiring a broad redesign or reshaping of the channel would not be considered routine maintenance and are beyond the scope of the SMP.

5.6 Sediment Disposal Approach

Though sediment disposal is not one of the three core activities of the SMP, it is an integral component of the maintenance program. Sediment removal activities described above (and in Chapter 6) will generate approximately 10,000 to 25,000 cubic yards of sediment per year. The majority of this material will be sediment but plant debris may be included. A small portion of the sediment can be reused onsite to support restoration activities or may be used for other SCWA activities, but the majority will require offsite disposal. This section describes the planning approach for sediment disposal as part of SMP maintenance activities. Sediment disposal activities will occur annually together with the core program activities. Sediment disposal planning also includes a longer-term consideration of sediment disposal needs as described below.

5.6.1 Sediment Disposal Goals

Federal and state regulations govern disposal of debris to land. SCWA must comply with these regulations, as well as ensure disposal activities do not harm people or wildlife. Thus, to ensure proper management of SMP maintenance activities and compliance with all appropriate regulations for disposal of sediment, the program has the following sediment disposal goals:

- Protect the safety of workers, the public, and the environment from potentially harmful debris;
- Beneficially reuse as much sediment as possible from maintenance activities;
- Utilize the nearest off-site disposal location as feasible to reduce potential impacts resulting from the hauling of sediment;
- Do not use sediment to fill creeks, lakes, or wetland habitat, except as part of previously permitted projects that are seeking good quality fill material;
- Contain disposal sites to prevent the migration of sediment to nearby waterbodies;
- Comply with human health and environmental protection standards, as established by federal and state agencies, for all sediment disposal activities; and
- Protect and ensure that fragments of regenerative matter cannot re-enter local channels. This is of particular importance for ludwigia removal in Zone1A where ludwigia is a major invasive species management issue.

To meet these goals, SCWA will conduct annual and long-term planning for sediment disposal, as described below.

5.6.2 Annual Disposal Planning

Sediment disposal planning will be coordinated and integrated with the annual SMP work cycle (as described in Chapter 9). The annual sediment disposal planning process was demonstrated during the interim permitting process while the SMP was under development during 2006-2008. In that three-year period, the Agency used multiple sites including a private landowner parcel (Grossi site) and two other sites owned by SCWA (Spring Lake Park site and Mirabel site) to receive the removed channel sediment.

The annual sediment disposal planning process includes the following key steps:

Step 1: Identify the need, location, and volume of sediment removal

The first step in annual sediment disposal planning is to determine the disposal needs for the identified maintenance work sites. As part of the maintenance project design process (see Chapter 9), specific locations and quantities of sediment will be identified. Surveyed cross sections will assist in calculating locations and quantities of sediment to be removed.

Once the volume and locations of the sediment to be removed are known, reuse or disposal options can be evaluated. Following the disposal goals presented above, all efforts will be made to reuse sediment on-site. However, it is likely that off-site disposal will be necessary.

Step 2: Identify sediment disposal options

Sediment disposal sites must be approved by the RWQCB Executive Officer on an annual basis, prior to initiation of sediment removal activities. The site will be approved by the RWQCB Executive Officer corresponding to the location of the site. For example, if the site is located within the North Coast RWQCB's jurisdiction, that Executive Officer will approve use of the site. The conditions for site approval will be based on analytical results from sediment sampling at the channels to be maintained and at the proposed disposal site(s). The conditions for approval will evolve as the RWQCB and SCWA become familiarized with the characteristics of sediment removed as part of maintenance activities and with sediment disposal and reuse conditions.

Sediment disposal options are grouped into seven categories based on potential reuse or disposal opportunities. These include on-site reuse, other SCWA channel or easement reuse, other wetland supporting reuse, upland agricultural or commercial reuse (dry), upland agricultural or commercial reuse (wet), landfill disposal, and hazardous waste disposal options. These disposal options are listed below in preferential order according to how well the options support program objectives for sustainability and avoidance of environmental impacts.

- **Option 1: On-site reuse.** This includes reusing the sediment on-site (i.e., at the project site) within the channel or easement area for various fill or restoration purposes. For example, sediment excavated from the channel bottom could be placed adjacent to the active channel (remaining within the easement area), to enhance soil, vegetation, and riparian habitat conditions. Sediment could also be used on-site for bank stabilization purposes.
- **Option 2: Other SCWA site reuse.** Similar to Option 1, this includes reusing the sediment within SCWA owned or managed sites, such as channel or easement areas, for fill or restoration purposes. The key difference is that Option 2 would occur at a different channel or easement area within the Program Area, but in a similar setting to where the sediment was originally removed. For example, sediment removed from Colgan Reach 4 could be placed in Laguna Reach 1 to enhance channel habitats. Additional SCWA properties approved to receive sediment include the Spring Lake, Mirabel, and Sonoma Booster Pump Station sites.
- **Option 3: Wetland or floodplain restoration or enhancement.** Option 3 consists of beneficial reuse of the sediment outside or off-site of SCWA channel or easement areas, but in a wetland or floodplain setting to support ecologic functioning and habitat. As examples, gravel removed from one creek that does not support steelhead or salmonids could be placed in another creek that does in order to enhance salmonid habitat. Additionally, excavated sediment could be reused as part of habitat enhancement activities in the Laguna area. Because reuse sites under this option would potentially be located farther from the work site, increased sediment hauling distances would result. For the purposes of the sediment criteria discussed

below, Option 3 sites are located in the vicinity of and potentially drain to wetlands or water bodies.

- **Option 4: Upland agricultural or commercial reuse (dry).** Sediment would be reused for upland agricultural or commercial reuses that are dry, whereby the sediment would not be secondarily eroded to stream channels or water bodies. Demand for dry sediment is high, particularly for use as soil amendment for agricultural crops and construction of foundation pads for buildings or structures. It is likely that upland disposal sites within Sonoma County will be frequently available and can accept large quantities of sediment.
- **Option 5: Upland agricultural or commercial reuse (wet).** Under this option, sediment would be used as fill in an already approved and permitted wetland project. This is a specific case where an approved and permitted project requires the use of sediment to fill a wetland. It is important to note that this sediment disposal plan in no way encourages or sanctions the filling of existing wetlands. However, for projects that are already approved and permitted, it may be preferable to use sediment materials that share similar wetland properties. In this way, using good quality excavated channel sediment for reuse in a wetland setting may be preferable or advantageous to using other fill material or soils.
- **Option 6: Landfill disposal.** In this option the sediment would be disposed at an approved and operating landfill for use as daily cover material for landfill operations. Currently, waste generated in the Program Area is taken to the Redwood Landfill in Novato, California through an agreement with the Sonoma County Waste Management Agency. Sediment would be taken to the nearest landfill in need of cover material.
- **Option 7: Hazardous waste disposal.** This option involves the disposal of sediments containing hazardous levels of contaminants. Hazardous waste will be disposed at appropriate hazardous waste facilities. The nearest hazardous waste landfill is located in Kettleman City, California.

These seven options will be pursued in decreasing preference. Multiple options can be selected in a given maintenance season for sediment disposal. It is anticipated that off-site disposal (Options 3, 4, 5, 6, and 7) will be required for the majority of maintenance activities. Option 7 would only be used if the sediment is deemed hazardous. The specific disposal sites for the options selected will be identified as part of annual and long-term sediment planning and approved by the RWQCB Executive Officer.

Due to the range of site locations for excavation and disposal, hauling distances will vary depending on the sediment removal project site location and the disposal option selected. The preference is to select disposal options that most beneficially reuse the sediment with the least environmental effects.

A resource assessment will be necessary for most potential disposal sites, though not necessary for the landfill and hazardous waste options. A resource assessment and screening will include delineating wetlands at the disposal site, evaluating site habitats for suitability and presence of sensitive species, and reviewing the site’s cultural and historic resources. Other natural resources that may influence the site’s suitability to receive sediment will also be evaluated. Similarly, the assessment of site resources will guide and screen the selection of the most suitable disposal methods. The following criteria were developed specifically for the SMP to guide sediment disposal activities:

- Disposal of sediment cannot conflict with previously planned land uses, as identified in city/county general plans or more site-specific plans.
- All required permits and approvals will be obtained prior to the onset of disposal activities.
- Biological and cultural surveys will be conducted at each site to determine the potential for impacts on sensitive resources. If sensitive resources have the potential to occur onsite, the site will not be selected for disposal unless measures can be implemented to avoid and protect the resources.
- Sediment disposal will not result in fill of wetlands or waters of the U.S. or state (unless previously permitted).
- Based on compliance with CCR Title 22 criteria, sediment identified as hazardous or designated waste will be placed at an appropriate hazardous waste facility.

This resource assessment information will be provided in the annual SMP notification and reporting process described in Chapter 9 to verify that the sites are acceptable. These criteria will be used to inform Steps 3 and 4 below, develop Step 5, and verify Step 6 as well.

Step 3: Characterize physical and chemical properties of sediment

Once the sediment removal sites and disposal options are identified, the characteristics of the sediment will be evaluated to determine the most appropriate disposal locations. Identification of the physical and chemical characteristics of the sediment both from the creek sites and the disposal sites is necessary to comply with federal and state regulations for disposal.

Sediment characteristics within the creek channel can vary according to site conditions. Sediment removed near a storm drain outfall may contain higher concentrations of urban contaminants, such as petroleum residue, compared to sediment removed from an upslope area as part of bank stabilization activities. Urban contaminants have the tendency to adhere to fine (silt and clay) sediments which settle to the channel bottom, as opposed to coarser (sand and gravel) sediments located on the channel banks. Additionally, large quantities of organic matter mingled with fine sediments encourage absorption of urban contaminants. Thus, when sediment is removed from the channel bottom as part of channel maintenance activities, the removed sediment may contain higher concentrations of pollutants than those found in sediment removed as part of bank stabilization activities. Also, the texture or size of bed sediments decreases from coarse sand and gravel to fine silts and clay moving from upstream to downstream, so fine sediment removed from areas lower in a watershed may contain higher concentrations of pollutants than those found in sediment removed from areas higher in the watershed. Therefore, every attempt will be made to collect representative samples at each project site and samples will be collected from the finest available sediment.

As required by the current conditions of the RWQCB Waste Discharge Requirements - Monitoring and Reporting Program (WDR-MRP) (Order No. R1-2009-0049), all sediment samples will be analyzed for the parameters/analytes listed in the WDR-MRP. Sampling parameters/analytes listed in the WDR-MRP may be modified after a history of sampling is obtained. This may result in not requiring monitoring for some of these contaminants under certain situations or at certain locations, or the addition of more parameters/analytes if deemed necessary by the RWQCB.

The frequency and locations of creek sediment samples will be selected according to the following WDR-MRP requirements. The number of samples collected and sampling locations will be determined depending on the project type and volume of sediment to be removed. Details on the methodology used to collect and composite samples are described in Appendix B.

- For localized sediment removal projects and bank stabilization projects that involve the removal and disposal of less than 250 cubic yards of sediment, one sample will be collected and analyzed.

- For sediment removal or bank stabilization projects that require the removal and disposal of more than 250 cubic yards of sediment, one sample will be collected for every increment of 500 cubic yards of sediment to be removed. Details on the methodology used to collect and composite samples are described below.

- For project sites that require more than one sample, sampling locations will be selected to represent overall reach conditions. Sampling sites will be selected to target conditions at the upstream and downstream ends of the project zone. Sampling sites will also specifically target conditions downstream of culvert crossings, culvert outfalls, and key stream confluences.

- There may be situations, where for long channel reaches that are not particularly wide or deep with sediment, it will be preferable to take sediment samples for every 1,000 feet of project length rather than per 500 cubic yards of sediment removal. SCWA shall use whichever approach results in requiring more samples. It is expected that most often, the 500 cubic yard requirement will result in more sampling, but for certain projects the 1,000 ft length requirement will require more sampling and provide better representation.

It is noted, in the past ten years of maintenance activities, sediment removal from a single reach has never resulted in the removal of more than 20,000 cubic yards of sediment in a single project. However, if more than 20,000 cubic yards of sediment will be removed from a single reach, an individual sampling plan will be submitted for RWQCB Executive Officer review and approval.

Samples from the proposed disposal sites will be retrieved from multiple locations to be representative of the site. The number of samples and sampling locations will be determined under guidance from the RWQCB. The sampling methodology described in Appendix B will be implemented for the proposed disposal sites.

For all projects, any observed contamination as evidenced by chemical-like odors, oily sheens, or irregularly colored sediment would be immediately reported to the local fire department's hazardous materials team and the appropriate RWQCB staff person in the Cleanups and Investigations Unit. These agencies will direct SCWA on how to handle and remove potentially hazardous sediment.

In addition, if results are found to exceed selected water quality criteria, SCWA will coordinate with the appropriate RWQCB to develop a contingency sampling plan. In this event, additional samples will be taken to determine the extent of contamination and pinpoint potential contamination sources. Under the guidance of the RWQCB, selection of the number and location of additional samples will be determined based on potential contamination sources such as parking lots, automotive service centers, and dry cleaners. All excavated materials will be stockpiled separately on heavy plastic, covered, and stored until an appropriate disposal location is determined. Additional sampling results will then be compared to the Total Threshold Limit Concentrations (TTLCs) and STLCs specified in CCR Title 22 Chapter 11 for hazardous waste identification. Sediments not meeting the TTLC and/or STLC criteria will be disposed of at an appropriate treatment, storage, and/or disposal, facility.

All sampling results, including a map showing the locations of the samples, will be submitted to the RWQCB prior to initiation of sediment management activities (preferably the results would be submitted along with the annual notification package). The RWQCB Executive Officer will review the testing results from the maintenance sites and the proposed disposal sites and, upon receipt of satisfactory results, will issue an approval letter for placement of sediment at the proposed disposal site(s).

Step 4: Identify the appropriate BMPs to avoid or reduce impacts generated by sediment loading, transport, and disposal activities.

All BMPs implemented for the maintenance activities, as described in Chapter 7 Table 7-1, will be applied to activities associated with loading, transport, and disposal of sediment. Based on the amount of sediment requiring off-site disposal, an estimate of the number of trucks required for transport to the disposal location will be identified, as well as the hauling routes.

Step 5: Notification.

Consistent with the annual notification process for the SMP (Chapter 9) the Agency will also notify the appropriate regulatory agencies permitting the SMP on the status of annual sediment disposal needs (following the planning process outlined above) and the identified disposal sites. Sediment testing results from the creek and disposal sites will be provided to the agencies along with the notification package. Approval for use of the disposal sites will be obtained from the RWQCB prior to initiation of maintenance activities.

Step 6: Reporting.

Consistent with the annual reporting requirements of the SMP described in Chapter 9, a description of the conducted sediment disposal activities will be included in the annual SMP summary report.

5.6.3 Long Term Sediment Disposal Planning

The SMP is envisioned as a long-term program continuing for the foreseeable future. At the initiation of the SMP, sediment disposal planning and implementation will occur annually, similar to how it has occurred under the interim process during SMP development. However, it is recognized that over the longer-term planning horizon, a more programmatic sediment disposal approach will be beneficial.

As such, in anticipation of the ongoing need to dispose of sediment off-site, an investigation and outreach effort will be conducted with local agencies and landowners to identify suitable long-term disposal options. Outreach to suitable public agencies and landowners will attempt to locate private and public parcels with enough capacity to receive and reuse sediment for several years of maintenance activities.

A variety of disposal sites will be sought in Zones 1A, 2A, and 3A, where the majority of SMP maintenance activities occur. The preference will be to establish 3 to 4 disposal sites which have adequate capacity to receive sediment for several years of maintenance activities. The environmental resource screening criteria described above will also be applied to any potential disposal site.

This longer-term sediment disposal plan will be developed over the initial years of the SMP and will be submitted to regulatory agency review in coordination with other SMP program annual reporting (see Chapter 9).

5.6.4 City of Santa Rosa Sediment Disposal Opportunities

As described above the City of Santa Rosa (City) has partnered with SCWA in developing the SMP to provide suitable sediment disposal locations capable of accepting SMP sediments. The City has identified two disposal sites that have been or are in the process of being permitted for sediment reuse as follows:

- Place-to-Play: Place-to-Play is a City park that is partially developed with soccer and baseball fields. The site is fully permitted and approximately 10,000 cubic yards of additional fill is needed to complete park development.
- West College Pond: West College Pond was constructed for the purpose of wastewater treatment, and was later converted to a storage pond for tertiary-treated recycled water. It was used for recycled water storage until 2007, when a portion of the levee was determined to be unsuitable for recycled water storage. West College Pond is proposed to be converted to a sediment reuse facility. A CEQA document on the conversion is scheduled for completion in mid-2009. The 300,000

cubic yard Pond would be available for SMP sediment disposal and receiving materials from other City construction projects. The Pond will be equipped with a runoff management system to prevent accumulation of rainfall inside the embankment and avoid discharge of suspended sediment. Approval of documents describing the Pond conversion is pending with the North Coast Regional Water Quality Control Board (NCRWQCB). Because of its history as a treatment and storage facility, the Pond does not include federal or State jurisdictional waters.

The location of these two sites in the central SMP Program Area is shown in Figure 5-8. The West College Pond site is adjacent to College Creek and just north of the College Creek/Santa Rosa Creek confluence. The Place-to-Play Park is located just south of Santa Rosa Creek. These potential sediment disposal sites represent floodplain locations which historically would have received stream sediments from the adjacent streams. Considering that the maximum annual sediment volume for the SMP is 25,000 cubic yards, the combined volume of these two sites providing up to 310,000 cubic yards would provide multiple years of disposal capacity in support of the SMP.

Neither of these potential City disposal sites is anticipated to have sensitive biological resources or present permitting challenges for the SMP. The City also owns approximately 1,700 acres of agricultural lands on which SMP sediments may be spread as a soil amendment subject to disposal planning approach described in Section 5.6.2. Use of these sites for sediment disposal cannot proceed without RWQCB approval.

Chapter 6
MAINTENANCE ACTIVITIES

6.1 Introduction

This chapter identifies and describes the activities of the Stream Maintenance Program (SMP). The primary program actions include sediment management, bank stabilization activities, and vegetation management. These primary activities are described below in Sections 6.2, 6.3, and 6.4 respectively. Descriptions for these three core activities are focused on maintenance in the Sonoma County Water Agency's (SCWA's) owned in fee-engineered channels and easement-engineered channels (see the red and orange channels in the maps of Figures 1-2 through 1-9). In this chapter these engineered and easement-engineered channels are collectively referred to as "engineered channels". This chapter describes other program activities as well (Section 6.6), including activities in modified and natural channels (seen as the blue and green channels respectively in the maps of Chapter 1), and maintenance activities at other SCWA facilities. Sediment management and disposal activities are described in Section 6.7.

The implementation of maintenance activities will be guided by the Maintenance Principles described in Chapter 5, whereby work in the channel will not occur unless the conveyance capacity is considered reduced such that a flood hazard exists. The activities described in this chapter will also incorporate the program-wide impact avoidance and minimization approaches and activity-specific Best Management Practices (BMPs) discussed in Chapter 7 *Impact Reduction and Minimization Measures* and identified in Tables 7-1 and 7-2.

6.2 Timing of Work

The core SMP maintenance activities of sediment management, vegetation management, and bank stabilization can be classified either as causing ground disturbance or not. In Table 7-1, BMP GEN-1 *Work Window* describes the annual timing of maintenance work according to the status of the maintenance project as either causing or not causing ground disturbance. All ground-disturbing maintenance activities occurring in the channel (including sediment removal and bank stabilization) will take place during the low-flow period, between June 15 and October 31. Exceptions may be made for emergencies or on a project-by-project basis with advance approval of RWQCB, CDFG, NMFS, and/or USFWS as appropriate. In particularly dry years when channels remain dry earlier than June 15 or later than October 31, SCWA may request approval to conduct ground-disturbing type maintenance work prior to June 15 or later than October 31. Ground-disturbing activities will only be conducted during periods of dry weather. In the fall season, once the first significant rainfall occurs, all in-channel equipment and/or diversion structures shall be removed. Exposed soils in upland channel areas will be stabilized via hydroseeding or with erosion control fabric/blankets. Significant rainfall is defined as 0.5 inch of rain in a 24-hour period. Non ground-disturbing work on the upper banks of stream channels (e.g., vegetation, road, and v-ditch maintenance) may be conducted year round. Non ground-disturbing work (vegetation thinning/pruning) may be conducted in the channel zone beyond the primary maintenance work window of June 15 to October 31, if the channel is dry (and with notification and approval by the relevant agencies).

6.3 Sediment Management

Sediment management refers to the removal of excess sediment from constructed flood protection facilities. As described above, sediment management activities are generally conducted from June 15th to October 31st when streams are typically at their driest. In dry years, work may begin earlier than June 15th and carry over longer than October 31st provided that SCWA has received approval from the appropriate regulatory agencies.

The SMP involves only sediment removal within the as-built design of the engineered channel. The SMP does not include any expansion of channel capacity beyond the original channel design.

The number of sediment removal projects undertaken and the quantity of sediment removed in a given year depend on the frequency and extent of past maintenance activities, and the weather and hydrologic conditions during recent years. Sediment removal requirements are generally greater following a wet winter with higher than usual runoff, slope erosion, and sediment delivery compared to an average or dry winter when sediment yields are less.

SCWA anticipates that on average, the SMP will involve removing between 10,000 and 25,000 cubic yards of sediment per year. As shown in Table 6-1, the amount of sediment removed during the 2006, 2007, and 2008 work years varied from 800 cubic yards to 22,000 cubic yards. There are three general types of sediment removal projects: (1) reach scale sediment removal projects; (2) more focused bar grading or geomorphic shaping projects; and (3) even more localized sediment removal projects at individual crossings, culverts, other in-channel facilities, or other isolated areas of sediment accumulation.

All channel sediment removal activities will follow the impact avoidance and minimization approach and principles described in Chapter 5 and will incorporate the best management practices described in Chapter 7 and presented in Table 7-1.

The following sub-sections further describe the program's sediment removal approach, including: sediment sources (Section 6.3.1); reach scale sediment removal projects which includes discussion of mechanical equipment used, access and staging, targeted removal areas, vegetation thinning for sediment removal, low flow channels, and dewatering techniques (Section 6.3.2); localized sediment removal including at culverts and crossings (Section 6.3.3); intermediate scale sediment management including bar grading and geomorphic shaping (Section 6.3.4); and sediment management at other facilities including reservoirs and sediment basins (Sediment 6.3.5).

Table 6-1. Interim Sediment Removal and Bank Stabilization Projects (2006-2008)

Permit Year	Project Reach	Project Type	Linear Feet	Total Acres Disturbed	Volume of Fill Below OHWM (Cubic Yards)	Volume of Sediment Removed (Cubic Yards)
2006						
	Bloomfield (Zone 8A)	Localized Sediment Removal	184	0.64	-	800
	Adobe 1	Bank Stabilization	20	0.00	0	-
	Austin 1	Bank Stabilization	90	0.02	85	-
	Austin 2	Bank Stabilization	30	0.01	29	-
	Austin 3	Bank Stabilization	20	0.01	19	-
	Colgan 1	Bank Stabilization	25	0.01	0	-
	Colgan 2	Bank Stabilization	30	0.01	29	-
	Colgan 3	Bank Stabilization	50	0.01	13	-
	Colgan 4	Bank Stabilization	100	0.04	29	-
	East Washington 1	Bank Stabilization	75	0.02	0	-
	Gossage 1	Bank Stabilization	18	0.01	12	-
	Gossage 2	Bank Stabilization	38	0.00	0	-
	Gossage 3	Bank Stabilization	75	0.02	69	-
	Gossage 4	Bank Stabilization	100	0.03	94	-
	Gossage 5	Bank Stabilization	25	0.01	23	-
	Gossage 6	Bank Stabilization	100	0.04	90	-
	Peterson 1	Bank Stabilization	50	0.01	47	-
	Peterson 2	Bank Stabilization	50	0.01	0	-
	Peterson 3	Bank Stabilization	35	0.01	33	-
	Peterson 4	Bank Stabilization	20	0.00	0	-
	Peterson 5	Bank Stabilization	70	0.01	5	-

Table 6-1. cont. Page 2 of 3

Permit Year	Project Reach	Project Type	Linear Feet	Total Acres Disturbed	Volume of Fill Below OHWM (Cubic Yards)	Volume of Sediment Removed (Cubic Yards)
	Piner 1	Bank Stabilization	15	0.00	0	-
	Piner 2	Bank Stabilization	18	0.01	9	-
	Piner 3	Bank Stabilization	35	0.01	20	-
	Piner 4	Bank Stabilization	30	0.01	23	-
	Russell 1	Bank Stabilization	90	0.03	83	-
	Russell 2	Bank Stabilization	90	0.03	88	-
	Russell 3	Bank Stabilization	120	0.04	104	-
	Russell 4	Bank Stabilization	85	0.03	73	-
	Steele 1	Bank Stabilization	50	0.01	9	-
	Steele 2	Bank Stabilization	25	0.00	4	-
		Total for 2006	**1,763**	**1.09**	**990**	**800**
2007						
	East Washington 1 and 2	Localized Sediment Removal	315	0.20	-	380
	East Washington 4 and 5	Reach-Scale Sediment Removal	1,390	1.72	-	3,800
	Hinebaugh 2, and 3	Reach-Scale Sediment Removal	2,400	2.04	-	4,785
		Total for 2007	**4,105**	**3.92**	**-**	**8,965**

Table 6-1. cont.

Permit Year	Project Reach	Project Type	Linear Feet	Total Acres Disturbed	Volume of Fill Below OHWM (Cubic Yards)	Volume of Sediment Removed (Cubic Yards)
2008						
	Copeland 4	Reach-Scale Sediment Removal	3,500	0.88	-	8,142
	Coleman 2	Reach-Scale Sediment Removal	1,337	0.73	-	2,990
	Hinebaugh 1	Reach-Scale Sediment Removal	4,532	5.89	-	7,350
	Todd 5	Reach-Scale Sediment Removal	1,270	0.88	-	2,570
	Airport 2	Localized Sediment Removal	252	0.09	-	140
	Colgan 6	Localized Sediment Removal	135	0.07	-	115
	College 1 and 2	Localized Sediment Removal	170	0.08	-	110
	Ducker 1	Localized Sediment Removal	174	0.1	-	205
	Steele 3	Localized Sediment Removal	131	0.07	-	75
	Washington 2 and 3	Localized Sediment Removal	197	0.09	-	145
	Gossage 1 and 2	Bank Stabilization	540	0.01	160	-
	Roseland 1	Culvert Replacement	7,200	0.17	168	-
		Total for 2008	**19,438**	**9.17**	**328**	**21,842**

6.3.1 Sediment Sources

Building on the understanding of key processes described in Chapter 3 and the reach conditions presented in Chapter 4, three primary mechanisms are observed to explain abundant sedimentation in certain Program Area reaches. These primary mechanisms are watershed sediment sources, channel geometry, and flow conditions (hydrology and hydraulics).

In general, sediment is delivered to a reach as transported material from upstream areas. This source material may be derived from upland areas (including landslides, gullies, or sheetwash erosion) or may be eroded directly from the channel bed or banks upstream. Upstream sediments are transported downstream through the drainage network of joining tributaries.

In terms of channel geometry components, gradient, channel width, and depth of flow are the key causal factors. A low gradient stream may favor sediment to fall out of suspension or result in bedload transport. A wide channel cross section may cause the dispersion of flows and reduced flow velocities resulting in net deposition and bed aggradation. The lack of a defined channel that can contain small and medium sized flows (approximately less than the 2-year return interval) within the broader cross section can also be a cause for sedimentation. In such cases, shallow diffuse flows are not adequate to transport sediment downstream. This results in deposition and aggradation across the entire width of the channel bed. This process is observed repeatedly in several of the channels in the Program Area (refer to Chapter 5, Figure 5-3). Use of two-staged low-flow channels to improve fine sediment transport and reduce deposition is described below in the sub-section *Creation of Two-Stage Low-Flow Channel*.

Hydrologic processes including intensity and duration of precipitation, infiltration, runoff, shallow throughflow, and recharge determine the water balance of the watershed and how much flow is carried in the channel system. Such hydrologic processes determine the magnitude, duration, and frequency of flows arriving to a reach. The in-channel hydraulic conditions will determine whether sediment will be deposited in a given reach, be eroded from the reach, or be transported through the reach. Sediment transport processes are complex and a combination of any or all three of these processes could occur in a given reach.

As described in Chapter 3 (Sections 3.2 through 3.4) there are certain locations in the Program Area where, due to sediment sources, channel geometry conditions, and hydrology/hydraulic conditions, abundant sedimentation is both expected and observed. At such locations channel maintenance activities, as described below, will need to be implemented.

6.3.2 Reach Scale Sediment Removal

As illustrated in the channel assessments and maps of Chapter 4, channel reaches in the Program Area have been typically defined at their upstream and downstream ends by hardened crossings or culverts. When in-channel deposited sediment aggrades throughout an entire reach such that flow capacity is significantly diminished, reach scale sediment removal may be required.

Individual reach scale projects are generally 1,000 to 3,000 feet long and might typically involve the removal of between 2,000 and 7,500 cubic yards of sediment, with yearly totals for multiple projects typically ranging between 10,000 and 25,000 cubic yards. Following a particularly wet year (or series of wet years) up to five or six reach scale sediment removal projects might occur. Following an average hydrologic year, three or four reach scale projects might be planned and implemented though some years may not require any. In 2007, there were three reach scale projects, and four reach scale projects were implemented in 2008. A summary of sediment removal volumes and reach lengths for the 2006-2008 maintenance years are presented in Table 6-1.

The Hinebaugh Creek and Copeland Creek sediment projects implemented in 2007 and 2008 exemplify reaches that had experienced significant sediment accumulation in recent years. In these channels, conveyance capacity was reduced, and local flooding resulted. Reach scale sediment removal projects were designed and implemented to address deposition and increased flooding risk along these specific reaches (Figure 6-1).

A reach scale sediment removal project will typically involve the following activities:

- mechanized sediment removal along a 1,000–3,000 ft. reach of channel;
- removal of approximately 2,000 to 7,500 cubic yards of sediment, with average depths of removal between 1.0 to 2.5 feet from the channel bed;
- installation of temporary access ramps if/as needed;
- use or designation of targeted sediment collection areas;
- removal of vegetation from channel bottom;
- removal or limbing of selected trees growing at the toe of channel banks;
- creation of a low-flow channel to convey flows and transport sediment for smaller sized flow events; and
- dewatering through the installation of temporary coffer dams if/as needed.

These activities are further described below. Note that reach scale sediment removal projects integrate several vegetation management actions. Vegetation activities closely associated with sediment removal projects are introduced below in this section, and described in more detail in Section 6.5. Approaches taken to reduce the need and frequency of reach-scale sediment removal activities are described in Chapter 5, Section 5.3.5.

Mechanized Sediment Removal

Aggraded sediment is removed with a long-reach excavator, bulldozer, scraper, or front loader. When using a long-reach excavator, sediment is excavated from the channel bed, collected, and removed with the excavator usually positioned on the maintenance roads located along the top-of-bank. If the channel shape or the presence of large mature vegetation along the channel banks prevents working from the top-of-bank, then the excavator may be positioned lower on the channel banks using an access ramp. Use of access ramps are described below. When working near the upstream or downstream limit of the reach the excavator may be positioned on the stream road crossing or culvert.

Once excavated, sediment is either placed directly into dump trucks parked on the access road or stockpiled into central locations along the channel and then subsequently lifted to the adjacent dump trucks. Figure 6-2 demonstrates the use of excavators, front loaders, and bulldozers in removing sediment from the 2007 reach scale project at East Washington Creek. Approximately 1,432 cubic yards of accumulated sediment (average depth 1.2 feet) was removed during this project and the before and after photos of the site are presented in Figure 6-2a and 6-2f.

BMPs and avoidance and minimization measures will be applied to sediment removal activities based on equipment used, site conditions, and access to the site. If equipment is operated in such a way that loose sediment may possibly enter the active channel, erosion control fabric will be installed at the toe-of-slope or along the edge of the active channel to avoid delivery of any dislodged sediment into the channel and/or low-flow channel. If equipment is used within the channel, or if activities conducted from top-of-bank may affect the active channel, the work area will be isolated from flowing stream segments using silt fences, wattles, and/or cofferdams (see the *Dewatering* sub-section below for more details). Additional BMPs are identified in Table 7-1 and will be applied as appropriate to all sediment removal projects.

Channel Access and Staging

Access to the project site and staging of equipment and vehicles will take place on existing access roads adjacent to the channel. The engineered channels have at least one access road running along the top-of-bank on one side of the channel. More often channels have an access road on either side of the channel. Where feasible, work is conducted from the north side of the channel to avoid needing to remove vegetation (and the accompanying shade reduction) from the south side. Many of the Program Area channels also have additional access roads at a lower level along the banks, and not just at the top-of-bank location.

When the channel shape, bank height, or the presence of large mature trees prevents the use of the top-of-bank access roads, an access ramp (earthen or hardened if already existing) will be used to move the equipment lower on the bank of the channel, or move the equipment into the channel. A pad may be placed halfway down the bank slope so that an excavator can work from that point, reaching down to the channel bed to collect sediment and then placing the sediment in a dump truck above on the access road. This approach could be used in locations where placement of a pad is feasible or where there is a low-flow access road (e.g., lower Santa Rosa Creek where the bank has a built-in shelf above the channel bed).

When necessary, sediment removal activities can be conducted from within the channel bed. This approach is favored where top-of-bank or side-bank access is unavailable, or would require unnecessary damage to trees along the riparian corridor. In-channel sediment removal activities would only occur under dry channel conditions. Scrapers, skid loaders, bulldozers, and smaller Bobcat® type loaders are used when working directly in the channel bed (Figure 6-3).

Access ramp locations are selected to avoid impacts to vegetation, while providing efficient, safe equipment access to the work area. If used, access ramps are temporary and will be regraded and replanted following the sediment removal activities. The ramps will be seeded with native grasses and erosion control fabric will be installed.

All removed sediment, whether working from top-of-bank, mid-bank, or in channel will be placed in 10- or 20-cubic-yard dump trucks located on the access road or within the staging area. As appropriate, exposed soil on streambanks that remains after sediment removal activities will either be seeded with grass and covered with erosion control fabric or planted according to the on-site restoration planting designs described in Chapter 8 *Program Mitigation*.

Targeted Sediment Removal Areas

As a means to reduce maintenance needs and impacts associated with removing sediment from an entire reach length or creating multiple access ramps, targeted sediment collection areas may be identified at appropriate locations. Such focused sediment removal areas are identified for reaches with chronic and abundant sedimentation. Typically this might involve a 100 ft section of channel immediately upstream or downstream of a site where sediment is known to collect, such as a bridge or culvert. This is observed at several locations including a number of sites in Rohnert Park such as the Wilfred Channel downstream of Snyder Lane, Copeland Creek downstream of Snyder Lane, and Coleman Creek upstream of Hillview Lane (Figure 6-4). Targeted removal areas use locations with easy access and limited vegetation near a crossing. The channel will be excavated to near as-built conditions locally within the channel footprint. This excavated zone will capture future deposited sediment and continue to provide easy access for removal.

Vegetation Thinning or Removal for Sediment Removal Projects

Sediment removal projects often require some degree of vegetation removal or thinning in order to access a project site or begin conducting work on the channel bed or bar surface. Cattails, willows, Himalayan blackberry, and various non-native grasses are the plants most typically thinned or removed in combination with reach scale sediment removal projects.

Whenever possible, access points will be sited to avoid trees and shrubs and will take place in locations where vegetative cover is minimal. If vegetation must be removed to provide short-term equipment access, removal of non-native species or less desirable species such as arroyo willow (*Salix lasiolepis*) will be prioritized. Other vegetation characteristics such as age/size of tree, local vegetation diversity, and if the vegetation is providing a particular habitat value will also be taken into consideration when prioritizing removal of vegetation for channel access. In areas where routine or repeated sediment removal is needed (once every three years or more often), an access route to the channel will be maintained free of woody trees and shrubs. These access points will be stabilized with native grasses and fabric. To reduce effects on habitat quality, the width of the access point should be the minimum needed to provide safe access for equipment. Please see Section 6.5 for additional discussion regarding tree removal.

For in-channel vegetation removal prior to conducting sediment removal activities, an effort will be taken to maintain and not remove vegetation that provides channel stability, anchors in-channel bars, or provides habitat benefits through the presence of large woody debris (LWD). Vegetation located on in-channel bars is particularly important at the bar's downstream tip (head) and/or along the bar's periphery. Allowing this vegetation to remain also provides shading benefits to the adjacent low-flow channel. Similarly, the presence of LWD will be evaluated for the opportunity to leave such material in place. Key determinants include whether the LWD is deflecting flow toward banks and the proximity to a channel crossing or other facility. While the habitat benefits of LWD are sought in the Program Area, these benefits will be evaluated in balance of the potential flooding or erosion effects, or threats to infrastructure downstream due to the presence of LWD. Any removal of LWD will be considered for reuse elsewhere within the SMP Area and in a restoration location that would not increase flooding potential, erosion effects or threaten infrastructure downstream. Invasive vegetation such as blackberry or fast-growing multi-trunked species such as arroyo willow will be targeted for removal. Section 6.5 below describes vegetation management approaches in more detail.

Creation of Two-Stage Low-Flow Channel

Developing a low-flow channel that can successfully transport sediment under lower flow conditions (annual flows and smaller) is an important strategy to reduce sediment deposition. This approach is not only advantageous in terms of preserving channel capacity, but also provides important water quality, habitat, and fish migration benefits. The general approach is to design a smaller conveyance channel nested inside the overall channel width (Figure 6-5). This smaller nested channel will have the hydraulic geometry conditions adequate to convey and pass sediments under lower flow conditions. As described above, where a defined channel is absent, gradients are gentle, and flows are shallow and diffuse across the channel bed, on-going deposition will occur (Figure 5-3).

To the extent possible, excavation of a low-flow channel should follow the channel thalweg (low point or bottom) or the location of the existing (or pre-existing) low-flow channel. If the low-flow channel has been fully aggraded, a new channel will be designed and excavated to an appropriate width, depth, and slope for the reach. Sediment removal and low-flow channel excavation activities will not exceed the depth of the original channel design. To the extent possible, the low-flow channel form and alignment will be based on channel forms and sinuosity in the existing channel or of natural streams observed in the project area.

If the reach easement and channel cross section is too narrow for a sinuous low-flow alignment, the low-flow channel will be sited to the side of the channel easement that receives the most shade. In east-west aligned channels, this would be on the south side of the channel where the low-flow channel would receive the most shade from any vegetation present on the south bank. If the channel does not have much existing vegetation, either on the south or north sides, tree planting will be integrated with the project during the following planting season, as with all channels receiving maintenance that have planting opportunities (see Section 6.5 and Chapter 8, Section 8.5) for additional detail on SCWA's tree planting program).

Figure 6-1 provides an example cross section and plan view for the 2007 sediment removal and low-flow channel excavation project at Hinebaugh Creek. Figure 6-2f shows a sinuously carved low-flow channel excavated at East Washington Creek in 2007. At East Washington Creek, the sinuous low-flow channel was constructed and aligned to preserve existing trees that can provide shade and bank stability. Figure 5-3 illustrates the recently implemented 2008 sediment removal and two-stage low-flow channel development at Copeland Creek.

Dewatering

Dewatering of the stream may be required in order to conduct sediment removal in the channel. Many Program Area creeks are intermittent or ephemeral and are dry in the summer maintenance season. Other creeks are perennial and carry flow year-round. Several of the channels in urbanized areas, or downstream of urbanized areas that were historically dry in summer, now receive flows from urban runoff and contain water year-round.

If the channel is conveying water or ponding at the time of maintenance, dewatering techniques will be used. After several years experience, SCWA has developed a flexible dewatering approach for use in Program Area channels. Typically a coffer dam, pump, and re-routing pipeline are used together to dewater a short section of channel at a time. The coffer dams are typically constructed using sand or gravel bags or if conditions require, an inflatable rubber cofferdam. Pumping rates are set to match inflows to the coffer dam with the downstream release of the diverted flows. Pump intake lines are protected with screens according to NMFS and CDFG criteria to prevent the entrainment of aquatic species. The diverted flows are released back into the channel as near as possible to the downstream end of the project area. Silt bags are used at the end of the diversion pipe to reduce any sediment discharge downstream and to dissipate flow velocity and prevent scour at the discharge site. Figure 6-6 illustrates the typical dewatering method in plan and profile view. Figure 6-7 provides an example of dewatering from a recent project at Hinebaugh Creek.

If needed, the coffer dam, pump, re-routing pipeline method can be sequenced to dewater a longer reach of channel. Up to three coffer dams may be operated at a time (45 CY of sandbags and gravel), using a phased approach that allows one section to be dewatered while another section is being excavated. If used in sequence, the upstream dam and the middle dam are used to surround either end of the active project site (i.e., where sediment removal is occurring) and the middle dam and the downstream dam form the stilling basin which receives water pumped around the site and/or from inside the active project area. Pumped water is held in the stilling basin to reduce turbidity and is slowly released through the downstream coffer dam which is constructed of sandbags surrounding a central pipe equipped with a filter sock. The coffer dam(s) and pump system(s) are moved downstream along the project area as needed during sediment removal. Following project completion, the dewatering system is removed.

Channels will only be dewatered to the extent necessary to conduct sediment removal activities while protecting water quality and avoiding impacts to aquatic species. Specific BMPs for channel dewatering are described in Table 7-1, *Biological Resources Protection*. As stated in RWQCB permits, water quality monitoring is required before, during, and after installation and use of water diversion structures.

6.3.3 Localized Sediment Removal

Localized sediment removal activities are much smaller in size than reach scale projects and typically occur at specific sites that experience sediment deposition or blockages. Most often localized sediment removal activities occur at culverted stream crossings where sediments tend to collect and deposit. Sediments often collect inside culvert crossings and also immediately upstream or downstream of the crossings (Figure 6-3). Due to the number of culverted stream crossings in the Program Area, removal of sediment from these locations is one of SCWA's most common sediment management activities. Table 6-1 summarizes localized sediment removal activities for the 2006-2008 maintenance seasons and represents the need for this work during a typical maintenance year.

The principal objective of this maintenance activity is to ensure adequate flood conveyance by removing accumulated sediment and debris from inside culverts. Culverted crossings often accumulate sediment and debris either due to their design conditions (size and slope) or due to debris or vegetation obstructions which cause secondary sedimentation. Several examples of blocked or partially occluded culverts are described and shown in the channel discussion in Chapter 4. Though typically occurring at culvert crossings, localized sediment removal activities can also occur at bridges, other facilities, or even at specific focus points at a mid-reach location.

Localized sediment removal projects will typically involve the following activities:

- removal of accumulated sediment from box culverts or corrugated metal pipes (CMP) and areas immediately upstream and downstream of the culverts or crossings (typically 100-200 linear feet and 75-200 cubic yards of sediment removal per crossing);
- installation of temporary access ramps if needed to enter the culvert crossings;
- dewatering if/as necessary; and
- selective removal or thinning of vegetation at sediment removal locations.

Most of the culvert crossings that SCWA maintains are concrete box culverts. Culverts greater than 36 inches in diameter tend to require use of an excavator from the road crossing above or directly inside the culvert if space allows. Large box culverts with cement bottoms and enough space for a person to enter may be cleared with a small Bobcat®, skid-steer, or walk-behind power-shovel as shown in Figure 6-3. A vacuum truck is also used to remove sediment from culverts.

Sediment removal from culvert crossings will also often include the removal of sediment and the clearing of debris both immediately upstream and downstream of the culvert. As described above, a designated in-channel sediment removal area immediately upstream or downstream of the culvert provides maintenance and environmental benefits. This is particularly advantageous at crossings because access from a roadway above is available. Using such in-channel targeted collection areas near crossings can reduce the need for additional in-channel disturbance further upstream or downstream of the crossing.

In addition to the concrete box culverts there are also many smaller culverts (12 to 36 inches) made of CMP. These culverts are generally private culverts that drain from adjacent properties. SCWA is not responsible for maintaining such local drainage culverts beyond SCWA's property or maintenance easement, but SCWA does maintain the outlet of such culverts when they enter flood control channels under their maintenance. A culvert outlet blocked with sediment or vegetation will not drain properly. Removing sediment from a small culvert outlet may require similar techniques as described above for culvert crossings, but may also simply require digging out the culvert outlet by hand.

The access, staging, vegetation thinning and clearing, and dewatering methods described above for reach scale sediment removal activities are also used for the localized sediment removal activities. The key distinction is the scale and extent of the activities. Whereas reach scale projects are typically greater than 1,500 linear feet, localized sediment removal projects are typically 100-200 feet long. Access, vegetation thinning, and dewatering activities all scale down accordingly for the localized sediment removal activities.

6.3.4 Intermediate Scale Sediment Removal Activities

Intermediate scale sediment removal activities involve activities that are smaller than reach scale projects but are larger than localized projects. These projects are generally 500-750 feet long and can occur at crossings or mid-reach locations where sediment has accumulated. Intermediate scale projects don't require sediment removal throughout the entire reach length; the exact length of work will depend on the specific reach conditions.

Intermediate scale sediment removal activities are often related to specific geomorphic features along the channel. For example, sediment may be collecting as a point-bar along the inside bend of a channel or may be collecting as a mid-channel longitudinal bar. Such features may be up to a few hundred feet long in distance. Sediment management approaches for such features may involve bar grading or geomorphic shaping activities that are more site-specific than the full reach scale sediment removal approach described above.

These approaches are used where in-channel bar or depositional features may provide good habitat or other environmental benefits. The SMP approach is to preserve such features in their locations, but to grade or shape their height to provide conveyance capacity as needed. Bar grading removes accumulated sediment from the top of the bar but does not alter the overall shape or dimension of the bar, thus maintaining the low-flow channel and flow sinuosity around the bar. Bar grading activities may require some degree of vegetation removal or thinning from the bar surface to allow for equipment access. Vegetation that is considered important in providing channel stability or anchoring the bar in place will be retained. In certain reaches, mid-channel bars may be very developed and solidified with mature willows that further anchor the bar in place. In such cases, mature trees that are healthy and of a desirable species (e.g., red willow [*Salix laevigata*], alder [*Alnus* ssp.]) will be removed with the root wad intact, appropriately pruned, and transplanted to a nearby appropriate location. The remainder of the bar will then be graded using techniques described above.

Geomorphic shaping activities may involve the minor contouring of existing channel features including the low-flow channel, in-channel bars, or toe-of-slope bars (or sediment wedges). Such minor shaping would be undertaken not so much to provide more conveyance capacity (as in the bar grading activities above) but to reduce flow deflection by such features, where the features are directing flows into the stream bank and causing erosion. Geomorphic shaping activities maintain the low-flow channel and other features in their basic form but may alter their alignment to reduce the bank erosion potential. As such, geomorphic shaping is similar to bar grading; but generally less sediment is removed. Geomorphic shaping activities are focused on realigning the low-flow channel and adjacent bars more than increasing channel capacity.

In summary, intermediate scale sediment removal projects will typically involve the following activities:

- mechanized sediment removal along a 500-750 ft. reach of channel;
- sediment removal focused on particular depositional features such as mid-channel bars, point-bars, or other sediment wedges;
- removal or limbing of selected trees and vegetation growing along mid-channel bars or other depositional channel features;
- installation of temporary access ramps if/as needed;
- dewatering through the installation of temporary coffer dams if/as needed.

6.3.5 Sediment Management at Other Facilities

Other facilities requiring sediment maintenance activities include in-channel structures, reservoirs, and sediment basins. Sediment removal from these types of facilities is described below.

In-Channel Engineered Structures

In-channel structures are concrete-lined portions of channel with hardened and non-earthen bed or banks. In-channel structures maintained by SCWA include the following.

- Concrete-lined or grouted rip-rap Channels – including sections of Colgan, Cotati, Bloomfield, Santa Rosa, and Lornadell creeks (Figure 6-8).
- Spring Lake Diversion – a complex structure designed and operated to divert flows from Oakmont Creek and Santa Rosa Creek into the Spring Lake Reservoir. The diversion structure includes a weir-controlled basin where sediments become deposited (Figure 6-8e).

These in-channel structures can collect large volumes of sediment and require routine and frequent sediment removal to maintain conveyance capacity through the structure. Maintenance of these facilities involves the removal of all accumulated sediment and returning the structures to their as-built conditions.

As these structures become filled with sediment, emergent wetland and riparian vegetation usually establishes on the accumulated sediment. This vegetation is removed at the time of sediment removal. Due to regular maintenance and limited root depth, it is unlikely that mature vegetation can establish in these structures. Furthermore, mature vegetation is not desirable in these structures as the root can penetrate the concrete and compromise the integrity of the structure.

For sediment removal activities at in-channel structures, placement and use of equipment in the channel is limited to the area of the structure that is lined with concrete and will not extend into any earthen channel bed areas. Sediment will be removed from these locations in such a manner that the transition from the concrete structure to the natural channel bottom will be smooth and not create a sudden and sharp ledge or wall of sediment.

Reservoirs

SCWA operates four reservoirs including: Brush Creek, Matanzas Creek, Piner Creek, and Spring Lake reservoirs. Brush Creek and Matanzas Creek reservoirs are flow-through reservoirs, designed to detain and store peak flood flows during storm events and provide controlled release of flows following the storm peak. These reservoirs are generally dry throughout the year, with some perennial flow occurring in the creeks that flow through the reservoir. Brush Creek Reservoir currently supports recreational uses of baseball and soccer and contains infrastructure to support such uses (e.g., fields, restrooms, and unpaved parking lots). Matanzas Creek Reservoir does not currently have any recreational facilities. Piner Creek and Spring Lake reservoirs maintain water throughout the year. Spring Lake Reservoir provides recreational uses of swimming, boating, fishing, hiking, and biking and contains infrastructure to support such uses (e.g., restrooms and paved parking lots). Piner Creek Reservoir does not currently have recreation facilities.

Sediment removal around reservoir dam inlet structures is required periodically. This maintenance is typically conducted every two years to maintain flow-through capacity from the reservoir to the outfall and creek downstream. However, sediment removal needs at reservoirs may be higher following wet years than in dry years. Figure 6-9 shows the inlet structures at Brush Creek and Piner Creek reservoirs. The inlet structure area may be inundated with pool storage of the reservoir and contain some emergent wetland and/or riparian vegetation, particularly at the point where the reservoir stream flows into the inundated area.

Sediment removal at the flood control reservoirs offers an opportunity for aggressive non-chemical control of aquatic non-native, invasive weeds such as *Hydrilla verticillata* which has been a problem at Spring Lake and has been successfully controlled by sediment removal in the past. It is important that sediment removal and grading activities at reservoirs do not contribute to the spread of species such as Eurasian watermilfoil (*Myriophyllum spicatum*), which propagate by fragmentation.

Sediment Basins

SCWA currently maintains two, engineered sediment basins in the Program Area at Cook Creek, and at Adobe Creek. The Cook Creek basin was constructed in 1998. At the time of its design and construction, the expected frequency for maintenance and sediment removal was approximately 5 years. Since the 2002/2003 winter, the presence of an active landslide upstream in the headwaters areas of Cook Creek resulted in abundant sediment loads being delivered downstream to the basin. As a result, the Cook Creek basin was dredged five times between 2004 and 2007. Erosion control practices were implemented in the summer of 2006 to reduce sediment loadings to the Cook Creek Basin. Following the upstream erosion control activities, the volume of sediment accumulating in the basin on an annual basis has decreased substantially.

The Adobe Creek Sediment Basin is located on Adobe Creek upstream of South McDowell Dr. (Figures 4-42 and 4-46). This is an "in-line" basin meaning that the basin is formed directly in the flow path of the creek. Sediments collect in abundance in the Adobe Creek sediment basin.

Under maintenance of sediment basins, all accumulated sediment is removed and the structure returned to as-built conditions. Figure 6-10 includes photos of the Cook Creek sediment basin before and after sediment removal activities in 2006. Sediment removal from the Cook Creek basin requires the use of heavy equipment such as an excavator and/or bulldozer. Access to the project site and staging of equipment and vehicles takes place from the access road that circumnavigates the sediment basin. During sediment removal activities, bulldozers and loaders are used inside the basin and excavators (positioned on the perimeter road at the top of the basin) are used to remove and load the sediment in 10- or 20-cubic-yard dump trucks also located on the access road.

6.4 Bank Stabilization

Bank stabilization involves the repair and stabilization of eroded or eroding stream or reservoir banks. Bank stabilization activities occur in engineered channels and other facilities, including culvert outlets in streams and the banks around reservoirs. Bank stabilization activities are generally conducted from June 15th to October 31st when streams are at their driest. In years that are dry, work may begin earlier than June 15th and extend past October 31st (usually not longer than an extra two weeks on either end), provided that SCWA has received permission from the appropriate regulating agencies. Based on past activities, bank stabilization projects in the SMP Program Area typically require two to four days to complete. The following sections include a description of bank stabilization activities in engineered channels (Section 6.4.1) and bank stabilization at other facilities (Section 6.4.2).

6.4.1 Engineered Channels

Similar to the sediment removal activities described above, the number of new bank stabilization projects undertaken in a given year depends on weather and hydrologic conditions during recent years. A higher number of bank stabilization projects are likely to occur in wet years when banks shear or slump due to bank soil saturation, high soil pore water pressure, and high stream velocities. Another key factor influencing bank stability is rodent activity and the presence of burrows within the bank that can reduce bank integrity. Following wet years such as 2005-2006, as many as 30 bank stabilization projects were conducted. Following the drier winters of 2007 and 2008 only three bank stabilization projects were conducted per year. In an average year approximately 5-10 bank stabilization projects may be identified and implemented.

The bank stabilization designs and implementation activities described below draw upon a palette of bioengineering techniques addressing slope stability. These approaches include using engineered back filled soils, erosion control fabric, and planting of native riparian trees at the top-of-bank and the toe-of-slope to provide additional bank stability and increased canopy in the channel. Preferred repair treatment designs were presented in Chapter 5 Figures 5-5, 5-6, and 5-7. As availability allows, sediment used in bank stabilization projects will be taken from stockpiled sediment collected during sediment removal projects (see Section 6.3). Where soil compaction, erosion control fabrics, and revegetation are not adequate in providing a stable slope on their own, other bioengineered solutions would be prioritized over the use of hardscape installations.

Use of hardscape is discouraged in the SMP. Hardscape will only be used in cases where other alternatives would not result in a sufficiently stabilized slope. A typical condition where a hardscape solution may be expected to be used is to stabilize an emerging culvert outlet to prevent reoccurring erosion. In such cases, rock will be used only beneath and below the culvert outfall, as well as on the sides to ensure stability of the culvert. Rock sizes are typically 1 foot in diameter or less (sized accordingly for culvert size). If riprap must be used for other bank slope stabilization purposes, it will consist of rock typically between 1-2 feet in diameter. During recent years, use of rock or other hardscape bank stabilization materials has been significantly reduced at SCWA in favor of more integrated bioengineering approaches.

The specific design of a bank stabilization project depends on site-specific conditions such as: (1) the type of bank failure (sheered slope, undercut bank, rotational slump, culvert failure, etc.); (2) hydraulic conditions (bank height, angle, shear stress, etc.); (3) geomorphic setting (such as the inside or outside of a stream bend); and (4) the characteristics of the channel adjacent to the site. These site-specific conditions will be considered when selecting treatments.

Chapter 9 provides more detailed information on program implementation including the site reconnaissance, evaluation, prioritization, and design steps that would be considered in developing a suitable bank stabilization design. Photos a and b of Figure 5-6 (Chapter 5) compares pre- and post-project conditions at a bank stabilization site on Gossage Creek.

Bank stabilization sites will be revegetated with native riparian trees regardless of whether or not a riparian canopy existed at the site prior to the repair project. Native riparian trees will be planted just above the 2-year event water level and/or at the top-of-bank, spaced appropriately based on tree species and the desired canopy extent. Trees will be selected from the plant palettes provided in Table 8-3 and Figures 8-2 and 8-3. Tree selection will consider site location, how appropriate the site is for the tree type, and the potential for the tree to destabilize the bank slope in the future. Arroyo willow (*Salix lasiolepis*), which is common to these systems, will not be planted due to its wide shrub-like form and the increases in channel roughness this species causes. Native grasses will be seeded or planted in areas disturbed by bank stabilization activities, including between existing or newly-planted trees.

When repairs are made, banks are recontoured to match the adjacent bank slope (i.e., returned to pre-failure condition). Most SCWA-maintained channels have bank slopes of 2:1 or steeper. If site conditions allow, the bank slope may be stabilized at a less steep slope (reducing the likelihood of renewed failure), but only if the work is conducted within the confines of the original channel as-built condition. Stabilized banks will be flush with the existing bank slope, and only limited new material may protrude from the bank.

Individual bank stabilization projects covered under this program should not affect more than 300 consecutive linear feet of bank. Repairs shall be confined to an area not to exceed 10 feet beyond the failed or failing bank or structure. If a riparian zone is present adjacent to the bank failure site, care will be taken to disturb the least amount of vegetation, including mature trees, as necessary. Bank failure sites may contain exposed soils or, by the time of bank repair, be covered by vegetation such as grasses or blackberries. Overgrown vegetation will only be removed to the extent necessary to repair the bank.

Equipment used for bank stabilization activities may include excavators, bulldozers, front-end loaders, and 10- and 20-cubic-yard dump trucks. Staging will occur on adjacent access roads. Soil and rip-rap will be staged in areas that have been previously disturbed (i.e., service road, turn-outs, etc).

BMPs and avoidance and minimization measures will be applied based on the equipment used, site conditions, and access to the site. If repair activities affect the active channel, the work area will be isolated from flowing stream segments using silt fences, wattles, and/or cofferdams. Additional BMPs are identified in Table 7-1 and will be applied, as appropriate, to all bank stabilization projects.

6.4.2 Bank Stabilization at Other Facilities

Other facilities that may require bank stabilization treatments include reservoirs. As described above under Section 6.3.5, in-channel structures are constructed of concrete and typically do not require bank stabilization, unless the structure were to fail. If such concrete structures fail or collapse they would be replaced in-kind. Due to the nature of sediment basins, any bank failures that occur would eventually be covered up by sediment trapped in the basin. When the basin is cleared of sediment, the banks would be recontoured to their original as-built design. Bank stabilization in reservoirs may be required infrequently. The design, construction, and maintenance of dam and levee features associated with the reservoirs involves dam safety engineering protocols and is beyond the scope of this SMP. However, any bank stabilization activities required on the banks around the reservoir would utilize the same techniques and requirements as described in Section 6.4.1 *Engineered Channels*.

6.5 Vegetation Management

6.5.1 Overview

A hydraulic assessment was conducted in 2000 to evaluate how channel capacity was impacted under various in-channel vegetation conditions (Entrix 2002). The hydraulic assessment indicated that for many channels in the SMP Program Area, the presence of young dense shrubby vegetation (mostly willows less than 5 years old) along the streambanks and/or cattails along the channel bed had resulted in diminished hydraulic capacity. The presence of this vegetation and the resulting reduction in flow capacity increases the flooding potential. The SMP seeks to manage vegetation to reduce the flooding potential while preserving and enhancing channel habitats as much as possible.

Vegetation management refers to the trimming and removal of potentially problematic vegetation in engineered channels and other constructed facilities. Vegetation management also includes planting of new trees in engineered channels at the top-of-bank and just above the toe-of-slope. Vegetation management does not include any ground-disturbing activities except as described in the following sections. Vegetation management activities occurring in engineered channels are grouped into eight activity types including: willow thinning and removal; blackberry removal; cattail removal; ludwigia removal; tree pruning and exotics removal; tree removal and relocation; mowing; and nursery stock tree planting. Each of these activities is described below in Section 6.5.2. Vegetation management at other facilities, including in-channel engineered structures, reservoirs, and sediment basins, is described in Section 6.5.3.

As described above in Section 6.2 *Timing of Work*, non ground breaking vegetation work on the upper banks of stream channels may be conducted year round. If the channel is dry, and with notification and approval by the CDFG, non ground-disturbing vegetation thinning/pruning work may be conducted in the channel zone beyond the primary maintenance work window of June 15 to October 31. More specifically, vegetation management occurs on different schedules depending on the type of thinning or removal being conducted. Vegetation management activities and general period of implementation are shown below.

- Routine vegetation pruning and removal (trees, ludwigia, cattails, blackberries) on the lower bank and in channel bed – June 15th to October 31st (with the potential for an extension dependent upon dry conditions and agency notification and approval).
- tree planting, relocating, and/or transplanting – all year
- Upper bank planting, pruning, and removal, access road and v-ditch clearing – all year
- Nursery stock tree planting – December 1st to May 31st
- Mowing (access roads and dam face) – March 1st to August 31st
- Access road spraying – April 1st to May 31st

Vegetation management and removal activities are relatively consistent from year to year, though locations change. Years that experience flooding or strong winds may require additional work to clear downed trees or vegetation debris. Conversely, vegetation management needs following dry or drought years are generally reduced. Some channels may require annual vegetation management while others do not. This largely depends on the type of vegetation in the channel. For example, channels characterized by cattails or willows may need annual pruning while channels with a mature riparian canopy generally require less maintenance to maintain flow capacity. A more detailed and comprehensive description of vegetation management activities, methodologies for implementation, and impact avoidance, minimization, and mitigation measures is included in Appendix E: *Vegetation Management Plan*.

Recommended plant palettes according to channel geomorphic form are shown in Table 8-3 and Figures 8-2 and 8-3. All listed plants are native riparian species found in Sonoma County waterways. Not all species will be equally appropriate for all sites; the planting list for any given site should be developed in consideration of the current and known historic native flora of the site and the local subwatershed area.

Vegetation management techniques include hand removal using small tools and hand-held equipment, mechanical removal using heavy equipment, and spot chemical control. Heavy equipment used for vegetation removal may include a flail mower attachment on an excavator or Bobcat® that is used to cut cattails or blackberries, or a backhoe or rubber-tracked excavator that is used for removing material from the channel (see Section 6.5.2 and associated figures for more detail on when these techniques may be used and the equipment used).

Vegetation management activities vary depending on the type of facility involved. While the methods described here are the common practices of SCWA, maintenance techniques may shift over time and by location depending on site constraints and new technologies. The following paragraphs describe vegetation management activities in the different types of SCWA-maintained facilities.

Figure 5-4 presented a comparison of Santa Rosa Creek in 1997 and 2007 highlighting some of the dramatic improvements in channel vegetation through the SMP approach. Figure 6-11 provides more details on the willow removal and alder pruning approach in Santa Rosa Creek. Figure 6-11 illustrates some general outcomes of vegetation management activities and is a useful example prior to discussing the more specific topics below.

6.5.2 Vegetation Management in Engineered Channels

Vegetation management in engineered channels is organized according to the type of activity. The degree of vegetation management performed depends on local reach conditions, neighboring land uses, and existing channel conveyance capacity. Most vegetation management activities utilize a 3 to 12 person crew and 2 to 3 crews can be deployed on the same day. Maintenance of access roads and v-ditches are more specifically discussed below in Sections 6.6.3 and 6.6.4.

Willow Removal

Willows are commonly found in reaches throughout the study area. These species generally grow from the bank slope, near or at the toe-of-slope, and can grow into and across the channel bed quickly, often within a single season (see Figure 6-12). SCWA generally conducts willow removal from June 15th to October 31st.

Pruning and removal of arroyo willows is the major activity related to vegetation management. Arroyo willows are an issue for SCWA's flood control channels due to their rapid growth (over 1.5 inches in diameter per year) and the bushy structure of the plant which is effective at slowing flows and trapping debris. Red and Pacific willow (*Salix lucida lasiandra*) species are better suited as they generally form a main trunk that can be limbed up, allowing room for flows. Species like red and Pacific willow are retained where they do not present issues for flows or roughness, or are transplanted when feasible.

Arroyo willows will be removed wherever they are significantly impeding the flow of water, or in areas that contain more desirable tree species. If arroyo willows are not removed, they will be pruned to minimize their ability to catch debris and impede the flow of water. Red and Pacific willows will generally be pruned to reduce the number of branches and trunks below the top of the channel banks. See Figure 6-13 for examples of how trees will be pruned.

Willow removal generally requires hand clearing using chainsaws, pole saws, pruners, and loppers. Willow stumps may be hand treated with an herbicide such as Aqua Master® (formerly known as Rodeo®) to prevent future growth (see Section 6.5.5 for additional detail). Cut vegetation must then be removed from the channel. This is achieved using a variety of methods including hand removal (passing branches up the slope), attaching a line to the cut limbs and pulling them up the slope with the aid of an excavator arm, using an excavator reaching into the channel from top-of-bank, using a skid-steer with a grapple bucket, or by angled pulls using a line and two vehicles.

In cases where arroyo willow root wads protrude from the channel bottom after limbs have been pruned, these are generally left in place but depending on the channel size and geometry, the root wad may require removal to reduce roughness on the channel bed. Removal of a root wad generally requires the use of heavy equipment such as an excavator. Arroyo willow removal may also be combined with sediment removal. In such cases, the channel is cleared of both sediment and arroyo willow roots using methods described in Section 6.3.2 in order to increase channel capacity and to decrease the rate of return of arroyo willows. Any use of heavy equipment in the channel for vegetation management purposes will follow and utilize the avoidance measures and BMPS identified for sediment removal projects in Table 7-1.

Blackberry Removal

Blackberries are commonly found in reaches with little to no riparian canopy. This species generally grows from the bank slope, particularly near or at the toe-of-slope and can grow into and across the channel bed quickly, often within a single season (see Figure 6-14). SCWA generally conducts in-channel blackberry removal from July 15th to October 31st (or later during dry years and under review and approval from the appropriate agencies as described above).

Blackberries are generally removed using a bladed weed-eater, or an excavator or Bobcat® with a flail mower attachment. Stalks are then raked together, picked up, and removed from the site using a dump truck. If a technique is used such as a flail mower or other violent chopping machine, efforts to remove all slash, sawdust, cuttings, etc. will be taken to leave the site free of significant quantities of vegetative debris. Remaining cut stalks are then sprayed with an herbicide (generally AquaMaster®) using a small backpack sprayer to control regrowth. The development of a canopy encouraged by tree planting (discussed below) also helps to reduce the regrowth of blackberries.

Cattail Removal

Cattails are commonly (but not necessarily) found in reaches with little to no riparian canopy. Cattails generally establish in low-gradient channels that support flows throughout much of the year (see Figure 6-15). This often means cattails are found within the active channel in areas of slow-moving flow. Finer sediments naturally settle out in these locations, but further sedimentation is encouraged by cattails that slow flows and trap sediments. Cattails are also the climax community (the final stage in ecological succession) that are favored in channels in need of sediment removal. SCWA generally conducts cattail removal from August 1st to October 31st (or later in dry years pending approval). Maintenance generally occurs later in the summer so that cattails do not have time to reestablish and grow before winter.

Cattails are generally removed using bladed weed-eaters. In areas where mature trees do not prohibit access, heavy equipment, such as an excavator with a flail mover extension positioned at top-of-bank, may be used. This approach to cattail management is a shorter-term solution as cattails readily grow back.

Cattail removal may also be combined with sediment removal. In such cases, the channel is cleared of both sediment and cattails using methods described in Section 6.3.2 in order to increase channel capacity. This approach includes removal of cattail roots along with the sediment and has proven successful in reducing in-channel cattail re-growth for several years. Over the long-term, cattail growth is further discouraged by the development of a canopy over the channel, strategic planting of cattail competitors, and the establishment of a low-flow channel.

SCWA has observed that cattail growth thins-out in areas of high canopy cover, but in the absence of stream gradient and flow processes to move sediment downstream, cattails can become a sediment catching problem in well shaded areas too. Cattail management requires a multi-pronged approach that considers vegetation interactions (canopy shading, competition, and seral stage) as well as geomorphic processes (sediment accumulation and flow frequency. Early seral vegetation can provide light shading and has a higher stem density then an established riparian corridor and can be an initial and effective retardant to cattail development. Climax riparian vegetation such as large oaks, bays, alders, box elders and maples over hanging the channel will provide more complete shading and exclude cattails.

Ludwigia Removal

Water primrose (*Ludwigia peploides montevidensis*) is an invasive, exotic, aquatic weed found in apparently increasing occurrence on the west coast as well as nationally. The species occurs in the Russian River as well as in the Laguna de Santa Rosa (Laguna) and in tributaries to the Laguna system. This plant can completely fill channels and trap sediment (Figure 6-16).

SCWA has been engaged with the issue as a member of the Ludwigia Task Force headed by the Laguna Foundation since 2002. Since 2002, SCWA has been coordinating the issue with UC Davis Weed researchers to accurately identify the species, define and document shade, nutrient, and inundation tolerances (Foster pers. comm. 2008). In certain situations ludwigia has been observed to be a flood management concern when large patches of the plant are up rooted and collect against bridgeheads during high flows. Additionally, if existing patches of the plant are not scoured out by winter high flows, the plant has a tendency to sprout new shoots from the previous year's stems. The build-up of biomass in the channel can cause problems similar to cattails by reducing channel capacity.

Ludwigia growth and channel blockages have been observed in some of the low-lying flood control channels of the Program Area draining to the Laguna de Santa Rosa west of Highway 101. Generally, in most SCWA flood control channels streamflow rises above the ludwigia patches and is not necessarily problematic in conveying flows. SCWA anticipates that the need to manage ludwigia and the appropriate methodology will be developed during the ongoing implementation of the SMP. Currently, SCWA anticipates routine and continued ludwigia removal efforts in flood control channels west of Highway 101 in the Rohnert Park/Cotati area. Ludwigia removal activities will be conducted between June 15th and October 31st.

In the past, ludwigia has been eradicated using a two-step process: first herbicide application and then mechanical removal. Herbicide treatment was initiated in the summer of 2005 and recommenced on June 26, 2006 under the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (WDID No. 1B05047NSON). Triclopyr triethylamine salt (trade name Renovate®) was used to control ludwigia. However, this method of treatment will not be employed as part of SMP vegetation management program due to the inefficient results from past applications and to protect wildlife.

Mechanical removal will be the primary method of control for this species and will generally be conducted using a long-reach excavator from maintenance roads adjacent to the project site channel. Where the channel is too wide, the excavator may occasionally travel partially down the bank in areas that will not impact existing native and riparian vegetation. The excavator will work from the mid-bank position, thus reducing the need for multiple trips along the bank slope by smaller equipment. Aquatic harvesters may be used to remove vegetation from the main Laguna channel.

The management of ludwigia is still somewhat new. SCWA is currently working to find approaches to management that are more effective than current approaches. The long-term solution to ludwigia management may expand to include canopy development, modifying inundation regimes, limiting available habitat, and improved hydraulics (e.g., installation of low-flow channels as appropriate) to discourage the spread of the species.

Tree Pruning and Exotics Removal

Maintenance activities related to tree pruning and exotics removal focus on selectively thinning brush and multi-trunked trees. The preferred maintenance approach is to prune lower limbs up to the top of the channel banks, if possible. Multi-stemmed trees are pruned down to a single trunk and lower limbs are removed up to the top of the channel banks, if possible. The goal of this maintenance approach is to develop a native canopy over the channel but not to increase channel roughness such that the flood hazard is increased. See Figure 6-17 for examples of tree pruning techniques.

In the top-of-bank area outside the stream channel (including the access road and adjacent above channel area), healthy native mature trees are only trimmed if a limb is blocking the access road, hanging over a fence into a private yard, or appears unbalanced or broken. Enough space will be maintained along the access road to allow maintenance and emergency vehicles.

Non-native, invasive trees and bushes (e.g., tree of heaven [*Ailanthus* ssp.], acacia [*Acacia* ssp.], white poplar [*Populus alba*], Lombardy poplar [*Populus nigra 'Italica'*], eucalyptus [*Eucalyptus* ssp.], London plane tree [*Platanus* x *hybrida*], Indian bean [*Catalpa* sp.], privet [*Ligustrum* sp], broom [*Genista, Spartium*, sp], red clusterberry [*Cotoneaster* sp.], and ivy [*Hedera* sp]), may be cleared from the top-of-bank area or within the channel. Non-native, mature trees that provide canopy or may provide habitat to nesting birds or raptors, such as eucalyptus, may be selectively removed if other native mature trees are present nearby and the loss in canopy and/or habitat is not considerable. If these trees are the only mature trees along the channel and provide the only canopy and habit in the area, they will be left in place until such a time as a native canopy is developed.

Tree pruning will take into consideration the extent of local riparian canopy and vegetation in general. For example, if the active channel is fully shaded by arroyo willow, the removal of which would expose the channel to direct sunlight, pruning techniques, such as allowing a narrow strip of vegetation to persist on the south side of the bank to shade the channel, will be used. The reach will also be identified for planting of more desirable trees the following planting season.

Hand clearing is usually required on bank slopes using chainsaws, pole saws, pruners, and loppers. Hand clearing may also be used at the top-of-bank to remove hazard trees (e.g., snags, dying or dead trees, broken branches) from areas with high public use or that are adjacent to residences or other structures.

Tree Removal and Relocation

Mature, healthy, native trees are generally only removed if channel capacity is significantly limited or if the tree is creating unacceptably high hydraulic roughness in the channel and the situation cannot be rectified though use of pruning.

Sick, dying, or dead mature trees may be removed if they are determined to be reducing channel capacity, increasing roughness, has the likely potential of falling into the channel and increasing the flood hazard, or presenting a potential safety hazard to recreational users (in areas where the access road is accessible to the public) or adjacent structures. The determination of tree health and likelihood of being a hazard to people or channel capacity is made on site by appropriate environmental staff (arborist or biologist). Snags will be left in place to provide habitat for birds and small mammals if it is determined by staff that they do not otherwise pose a flood or safety hazard. Sick, dying, or dead trees/snags may also be pruned so that the flood and/or safety hazard is reduced and so that at least a portion of the tree may remain in place to provide habitat. This approach has been successfully used by cities including Seattle, WA and Victoria, B.C. (Williams 2001).

As described above in Section 6.3, the presence of LWD will be evaluated for the opportunity to leave such material in place. Key determinants include whether the LWD is deflecting flow toward banks and the proximity to a channel crossing or other facility. While the habitat benefits of LWD are sought in the Program Area, these benefits will be evaluated in balance of the potential flooding or erosion effects due to the presence of LWD.

If a native tree does require removal, it will be evaluated for potential use in another location within the channel or at a different site. Trees that may be desirable include those with a single trunk that provide canopy such as alders, red willow, or Pacific willow (*Salix lucida lasiandra*). If it is determined that the tree may be used in another location where it would not present issues for channel flow or roughness, the tree will be removed with root structure intact, pruned to compensate for root damage, and immediately planted and watered. The vacated root structure site will be treated as a bank stabilization project and treated with bioengineered methods as described in Section 6.4. Large red or Pacific willows that require removal may also be cut into large sprigs and planted on mid-bank with the use of an auger. See Figure 6-17 for examples of tree removal activities.

Removal of trees from the channel bed may require heavy equipment in the channel depending on the size of the tree and the site conditions. This may require a backhoe, excavator, or Bobcat® with a tree-spade attachment.

Mowing

Grasses in the top-of-bank area are mowed up to three times annually using a flail mower where space allows or with hand-held tools such as a weed-whacker where a flail mower is not practical. See Figure 6-18a for examples of flail mowing machine used in the top-of-bank area. If a flail mower or other violent chopping machine is used, then all slash, sawdust, cuttings, will be left in place as mulch (except in the active channel).

Nursery Stock Tree Planting

Planting of nursery stock typically occurs December 1st to May 31st. This is timed during the typically wetter months of the year so that newly planted trees have the opportunity to establish before the hotter and drier summer months. Planted nursery stock trees are generally planted as 1 to 15 gallon container trees. Once planted, trees are monitored and watered by hand during the dry season as necessary for approximately 2 to 3 years or until established. Trees planted on the upper bank require irrigation longer than those located closer to the toe-of-slope. Some trees planted near the toe-of-slope may not require irrigation (although all planted trees will be monitored for watering needs).

Trees are planted just up from the toe-of-slope and along the top of the bank slope. Trees planted along the top-of-bank may include maples (*Acer* ssp.), oaks (*Quercus* ssp.), box elder, and Fremont poplar. Trees planted at the ordinary high water mark, slightly above the toe-of-slope may include alders, ash, maples, and red or Pacific willows. Trees will be spaced appropriately to allow room for a mature tree canopy to develop and thinned later as necessary to maximize canopy yet retain channel capacity. See the SMP plant palettes shown in Table 8-3 and Figures 8-2 and 8-3 for additional tree species that may be planted. See Figure 6-18, Photo b for examples of tree planting activities. Chapter 8 includes more detail on the SMP planting template and plant palette.

6.5.3 Vegetation Management at Other Facilities

Other SMP Program Area facilities include in-channel structures, reservoirs, and sediment basins. Vegetation management at these other facilities only includes vegetation removal as described below.

In-Channel Engineered Structures

Vegetation management at in-channel engineered structures is focused on maintaining a clear access to the structure and ensuring that the structure can operate as designed. Access roads may be mowed using a flail mower or treated with herbicide (see Section 6.6.3 for more detail on road maintenance and Section 6.5.5 for more details on herbicide use). Pruning of branches overhanging the road will be conducted using hand-held tools such as pruners, pole saws, and chainsaws. In-channel concrete structures will generally be maintained free of vegetation.

Reservoirs

The majority of vegetation management conducted in reservoirs is focused on the mowing of the dam levee, both inside the reservoir and on the outer dam face, and clearing of vegetation from around dam structures including the spillway and inlet structure.

Mowing is conducted using a flail mower and access to the dam is provided via the access road along the top of the dam. The California Division of Safety of Dams (DSOD) requires that all earthen dams be maintained free of shrubs and woody debris to maintain structural integrity of the dam and to enable visual inspection of dams for leaks. Because the Program Area dams are maintained free of any vegetation except grass, it is very unlikely that any shrubs and/or trees will require removal from the dam.

Vegetation clearing around the spillway will also follow DSOD requirements that the spillway be maintained free of vegetation except grass. If vegetation maintenance is necessary at spillways, it will be conducted using hand-held tools such as weed-whackers, pruners, and chainsaws (for any overhanging branches). Reservoir spillways will generally be maintained free of vegetation.

Sediment Basins

Vegetation management in sediment basins is focused on maintaining a clear access road. The road may be mowed using a flail mower or treated with herbicide (see Section 6.6.3 for more detail on road maintenance and Section 6.5.5 for more details on herbicide use). Clearing of branches overhanging the road will be conducted using hand-held tools such as pruners, pole saws, and chainsaws.

Vegetation in the sediment basin will be removed when sediment management activities occur. See Section 6.3 for more detail on sediment removal activities.

6.5.4 Access and Staging

Access to maintenance sites will occur via the adjacent access roads where present. At project sites with no access road, access will be provided via the least environmentally damaging, yet feasible, route (typically along the top-of-bank area). Access to vegetation maintenance sites occurs via the adjacent access road to the general location, and by foot into the channel. Removal of mature trees for access to the channel bed by foot is generally not necessary.

Selective clearing of shrubs or trees may be necessary on the banks to provide access to the channel bed. If clearing is required, invasive species such as blackberry or fast-growing species such as arroyo willow will be targeted.

Staging for vegetation maintenance activities will occur to the extent possible on the adjacent access road. Cut vegetation is chipped on site and/or hauled away in a dump truck.

Cut vegetation will be transported from the channel bed up the bank slope to the access road by hand or by mechanical equipment such as a an excavator or back hoe. Vegetation is chipped on site and/or hauled away in dump trucks.

6.5.5 Herbicide Use

Herbicide use in SCWA-maintained channels is minimal. In-channel use of herbicides is limited to direct application on stumps of trees, such as willows that have been removed during maintenance, and for blackberry eradication. See Figure 6-19 for examples of herbicide application activities.

Herbicides are also used on unpaved access roads during the spring to suppress weeds from the roadway and to protect the integrity of the road. However, there is no use of herbicides on access roads that are set within the channel banks/levees. Such “low-flow” access roads are often inundated annually by stream flows and do not receive any herbicide treatment. For the top-of-bank access roads, herbicides are sprayed from a truck-mounted rig. The area sprayed is limited to as a narrow a width as practicable (Figure 6-19). Spraying usually occurs very early in the morning (approximately two or three o'clock AM) and concludes around nine o'clock AM to reduce the possibility of contact with recreational users at the sites that are also recreational facilities.

SCWA generally uses Aqua Master® (formerly known as Rodeo®), an aquatic contact herbicide that consists of glyphosate isopropylamine salt and water, for treatment of stumps and access roads, but other herbicides may be used depending on the target plant species. Approximately 5-10 gallons of Aqua Master® is used per month during the 5-month summer field season (25 to 50 gallons per season) for treatment of willow stumps. A drift-reduction agent called Stay-Put® is mixed with the herbicide. Drift-reduction agents such as Stay-Put® commonly consist of poly-acrylamide or polyvinyl polymers.

All herbicide application activities is conducted in accordance with all applicable federal, state, and local regulations (under regulatory authority of the United States Environmental Protection Agency (USEPA), the California Department of Pesticide Regulation (DPR), and the Sonoma County Agricultural Commissioner, respectively) and SCWA utilizes BMPs as identified in Table 7-1 when applying herbicides. See Chapter 2 Section 2.2.4 for a more complete description of relevant regulations pertaining to herbicide use and the SMP compliance approach.

6.6 Other Maintenance Activities

Sections 6.3, 6.4, and 6.5 described maintenance activities for the core program activities of sediment management, bank stabilization, and vegetation management. This section describes maintenance activities for additional features and issues covered by the program including:

- Modified channels
- Natural channels
- Access road maintenance
- V-ditch maintenance
- Culvert Repair and Installation
- Debris removal
- Fence maintenance
- Graffiti removal
- Sediment disposal

As discussed in Chapter 1 Section 1.5.6 *Activities Not Covered in the SMP*, the SMP does not cover stream maintenance activities conducted on an emergency basis. For these other maintenance activities listed above, SCWA will include notification and reporting for known and planned activities in the annual notification package sent to regulatory agencies (see Chapter 9 for more detail on program implementation and agency notification).

6.6.1 Modified Channels

Modified channels are natural channels with existing earthen beds and banks that have been modified either through vegetation removal, in-channel grading, channel widening or straightening, or debris clearing to improve flow conveyance. Though modified, these channels are not engineered or constructed according to specific design criteria to convey a discharge of a particular magnitude.

SCWA holds hydraulic easements over approximately 49 miles of modified channels. These are permissive easements where another jurisdiction, authority, or private landowner owns the modified channel feature. SCWA is not obligated to conduct maintenance and has no responsibility to perform any specific level of maintenance in easement modified channels. However, SCWA may perform maintenance on these channels at its discretion if it determines that the debris or vegetation has the potential to cause flooding or result in property damage. Modified channels are shown as blue streams in the maps of Figures 1-2 through 1-9.

Maintenance activities in modified channels typically include the removal of log jams, debris jams, and the clearance of vegetation to remove significant flow obstructions. In modified channels, LWD preservation or removal will be evaluated based on site-specific conditions and whether the LWD is deflecting flow toward the streambanks or if the site is near a crossing or facility whereby the LWD could trap additional debris and/or create blockages at the crossing. If such threats do not exist, and the LWD is providing valuable habitat, then the LWD will be preserved in-situ.

The most common type of work conducted in these channels is the removal of blackberry thickets or fallen trees that significantly increase the potential for flood damage to structures. Trash or vegetation debris may also cause a blockage and require removal. See Figure 6-20 for examples of maintenance activities in modified channels.

Work in modified channels occurs only on an as-needed basis, usually at the request of an adjacent land-owner during or following a large storm event. Maintenance work in modified channels is performed relatively infrequently.

Landowner requests for emergency maintenance and debris clearance activities that occur during a storm event are not covered by the SMP and its associated programmatic permits. However, routine maintenance work as described above that occurs as a planned activity is covered by the SMP and its associated programmatic permits.

The equipment used to remove channel debris or blockages in modified channels will depend on the size of the material to be removed and may include either hand-held tools or larger mechanized tools. Access to sites and staging will occur via the adjacent access road if one is present. If no access road is present, access and staging will occur in the least damaging way to surrounding vegetation and habitat. Preference will be given to already disturbed areas, private yards, or grassy areas.

6.6.2 Natural Channels

Natural channels are non-engineered creek systems with a permissive clearing easement. SCWA holds hydraulic easements over approximately 80 miles of natural channels. Natural channels are shown as green creeks in the zone maps of Figures 1-2 through 1-9.

Like modified channels, natural channels may still require maintenance activities to maintain flow conveyance and reduce the flooding hazard. Similar to modified channels, maintenance work in natural channels typically involves clearing debris or vegetation that is causing a flow obstruction. Like modified channels, work in natural channels is infrequent and typically occurs at the request of an adjacent landowner who has observed a problem.

Any planned maintenance work in natural channels requires specific notification to the relevant regulatory agencies to indicate on which creek the work will occur and what will be done. It is envisioned that planned maintenance work on natural channels would only typically occur as a precautionary measure to prevent an anticipated and likely flooding or erosion event.

Any planned maintenance work in natural channels will not result in the reduction or removal of instream woody vegetation or LWD that is providing functioning habitat. An exception to this condition occurs at culvert crossings and the areas 75 feet upstream or downstream of culvert crossings or facilities where the clearing of woody vegetation may be necessary to clear or prevent a flow blockage.

Finally, through the development of the SMP the following natural channels were identified as hosting particularly sensitive aquatic habitats and were removed from program coverage: Blutcher Creek (Zone 1A), Willow Creek (Zone 5A), Sheephouse Creek (Zone 5A), Dutch Bill Creek (Zone 5A), Green Valley Creek (Zone 5A), Jonive Creek (Zone 5A), and Salmon Creek (Zone 8A). This means that debris and vegetation clearing shall not occur in these creeks under the SMP. These sensitive creeks are mapped in Figure 1-12 (see Chapter 1).

6.6.3 Access Road Maintenance

Access road maintenance may include grading and/or resurfacing road repairs and vegetation removal. Access road maintenance work may involve hand tools, mechanized equipment, or chemical application (for vegetation treatments). The potential timing for road maintenance activities is:

- Road repairs, grading, and/or resurfacing – All year.
- Access road pruning – All year.
- Spray dirt/gravel access roads – March 1st to April 30th.
- Mow low-flow access roads – March 1st to August 30th.

Road repairs will generally require grading to restore the original contours of the road. Road repairs may also include replacement of culverts, pipes, valves, drop-inlets or other similar structures that help to drain the road. Equipment used may include a motor grader, roller, and trucks. All repairs will be conducted in compliance with SCWA's Flood Control Design Criteria (FCDC).

Vegetation removal for road repair and maintenance will be accomplished by pruning of limbs and branches that overhang the road, mowing, and/or application of contact herbicides approved for use in aquatic environments. The access road and the area between the access road and the fence lines enclosing SCWA's right-of-way or easement will be mowed using a flail mower or hand tools to reduce fire hazards and protect the integrity of the roadway and fence. Hand tools such as pole saws, loppers, and chainsaws will be used to remove tree limbs that overhang the road or otherwise block access.

During the spring, SCWA will use AquaMaster® herbicide or a similar product on the surfaces of gravel access roads to discourage weeds from establishing in the roadway and protect the integrity of the road. Spraying is limited to as a narrow a corridor as possible, and only gravel road surfaces will be treated.

As described in Section 6.5.5, all herbicide application activities will be conducted in accordance with all applicable federal, state, and local regulations as referenced in Chapter 2, Section 2.2.4 (under regulatory authority of the USEPA, DPR, and the Sonoma County Agricultural Commissioner, respectively) and SCWA will utilize BMPs as identified in Table 7-1 when applying herbicides.

Some of the SCWA maintained channels, particularly channels with larger cross sections such as Santa Rosa Creek, were designed with a low-flow access road mid way down the channel bank on the inside of the channel. These access roads may be mowed and maintained free of woody vegetation to facilitate channel access and maintenance.

6.6.4 V-Ditch Maintenance

As shown in Figure 3-24 Photo a, V-ditches are typically located above and beyond the top-of-bank zone, on the outer edge of the access road. These facilities were designed to collect runoff from the access roads and adjacent slopes. Flow from V-ditches is conveyed beneath the access roads and discharged into the adjacent channel via culverted outlets. V-ditches require maintenance that may include clearing of leaves and overgrown grasses, and re-grading if the ditch banks fail or sediment accumulates. Maintenance work may also require repositioning culverts that drain the ditch under the road. Due to excessive rodent activity along many of SCWA's service roads, V-ditches, and banks water is sometimes captured by rodent burrows instead of entering the V-ditch culverts. This process can cause piping and instability along banks and beneath the V-ditch culverts. Repairs and maintenance to V-ditches typically entail:

- repositioning the culvert or installing a new culvert to replace a damaged culvert within the existing culvert footprint;

- strengthening culvert outlets where they join channels with rip-rap to reduce the erosion culvert destabilization potential; and
- installing flow dissipation devices below the outfall of culverts to further reduce the potential for future bank erosion and scour.

6.6.5 Culvert Repair and Installation

Culverts in the Program Area occasionally require repair or replacement. The installation and repair of drop-inlet culverts and the clearing, repair, or replacement of road crossing culverts are the most common routine culvert maintenance activities. A discussion of these culvert activities is provided below.

Drop-Inlet Culverts

Drop-inlet culverts are typically used to route drainage from V-ditches on the outside edge of the channel access roads (or other upland areas) to the stream channel below. These culverts cross beneath the access road and generally exit into the channel bank a few feet above the toe-of-bank.

Installation of a new drop-inlet culvert may be appropriate where existing V-ditch drainage and routing are not adequate. Pooled water in the V-ditch that is not adequately drained can overtop the bank and then directly flow down the bank face causing surface erosion or rotational failures due to saturated soils. Additionally, flows entering the upper bank area increase the opportunity for bank failure. New drop-inlet culverts would be installed to drain areas within the channel right-of-way to reduce bank failure issues related to pooling water.

Beside installation of new drop-inlet culverts to aid drainage, the repair of existing drop-inlet culverts is also a routine maintenance activity. Figure 5-7 shows an example design detail of how drop-inlet culverts may be repaired at sites where bank failure has occurred around the culvert.

The following design guidance is provided to ensure proper drop-inlet culvert functioning while avoiding and reducing impacts:

- Repair or replacement of an existing culvert will occur within the same footprint as the original culvert.
- The culvert outfall path, from the culvert edge down to toe-of-slope should be protected with erosion control material as needed to dissipate energy and reduce the erosion potential.
- The culvert placement and slope will be installed to minimize outfall velocity and reduce the potential for future bank erosion and scour from outfall. Energy dissipation approaches will be used as needed.

Road-Crossing Culverts

SCWA owns and maintains approximately five culverted road crossings. These crossings are on non-public access roads within SCWA's maintenance right-of-way. These culverts may require repair or replacement due to structural failures of the culvert or supporting footings or headwalls, or the partial or complete internal failure of the culvert itself. Causes of failures may include improper sizing, misalignment, the road design and its loadings, and the age of materials. Culvert failure typically reduces hydraulic capacity due to flow obstruction by the culvert, sediment, or debris that collects as a result of the failure. Failure may also lead to increased erosion downstream of the culvert where concentrated flows may become more erosive.

Repair or replacement of an existing culvert will occur within the same footprint as the original culvert. Culvert replacement will include replacing the culvert (generally CMP or reinforced concrete pipe) and anchoring it in place with steel reinforced concrete or grouted rip-rap depending upon the road crossing situation. Culverts will generally be installed using an excavator working above the channel from top-of-bank. Culverts will be placed at grade and anchored to subgrade. The excavation will be backfilled and the bull walls poured. When forms are removed the remaining fill material will be added and protective rip-rap installed at the outfall. Road material will be laid, graded, and compacted.

Like with other maintenance projects, staging will occur to the extent possible on the access road adjacent to the channel. Rip-rap for the replacement will also be stockpiled on the access road, or other disturbed areas.

This SMP intends to cover repair activities for existing culverts of all sizes. However, the installation of new or replacement culverts is limited up to a 48" size diameter for purposes of the program. Required culvert installation larger than 48" would occur outside of the program.

6.6.6 Debris Removal

Debris consists of all non-sedimentary materials deposited in channels as a result of floodwaters or through human activity, including such materials as downed trees and/or tree limbs, tires, shopping carts, trash, furniture, homeless encampments, and other substances. Debris removal is performed regularly in engineered channels and far more infrequently in modified and natural channels (as described above in Sections 6.6.1 and 6.6.2). Debris removal may also be required to provide access for minor maintenance activities at stream gages, outfalls, culverts, flap gates, and grade control structures. See Figure 6-21 for examples of debris removal activities.

The SMP approach to the removal of woody debris is described above in Sections 6.3.2 *Vegetation Thinning or Removal for Sediment Removal Projects*, Section 6.5.2 *Tree Removal and Relocation*, Section 6.6.1 *Modified Channels*, and Section 6.6.2 *Natural Channels*.

SCWA patrols its flood control channels to remove debris that could significantly increase the potential for flooding. Debris removal activities are generally conducted by work crews using hand tools and occasionally a winch. Heavy equipment is typically not used for debris removal. Vegetative debris may be chipped on site or simply removed via dump truck. Non-vegetative debris is removed from the site via dump truck for disposal at a solid waste landfill. However, containers of hazardous waste, such as paint and oil, are sealed in protective containers and disposed at an appropriate hazardous waste facility. BMPs identified in Table 7-1 will be applied, as appropriate.

Related to debris removal, SCWA also coordinates with local law enforcement to control the establishment of homeless encampments on the flood control channels that SCWA owns. Such encampments can be major sources for debris, garbage, and water pollution. Signs are posted 48 hours in advance of homeless encampment removal.

6.6.7 Fence Maintenance

SCWA maintains the fencing that lines its channel parcels and easements as well as the gates to the access roads. Maintenance activities generally include repair of broken fences. Fence repair and maintenance activities will include the complete removal of any old or damaged fencing material that is subsequently replaced. Fence maintenance activities will apply all appropriate BMPs as identified Table 7-1. See Figure 6-21 for examples of fence maintenance activities.

6.6.8 Graffiti Removal

SCWA concrete facilities, gates, and trees are sometimes subject to spray paint graffiti. SCWA work crews survey for graffiti and then remove or cover graffiti as necessary. Graffiti removal activities will apply all appropriate BMPs as identified Table 7-1. See Figure 6-21 for examples of graffiti removal maintenance activities.

6.7 Sediment Disposal

Though not one of the three core in-channel activities of the SMP, sediment disposal activities are essential to the completion of the sediment removal, bank stabilization, and vegetation removal activities. As discussed in Chapter 5, both annual and long-term sediment disposal planning will occur to facilitate the safe removal and disposal of the program's sediment. Through pre-planning efforts, disposal sites will be identified and permitted for use in accordance with federal, state, and local regulations, and appropriate landowner permits or agreements. The sediment disposal plan, developed along with the workplan for annual maintenance activities, will identify disposal sites; loading, transportation, and placement BMPs; transportation routes; and other procedures to avoid or minimize potential impacts on people and the environment. Once the sediment from the creek and disposal sites have been tested and disposal locations have been approved by the RWQCB, implementation of the annual sediment disposal plan will proceed.

Sediment disposal activities will involve loading, transport, and placement of sediment at the selected disposal locations. Sediment loading will take place at or near the channel maintenance site and involve use of front-end loaders and bobcats to collect and place sediment into hauling trucks (see Figure 6-2d). Multiple hauling trucks may be filled depending on the quantity of sediment to be disposed. The trucks will be covered to prevent spillage during transport, and applicable BMPs described in Table 7-1 will be implemented to prevent impacts during handling and transport of the sediment.

Transport from the maintenance site to the disposal locations will occur through pre-planned routes identified in the sediment disposal plan. These routes will avoid congested areas, to the extent feasible, and transport will occur outside of peak traffic periods. Placement of the sediment at the offsite locations may involve use of equipment, such as bulldozers. The same BMPs applied during loading of the sediment, including those relating to equipment staging and maintenance, will be applied while activities are conducted at the disposal site. The disposal site will be managed in the same manner as the maintenance sites. If sediment is transported to a landfill for disposal, the trucks will unload the sediment at the landfill. The landfill operators would then handle the sediment. Extra handling and transport precautions may be required if the sediment is classified as a hazardous material.

Chapter 7
IMPACT REDUCTION, MINIMIZATION MEASURES, AND BEST MANAGEMENT PRACTICES (BMPS)

7.1 Introduction

This chapter presents the program's impact reduction and minimization measures and Best Management Practices (BMPs). These measures were identified and developed to protect the natural resources of the program area and the Beneficial Uses of the program's flood control channels. This chapter is best viewed in sequence, after Chapters 5 and 6 which precede it. Chapter 5 *Pre-Maintenance Planning Approach and Impact Avoidance* describes the program's approach to avoiding impacts through pre-maintenance planning. Maintenance Principles were identified to guide the maintenance prioritization process, as well as the maintenance work itself. Chapter 6 describes the maintenance activities focusing on sediment removal, bank stabilization, and vegetation management actions. The measures identified and described in this chapter are to be applied to the program maintenance activities of Chapter 6. Taken together, the pre-maintenance planning measures described in Chapter 5 and the maintenance activity based measures described in this chapter provide a comprehensive approach to avoiding and minimizing program impacts. Chapter 8 *Program Mitigation* will address the mitigation of residual impacts that are not adequately avoided or minimized through the approaches described in Chapters 5-7.

This chapter is organized around three essential tables: Tables 7-1, 7-2, and 7-3, located at the end of the chapter. Table 7-1 presents program-wide BMPs according to the following topics:

- General impact avoidance and minimization
- Air quality
- Biological resources (including species-specific measures)
- Cultural resources
- Construction and seismicity
- Hazardous materials safety
- Vegetation management
- Water quality and channel protection
- Good neighbor policies

Table 7-2 indicates which BMPs from Table 7-1 are applicable to the program activities described in Chapter 6. For example, BMPs for channel dewatering (measure BR-4 in Table

7-1) apply to sediment removal and bank stabilization activities, but not to blackberry removal or mowing activities.

Many of the BMPs in Table 7-1 aim to avoid or reduce impacts to sensitive wildlife and plant species and their supporting habitats. Table 7-3 lists all of the engineered channel reaches in the program area, and indicates any observed federal or state listed species (or the presence of suitable habitat for the listed species).

In sum, these three tables describe what the avoidance and minimization practices are (Table 7-1), which BMP measures apply to which program activities (Table 7-2), and what is the status of federally or state listed species in the program reaches (Table 7-3). The Stream Maintenance Program (SMP) Manager will use these three tables iteratively throughout program operations to identify the appropriate protective measures based on the nature of the planned maintenance activity, and the resources found in the reach where the activity will occur.

7.2 Programwide Best Management Practices

The following text sections provide a summary of the avoidance and minimization measures and BMPs for the resource topics listed above and presented in Table 7-1. For each resource topic, the key environmental concerns are described and the objectives of the protective measures are presented. If relevant, additional information on the regulatory context or specific regulatory requirements for the measures is provided. Table 7-1 should be referenced for specific details.

7.2.1 General Avoidance and Minimization Measures

Channel maintenance activities occurring during the rainy season can result in potential environment impacts, particularly to aquatic habitats. Potential impacts could include erosion from stockpiled sediments or pollutants from work equipment entering the creek. To prevent such wet season impacts, all SMP maintenance activities shall occur during the dry season when rain and flows are minimized. BMP measure GEN-1 *Work Window* defines the period of seasonal work activity for the SMP from June 15th to October 31st, although this work period could be extended in consultation with regulatory agencies. Additionally, the staging and stockpiling of maintenance equipment and materials will be restricted, monitored, and maintained to prevent transport of wash water containing sediment or hazardous chemicals to storm drains, creeks, or surrounding properties.

In accordance with the Maintenance Principles presented in Chapter 5, BMPs were also developed to ensure that maintenance activities would be conducted to protect and enhance existing habitat-supporting characteristics of the stream system. When heavy equipment must access sensitive areas of the creek, such as the creek bed and banks, measures will be taken to avoid harm to trees and compaction of soil and the area will be stabilized and restored after maintenance is complete. Details of these measures are provided in Table 7-1.

The impact avoidance and minimization measures provided in Table 7-1 are based on conditions required in a typical storm water pollution prevention plan (SWPPP). These conditions are required for construction activities conducted under the National Pollution Discharge Elimination System (NPDES) Construction General Permit. Storm Water Management Plans (SWMPs) are required by current municipal NPDES permits in the County. SMP maintenance activities are not directly required to comply with conditions of NPDES stormwater permits; however, implementation of SMP maintenance activities would be consistent with requirements of the permits and management plans.

7.2.2 Air Quality Protection

All activities conducted under this SMP will comply with pertinent requirements of federal, state, and local environmental laws and regulations for air quality, including, but not limited to, the federal Clean Air Act and state and local air pollution ordinances.

Any activity that entails earthwork and/or construction must implement dust control measures, as required by the Bay Area Air Quality Management District (BAAQMD). The BAAQMD's *Feasible Control Measures for Construction Emissions of PM10* (Bay Area Air Quality Management District 1999) will be implemented for all stream maintenance activities (BMP measure AQ-1). Additionally, enhanced dust control measures will be implemented because the SMP as a whole will encompass an area larger than four acres (BMP measure AQ-2).

7.2.3 Biological Resources Protection

A large number of maintenance activities would be conducted in areas which are natural or semi-natural, and therefore these activities could directly disturb biological resources. The primary maintenance activities of the SMP are sediment and vegetation removal from creek channels that provide habitat for a variety of species, including special-status species which are protected under federal and state regulations. Implementation of ground-disturbing maintenance during the dry season, as prescribed by BMP measure GEN-1 *Work Window*, will assist in minimizing impacts to aquatic biological resources. As shown in Table 7-1, additional measures were developed to minimize disturbance to biological resources including the training of maintenance personnel to identify and protect special-status species and proper implementation of dewatering activities. Activities conducted under this SMP will comply with applicable federal, state, and local laws and policies that protect biological resources, including but not limited to the federal Endangered Species Act, federal Migratory Bird Treaty Act, the California Endangered Species Act, the California Environmental Quality Act, and the California Fish and Game Code. Compliance with these regulations are met through the programmatic permitting for the SMP and the SMP Environmental Impact Report. This includes compliance with terms and conditions of biological opinions issued for federally protected species, such as salmonids.

As introduced in Chapter 1 and further discussed in Chapter 5, the SMP Manual was developed to include a fundamental appreciation for biological resources within the flood control channel system. The SMP maintenance approach considers the ecological health of the channels and the link between maintenance and the opportunities to improve or enhance habitats. To support this connection, programmatic BMPs were developed, as were activity-specific BMPs. Table 7-1 identifies specific BMPs that are intended to support and ensure compliance, as well as support the ecological health of maintained channels. Table 7-2 identifies which BMPs should be implemented according to SMP activity type. Table 7-3 identifies the fish, wildlife, and plant species of the program area and shows in which SMP maintenance reaches these species may occur. Based on possible occurrence of species as shown in Table 7-3, the species-specific BMPs identified in Table 7-1 will be applied when conducting maintenance activities in those reaches.

7.2.4 Cultural Resources Protection

Due to the fact that most of the flood control channels that SCWA maintains have been engineered or modified from their natural condition, most activities identified in this SMP Manual would have little or no potential to affect cultural resources. However, bank stabilization or other activities that require disturbance or compaction of native soils could disturb or damage buried resources, if any are present. Consequently, ground-disturbing activities conducted under this SMP must comply with federal, state, and local laws and policies protecting cultural resources and human remains, including but not limited to the National Historic Preservation Act, Native American Graves Protection and Repatriation Act, and the California Public Resources Code. SCWA will also ensure compliance with laws regarding the treatment of Native American remains. Pursuant to Section 5097 of the California Public Resources Code, Native American burials are under the jurisdiction of the Native American Heritage Commission and the treatment of any native remains will be coordinated with this agency and the appropriate affiliated Native American Tribe(s).

Compliance with these regulations is met through the programmatic permitting for the SMP. A cultural resources inventory has been conducted and a report developed, which identifies known cultural resources in the program area. This report provides guidance to SCWA when conducting ground-disturbing activities as identified in this SMP Manual. The SMP data management system will be used to track and identify locations with cultural sensitivity. The status of sensitive cultural resources for the planned project sites or reaches will be confirmed by the program manager prior to any work occurring.

Although the cultural resources inventory provides SCWA with information on known cultural resources, it is possible that undiscovered cultural or paleontological resource may be present in the program area. Therefore, Tables 7-1 and 7-2 identify programmatic BMPs that will be applied to ground-disturbing activities undertaken through implementation of the SMP to identify potential resources that are currently unknown. Additionally, because some of the maintenance sites may not have been surveyed or disturbed for over five years, and new discoveries may have surfaced during that time, a BMP measure is included to conduct a cultural resources assessment of those sites. The assessment will include a records search, Native American Tribe consultation, a pedestrian survey, and preparation of a report to document the results.

7.2.5 Hazardous Materials Safety

Maintenance activities conducted as part of the SMP will require mechanical equipment that uses fuel and lubricants and the application of herbicides that are hazardous to people and the environment if misused. If such fuels, lubricants, or other chemicals were accidently spilled, potential contamination of the program area's water and soil could result.

BMPs in Table 7-1 include detailed procedures to ensure all equipment is properly maintained and handled to minimize the risk of environmental contamination. Procedures to respond to accidental spills or discovery of previously unknown contamination will be implemented as part of a Spill Prevention and Response Plan. This plan is also a requirement of the NPDES Construction General Permit mentioned previously.

Historic and current soil and groundwater contamination from industrial and commercial activities (gas stations and dry cleaners) in close proximity to maintenance sites may be contributing pollutants to the sediments or water in the channels. Disturbance of existing known contamination, including groundwater plumes, during maintenance could disrupt cleanup efforts or exacerbate pollution issues. As such, a database search for existing contamination within 1,500 feet of the work site will be conducted during the project design phase. SCWA will work with staff from the Regional Water Quality Control Board's Cleanup and Investigations unit to determine if and how maintenance activities can proceed.

As creeks are common locations for illegal dumping of trash containing hazardous waste, such as tires, oil filters, paint cans, and electronic devices, project activities could encounter hazardous waste. Creek channels also receive runoff from streets and urbanized areas which carry non-point source contaminants like oil and paint that are poured down storm drains. Thus, indirect contamination of creeks occurs when contaminants are transported through the storm drain network and deposited directly to streams. Presence of these contaminants can sometimes be observed as an oily sheen, a discoloration of the soil, or an unnatural chemical odor. If presence of potential contaminants is observed at the site, the area will be treated as if a hazardous spill occurred.

Soil testing will be conducted in all sediment removal and bank stabilization projects. Should soils be encountered that contain concentrations of listed substances that exceed hazardous waste levels, the contaminated area will be treated as if a hazardous spill occurred (i.e., the Spill Prevention and Response Plan will be implemented) and all measures to ensure compliance with federal, state, and local regulations will be taken. In addition, any observed contamination as evidenced by chemical-like odors, oily sheens, or irregularly colored sediment will be immediately reported to the local fire department's hazardous materials team and the appropriate Regional Water Quality Control Board staff person in the Cleanups and Investigations Unit. Sediment sampling and analysis procedures, including protocols for the management of contaminated sediments, are discussed in more detail in Appendix B: *Sediment Sampling and Analysis Guidelines*.

Maintenance activities will be conducted during the dry season, a period when the threat of wildland fire is the highest. Equipment used for maintenance activities use flammable fuels and lubricants. Thus, Table 7-1 includes a BMP to reduce the risk of fire ignition during maintenance activities.

7.2.6 Vegetation Management

Vegetation management activities will involve removal, pruning, and relocation of trees and shrubs by hand or with the use of machinery. Herbicides will be used to control invasive plant species. Maintenance activities also include planting and revegetation of the work site. A detailed description of vegetation management activities is provided in Appendix E.

Table 7-1 includes specific BMPs to avoid or minimize potential impacts from vegetation management activities. Vegetation management BMPs support preservation of as much existing vegetation as is possible, particularly for native species, and fostering a balance between habitat and flood conveyance. To prevent unintended damage to existing vegetation, setback areas will be flagged and hand pruning and clearing will be implemented, as opposed to use of machinery. BMP measure VEG-2 *Use of Herbicides* will ensure the use and handling of herbicides for maintenance activities is consistent with federal, state, and local regulations. BMP measure VEG-3 will ensure that work sites are properly replanted and monitored for successful revegetation.

7.2.7 Water Quality and Channel Protection

The combination of the General Impact Avoidance Measures and the Biological Resource Protection, Hazardous Materials Safety, Sediment Management, and Vegetation Management BMPs discussed above and in Table 7-1 will adequately protect against degradation of water quality during and after maintenance activities. An additional BMP measure is included in Table 7-1 that prescribes proper use of erosion controls for exposed soils after maintenance work is complete (BMP WQ-1 *Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils*).

Implementation of the BMPs in Table 7-1 will comply with federal, state, and local regulations to protect water quality, including the requirements of NPDES stormwater discharge permits and management plans.

Table 7-1 also includes a BMP to guide in-channel grading activities such that post sediment removal channel grades are geomorphically appropriate, that in-channel bed forms such as meanders, bars, and benches are preserved, and that sudden or sharp transitions in bed elevations do not occur.

7.2.8 Good Neighbor Policies

The duration of maintenance activities at a particular project site or reach will vary from a less than a day to a week. Many of the work sites are located in residential areas or in close proximity to business, schools, and libraries. To reduce potential inconvenience to the public and protect their safety during maintenance activities, the Good Neighbor BMPs were developed to keep the work site clean, reduce loud noises, ensure vehicle and pedestrian access, and reduce unpleasant odors.

To avoid adverse effects on creekside views from neighboring homes and businesses, SMP activities will implement work site “housekeeping” measures to keep the site neat, clean, and orderly during and after maintenance.

To minimize the effects of noise on neighboring homes and businesses, work will be limited to normal business hours (8:00 a.m.–5:00 p.m.). Routine activities in residential areas will not occur on Saturdays, Sundays, or Sonoma County Water Agency (SCWA) holidays. Sound control devices will be actively used on all power equipment.

Most maintenance activities will occur on access roads adjacent to stream channels that are not open to public vehicular use. Therefore, SMP maintenance activities would have very little potential to disrupt traffic circulation except in situations when it is necessary to close travel lanes temporarily (e.g., to remove debris from a bridge or culvert), or where maintenance vehicles are traveling to and from the maintenance sites (e.g., fill hauling).

Depending on the channel location and reach conditions, sediment removed as part of maintenance activities may be rich in decaying organic matter which generates gases such as reduced sulfur compounds that are unpleasant. Where feasible, to prevent impacts of nuisance odors on nearby residences, stockpiled sediment removed from channels will be promptly removed or placed as far away as possible from residential areas and odor sensitive land uses.

In efforts to keep the public informed about stream maintenance work (why it is necessary, when it occurs, and what a neighborhood can expect when crews arrive to conduct maintenance work) SCWA will post and update information about the SMP and maintenance activities on their website, as stated in BMP measure GN-2 *Public Outreach*. Each spring, once maintenance sites have been selected for the annual work season, a newspaper notice will be published with information on the maintenance sites, approximate work dates, and contact information. This information will also be posted on SCWA’s website.

Signs will be posted in the neighborhood to notify the public two weeks in advance of maintenance schedules, trail closures, and road/land closures as necessary. As discussed under BMP measure GN-2 *Public Outreach*, signage used at work sites will provide contact information for lodging comments and/or complaints regarding the activities.

Table 7-1. Stream Maintenance Program Best Management Practices

BMP ID	Name	BMP
General Impact Avoidance and Minimization		
GEN-1	Work Window	1. All ground-disturbing maintenance activities occurring in the channel (i.e., from top-of-bank to top-of-bank) will take place during the low-flow period, between June 15 and October 31. Exceptions may be made for emergencies or on a project-by-project basis with advance approval of RWQCB, CDFG, NMFS, and/or USFWS as appropriate. 2. Once the first significant rainfall occurs, all in-channel equipment and/or diversion structures shall be removed. Exposed soils in upland areas will be stabilized via hydroseeding or with erosion control fabric/blankets. Significant rainfall is defined as 0.5 inch of rain in a 24-hour period. 3. Work on the upper banks of stream channels (e.g., vegetation, road, and v-ditch maintenance) may be conducted year round. Ground disturbing activities will only be conducted during periods of dry weather.
GEN-2	Staging and Stockpiling of Materials	1. Staging will occur on access roads, surface streets, or other disturbed areas that are already compacted and only support ruderal vegetation to the extent feasible. Similarly, to the extent practical, all maintenance equipment and materials (e.g., road rock and project spoil) will be contained within the existing service roads, paved roads, or other pre-determined staging areas. Staging areas for equipment, personnel, vehicle parking, and material storage shall be sited as far as possible from major roadways. 2. All maintenance-related items including equipment, stockpiled material, temporary erosion control treatments, and trash, will be removed within 72 hours of project completion. All residual soils and/or materials will be cleared from the project site. 3. As necessary, to prevent sediment-laden water from being released back into waters of the State during transport of spoils to disposal locations, truck beds will be lined with an impervious material (e.g., plastic), or the tailgate blocked with wattles, hay bales, or other appropriate filtration material. If appropriate, and only within the active project area where the sediment is being loaded into the trucks, trucks may drain excess water by slightly tilting the loads and allowing the water to drain out through the applied filter. 4. Building materials and other maintenance-related materials, including chemicals and sediment, will not be stockpiled or stored where they could spill into water

Table 7-1. Cont.

BMP ID	Name	BMP
		bodies or storm drains or where they will cover aquatic or riparian vegetation. 5. No runoff from the staging areas may be allowed to enter waters of the State, including the creek channel or storm drains, without being subjected to adequate filtration (e.g., vegetated buffer, hay wattles or bales, silt screens). The discharge of decant water from any on-site temporary sediment stockpile or storage areas, to waters of the State, including surface waters or surface water drainage courses, outside of the active project site, is prohibited. 6. During dry season, no stockpiled soils shall remain exposed and unworked for more than 30 days. During wet season, no stockpiled soils shall remain exposed, unless surrounded by properly installed and maintained silt fencing or other means of erosion control. 7. All spoils will be disposed of in an approved location. Sediments that are found to contain contaminants in excess of hazardous materials disposal criteria will be stockpiled separately on heavy plastic pending disposal at an appropriate hazardous materials disposal location.
GEN-3	Channel Access	1. Access points to the channel for the purposes of stream maintenance will be minimized according to need. Access points should avoid large mature trees, native vegetation, or other significant habitat features as possible. Temporary access points shall be sited and constructed to minimize tree removal. 2. In considering channel access routes, slopes of greater than 20 percent shall be avoided if possible. Any sloped access points will be examined for evidence of instability and either revegetated or filled with compacted soil, seeded, and stabilized with erosion control fabric as necessary to prevent future erosion. 3. Personnel will use the appropriate equipment for the job that minimizes disturbance to and compaction of the stream bottom. Appropriately-tired vehicles, either tracked or wheeled, will be used depending on the site and maintenance activity.
Air Quality Protection		
AQ-1	Dust Management (based on Bay Area Air Quality Management District's basic dust control measures for all sites)	1. Water all active maintenance areas as necessary to reduce dust emissions. In dry areas, this may be twice daily or more, while in already wet areas, no watering may be needed. 2. Cover all trucks hauling soil, sand, and other loose materials or require all trucks

Table 7-1. Cont.

BMP ID	Name	BMP
		to maintain freeboard as necessary to prevent transported material from blowing from the trucks. 3. Sweep as necessary (with water sweepers or dry sweepers, as appropriate) all paved access roads, parking areas and staging areas at construction sites. 4. Sweep streets as necessary (with water sweepers or dry sweepers, as appropriate) if visible soil material is carried onto adjacent public streets.
AQ-2	Enhanced Dust Management (based on Bay Area Air Quality Management District's enhanced dust control measures for sites greater than 4 acres)	1. As necessary, enclose, cover, water, or apply (non-toxic) soil binders to exposed stockpiles. 2. Limit traffic speeds on unpaved roads to 15 mph. 3. Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
Biological Resources Protection		
General Measures		
BR-1	Area of Disturbance	1. Activities will avoid damage to or loss of native vegetation to the maximum extent feasible. 2. Soil disturbance shall not exceed the minimum area necessary to complete the operations as described.
BR-2	Pre-Maintenance Educational Training	1. At the beginning of each maintenance season and before conducting stream maintenance activities, all personnel will participate in an educational training session conducted by a qualified biologist.[1] This training will include instruction on how to identify bird nests, recognize special-status species that may occur in the work areas, and the appropriate protocol if any nests or listed species are found during project implementation. 2. Personnel who miss the first training session or are hired later in the season must participate in a make-up session before conducting maintenance activities.

[1] A qualified biologist (including those specializing in botany, wildlife, and fisheries) is determined by a combination of academic training and professional experience in biological sciences and related resource management activities. SCWA may also utilize appropriately experienced and/or trained environmental staff. Resumes will be submitted to CDFG, USFWS and/or NFMS for approval prior to commencement of biological surveys, as stated in CDFG, USFWS and NMFS permit conditions.

Table 7-1. Cont.

BMP ID	Name	BMP
BR-3	Biotechnical Bank Stabilization	If hydraulic conditions allow, the natural bank will be retained or a biotechnical repair technique will be used rather than, or along with, a hardscape repair.
BR-4	Impact Avoidance and Minimization During Dewatering	1. All dewatering activities conducted in streams bearing state- or federally-listed salmonids shall comply with the terms and conditions of the Russian River Biological Opinion (summarized in BMP BR-18), and any other Biological Opinions and associated Consistency Determinations issued by NOAA or DFG for the SMP. 2. Prior to dewatering, the best means to bypass flow through the work area will be determined to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates. The area to be dewatered will encompass the minimum area necessary to perform the maintenance activity. The period of dewatering will extend for the minimum amount of time needed to perform the maintenance activity. Where feasible and appropriate, dewatering will occur via gravity driven systems. Where feasible and appropriate, diversion structures shall be installed on concrete sections of the channels, such as concrete box culverts often used at road crossings. 3. A species relocation plan (BMP BR-5) shall be implemented as a reasonable best effort to ensure that native fish and other native aquatic vertebrates and macroinvertebrates are not stranded. 4. Instream cofferdams shall only be built from materials such as sandbags, clean gravel, or rubber bladders which will cause little or no siltation or turbidity. Visqueen shall be placed over sandbags to minimize water seepage into the maintenance areas. The visqueen shall be firmly anchored to the streambed to minimize water seepage. If necessary, the footing of the dam shall be keyed into the channel bed at an appropriate depth to capture the majority of subsurface flow needed to dewater the streambed. 5. When use of gravity fed dewatering is not feasible and pumping is necessary to dewater a work site, a temporary siltation basin and/or use of silt bags may be required to prevent sediment from re-entering the wetted channel. 6. Downstream flows adequate to prevent fish or vertebrate stranding will be maintained at all times during dewatering activities. Bypass pipe diameter will be sized to accommodate, at a minimum, twice the summer baseflow. 7. Diverted and stored water will be protected from maintenance activity-related

Table 7-1. Cont.

BMP ID	Name	BMP
		pollutants, such as soils or equipment lubricants or fuels. 8. If necessary, discharged water will pass over some form of energy dissipater to keep erosion of the downstream channel to a minimum. Silt bags will be equipped to the end of discharge hoses and pipes to remove sediment from discharged water. 9. For full channel dewatering, filtration devices or settling basins will be provided as necessary to ensure that the turbidity of discharged water is not visibly more turbid than in the channel upstream of the maintenance site. If increases in turbidity are observed, additional measures shall be implemented such as a larger settling basin or additional filtration. If increases in turbidity persist, turbidity measurements will be taken on a regular (i.e., at least daily) basis up- and downstream of the cofferdam enclosure. Data recorded will be compared against Regional Water Quality Control Board Basin Plan water quality standards. If Basin Plan standards are being exceeded, additional measures shall be installed and monitored to ensure Basin Plan standards are met. 10. When maintenance is completed, the flow diversion structure shall be removed as soon as possible. Impounded water will be released at a reduced velocity to minimize erosion, turbidity, or harm to fish or amphibians downstream. Cofferdams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. 11. The area disturbed by flow bypass mechanisms will be restored at the completion of the project. This may include, but is not limited to, recontouring the area and planting of riparian vegetation as appropriate.
BR-5	Fish and Amphibian Species Relocation Plan	1. All fish relocation conducted in streams bearing state- or federally-listed salmonids shall comply with the terms and conditions of the Russian River Biological Opinion (summarized in BMP BR-18), and any other Biological Opinions and associated Consistency Determinations issued by NOAA or DFG for the SMP. This measure will also apply to relocation of other special status species aquatic species (i.e., foothill yellow-legged frog and western pond turtle), and native aquatic species that could be relocated. Relocation for California red-legged frog will be conducted in accordance with BMPs BR-10 and BR-11 and any additional measures contained in the forthcoming SMP Biological Opinion issued by the USFWS. 2. Prior to and during dewatering activities, native fish, tadpoles, and other

Table 7-1. Cont.

BMP ID	Name	BMP
		vertebrates will be excluded from the work area by blocking the stream channel above and below the work area with fine-meshed net or screens. The bottom of the screens will be completely secured to the channel bed. Exclusion screening will be placed in areas of low water velocity to minimize fish impingement. Screens will be checked periodically and cleaned of debris to permit free flow of water. 3. The most efficient means for capturing fish will be determined and implemented. Complex stream habitat generally requires the use of electrofishing equipment, whereas in deep pools, fish may be concentrated by pumping-down the pool and then removing the fish by seining or dipnetting. Ample time will be scheduled to allow for a reasonable fish removal effort to be conducted. 4. Initial fish relocation efforts will be conducted several days prior to the start of maintenance activities. This provides the biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to maintenance activities. 5. All native captured fish will be allowed to recover from electrofishing before being returned to the stream. 6. During dewatering, a qualified biologist will direct and monitor activities as necessary to net and rescue any additional fish and/or amphibians that may have become stranded throughout the dewatering process. 7. Prior to capturing fish and/or amphibians, the most appropriate release location(s) will be identified and used. The following issues will be considered when selecting release site(s): ▪ proximity to the project area; ▪ similar water temperature as capture location; ▪ ample habitat availability prior to release of captured fish; ▪ presence of other same species so that relocation of new individuals will not upset the existing prey/predation function; ▪ low potential for relocated individual to transport disease; and ▪ low likelihood of fish reentering work site or becoming impinged on exclusion

Table 7-1. Cont.

BMP ID	Name	BMP
		net or screen. 8. In areas where aquatic vertebrates are abundant, to increase survival rates and ensure captured vertebrates are not held overly long, capture will be periodically ceased, and release will occur at predetermined locations.
BR-6	On-Call Wildlife Biologist	A qualified biologist will be on-call in southern Sonoma County and available to visit a project site at any point during maintenance activities in the event a special status species is encountered.
Species-Related Measures		
BR-7	Special Status Plants	1. For projects located in areas where federally-listed plant species have been identified as potentially occurring (see SMP Manual Table 7-3), a qualified botanist will conduct appropriately timed focused botanical surveys of the project site for these species. If these species is observed in or near the project site, SCWA will follow the measures below as well as any additional measures contained in the forthcoming Biological Opinion issued by the USFWS for the SMP. The USFWS BO does not cover Sonoma white sedge (*Carex albida*) or many-flowered navaarretia (*Navarretia leucocephala* ssp. *plieantha*). SCWA will initiate ESA Section 7 consultation with USFWS if these species are found. 2. For projects located in areas where special status plant populations have been identified as potentially occurring (see SMP Manual Table 7-3), a qualified botanist will conduct appropriately timed focused botanical surveys of the project site for special status plant occurrences. A qualified botanist will also assess habitat suitability for the potential occurrence of special status plant species at any newly identified sediment disposal sites or previously unidentified staging areas. 3. If discovered, special-status plant populations identified during the field surveys and with potential to be impacted will be enumerated, photographed and conspicuously flagged to maximize avoidance, as well as to determine the total number of individuals affected. If feasible, the project shall be redesigned or modified to avoid direct and indirect impacts on special-status plant species. 4. Special-status plant species near the project site will be protected from temporary disturbance by installing environmentally sensitive area fencing (orange construction barrier fencing) around special-status plant species populations. Protective fencing will be installed under the direction of the botanist as necessary to protect the plant and its habitat; where feasible, the environmentally sensitive

Table 7-1. Cont.

BMP ID	Name	BMP
		area fencing will be installed at least 50 ft. from the edge of the population. Where special-status plant populations are located in wetlands, silt fencing will also be installed. The location of the fencing will be shown on the maintenance design drawings and marked in the field with stakes and flagging. The design specifications will contain clear language that prohibits maintenance-related activities, vehicle operation, material and equipment storage, and other surface-disturbing activities within the fenced environmentally sensitive area. 5. Vegetation management activities in sensitive plant areas will be conducted under the guidance of the botanist. These activities should be timed following the blooming periods of potentially occurring listed species, after the month of June. 6. If impacts to state or federally listed plants are unavoidable, then the Agency shall coordinate with the appropriate resource agencies and local experts to determine whether transplantation of special-status plant species is feasible. If the agencies concur that it is a feasible mitigation measure, the botanist shall develop and implement a transplantation plan in coordination with the appropriate agencies. As part of the plan, the Agency, in conjunction with a qualified restoration ecologist and DFG and/or USFWS, shall identify a suitable on- or off-site location for mitigation and appropriate methods for seed collection, propagation, relocation, maintenance and monitoring. If the impacted species are annuals, it is expected that the current seed crop from the individuals to be lost will be collected (as well as immediate soils making up the dormant seed bed) and then sown on appropriate habitat located on the mitigation site. If the species is a perennial, it is expected that both the seed and the plants themselves will be salvaged and relocated to the mitigation site. Seed from the populations that will be impacted may be collected and propagated at a native plant nursery, prior to planting to increase the potential for establishment and survival. Annual monitoring of the mitigation site shall be conducted for 5 years to assess vegetative density, population size, natural recruitment, and plant health and vigor. Monitoring results may trigger management actions such as collection and sowing of additional seed, tillage/disturbance within existing populations to induce establishment, installation of container plants, and control of exotic invasive vegetation such as yellow star thistle to ensure successful plant establishment and survival. The site shall be evaluated at the end of the 5-year monitoring period to determine whether the mitigation has met the success criteria identified in the rare plant relocation, management, and protection plan.

Table 7-1. Cont.

BMP ID	Name	BMP
		7. If appropriately timed focused botanical surveys cannot be conducted in areas identified as suitable for listed plants prior to vegetation management activities, then the Agency shall assume presence of the plant species in question and coordinate with the appropriate resource agencies and local experts to develop appropriate mitigation for the impact.
BR-8	Nesting Migratory Bird and Raptor Pre-maintenance Surveys	1. To the extent feasible, maintenance activities, including tree trimming, will take place outside the migratory bird and raptor nesting period (February 15 through August 15 for most birds). During the nesting bird season, work sites that are less densely vegetated will be prioritized, to facilitate pre-maintenance surveys and decrease the likelihood of disturbing undiscovered nests. 2. If maintenance activities must be scheduled to occur during the nesting season, a qualified wildlife biologist, familiar with the species and habitats in the Program Area, will be retained to conduct pre-maintenance surveys for raptors and nesting birds within suitable nesting habitat within 300 feet of SMP activities. The surveys should be conducted within one week before initiation of maintenance activities within those habitats. If no active nests are detected during surveys, activities may proceed. Vegetation removal activities will be conducted under the guidance of a biologist. If active nests are detected then measure 3 would be implemented. 3. If active nests are identified within the SMP area, non-disturbance buffers shall be established at a distance sufficient to minimize disturbance based on the nest location, topography, cover and species' tolerance to disturbance. Buffer size shall be determined in cooperation with the CDFG. If active nests are found within 300 feet of the project area, a qualified biologist shall be on site as necessary to monitor the nests for signs of nest disturbance. If it is determined that maintenance activity is resulting in nest disturbance, work shall cease immediately and CDFG shall be contacted. Buffers will be developed through consultation with CDFG. Buffers will remain in place until biologists determine that the young have successfully fledged or nests have been otherwise abandoned.
BR-9	California Freshwater Shrimp Avoidance and Impact Minimization for Vegetation Management	Maintenance activities occurring along streams supporting California freshwater shrimp will be restricted to only conducting vegetation management and/or debris removal above the water level. In addition, vegetation or debris overhanging into pools or glides (slow or slack water) within the natural reaches of Sonoma Creek will not be removed or altered. ***Note:*** *The only stream maintained under the SMP that supports California freshwater*

Table 7-1. Cont.

BMP ID	Name	BMP
		shrimp is Sonoma Creek. This creek has natural and modified channels along its length, and does not have any engineered channels. Therefore, the only type of activity that will be conducted along Sonoma Creek is vegetation management for hydraulic easement purposes. Applying this BMP will ensure that stream channels which support California freshwater shrimp will retain habitat elements (e.g., undercut banks with exposed, fine roots of willows or alders, trailing vines and overhanging woody vegetation) and continue to provide habitat for this species.
BR-10	California Red-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	1. For ground-disturbing maintenance activities occurring in areas where California red-legged frog (CRLF) has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will complete focused surveys using the USFWS CRLF survey protocol will be completed or CRLF presence will be assumed. 2. If protocol level surveys indicate CRLF is not present in the maintenance area, no further CRLF BMPs will be necessary. 3. If CRLF are present or assumed present, a qualified biological monitor, or a biologist with an Incidental Take Permit, will inspect the area daily before the start of work and will be present during maintenance activities in sensitive habitats. If appropriate, SCWA will install exclusionary fencing. 4. In the event that a CRLF is encountered within the maintenance area, the USFWS Sacramento Field Office will be contacted within 48 hours of any CRLF observations, and a qualified biologist will move the frog to a safe location outside of the project area. Actions taken to move CRLF will be consistent with applicable USFWS and CDFG regulations and permits. The biological monitor will have the authority to stop work if a CRLF is encountered until such a time as the frog may be moved to an area outside of the project area fencing. 5. If dewatering of a creek is required, dipnet and seine surveys for CRLF tadpoles will be completed prior to initiation of dewatering. Captured tadpoles will be moved to a safe location elsewhere in the creek.
BR-11	California Red-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management	1. For vegetation maintenance activities occurring in areas where CRLF frog has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys of aquatic habitats and identify potential CRLF breeding and foraging areas. These areas will be flagged and avoided by maintenance crews.

Table 7-1. Cont.

BMP ID	Name	BMP
		2. In areas where CRLF could potentially occur, field crews conducting hand trimming of vegetation will access channel banks by foot only and will avoid entering open water. Vehicles will be restricted to existing access roads. 3. In work sites where potential CRLF breeding and foraging areas were identified during the pre-maintenance survey, a qualified biological monitor or a biologist with an Incidental Take Permit, will be on-site during project activity in sensitive habitats. The biological monitor will have the authority to stop work if a CRLF (or any of its life stages) is encountered until such a time as the frog may be moved to an area away from the project site. 4. The USFWS Sacramento Field Office will be contacted within 48 hours of any CRLF observations.
BR-12	California Tiger Salamander Avoidance and Impact Minimization Measures for Sediment and Debris Removal	1. For sediment and debris removal maintenance activities occurring in areas where California tiger salamander (CTS) has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with small mammal burrows. Areas with an abundance of small mammal burrows will be flagged and avoided by maintenance crews. 2. Maintenance activities will be restricted to the streambed and avoid disturbance to adjacent upland habitat. 3. Sediment and debris removal activities shall minimize removal of upland vegetation and soil compaction. 4. If upland banks must be traversed by heavy equipment to access a streambed, the route will be located where no small mammal burrows are present and will be delineated by temporary fencing to minimize upland habitat disturbance. 5. If burrows or other suitable aestivation habitat are present where sediment or debris removal activities are proposed, a qualified biological monitor or a biologist with an Incidental Take Permit will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 6. Maintenance activities located in proximity to upland CTS habitat will be scheduled to avoid the CTS migration season (October 15 – June 30). If work must be completed during the migration season, barrier fencing will be installed to

Table 7-1. Cont.

BMP ID	Name	BMP
		exclude CTS from maintenance areas. 7. In the event that a California tiger salamander is encountered within the maintenance area, a biologist with an Incidental Take Permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFG regulations and permits. 8. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-13	California Tiger Salamander Avoidance and Impact Minimization Measures for Bank Stabilization	1. For bank stabilization activities occurring in areas where California tiger salamander has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with burrows and/or other suitable aestivation habitat. 2. If burrows or other suitable aestivation habitat are present where bank stabilization activities are proposed, a qualified biological monitor or a biologist with an Incidental Take Permit, will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 3. Maintenance activities located in proximity to upland CTS habitat will be scheduled to avoid the CTS migration season (October 15 – June 30). If work must be completed during the migration season, barrier fencing will be installed to exclude CTS from maintenance areas. 4. In the event that a California tiger salamander is encountered within the maintenance area, a biologist with an Incidental Take permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the fenced maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFG regulations and permits. 5. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-14	California Tiger Salamander Avoidance and Impact	1. For vegetation management activities occurring in areas where California tiger salamander has been identified as potentially occurring (see SMP Manual Table 7-

Table 7-1. Cont.

BMP ID	Name	BMP
	Minimization Measures for Vegetation Management	3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with small mammal burrows. Areas with an abundance of small mammal burrows will be flagged and avoided by maintenance crews. 2. Based on surveys, if California tiger salamander is identified as potentially present, then access across upland channel banks and adjacent upland habitats will be by foot only. Vehicles will be restricted to existing access roads. 3. A qualified biological monitor, or biologist with an Incidental Take Permit, will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 4. In the event that a California tiger salamander is encountered within the maintenance area, a biologist with an Incidental Take Permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the fenced maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFG regulations and permits. 5. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-15	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	1. For ground-disturbing activities occurring in areas where foothill yellow-legged frog has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys to assess habitat within the proposed maintenance area. 2. A qualified biologist will inspect the maintenance area daily before the start of work. If appropriate, SCWA will install exclusionary fencing. In the event that foothill yellow-legged frogs are encountered within the maintenance area, a qualified biologist will move the frog to a safe location outside of the maintenance area. Actions taken to move foothill yellow-legged frog will be consistent with applicable CDFG regulations and permits. 3. If dewatering a creek segment is required, a qualified biologist will conduct visual and dipnet surveys and move captured frogs and tadpoles to a safe location in the creek. Actions taken to move foothill yellow-legged frog will be consistent with applicable CDFG regulations and permits. 4. CDFG will be notified within 48 hours of any foothill yellow-legged frog

Table 7-1. Cont.

BMP ID	Name	BMP
		observations.
BR-16	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management	1. For vegetation maintenance activities occurring in areas where foothill yellow-legged frog has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys of aquatic habitats and identify potential foothill yellow-legged frog breeding and foraging areas. These areas will be flagged and avoided by maintenance crews. 2. Based on surveys, if foothill yellow-legged frog is identified as potentially present, then field crews will access channel banks by foot only and will avoid entering open water. Vehicles will be restricted to existing access roads.
BR-17	Western Pond Turtle Pre-maintenance Surveys for Ground-Disturbing Activities	1. For projects located in areas where western pond turtle has been identified as potentially occurring (see SMP Manual Table 7-3), a qualified biologist will conduct pre-maintenance surveys to assess habitat within the proposed maintenance area. 2. If suitable instream habitat for the western pond turtle is present in the maintenance area, a qualified biologist will inspect the maintenance area daily before the start of work. In the event that a western pond turtle is encountered before or during the maintenance activity, a qualified biologist will move the turtle to a safe location outside of the work area. Actions taken to move western pond turtle will be consistent with applicable CDFG regulations and permits. 3. If dewatering of a creek segment is required, a qualified biologist will be present and will move turtles – if found – to a safe location in the creek. Actions taken to move western pond turtle will be consistent with applicable CDFG regulations and permits. 4. CDFG will be notified within 48 hours of any western pond turtle observations.
BR-18	Zone 1A Salmonid Avoidance and Impact Minimization Measures (based on NMFS Russian River BO issued on September 24, 2008)	These conditions apply to steelhead-bearing streams identified in the BO as: Laguna de Santa Rosa, Copeland Creek, Santa Rosa Creek, and Windsor Creek. SCWA will not perform any flood control maintenance activities in the Mark West Creek mainstem or tributaries of Mark West Creek upstream of the confluence with its largest tributary, the Laguna de Santa Rosa. As such, maintenance activities conducted on Wikiup or Fulton Creeks are not covered under the Zone 1A BO and will require a separate consultation with NMFS. Sediment maintenance activities conducted in steelhead-bearing streams will comply

Table 7-1. Cont. Page 15 of 32

BMP ID	Name	BMP
		with the terms and conditions of Reasonable and Prudent Measure 5 of the Russian River BO for Zone 1A, which states: 1. **Term and Condition A:** SCWA shall isolate work areas located in aquatic habitat from the flowing stream and relocate listed salmonids prior to proceeding with in-channel work for food control maintenance or habitat enhancement: ▪ retain a qualified biologist with expertise in anadramous salmonid biology; ▪ the biologist shall be onsite during all dewatering events; ▪ all captured salmonids will be properly cared for; ▪ if any salmonids are found dead or injured, the Santa Rosa Area NMFS office will be contacted immediately; and ▪ NMFS staff or persons designated by NMFS will be allowed on-site during dewatering activities. 2. **Term and Condition B:** at all channel maintenance sites in Zone 1A, SCWA will: ▪ check construction equipment for leaks each day prior to conducting work in the channel; ▪ ensure that all fill material for cofferdams is fully contained; ▪ ensure that all diversion pumps are screened in compliance with NMFS' and CDFG's fish screening criteria; ▪ ensure that coffer dams are properly sized and maintained throughout the duration of maintenance activities; and ▪ ensure that all material is removed after completion of the project. 3. **Term and Condition C:** SCWA will provide NMFS and DFG with reports on construction-related and fish relocation activities by February 15 of the year following maintenance. 4. **Term and Condition D:** SCWA will reduce impacts on habitat complexity: ▪ all work in natural channels, except for revegetation activities, will be conducted between June 15 and October 15;

Table 7-1. Cont.

BMP ID	Name	BMP
		▪ no work will be started that cannot be completed before the onset of a storm event; ▪ vehicles may be driven in the dry streambed only as necessary to accomplish work; ▪ all exposed/disturbed areas on upper stream banks within the project site will be stabilized; ▪ install erosion control measures to divert runoff to stable areas; ▪ all new riprap will be planted with willows or other native trees; ▪ no grouted riprap shall be installed; ▪ bioengineering techniques shall be incorporated into all bank stabilization projects; ▪ when grading gravel bars, a buffer of 25 feet or 10 percent of the maximum bar width, whichever is greater, shall be maintained; ▪ SCWA will construct a low flow channel at sediment removal sites in Zone 1A to provide enhanced migration habitat through sediment removal areas. 5. Sediment removal project designs will be submitted to NMFS and DFG 60 days prior to implementation for approval. 6. The low flow channel shall be monitored at least two times in-between large storm events during the winter period to assess its function as a migration corridor and impact on stream stability.
BR-19	Zone 2A and 3A Salmonid Avoidance and Minimization Measures	*[placeholder for forthcoming NMFS BO for Zone 2/3A. Until then, BR-18 will be utilized for salmonid-bearing streams.]*
Cultural Resources Protection		
CR-1	Cultural Resources Investigation	For maintenance activities which require excavation into native soils (e.g., bank stabilization, culvert replacement, etc.), and for all new sediment disposal sites, a cultural resources investigation shall be conducted by a qualified professional archeologist prior to performing the maintenance activity. The cultural resources

BMP ID	Name	BMP
		investigation shall include the following elements: **1.** *Background Research and Native American Consultation***.** An updated records search shall be conducted at locations planned for maintenance that have not had a records search completed within the previous five years. Sediment disposal sites shall only require an initial records search. Investigations should begin with a review of the data acquired for this document to determine whether the proposed activity will occur within a previously-known culturally-sensitive area. An addendum records search at the NWIC will also be necessary to determine if any cultural resources have been recorded since the creation of this document. The records search will identify resources within or near the project location and determine whether that location has been previously surveyed up to current standards. In conjunction with the background research, the appropriate Native American Tribes will be contacted to provide comments or concerns about a maintenance activity location. The NAHC will also be contacted for a Sacred Lands File Check. **2.** *Pedestrian Survey.* If an adequate survey has not been completed for a project location within a ten-year period from the date of scheduled maintenance, a pedestrian survey is required. Sediment disposal sites shall only require an initial pedestrian survey. All areas of exposed ground should be closely inspected for the presence of cultural materials. Areas of dense vegetation should be inspected as closely as possible and any exposed channel banks should be carefully examined for the presence of buried cultural resources. Depending on the likelihood for encountering subsurface remains, based on an analysis of site distribution and geomorphology of the project location, a series of small, hand-auger borings may be excavated, with all sediments passed through 1/4-inch screen, to assure that no subsurface archaeological materials are present. The auger borings would also provide an initial assessment of the surface integrity of the landform (e.g., is a substantial amount of imported or redeposit fill material present?) and provide additional information about the potential for buried archaeological material. If the limited subsurface testing does not reveal buried cultural material, there will be less likelihood that unexpected discoveries will delay activities. If an archaeological deposit is encountered, a preliminary assessment of site boundaries should be made in consultation with the appropriate affiliated tribe(s). Any archaeological material recovered in auger holes will be recorded,

Table 7-1. Cont.

BMP ID	Name	BMP
		cataloged, and re-deposited. A map should be prepared depicting site boundaries in relation to the project area, and the site should be recorded on a standard archaeological site record (DPR 523 form). **3.** *Documentation.* If findings are negative, these results will be presented in the SMP annual notification package. If findings are positive, a positive Archaeological Survey Report (ASR)/Historic Property Survey Report (HPSR) will be prepared that includes appropriate background research, site records, and recommendations for additional work. Prior to finalization of such document, a copy will be provided to the appropriate affiliated tribe(s) for review and comment. The report will include results of background research, descriptions of field work, findings, appropriate maps and photos, and a record of Native American consultation. A cover letter will detail management recommendations, which could include archaeological and Native American monitoring, site avoidance, or test excavations to determine site significance. The report will be submitted to SCWA and the NWIC. All information regarding the site locations, Native American human remains, and associated funerary objects will be kept confidential and will not be made available for public disclosure. The final written report will be submitted within 3 months after work has been completed to the NWIC. **4.** *Management Requirements.* If a cultural resource is located within an area of maintenance activity the following steps shall be implemented. The following are examples of management requirements regarding the treatment of known or unknown cultural resources; other measures may be implemented instead, provided they are at least as protective of the cultural resource in question. ▪ *Archaeological and Native American Monitoring:* SCWA shall retain the services of a Native American monitor or Native American Monitors, depending on the site constraints, through agreements with the appropriate affiliated tribe(s), and a qualified archaeological consultant that has expertise in California prehistory to monitor ground-disturbing activities within 200 feet of known archaeological sites or in areas designated as having a high potential for encountering archaeological sites. If an intact archaeological deposit is encountered, all soil disturbing activities in the vicinity of the deposit should stop until the deposit is evaluated. The archaeological monitor shall immediately notify SCWA of the encountered archaeological deposit. The monitors shall, after making a reasonable effort to assess the identity,

Table 7-1. Cont.

BMP ID	Name	BMP
		integrity, and significance of the encountered archaeological deposit, present the findings of this assessment to SCWA. During the course of the monitoring, the archaeologist may adjust the frequency—from continuous to intermittent—of the monitoring based on the conditions and professional judgment regarding the potential to impact resources. ▪ *Cultural Resources Monitoring Plan:* If monitoring is the preferred recommendation, a cultural resources monitoring plan shall be prepared by a qualified professional archaeologist. Prior to finalization of such document, a copy will be provided to the appropriate affiliated tribe(s) for review and comment. The plan should address (but not be limited to) the following issues: - Training program for all construction involved in site disturbance and field workers; - Person(s) responsible for conducting monitoring activities, including Native American monitors; - How the monitoring shall be conducted and the required format and content of monitoring reports, including any necessary archaeological re-survey; - Person(s) responsible for overseeing and directing the monitors; - Schedule for submittal of monitoring reports and person(s) responsible for review and approval of monitoring reports; - Procedures and construction methods to avoid sensitive cultural resource areas; - Clear delineation and fencing of sensitive cultural resource areas requiring monitoring; - Physical monitoring boundaries (e.g., 200-foot radius of a known site); - Protocol for notifications and stop-work guidelines in case of encountering of cultural resources, as well as methods of dealing with the encountered resources (e.g., collection, identification, curation); - Methods to ensure security of cultural resources sites; - Protocol for notifying local authorities (i.e. Sheriff, Police) should site

BMP ID	Name	BMP
		looting and other illegal activities occur during construction. - If SCWA, in consultation with the monitors, determines that a significant archaeological resource is present and that the resource could be adversely affected by the proposed Project, SCWA shall: - Re-design the proposed project to avoid any adverse effect on the significant resource; or, - Implement an archaeological data recovery program (ADRP) (unless the archaeologist determines that the archaeological resource is of greater interpretive than research significance, and that interpretive use of the resource is feasible). The project archaeologist**,** SCWA, and appropriate affiliated tribe(s) shall meet and consult to determine the scope of the ADRP. The archaeologist will prepare a draft ADRP and submit it to SCWA for review and approval. Prior to finalization of such document, a copy will be provided to the appropriate affiliated tribe(s) for review and comment. The ADRP will identify how the proposed data recovery program will preserve the significant information the archaeological resource is expected to contain. The ADRP will identify the scientific/historic research questions applicable to the expected resource, the data classes the resource is expected to possess, and how the expected data classes will address the applicable research questions. Data recovery, in general, shall be limited to the portions of the historic property that could be adversely affected by the proposed Project. Destructive data recovery methods shall not be applied to portions of the archaeological resources if nondestructive methods are practical.
CR-2	Previously Undiscovered Cultural Resources	*Inadvertent Discoveries:* If discovery is made of items of historical or archaeological interest, activity will immediately cease in the project location (within approximately 50-feet) of discovery. Prehistoric archaeological materials might include obsidian and chert flaked-stone tools (e.g., projectile points, knives, scrapers) or toolmaking debris; culturally darkened soil ("midden") containing heat-affected rocks, artifacts, or shellfish remains; and stone milling equipment (e.g., mortars, pestles, handstones, or milling slabs); and battered stone tools, such as hammerstones and pitted stones. Historic-period materials might include stone, concrete, or adobe footings and walls; filled wells or privies; and deposits of metal, glass, and/or ceramic refuse. After cessation of excavation the contractor shall immediately contact SCWA. Maintenance will not resume until authorization is received from the SCWA.

Table 7-1. Cont.

BMP ID	Name	BMP
		▪ In the event of unanticipated discovery of archaeological indicators during construction, SCWA will retain the services of a qualified professional archaeologist to evaluate, in consultation with the appropriate affiliated tribe(s), the significance of the items prior to resuming any activities that could impact the site. ▪ In the case of an unanticipated archaeological discovery that is determined to be potentially eligible for listing in the National and/or California Register, and the site cannot be avoided, SCWA will implement an ADRP, prepared by a qualified archaeologist, as outlined under BMP CR-1. *Discovery of Human Remains:* If potential human remains are encountered, SCWA shall halt work in the vicinity of the find and contact the county coroner in accordance with Public Resources Code Section 5097.98 and Health and Safety Code Section 7050.5. If the coroner determines the remains are Native American, the coroner will contact the NAHC. As provided in Public Resources Code Section 5097.98, the NAHC will identify the person or persons believed to be most likely descended from the deceased Native American. The Most Likely Descendent makes recommendations for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in Public Resources Code Section 5097.98.
CR-3	Previously Undiscovered Paleontological Resources	If fossil remains are encountered during maintenance, the maintenance activity will be stopped until a qualified professional paleontologist can assess the nature and importance of the find and recommend appropriate treatment. SCWA shall retain a consultant who meets the Society for Vertebrate Paleontology's criteria for a "qualified professional paleontologist" (Society of Vertebrate Paleontology Conformable Impact Mitigation Guidelines Committee 1995). Treatment may include preparation and recovery of fossil materials so that they can be housed in an appropriate museum or university collection, and may also include preparation of a report for publication describing the finds. SCWA shall be responsible for ensuring that the recommendations of the paleontologist regarding treatment and reporting are implemented.
Hazardous Materials Safety		
HAZ-1	Spill Prevention and Response Plan	The Agency will develop a Spill Prevention and Response Plan prior to commencement of maintenance activities. The plan will summarize the measures required under BMPs HAZ-2 through HAZ-6. It will also require that: 1. Equipment and materials for cleanup of spills be available on site and that spills

BMP ID	Name	BMP
		and leaks will be cleaned up immediately and disposed of properly; 2. Prior to entering the work site, all field personnel shall be appropriately trained in spill prevention, hazardous material control, and clean-up of accidental spills. 3. Field personnel shall implement measures to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means. 4. Spill prevention kits shall always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations). All field personnel shall be advised of these locations and trained in their appropriate use. The Agency will routinely inspect the work site to verify that the Spill Prevention and Response Plan is properly implemented and maintained. The Agency will notify contractors immediately if there is a noncompliance issue and will require compliance. Absorbent materials will be used on small spills located on impervious surface rather than hosing down the spill; wash waters shall not discharge to the storm drainage system or surface waters. For small spills on pervious surfaces such as soils, wet materials will be excavated and properly disposed rather than burying it. The absorbent materials will be collected and disposed of properly and promptly. As defined in 40 CFR 110, a federal reportable spill of petroleum products is the spilled quantity that: ▪ violates applicable water quality standards; ▪ causes a film or sheen on, or discoloration of, the water surface or adjoining shoreline; or ▪ causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines. If a spill is reportable, the contractor's superintendent will notify the Agency, and the Agency will take action to contact the appropriate safety and cleanup crews to ensure that the Spill Prevention and Response Plan is followed. A written description of reportable releases must be submitted to the appropriate RWQCB and the California Department of Toxic Substances Control (DTSC). This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a

Table 7-1. Cont.

BMP ID	Name	BMP
		description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form. If an appreciable spill has occurred, and results determine that project activities have adversely affected surface water or groundwater quality, a detailed analysis will be performed to the specifications of DTSC to identify the likely cause of contamination. This analysis will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, the Agency or contractors will select and implement measures to control contamination, with a performance standard that surface and groundwater quality must be returned to baseline conditions. These measures will be subject to approval by the Agency, DTSC, and the RWQCB.
HAZ-2	Equipment and Vehicle Maintenance	1. All vehicles and equipment will be kept clean. Excessive build-up of oil or grease will be avoided. 2. All equipment used in the creek channel will be inspected for leaks each day prior to initiation of work. Action will be taken to prevent or repair leaks, if necessary. 3. Vehicle and equipment maintenance activities will be conducted off-site or in a designated, protected area away from the channel where vehicle fluids and spills can be handled with reduced risk to water quality. 4. If maintenance must occur on-site, designated areas will not directly connect to the ground, surface waters, or the storm drainage system to prevent the run-on of stormwater and runoff of spills. The service area will be clearly designated with berms, sandbags, or other barriers. 5. Secondary containment, such as a drain pan or drop cloth, to catch spills or leaks will be used when removing or changing fluids. Fluids will be stored in appropriate containers with covers, and properly recycled or disposed of off-site. 6. Cracked batteries will be stored in a non-leaking secondary container and removed from the site. 7. Spill clean-up materials will be stockpiled where they are readily accessible. 8. Incoming vehicles and equipment will be checked for leaking oil and fluids (including delivery trucks, and employee and subcontractor vehicles). Leaking vehicles or equipment will not be allowed on-site.

Table 7-1. Cont.

BMP ID	Name	BMP
HAZ-3	Equipment and Vehicle Cleaning	1. Equipment will be cleaned of any sediment or vegetation before transferring and using in a different watershed to avoid spreading pathogens or exotic/invasive species between watersheds. 2. Vehicle and equipment washing will occur on-site as needed to prevent spread of pathogens or exotic/invasive species. No runoff from vehicle or equipment washing will be allowed to enter waters of the State, including the creek channel or storm drains, without being subjected to adequate filtration (e.g., vegetated buffers, hay wattles, or bales, silt screens). The discharge of decant water from any on-site wash areas to waters of the State or to areas outside of the active project site is prohibited. Additional vehicle and equipment washing will occur on an appropriate wash rack at SCWA's maintenance center.
HAZ-4	Refueling	1. No fueling shall be done in the channel (top-of-bank to top-of-bank) unless equipment stationed in these locations cannot be readily relocated (e.g., pumps and generators). 2. All off-site fueling sites (e.g., on access roads above the top-of-bank) shall be equipped with secondary containment and avoid a direct connection to underlying soil, surface water, or the storm drainage system. 3. For stationary equipment that must be fueled on-site, secondary containment, such as a drain pan or drop cloth, shall be provided in such a manner to prevent accidental spill of fuels to underlying soil, surface water, or the storm drainage system.
HAZ-5	On-Site Hazardous Materials Management	1. The products used and/or expected to be used and the end products that are produced and/or expected to be produced after their use will be inventoried. 2. As appropriate, containers will be properly labeled with a "Hazardous Waste" label and hazardous waste will be properly recycled or disposed of off-site. 3. Contact of chemicals with precipitation will be minimized by storing chemicals in watertight containers or in a storage shed (completely enclosed), with appropriate secondary containment to prevent any spillage or leakage. 4. Quantities of toxic materials, such as equipment fuels and lubricants, shall be stored with secondary containment that is capable of containing 110% of the primary container(s). 5. Petroleum products, chemicals, cement, fuels, lubricants, and non-storm drainage

Table 7-1. Cont.

BMP ID	Name	BMP
		water or water contaminated with the aforementioned materials shall not contact soil and not be allowed to enter receiving waters or the storm drainage system. 6. Sanitation facilities (e.g., portable toilets) will be surrounded by a berm, and a direct connection with soil or to the storm drainage system or receiving water will be avoided. 7. Sanitation facilities will be regularly cleaned and/or replaced, and inspected daily for leaks and spills. 8. All toxic materials, including waste disposal containers, will be covered when they are not in use, and located as far away as possible from a direct connection to the storm drainage system or receiving water. 9. All trash that is brought to a project site during maintenance activities (e.g., plastic water bottles, plastic lunch bags) will be removed from the site daily.
HAZ-6	Existing Hazardous Sites or Waste	Upon selection of maintenance project locations, the Agency will conduct a search for existing known contaminated sites on the State Water Resource Control Board's GeoTracker website (http://www.geotracker.waterboards.ca.gov). For any proposed maintenance sites located within 1,500 feet of any "open" sites where contamination has not been remediated, the Agency will contact the RWQCB case manager listed in the database. The Agency will work with the case manager to ensure maintenance activities would not affect cleanup or monitoring activities or threaten the public or environment. If hazardous materials, such as oil or paint cans, are encountered at the maintenance sites, the Agency will carefully remove and dispose of them according to the Spill Prevention and Response plan. Agency staff will wear proper protective gear and store the waste in an appropriate hazardous waste container until it can be disposed at a hazardous waste facility.
HAZ-7	Fire Prevention	1. All earthmoving and portable equipment with internal combustion engines will be equipped with spark arrestors. 2. During the high fire danger period (April 1–December 1), work crews will have appropriate fire suppression equipment available at the work site. 3. On days when the fire danger is high and a burn permit is required (as issued by the relevant Air Pollution Control District), flammable materials, including flammable vegetation slash, will be kept at least 10 feet away from any equipment

Table 7-1. Cont.

BMP ID	Name	BMP
		that could produce a spark, fire, or flame. 4. On days when the fire danger is high and a burn permit is required, portable tools powered by gasoline-fueled internal combustion engines will not be used within 25 feet of any flammable materials unless at least one round-point shovel or fire extinguisher is within immediate reach of the work crew (no more 25 feet away from the work area).
HAZ-8	Testing and Disposal of Spoils	As specified in the Sediment Sampling and Analysis Guidelines (SMP Manual Appendix B), the Agency will test the sediment to be removed to determine the suitability for disposal based on presence of contaminants. The Regional Water Board will review the test results and their Executive Officer will consider approval of a disposal or reuse site proposed by the Agency. As specified in the Sediment Sampling and Analysis Guidelines, samples will be compared against federal and state environmental screening levels (ESLs) for protection of human health, groundwater quality, and terrestrial receptors. If hazardous levels of contaminants are present such that disposal at the preferred locations is not feasible, the material will be taken to a permitted hazardous waste facility. The waste discharge requirements included in the discharge orders issued by the Regional Water Boards dictate the degree of sediment sampling and testing required in order to obtain Executive Officer approval of a sediment disposal or reuse site. Executive Officer approval must be received prior to the initiation of sediment disposal activities. This mitigation measure incorporates these requirements by reference to ensure adequate protection of water quality.
Vegetation Management		
VEG-1	Removal of Existing Vegetation	1. Vegetation pruning and removal activities will be conducted under the guidance of a staff biologist or certified arborist and will follow the approaches of the Vegetation Management Plan (Appendix E of the SMP Manual). For tree relocation activities, a botanist, certified arborist, or other vegetation specialist will be on site to help direct maintenance activities and to consult if questions and/or issues arise. 2. Only vegetation that is noxious, invasive, hazardous, or could obstruct channel flows will be removed. Herbaceous layers that provide erosion protection and habitat value will be left in place. Invasive plant species that inhibit the health

Table 7-1. Cont.

BMP ID	Name	BMP
		and/or growth of native riparian trees will be targeted for removal. 3. Where a choice between species that may be removed to maintain flood conveyance is feasible, slower-growing species such as oaks (*Quercus* spp.) that develop large canopies will be preferentially preserved, because these species take longer to establish, and provide essential nesting habitat for cavity nesters and food sources for a variety of resident and migratory animals and birds. Faster-growing species such as alders (*Alnus* spp.) and cottonwoods (*Populus* spp.) are the second priority for preservation; these single-trunked species offer the benefit of improved flood conveyance and reduced roughness by comparison with multi-trunked species. 4. Vegetation will be removed and/or pruned in such a manner that channel roughness is reduced while allowing the maximum amount of vegetation to remain in place. Trees will be trimmed or pruned to reduce impedance of floodflows while allowing the canopy to develop. Specifics for each site will differ, but typical options include limbing up to remove lower branches that have potential to interfere with floodflows, and pruning into a "fan" roughly parallel to flow direction. In areas where extensive vegetation removal is desirable to maintain flood flow capacity, *phasing of remov*al shall be considered so that some vegetation may remain in place to provide habitat to birds. 5. Vegetation management will emphasize the preservation of large mature trees that provide well developed overstory for bird habitat, canopy closure for stream shading, and add vertical complexity to the riparian corridor. Vegetation management will be conducted in such a manner that maximizes shading over the active channel. Where vegetation is removed from the active channel, removal will target nonnative species and removal of native species that are stiff and/or multi-trunked such as arroyo willow (*Salix lasiolepis*). Trees will never be topped as this encourages shrubby growth and weak branch attachments 6. Large woody debris, stumps, or root wads that are fully or partially buried and do not present a flood hazard shall be allowed to remain in place to provide habitat and to maintain bank stability. 7. If vegetation requires removal for access to project site, non-native species and/or quick growing species (Class 2 species) shall be targeted first and Class 3 species next for removal. Removal of native, mature Class 1 trees will be avoided whenever possible.

Table 7-1. Cont.

BMP ID	Name	BMP
		8. To the extent feasible, removed native vegetation shall be saved to replant after maintenance or plant in other nearby sites. This includes the reuse of mulch and willow sprigs where possible.
VEG-2	Use of Herbicides	1. All herbicide use shall be consistent with all Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label instructions and any use conditions issued by the Sonoma County Agricultural Commissioner. 2. Herbicide use will be restricted to the minimum amount needed to ensure adequate control of vegetation. 3. Application of herbicides to upland areas shall not be made within 72 hours of predicted rainfall. 4. Herbicides will not be directly applied to waters of the U.S., such as for ludwigia eradication. 5. Herbicides, including AquaMaster© and Renovate©, will not be used within 60 feet of areas identified in the Court-Ordered Stipulated Injunction for the protection of California red-legged frogs. This includes areas in Zones 1A and 3A, as well as Zones 8A and 9A (see SMP Manual Figure 3-29 for detail on where these areas are located.) The Agency will review the details and exceptions in the court order and comply with the herbicide use buffers as appropriate. 6. As required by the Court-Ordered Stipulated Injunction for pesticide use near Pacific salmon-supporting waters in Sonoma County, pesticides specified in the injunction including triclopyr (Renovate©) will not be used within 20 yards of salmon-supporting waters. The Agency will review the details and exceptions in the court order and comply with the herbicide use buffers as appropriate.
VEG-3	Planting and Revegetation After Soil Disturbance	1. Sites where maintenance activities result in exposed soil will be stabilized to prevent erosion and revegetated with native vegetation as soon as feasible after maintenance activities are complete. 2. Revegetation will occur at a ratio of at least 1½: 1 to account for initial mortality of plantings. 3. If soil moisture is deficient, new vegetation will be supplied with supplemental water until vegetation is firmly established. 4. To the extent possible, native grass seed will be used when seeding a project site.

Table 7-1. Cont.

BMP ID	Name	BMP
		5. Erosion control fabric, hydromulch, or other mechanism will be applied as appropriate to provide protection to seeds, hold them in place, and help retain moisture. 6. Revegetation shall be regularly monitored for survival for at five years or until minimum survival/cover is achieved. If invasive species colonize the area, action shall be taken to control their spread; options include hand and mechanical removal and replanting with native species.
Water Quality and Channel Protection		
WQ-1	Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils	1. Upland soils exposed due to maintenance activities will be seeded and stabilized using erosion control fabric or hydroseeding. The channel bed and other areas below ordinary high water mark are exempt from this BMP. 2. Erosion control fabric will consist of natural fibers that will biodegrade over time. No plastic or other non-porous material will be used as part of a permanent erosion control approach. Plastic sheeting may be used to temporarily protect a slope from runoff, but only if there are no indications that special-status species would not be impacted by the application. 3. The site will be properly prepared to make sure the fabric/mat has complete contact with the soil. Sites can be prepared by grading and shaping the installation area; removing all rocks, dirt clods, vegetation, etc.; preparing the seedbed by loosening the top 2- to 3-inches of soil; and applying soil amendments as directed by soil tests, the seeding plan, and manufacturer's recommendations. 4. The area will be seeded before installing the fabric. All areas disturbed during installation will be re-seeded. 5. Erosion control fabric will be anchored in place. Anchors can include U-shaped wire staples, metal geotextiles stake pins or triangular wooden stakes. 6. The manufacturer's installation recommendations will be followed. 7. Other erosion control measures shall be implemented as necessary to ensure that sediment or other contaminants do not reach surface water bodies for stockpiled or reused/disposed sediments.
WQ-2	Prevent Scour Downstream of Sediment Removal	After sediment removal, the channel shall be graded so that the transition between the existing channel both upstream and downstream is smooth and continuous between

Table 7-1. Cont.

BMP ID	Name	BMP
		the maintained and non-maintained areas and does not present a “wall” of sediment or other blockage that could erode once flows are restored to the channel.
WQ-3	In-Channel Grading	1. Where pre-maintenance channel form exhibited desirable features, the channel bed will be regraded to mimic the channel form before work was conducted. 2. Where possible, grading may include channel enhancements such as excavation of a low-flow channel, development of a meander, or riffle/pool configurations. No channel grading will occur below the as-built design for the flood control channels. 3. If gravels that have the potential to be utilized for spawning are removed to conduct maintenance activities, the gravels will be carefully removed and stored where maintenance activities will not impact the quality of the gravel. The gravel shall be replaced as close to original conditions as possible upon completion of the maintenance activities. 4. Where in-stream gravel and gravel (or cobble) bars are encountered, sediment removal activities will aim to preserve the overall shape and form of the existing bar or gravel feature. Sediment removal activities will aim to retain the form of the gravel or cobble bar feature, while reducing bar elevations as necessary to accommodate flood conveyance capacity.
Good Neighbor Policies		
GN-1	Work Site Housekeeping	1. SCWA will maintain the work site in a neat and orderly condition, and will leave the site in a neat, clean, and orderly condition when work is complete. To the extent feasible, slash, sawdust, cuttings, etc. will be removed to clear the site of vegetation debris. Paved access roads will be swept and cleared of any residual vegetation or dirt resulting from the maintenance activity. 2. For activities that last more than one day, materials or equipment left on the site overnight will be stored as inconspicuously as possible, and will be neatly arranged.
GN-2	Public Outreach	1. In efforts to keep the public informed about stream maintenance work, why it is necessary, when it occurs, and what a neighborhood can expect when crews arrive to conduct maintenance work, SCWA will post and update information about the SMP and maintenance activities on their website (http://www.scwa.ca.gov/about_your_water/). 2. Each spring, once maintenance sites have been selected for the annual work

Table 7-1. Cont.

BMP ID	Name	BMP
		season, a newspaper notice will be published with information on the maintenance sites, approximate work dates, and contact information. This information will also be posted on SCWA's website. 3. For high profile projects, at SCWA's discretion, signs will be posted in the neighborhood to notify the public at least one week in advance of maintenance schedules, trail closures, and road/land closures as necessary and as possible. Signage used at work sites will provide contact information for lodging comments and/or complaints regarding the activities.
GN-3	Noise Control	1. With the exception of emergencies, normal work will be limited to normal business hours (8:00 a.m.–5:00 p.m.). Routine activities in residential areas will not occur on Saturdays, Sundays, or SCWA observed state holidays except during emergencies, or with approval by the local jurisdiction and advance notification of surrounding residents. 2. SCWA will ensure that power equipment (vehicles, heavy equipment, and hand equipment such as chainsaws) is equipped with original manufacturer's sound-control devices, or alternate sound control that is no less effective than those provided as original equipment. Equipment will be operated and maintained to meet applicable standards for construction noise generation. No equipment will be operated with an unmuffled exhaust.
GN-4	Traffic Flow, Pedestrians, and Safety Measures	1. To the extent feasible, work will be staged and conducted in a manner that maintains two-way traffic flow on public roadways in the vicinity of the work site. If temporary lane closures are necessary, they will be coordinated with the appropriate jurisdictional agency and scheduled to occur outside of peak traffic hours (7:00 – 10:00 a.m. and 3:00 – 6:00 p.m.) to the maximum extent practicable. Any lane closures will include advance warning signage, a detour route and flaggers will be provided in both directions. When work is conducted on public roads and may have the potential to affect traffic flow, work will be coordinated with local emergency service providers as necessary to ensure that emergency vehicle access and response is not impeded. 2. Public transit access and routes shall be maintained to the extent feasible. If public transit would be affected by temporary road closures and require detours, affected transit authorities will be consulted and kept informed of project activities. 3. Heavy equipment and haul traffic will be prohibited in residential areas, except when no other route to and from the site is available.

Table 7-1. Cont.

BMP ID	Name	BMP
		4. Roadway segments or intersections in the vicinity of project sites will be assessed to determine if they are at, or approaching an LOS that exceeds local standards. Maintenance traffic will avoid these locations to the extent feasible, either by traveling different routes or by traveling at non-peak times of day. 5. Adequate off-street parking will be provided or designated public parking areas will be used for maintenance workers' personal vehicles and maintenance-related vehicles not in use through the maintenance period. 6. Access for driveways and private roads will be maintained to the extent feasible. If brief periods of maintenance would temporarily block access, property owners will be notified prior to maintenance activities.
GN-5	Odors	Sediment that is rich in decaying organic matter that could generate assorted malodorous gases such as reduced sulfur compounds shall be handled to minimize impacts on sensitive receptors such as nearby residents and businesses and their patrons. In general, such materials will be hauled off of the site at the time of excavation. Where it needs to be temporarily stockpiled, maintenance personnel shall stockpile potentially odorous sediments as far as possible from residential areas, businesses and their patrons, and other odor sensitive land uses.

Table 7-2. Best Management Practices by Activity

				Vegetation Management									Other Activities								
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Reservoir Inlet Clearing	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
General Impact Avoidance and Minimization																					
GEN-1	Work Window	X	X	X		X	X	X	X	X		X	X			X	X	X			X
GEN-2	Staging and Stockpiling of Materials	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GEN-3	Channel Access	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X			
Air Quality Protection																					
AQ-1	Dust Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
AQ-2	Enhanced Dust Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Biological Resources Protection																					
BR-1	Area of Disturbance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-2	Pre-maintenance Educational Training	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-3	Biotechnical Bank Stabilization		X										X		X	X					
BR-4	Impact Avoidance and Minimization During Dewatering	X	X				X						X		X	X	X				
BR-5	Fish and Amphibian Species Relocation Plan	X	X				X						X		X	X	X				
BR-6	On-Call Wildlife Biologist	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BR-7	Special Status Plant Survey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BR-8	Nesting Migratory Bird and Raptor Pre-maintenance Surveys	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BR-9	California Freshwater Shrimp Avoidance and Impact Minimization for Vegetation Management	X	X	X	X	X	X	X	X			X	X			X		X			X

Table 7-2. Cont.

				Vegetation Management									Other Activities								
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Reservoir Inlet Clearing	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
BR-10	California Red-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X			
BR-11	California Red-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management			X	X	X	X	X	X	X	X	X	X				X				
BR-12	California Tiger Salamander Avoidance and Impact Minimization Measures for Sediment and Debris Removal	X		X		X	X						X	X	X	X	X	X			X
BR-13	California Tiger Salamander Avoidance and Impact Minimization Measures for Bank Stabilization		X													X					
BR-14	California Tiger Salamander Avoidance and Impact Minimization Measures for Vegetation Management			X	X			X	X	X	X	X	X	X	X		X	X	X	X	
BR-15	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	X	X	X	X	X	X						X			X	X	X			
BR-16	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management			X	X	X	X						X				X				
BR-17	Western Pond Turtle Pre-maintenance Surveys for Ground-Disturbing Activities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-18	Zone 1A Salmonid Avoidance and Impact Minimization Measures	X	X	X	X	X	X	X	X			X	X			X		X			

Table 7-2. Cont.

				Vegetation Management									Other Activities									
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Reservoir Inlet Clearing	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
BR-19	Zones 2A and 3A Salmonid Avoidance and Impact Minimization Measures	X	X	X	X	X	X	X	X			X	X			X		X			
Cultural Resources Protection																					
CR-1	Phase I Cultural Investigation and Report		X						X				X	X	X	X	X				X
CR-2	Previously Undiscovered Cultural Resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CR-3	Previously Undiscovered Palentological Resources	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Hazardous Materials Safety																					
HAZ-1	Spill Prevention and Response	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-2	Equipment and Vehicle Maintenance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-3	Equipment and Vehicle Cleaning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-4	Refueling	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-5	On-Site Hazardous Materials Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-6	Existing Hazardous Sites or Waste	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-7	Fire Prevention	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-8	Testing and Disposal of Spoils	X	X										X	X	X	X	X	X			X
Vegetation Management																					
VEG-1	Removal of Existing Vegetation	X	X	X				X	X		X	X	X	X	X	X	X				
VEG-2	Use of Herbicides			X	X	X	X	X	X			X	X	X	X		X		X		
VEG-3	Planting and Revegetation After Soil Disturbance	X	X					X	X		X		X		X	X	X				

Table 7-2. Cont.

				Vegetation Management									Other Activities									
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Reservoir Inlet Clearing	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
Water Quality and Channel Protection																					
WQ-1	Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils	X	X	X	X	X		X	X				X	X	X	X	X	X	X		X
WQ-2	Prevent Scour Downstream of Sediment Removal	X											X				X				
WQ-3	In-Channel Grading	X	X										X			X					
Good Neighbor Policies																					
GN-1	Work Site Housekeeping	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-2	Public Outreach	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-3	Noise Control	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-4	Traffic Flow, Pedestrians, and Safety Measures	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-5	Odors	X	X										X		X	X	X	X	X		X

Table 7-3. Listed Species by SMP Reach

Legend

O	Known occurrence in reach
O*	Presence documented within adjacent reach or tributary; not applicable for fish if known barrier or reach goes dry
P	Potential habitat
M	Migration corridor (fish only)
S	Known or potential spawning habitat (fish only)
R	Known or potential rearing habitat (fish only)
H	Historic occurrence; recent occurrence not confirmed
U	Unsuitable habitat, unlikely to occur and/or no known occurrence

CTS Habitat Rankings

P/A-1	Moderate-High likelihood for occurrence in potential upland habitat
P/A-2	Moderate likelihood for occurrence in potential upland habitat
P/A-3	Low likelihood for occurrence in potential upland habitat
P/A-4	Unlikely to occur in potential upland habitat

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Zone 1A - Laguna de Santa Rosa Watershed										
Abramson Creek	Abramson1	U	U	P/A-4	U	P	U	U	U	U
	Abramson2	U	U	P/A-4	U	P	U	U	U	U
Airport Creek	Airport1	U	U	P/A-4	U	P	U	U	U	U
	Airport2	U	U	P/A-4	U	P	U	U	U	P
Austin Creek	Austin1	U	P	U	U	P	O (M)	U	U	U
	Austin2	U	P	U	U	P	O (M)	U	U	U
	Austin3	U	P	U	U	O	O (M/R)	U	U	U
Bellevue Wilfred Channel	BellWil1	U	U	P/A-1	U	P	U	U	U	P

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
	BellWil2	U	U	P/A-1	U	P	U	U	U	U
	BellWil3	U	U	P/A-1	U	P	U	U	U	U
	BellWil4	U	U	P/A-1	U	P	U	U	U	U
Brush Creek	Brush1	U	P	U	U	O	O (M)	U	U	U
	Brush2	U	P	U	U	P	O (M/R)	U	U	U
	BrushRes	U	P	U	U	P	U	U	U	U
Coffey Creek	Coffey1	U	U	U	U	P	U	U	U	U
Coleman/Cook Creek	Cook1	U	U	U	U	U	U	U	U	U
	Coleman1	U	U	U	U	U	U	U	U	U
	Coleman 2	U	U	U	U	U	U	U	U	U
Colgan Creek	Colgan1	U	U	P/A-1	U	P	U	U	U	U
	Colgan2	U	U	P/A-1	U	P	U	U	U	P
	Colgan3	U	U	P/A-1	U	P	U	U	U	U
	Colgan4	U	U	P/A-1	U	P	U	U	U	U
	Colgan5	U	U	P/A-1	U	P	U	U	U	U
	Colgan6	U	U	P/A-1	U	P	U	U	U	U
	Colgan7	U	U	U	U	P	U	U	U	U
College Creek	College1	U	U	U	U	P	U	U	U	U
	College2	U	U	U	U	P	U	U	U	U
	College3	U	U	U	U	P	U	U	U	U
Cook Creek	Cook1	U	U	U	U	U	U	U	U	U
	Cook2 (basin)	U	P	P/A-4	P	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Copeland Creek	Copeland1	U	U	U	U	P	O (M)	U	U	U
	Copeland2	U	U	U	U	P	O (M)	U	U	U
	Copeland3	U	U	U	U	P	O (M/R)	U	U	U
	Copeland4	U	U	U	U	P	O (M)	U	U	U
	Copeland5	U	U	U	P	P	O (M/R)	U	U	U
South Fork Copeland Creek	SFCope1	U	U	U	U	P	U	U	U	U
	SFCope2	U	U	U	U	P	U	U	U	U
Cotati Creek	Cotati1	U	U	P/A-4	U	P	U	U	U	U
	Cotati2	U	P	P/A-4	U	P	U	U	U	U
Crane Creek	Crane1	U	U	P/A-4	U	P	P(M)	U	U	U
	Crane2	U	U	P/A-4	O	P	P(M)	U	U	U
Ducker Creek	Ducker1	U	P	U	U	P	U	U	U	U
	Ducker2	U	P	U	U	P	U	U	U	U
Faught Creek	Faught1	U	P	U	U	P	U	U	U	U
Five Creek	Five1	U	U	P/A-4	U	P	U	U	U	U
Forestview Creek	Forestview1	U	U	P/A-2	U	P	U	U	U	U
	Forestview2	U	U	P/A-2	U	P	U	U	U	U
	Forestview3	U	U	P/A-2	U	P	U	U	U	U
Fulton Creek	Fulton1	U	P	P/A-4	U	P	U	U	U	U
Gossage Creek	Gossage1	U	U	P/A-1	U	P	O*	U	U	U
	Gossage2	U	U	P/A-1	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
	Gossage3	U	U	P/A-1	U	P	U	U	U	U
Hinebaugh Creek	Hinebaugh1	U	U	P/A-1	U	P/O	P(M)	U	U	U
	Hinebaugh2	U	U	P/A-1	U	P	P(M)	U	U	U
	Hinebaugh3	U	U	P/A-1	U	P	P(M)	U	U	U
	Hinebaugh4	U	U	U	U	P	P(M)	U	U	U
	Hinebaugh5	U	U	U	U	P	P(M)	U	U	U
	Hinebaugh6	U	U	U	U	P	P(M)	U	U	U
	Hinebaugh7	U	U	U	U	P	P(M)	U	U	U
Hunter Creek	Hunter1	U	U	P/A-4	U	P	U	U	U	U
	Hunter2	U	U	P/A-4	U	P	U	U	U	U
	Hunter3	U	U	P/A-4	P	P	U	U	U	U
Kawana Springs Creek	Kawana1	U	U	P/A-4	U	P	U	U	U	U
Laguna de Santa Rosa	Laguna1	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna2	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna3	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna4	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna5	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna6	U	U	P/A-4	U	P	O (M)	U	U	P
	Laguna7	U	U	P/A-4	U	P	O (M)	U	U	P
Lornadel Creek	Lorna Dell1	U	U	U	U	P	U	U	U	U
Matanzas Reservoir	MatanzasRes	U	P	U	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Middle Fork Brush Creek	MiddleBrush1	U	P	U	U	P	O*	U	U	U
	MiddleBrush2	U	P	U	U	P	U	U	U	U
Oakmont Creek	Oakmont1	U	P	U	U	U	U	U	U	U
Paulin Creek	Paulin1	U	U	U	U	P	O (M/R)	U	U	U
	Paulin2	U	U	U	U	P	O*	U	U	U
	Paulin3	U	U	U	U	P	U	U	U	U
	Paulin4	U	U	U	U	P	U	U	U	U
	Paulin5	U	U	U	U	P	U	U	U	U
	Paulin6	U	U	U	U	P	U	U	U	U
Peterson Creek	Peterson1	U	U	P/A-1	U	P	U	U	O*	U
	Peterson2	U	U	P/A-1	U	P	U	U	U	P
Piner Creek	Piner1	U	U	P/A-3	U	P/O	O (M)	U	O*	U
	Piner2	U	U	U	U	P/O	O (M)	U	U	U
	Piner3	U	U	U	U	P	O (M/R)	U	U	U
	Piner4	U	U	U	U	P	O*	U	U	U
	Piner5	U	U	U	U	P	U	U	U	U
	Piner6	U	U	U	U	U	U	U	U	U
	Piner7	U	U	U	U	U	U	U	U	U
	Piner8	U	U	U	U	U	U	U	U	U
	PinerRes	U	P	U	U	P	U	U	U	U
Roseland Creek	Roseland1	U	U	P/A-1	U	P	U	U	U	P

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
	Roseland2	U	U	P/A-1	U	P	U	U	U	U
	Roseland3	U	U	P/A-1	U	P	U	U	U	P
	Roseland4	U	U	P/A-1	U	P	U	U	U	U
	Roseland5	U	U	P/A-4	U	U	U	U	U	U
	Roseland6	U	U	P/A-4	U	U	U	U	U	U
Russell Creek	Russell1	U	U	U	U	P	U	U	U	U
	Russell2	U	U	U	U	P	U	U	U	U
Santa Rosa Creek	Santa Rosa0	U	U	U	U	P	O (M/R)	U	O (M/S/R)	P
	Santa Rosa1	U	U	P/A-3	U	P	O (M)	U	O (M/S/R)	P
	Santa Rosa2	U	U	P/A-1	U	P	O (M/R)	U	O (M/S/R)	P
	Santa Rosa3	U	U	P/A-4	U	P	O (M/R)	U	O (M/S/R)	P
	Santa Rosa4	U	U	U	U	P	O (M/R)	U	O (M/S/R)	P
	Santa Rosa5	U	U	U	U	P	O (M/R)	U	O (M/S/R)	P
	Santa Rosa6	H	P	U	U	O	O (M/R)	U	O (M/S/R)	P
Santa Rosa Creek Diversion	Santa Rosa Div.1	U	P	U	P	P	O*	U	U	U
Sierra Park Creek	Sierra Park1	U	P	U	U	P	U	U	U	U
	Sierra Park2	U	P	U	U	P	U	U	U	U
	Sierra Park3	U	P	U	U	P	U	U	U	U
Spring Creek	Spring1	U	P	U	U	P	U	U	U	U
	Spring3	U	P	U	U	P	U	U	U	U
	SpringRes	U	P	U	U	P	P	U	U	U
Starr Creek	Starr1	U	P	U	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
	Starr2	U	P	U	U	P	U	U	U	U
	StarrTrib1	U	P	U	U	U	U	U	U	U
Steele Creek	Steele1	U	U	U	U	P	U	U	U	U
	Steele2	U	U	U	U	P	U	U	U	U
	Steele3	U	U	U	U	P	U	U	U	U
	Steele4	U	U	U	U	P	U	U	U	U
	Steele5	U	U	U	U	P	U	U	U	U
Todd Creek	Todd1	U	U	P/A-1	U	P	U	U	U	U
	Todd2	U	U	P/A-1	U	P	U	U	U	U
	Todd3	U	U	P/A-4	U	P	U	U	U	U
	Todd4	U	U	P/A-4	U	P	U	U	U	U
	Todd5	U	U	P/A-4	U	P	U	U	U	U
Washoe Creek	Washoe1	U	U	U	U	P	U	U	U	U
Wikiup Creek	Wikiup1	U	P	U	P	P	U	U	U	U
Wilfred Creek	Wilfred1	U	U	P/A-4	U	P	U	U	U	U
Wilfred Extension	Wilfred Ext.1	U	U	P/A-4	U	P	U	U	U	U
Windsor Creek	Windsor1	U	P	U	U	P	O (M/R)	U	U	P
	Windsor2	U	P	U	U	P	U	U	U	U
	Windsor3	U	P	U	U	P	U	U	U	U
	Windsor4	U	P	U	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Zone 2A – Petaluma River Watershed										
Adobe Creek	Adobe1	U	P	U	U	P	O (M)	U	U	U
	Adobe2	U	P	U	U	P	O (M)	U	U	U
	Adobe3	U	P	U	P	P	O (M)	U	U	U
	Adobe4	U	P	U	O	P	O (M/R)	U	U	U
Capri Creek	Capri1	U	P	U	U	P	O*	U	U	U
	Capri2	U	P	U	U	P	U	U	U	U
	Capri3	U	P	U	U	P	U	U	U	U
	Capri4	U	P	U	U	P	U	U	U	U
Corona Creek	Corona1	U	P	U	U	P	U	U	U	U
	Corona2	U	P	U	U	P	U	U	U	U
	Corona3	U	P	U	U	P	U	U	U	U
	Corona4	U	P	U	U	P	U	U	U	U
	Corona5	U	P	U	U	U	U	U	U	U
	Corona6	U	P	U	U	U	U	U	U	U
	Corona7	U	P	U	U	U	U	U	U	U
East Fork McDowell Creek	East Fork McDowell1	U	P	U	U	P	U	U	U	U
East Washington Creek	East Washington1	U	P	U	U	P	U	U	U	U
	East Washington2	U	P	U	U	P	U	U	U	U
	East Washington3	U	P	U	U	P	U	U	U	U
	East Washington4	U	P	U	U	P	U	U	U	U
	East Washington5	U	P	U	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Jessie Lane Creek	Jessie Lane1	U	P	U	U	P	O*	U	U	U
Lichau Creek	Lichau1	U	P	P/A-4	U	P	O (M)	U	U	U
	Lichau2	U	P	P/A-4	U	P	O (M)	U	U	U
	Lichau3	U	P	P/A-4	U	P	O (M)	U	U	U
Lynch Creek	Lynch1	U	P	U	U	P	O(M)	U	U	U
McDowell Creek	McDowell1	U	P	U	U	P	O*	U	U	U
	McDowell2	U	P	U	U	P	U	U	U	U
Thompson Creek	Thompson1	U	P	U	U	P	U	U	U	U
Washington Creek	Washington1	U	P	U	U	P	O*	U	U	U
	Washington2	U	P	U	U	P	U	U	U	U
	Washington3	U	P	U	U	P	U	U	U	U
	Washington4	U	P	U	U	P	U	U	U	U
	Washington5	U	P	U	U	P	U	U	U	U
	Washington6	U	P	U	U	U	U	U	U	U
	Washington7	U	P	U	U	U	U	U	U	U
Zone 3A - Sonoma Creek Watershed										
Fryer Creek	Fryer1	U	P	U	U	P	U	U	U	P
	Fryer2	U	P	U	U	P	U	U	U	U
	Fryer3	U	P	U	U	P	U	U	U	U
	Fryer4	U	P	U	U	U	U	U	U	U
Lower East Fork Fryer Creek	Lower East Fork Fryer1	U	P	U	U	P	U	U	U	U

Table 7-3. Cont.

Creek Name	Reach	California Freshwater Shrimp	California Red-legged Frog	California Tiger Salamander	Foothill Yellow-legged Frog	Western Pond Turtle	Central California Coast Steelhead	Central California Coast Coho	California Coastal Chinook	Plants
Zone 8A – Bodega Bay and Adjacent Coastal Creeks										
Bloomfield Channel	Bloomfield1	U	P	U	U	U	U	U	U	U

Legend

O	Known occurrence in reach
O*	Presence documented within adjacent reach or tributary; not applicable for fish if known barrier or reach goes dry
P	Potential habitat (includes areas rated potential or marginal)
M	Migration corridor (fish only)
S	Known or potential spawning habitat (fish only)
R	Known or potential rearing habitat (fish only)
H	Historic occurrence; recent occurrence not confirmed
U	Unsuitable habitat, unlikely to occur and/or no known occurrence

CTS Habitat Rankings

P/A-1	Moderate-High likelihood for occurrence in potential upland habitat
P/A-2	Moderate likelihood for occurrence in potential upland habitat
P/A-3	Low likelihood for occurrence in potential upland habitat
P/A-4	Unlikely to occur in potential upland habitat

Chapter 8
PROGRAM MITIGATION

8.1 Introduction

Stream Maintenance Program (SMP) impacts are greatly reduced through the avoidance and minimization measures described in Chapters 5, 6, and 7. Efforts are made to reduce potential impacts through pre-maintenance planning and avoidance approaches, using a variety of impact avoidance and reduction measures during the actual maintenance work, and by taking steps to reduce the overall need for maintenance work over the longer-term. However, there are potential program impacts that are not entirely avoided or reduced through such steps. Such residual impacts will require additional mitigation. This chapter describes the SMP's mitigation approach.

Section 8.2 *Regulatory Guidance* of this chapter presents mitigation guidelines provided by the U.S. Army Corps of Engineers (USACE), Regional Water Quality Control Boards (RWQCBs), the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS) that are relevant for stream maintenance activities. In addition to formal regulatory guidance, the SMP's mitigation approach was developed through multiple discussions with agency representatives from the USACE, RWQCBs, CDFG, USFWS, and NMFS. Meetings were held with individual agencies and also together through group meetings of the Inter-Agency Working Group (IAWG). The SMP mitigation approach was also developed over the course of three years of interim permitting (2006-2008). During that period individual maintenance projects were developed, submitted for agency review, permitted, and implemented. The interim permitting period was used to demonstrate and refine program maintenance activities, as well as mitigation approaches.

Section 8.3 *Summary of Program Impacts* provides an overview of program impacts related to water quality, habitat, aquatic functions, and fish and wildlife resources. The impact summary is not a comprehensive disclosure of program impacts, nor is it a statement of environmental impacts to be used for compliance with the California Environmental Quality Act (CEQA). A comprehensive description of program impacts is provided in the SMP Environmental Impact Report (EIR). Rather, the impact discussion in this chapter provides a context and rationale to understand the program's mitigation approach given the resources over which the various agencies identified above have jurisdiction.

Sections 8.5, 8.6, and 8.7 describe the SMP's three-tiered approach for mitigation, whereby habitats and ecologic functions are enhanced or restored: (1) on-site and in-kind where the maintenance work occurred; (2) at other Sonoma County Water Agency (SCWA) reaches; or (3) off-site within the watershed. The three-tiered mitigation approach ensures that mitigation seeks first and foremost to compensate for the impacts occurring at the specific project reach, then expands to consider other potential reaches, and finally seeks watershed opportunities.

Section 8.8 *Mitigation Performed During the Interim Period* draws on impact and mitigation data from the interim permitting period 2006-2008 to portray expected mitigation outcomes for the program. The program's mitigation approach was developed and refined during the interim permitting period to reflect improvements in the program and regulatory agency requests. Section 8.9 describes the environmental commitments established between SCWA and the permitting agencies overseeing the SMP. Section 8.10 provides an overview of mitigation ratios and specific mitigation requirements for program activities. Section 8.11 describes how mitigation activities will be communicated and coordinated with the relevant regulatory agencies.

8.2 Regulatory Guidance

The SMP mitigation program has been designed to meet the mitigation requirements of a variety of agencies, including the USACE, the North Coast and San Francisco Bay RWQCBs (NCRWQCB and SFRWQCB, respectively), CDFG, USFWS, and NMFS. A summary of their relevant jurisdictions is provided in Table 8-1; this table identifies the geographic extent and types of activities over which each agency has authority, and the activities that require coverage under their respective programmatic permits/approvals. Within that context, this section describes regulatory guidance for mitigation provided by each of these agencies that is relevant to the stream maintenance activities of the SMP. Regulatory guidance presented in this chapter reflects both general guidelines provided in agency publications, as well as more specific direction targeted to the SMP, as provided through specific meetings and discussions. Together this published mitigation guidance and the specific guidance provided as part of SMP development served as the fundamental basis for developing the SMP mitigation approach.

8.2.1 U.S. Army Corps of Engineers

Regulatory oversight of Section 404 of the Clean Water Act (CWA) requires that aquatic resource functions unavoidably lost or adversely affected by authorized activities should be replaced.

Section 404(b)(1) Guidelines and the 1990 Memorandum of Agreement (MOA) between the USACE and the U.S. Environmental Protection Agency (USEPA) provide more specific guidance on the mitigation planning process for impacts to aquatic resources (e.g., wetlands and waters of the United States). Proposed revisions to the USACE/USEPA 1990 memorandum (71 FR 15520, March 28, 2006) provided more recent guidance. Additional clarification on compensatory mitigation is provided by the USACE Regulatory Guidance Letter (RGL) No. 02-2 *Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899* (December 24, 2002).

Based on these guidance documents, impacts to waters of the United States (and other aquatic resources) can be mitigated in the following preferential sequence: (1) avoidance of impacts; (2) minimization of impacts; and (3) compensatory mitigation to offset remaining impacts not avoided or minimized. Avoidance and minimization are considered primary and secondary forms of mitigation that should be pursued (to the extent practicable while meeting the basic project purpose) prior to considering compensatory mitigation.

Table 8-1. Regulatory Agencies and Relevant Jurisdictions

				Are SMP Activities under Agency's Jurisdiction?					
Agency	**Regulatory Authority**	**Geographic Extent of Jurisdiction**	**Trigger for Permitting**	**Sediment Removal**	**Bank Stabilization**	**Vegetation Management**	**Access Road and V-Ditch Maintenance**	**Culvert Repair and Replacement**	**Debris Removal, Fence Maintenance and Graffiti Removal**
USACE and the RWQCBs	Clean Water Act Sections 404 and 401	Waters of the United States; for the purposes of the SMP, this will primarily be areas below the Ordinary High Water Mark	Placement of dredge or fill materials within Waters of the United States	Generally no. Possible, where temporary fill to Waters of the United States (e.g., coffer dams for dewatering) is necessary.	Yes	No	Yes, where maintenance of V-ditch culverts and outfalls involve temporary or permanent fill to Waters of the U.S.	Yes, where activities involve temporary or permanent fill to Waters of the U.S.	No
RWQCBs	Porter-Cologne Water Quality Control Act	Waters of the State; for the purposes of the SMP, this area includes the bed, bank, and riparian zone of a stream channel, all wetlands, and impacts to beneficial uses of Waters of the State	Discharge of waste that could adversely affect the quality of Waters of the State	Yes	Yes	Yes (only ground-disturbing activities and activities that affect beneficial channel shading)	Yes, where activities could result in discharges within or that could reach Waters of the State (e.g. herbicide use, grading activities, culvert repair).	Yes, where activities are within or could discharge waste (e.g., fill, sediment) to Waters of the State.	No (no regulation of non-ground disturbing activities)
CDFG	Fish and Game Code Section 1600 et seq.	Rivers, streams, or lakes that flow at least intermittently through a bed or channel	Activities that will: ▪ substantially divert or obstruct the natural flow of any river, stream or lake; ▪ substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake; or ▪ deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.	Yes	Yes	Yes	Yes	Yes	No
CDFG	CESA	N/A	Activities with potential for take of species listed as threatened or endangered under CESA.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.
USFWS and NMFS	ESA	N/A	Activities with potential for take of species listed as threatened or endangered under ESA.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.	Yes, where activities could result in take of listed species.

These primary guidance documents, in combination with an informed understanding of the functions and processes of the aquatic resources and wetlands in the Program Area, were considered in developing the mitigation framework described in this chapter.

Watershed Approach to Mitigation

Guidance provided in RGL 02-2 (US Army Corps of Engineers 2002) recommends that watershed and ecosystem approaches be used in developing mitigation programs. More specifically, a watershed-based approach should consider how the watershed physically functions, the overall resource conditions and needs within the watershed, and the relationship between program impacts and overall watershed processes. In other words, the relevance and significance of potential program impacts should be viewed within a comprehensive watershed context. In this way the most appropriate and effective avoidance, minimization, and compensatory mitigation actions can be made.

Guidance in RGL 02-2 (US Army Corps of Engineers 2002) additionally encourages applicants to provide compensatory mitigation through a mix of habitats including open water, wetlands, and adjacent uplands throughout the affected watershed. Multiple mitigation targets can provide a greater variety of ecosystem functions and opportunities for success to compensate for lost or impacted functions.

Appendix B to RGL 02-2 recommends the following approaches.

- Consider the hydrogeomorphic and ecological landscape and climate;
- Adopt a dynamic landscape perspective;
- Whenever possible, choose wetland restoration over creation;
- Restore or develop naturally variable hydrologic conditions; and
- Avoid over-engineered structures in wetland design.

The SMP was entirely conceptualized and framed to follow a watershed approach as referenced in the USACE's guidance above. Section 1.4 of this Manual, *Overview of SMP Approach,* describes how the SMP was developed using a comprehensive understanding of watershed conditions. The physical processes and biological attributes that govern the SMP Program Area are presented in Chapter 3 *Environmental Setting* through a watershed-based approach. Beyond considering general watershed conditions, essential to the SMP is recognizing how specific sites or reaches function as components within the larger watershed system. The subwatershed assessments and channel characterization reach sheets included in Chapter 4 *Channel Characterization* describe physical and biological channel conditions, as well as management considerations for each reach. In conducting the field evaluations to complete the reach sheets, channel assessments were integrated across the watershed, with upstream inputs and downstream outputs considered for each reach. This watershed approach enabled improved understanding of resources and the management of those resources across the whole watershed system.

A watershed-based approach was also used in recognizing program impacts and designing appropriate avoidance and minimization measures. Chapter 5 *Pre-Maintenance Planning Approach and Impact Avoidance* includes several Maintenance Principles operating at the watershed and reach scales that reduce program impacts through avoidance and minimization techniques. Many of the policies and principles in Chapter 5 were developed to ensure an awareness of reach conditions within a watershed context; to know how a particular reach functions in relation to sensitive habitats and fundamental natural processes in the Program Area.

Watershed processes were also considered in developing compensatory mitigation approaches to provide integrated watershed solutions and benefits. Off-site compensatory mitigation for the SMP occurs through funding watershed projects such as erosion control and habitat conservation and restoration in headwater watershed areas upstream of the engineered flood control channels in the Program Area (Section 8.7 below). By reducing sediment inputs from the watershed upstream, the frequency of sediment removal activities (and impacts) occurring in downstream channels is reduced over time.

8.2.2 Regional Water Quality Control Boards

Mitigation planning for the SMP considered potential impacts to beneficial uses within Waters of the State of California, which are under the jurisdiction of the State Water Resources Control Board (SWRCB) and the RWQCBs. Several guidance documents were considered, including the Stream and Wetlands Protection Policy, which is under development by the NCRWQCB and SFRWQCB, and the General Criteria for Mitigation Projects prepared by the Central Coast RWQCB (CCRWQCB 1998). In addition, direct guidance and mitigation preferences were provided by the NCRWQCB and SFRWQCB through the IAWG and the review and approval of previous permitting efforts for SCWA stream maintenance activities.

The Stream and Wetlands Protection Policy has been described in detail in Chapter 2. The implementation plan for the policy is anticipated to establish a general framework for avoiding, minimizing, and mitigating water quality impacts. Key issues relevant to stream maintenance that the policy addresses include maintaining hydrologic connectivity, stream equilibrium, and wetland and riparian area integrity. The SMP's mitigation approach addresses these topics and is based on an informed understanding of the stream systems in the Program Area.

The General Criteria for Mitigation Projects (CCRWQCB 1998) identifies the following criteria for evaluation of mitigation proposals:

- **Water Quality Focus.** Mitigation should incorporate a focus on protection or enhancement of water quality.
- **Geographic Nexus.** Mitigation should have a geographic link or nexus with the area where the impact occurs. Mitigation in a tributary watershed might be appropriate depending on the circumstances, however, work in a far different part of the region or state would likely not meet the geographic nexus criterion.
- **Type of Impact.** The mitigation should be related to the specific impacts of the maintenance project.
- **Beneficial Use Protection.** Mitigation should address protection and improvement of the specific beneficial uses impacted by the maintenance project.

- **Regionwide Use/Benefit.** Mitigation projects may benefit the specific geographic area yet still provide added value regionwide or even statewide.
- **Leveraged funding.** Mitigation for a specific project may be combined with that for other projects to create a much greater or leveraged benefit.
- **Institutional Stability and Capacity.** Mitigation projects should be conducted by entities which are capable of accomplishing the work and providing the products and reports expected.

The SMP's mitigation approach addresses each of these criteria. Beneficial uses, including water quality protection, are maintained or enhanced through the restorative and mitigating actions. Mitigation activities are geographically tied to impacts, occurring on-site and within the watershed, and also provide regional benefits. Restorative and mitigating activities are in-kind to the impacts. Grant funding supports project partners in the SMP watersheds to implement projects with leveraged benefits. SCWA provides institutional stability and capacity to oversee, monitor, and report on the status of all SMP mitigation activities.

In addition to these general criteria, the NCRWQCB and SFRWQCB provided SMP-specific feedback that shaped the program's mitigation approach. This additional guidance reinforces the above criteria and includes the following:

- SMP impacts should be quantified, and mitigation projects should document how or to what scale the mitigation responds to the impacts. Accounting should be performed that clearly links which portion of each mitigation project is attributable to the impacts of a given maintenance project.
- The SMP should utilize the least-damaging practicable alternatives for the various types of channel and habitat maintenance activities. Banks stabilization projects that utilize biotechnical stabilization measures may be considered self-mitigating.
- SMP should prioritize in-kind mitigation for impacts to particular habitat types, and beneficial uses lost as a result of specific activities must be restored. Mitigation for impacts on already degraded habitats (e.g., *Typha*-dominated channels) should focus on replacement with more beneficial habitats, such as creation of low-flow channels, planting of shade species, etc. The RWQCBs strongly support establishment of riparian canopy and healthy understory vegetation, which serves as habitat and helps mitigate impacts of sheet flow runoff. Other mitigation examples include habitat creation, habitat restoration which incorporates spawning gravels and/or pool creation, restoring hardened or culverted channels, sloping back banks to reduce erosion, removing instream reservoirs/dams where feasible, and establishing more natural stream/floodplain systems. Reducing channelization and establishing sinuosity when possible to reduce flows, and widening channels to reduce flow velocity were other suggestions.
- Mitigation activities should occur at, or as near to as possible, to the maintenance site.
- Mitigation targets should be developed which reflect the intensity and duration of impact. Long-term impacts (those with a duration of more than a year) can be

addressed through on-site restoration of the maintenance site. Short-term impacts which remain unmitigated while on-site restoration is established will require off-site mitigation. A 1:10 mitigation ratio of acres restored to acres impacted is an appropriate metric for short-term impacts.

- SCWA needs to provide assurances that mitigation projects will succeed and be appropriately monitored. To this end, a full description of each mitigation project needs to be submitted, and should include a monitoring and reporting plan which is implemented for 5 years after mitigation project completion. Clear performance standards (e.g., 80% survival rate) should be identified, as well as remedial measures should performance standards not be met.
- Mitigation projects need to be reviewed for their own water quality impacts, and may require their own permitting.
- The SMP should consider measures to avoid the need for channel maintenance, including off-stream flood storage, high flow bypass, floodplain restoration, focused sediment collection areas, and runoff minimization. Watershed-level mitigation should be considered that addresses source control of sediments and flow where possible[1].

8.2.3 California Department of Fish and Game

CDFG is mandated with protecting the State's fish and wildlife resources. For the SMP, this protection is articulated through two primary regulations. Under the California Endangered Species Act (CESA), CDFG regulates "take" of species listed by the state as threatened or endangered. Impacts to aquatic and riparian habitat are regulated by CDFG through Fish and Game Code Section 1600 et seq. (the Streambed Alteration Program). These two regulations are described in more detail in Chapter 2.

While it is possible that larger SMP mitigation projects will address potential take of CESA-listed species, it is likely that other more specific mitigation projects will need to be implemented to address species-specific needs, if take of a CESA listed species occurs. Such species-specific mitigation would occur in addition to the general mitigation implemented on behalf of the USACE or RWQCBs. This would occur when general project mitigation does not provide the particular benefits needed to address potential take of CESA species.

No published guidance exists to develop mitigation for impacts to aquatic and riparian habitat under the Streambed Alteration Program. Rather, under the program, CDFG has broad authority to identify the fish and wildlife resources that maintenance activities may substantially adversely affect and identify measures as necessary to protect those resources. For the SMP, direct guidance and mitigation preferences were provided by CDFG through the IAWG and the review and approval of previous permits for recent stream maintenance projects. SMP-specific guidance from CDFG has included the following:

[1] Through IAWG discussions (January 16, 2008 and March 19, 2008), the RWQCBs acknowledged that discharge control and hydromodification management are beyond the immediate scope and purpose of the SMP. However, the RWQCBs consider the hydrologic impacts of urban stormwater related to the SMP as runoff reaches the SMP channels. SCWA's Flood Control Design Criteria Manual (FCDC) addresses urban drainage design. The FCDC Manual is currently under revision to incorporate additional Low Impact Development (LID) and other runoff impact avoidance measures.

- Maintenance activities may have beneficial impacts. For instance, activities which lead a channel away from cattail dominance towards a more varied and complete riparian corridor with overstory canopy and understory shrubs are encouraged. In-kind mitigation should be guided by reach ecologic needs (e.g., removal of cattails should not be mitigated by planting cattails), and should focus on replacement or improvement of stream function.
- Mitigation should consider existing high quality stream areas, and avoid impacts to such habitat values.
- While a historic reference condition may not be available, channels should be maintained to function hydraulically as well as provide habitat value.
- As a goal, mitigation should be implemented in the same year that the impact occurs, to reduce the time between the impact and the mitigation.
- SMP mitigation projects should only account for impacts resulting from SMP maintenance projects. To prevent redundancy in mitigation crediting, SMP mitigation projects should not be used to fulfill mitigation requirements for other Streambed Alteration Agreements or CESA permits.
- The monetary contribution to mitigation projects needs to be translated to ecological benefit that can sufficiently offset the impacts of SMP projects. Mitigation projects shouldn't have to rely on other monetary sources for successful implementation.
- Mitigation projects should be limited to the planning and implementation of on-the-ground habitat restoration and enhancement activities. Education and outreach may be considered in the future if sufficient evidence demonstrates a clear correlation between education and outreach programs and reduced work re-occurrence intervals.

8.2.4 U.S. Fish and Wildlife Service and National Marine Fisheries Service

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) oversee impacts to species listed as threatened or endangered under the federal Endangered Species Act. As part of the SMP, Biological Opinions will be obtained from USFWS and NMFS which identify mitigation requirements for take of federally listed species. Off-site mitigation will typically be identified through a mitigation ratio (X acres preserved or restored for each X acre of impact to habitat). Where feasible and appropriate, such mitigation requirements would be combined with the mitigation approaches identified in this chapter to provide comprehensive mitigation through the SMP mitigation program. However, similar to the situation above for CDFG, it is likely that impacts to particular listed species may require additional species-specific mitigation.

8.3 Summary of Program Impacts

8.3.1 Overview

This section provides a brief summary of impacts related to water quality, habitat, aquatic functions, and fish and wildlife resources. A complete description of impacts is provided in the SMP EIR, and is not repeated here. However, a summary is included in the SMP to provide context for the mitigation approaches that have been developed and are described below.

The impact discussion in this section is organized through the framework of Beneficial Uses. Beneficial Uses are a collection of functions and values identified for water bodies in RWQCB Basin Plans. The CWA and Porter-Cologne Water Quality Control Act grant the RWQCBs authority to assign and protect these Beneficial Uses. Through IAWG discussions (at meetings on January 16, 2008 and March, 19, 2008) regulatory agency staff recommended using Beneficial Uses as a method to organize and evaluate program impacts. Beneficial Uses include a wide range of resource topics such as aquatic functions and values, fish and wildlife habitat protection, and effects on state- and federally-listed species. The Beneficial Uses identified for and applicable to water bodies within the SMP area are shown in Table 8-2.

The SMP Manual describes three main activity types: sediment management, bank stabilization, and vegetation management. Several smaller scale activities are also described including removing flow blockages from modified and natural channels, maintenance of access roads and roadside V-ditches, culvert repair and installation, debris removal, fence maintenance, and graffiti removal. This section describes the potential direct and indirect impacts to aquatic and terrestrial habitat and water quality Beneficial Uses that may occur as a result of implementing SMP activities. These impacts are characterized as temporary or permanent, as appropriate, and any residual impacts remaining after implementation of avoidance and minimization measures are discussed. Additionally, beneficial impacts resulting from the maintenance activities are discussed in light of their effect on Beneficial Uses.

The description of potential impacts is based on impacts that were identified during the 2006-2008 interim stream maintenance permitting process, and the current SMP EIR analysis. The 46 projects reviewed, permitted, and implemented during the three year interim SMP development period provided a broad basis to understand program impacts. The projects implemented during the 2006-2008 period are very representative of SMP activities. Experience gained during the interim permitting effort is used to support the mitigation discussion below.

This section does not disclose or provide a comprehensive review of all potential environmental impacts that may occur as a result of implementing activities described in this SMP Manual. A complete review of such impacts has been conducted for the SMP in the accompanying EIR. Impacts identified in this chapter focus on resource issues that are relevant under the authority of the various resource agencies issuing permits for the SMP. The impact discussion considers the approach to maintenance presented in Chapter 5, the description of activities presented in Chapter 6, and the avoidance and minimization approach presented in Chapter 7. In other words, this impact discussion assumes that the pre-maintenance planning and impact avoidance measures described in Chapter 5 and the Best Management Practices (BMPs) described in Chapter 7 have already been applied. As such, the impact discussion focuses on the residual impacts of SMP activities that cannot be completed avoided or minimized, and may still require additional compensatory mitigation.

Table 8-2. Potential Impact of SMP Maintenance Activities on Beneficial Uses

SMP Maintenance Activity	GWR		REC-2		WARM		COLD	
	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial
Sediment Removal	None	Improved infiltration after removal of fine sediments. (Permanent)	Sediment removal activities would temporarily suspend recreational access to channels, and would degrade the aesthetic quality of the channels in the short term. (Temporary)	Sediment management activities will improve riparian condition over time, with corresponding recreational benefits. (Permanent)	Dewatering and sediment removal would temporarily impact habitat in the dewatered area. (Temporary)	Removal of sediment and creation of low-flow channels will improve flow and water quality conditions, which will improve warm water habitat. (Permanent)	Dewatering and sediment removal would temporarily impact habitat in the dewatered area. (Temporary)	Removal of sediment and creation of low-flow channels will improve flow and water quality conditions, which will improve cold water habitat. (Permanent)
Bank Stabilization	None	Reduced release of fine sediments which could impair groundwater recharge. (Permanent)	Bank stabilization activities could temporarily suspend recreational access to channels, and newly stabilized areas would appear somewhat unnatural in the short term. (Temporary)	Bank stabilization will ultimately improve riparian condition, with corresponding recreational benefits. (Permanent)	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in the work area. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will improve warm water habitat. (Permanent)	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in the work area. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will improve cold water habitat. (Permanent)
Vegetation Management	None	Improved infiltration after removal of vegetation. (Permanent)	Vegetation removal activities could temporarily suspend recreational access to channels, and would degrade the aesthetic quality of the channels in the short term. (Temporary)	Vegetation management and riparian canopy development will improve riparian condition over time, with corresponding recreational benefits. (Permanent)	Vegetation removal would temporarily reduce canopy cover, impacting warm water habitat. (Temporary)	Vegetation management will improve flow and water quality conditions. In addition, revegetation activities will encourage riparian canopy development and improve habitat conditions over time through such mechanisms as water temperature moderation. (Permanent)	Vegetation removal would temporarily reduce canopy cover, impacting cold water habitat. (Temporary)	Vegetation management will improve flow and water quality conditions. In addition, revegetation activities will encourage riparian canopy development and improve habitat conditions over time through such mechanisms as water temperature moderation. (Permanent)
Other Activities Access Roads V-ditch Maintenance Culvert Replacement Debris Removal	None	None	Temporary closure of public trails during maintenance activities. (Temporary)	Maintenance would improve creek and trail aesthetics, public safety, and storm runoff. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on warm water habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on cold water habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)

Table 8-2. Potential Impact of SMP Maintenance Activities on Beneficial Uses

SMP Maintenance Activity	WILD		RARE		EST		MIGR	
	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial
Sediment Removal	Dewatering and sediment removal would temporarily impact habitat in the dewatered area. (Temporary)	Removal of sediment and creation of low-flow channels will improve flow and water quality conditions, which will benefit a wide array of native fish and wildlife. (Permanent)	Dewatering and construction activities would temporarily impact habitat in and around the work site. (Temporary)	Sediment removal and creation of low-flow channels will improve flow and water quality conditions, which will benefit habitat for rare, threatened, and endangered species. (Permanent)	Dewatering and maintenance activities could temporarily impact habitat in and around tidal areas. (Temporary)	Sediment removal and channel reshaping will improve flow and water quality conditions, which will benefit estuarine habitat. (Permanent)	Reaches that support migratory habitat would be temporarily dewatered during the dry season. (Temporary)	Sediment removal and creation of low-flow channels will improve flow and water quality conditions, which will improve migratory habitat. (Permanent)
Bank Stabilization	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in the work area. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will benefit a wide array of native fish and wildlife. (Permanent)	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in the work area. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will benefit habitat for rare, threatened, and endangered species. (Permanent)	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in tidal areas. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will benefit estuarine habitat. (Permanent)	Bank stabilization activities, and dewatering, where necessary, would temporarily impact habitat in the work area. (Temporary)	Bank stabilization will remove sediment inputs to the channel and enhance the riparian corridor, which will improve migratory habitat. (Permanent)
Vegetation Management	Vegetation removal would temporarily reduce canopy cover, impacting wildlife habitat. (Temporary)	Vegetation management and riparian corridor enhancement will benefit a wide array of native fish and wildlife. (Permanent)	Vegetation removal would temporarily reduce canopy cover, impacting habitat for rare, threatened, and endangered species. (Temporary)	Vegetation management and riparian corridor enhancement will benefit habitat for rare, threatened, and endangered species. (Permanent)	Vegetation removal would temporarily impact habitat in and around tidal areas. (Temporary)	Vegetation management and riparian corridor enhancement will improve flow and water quality conditions, which will benefit estuarine habitat. (Permanent)	Vegetation removal would temporarily reduce canopy cover, impacting migratory habitat. (Temporary)	Vegetation management and riparian corridor enhancement will improve migratory habitat over time. (Permanent)
Other Activities Access Roads V-ditch Maintenance Culvert Replacement Debris Removal	If culvert replacement requires site dewatering, temporary impacts on wildlife habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on special status species habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on estuarine habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on migratory habitat would result. (Temporary)	Maintenance will ensure culverts are free of debris so flows and aquatic species can move freely through the system. (Permanent)

Table 8-2. Potential Impact of SMP Maintenance Activities on Beneficial Uses

SMP Maintenance Activity	SPWN		FLD		WET		WQE	
	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial
Sediment Removal	Spawning does not currently occur in SCWA-maintained channels.	Improved flow and water quality conditions will benefit habitat for salmonids elsewhere in the watershed. (Permanent)	Activities would be conducted during the dry season, so there would be no impact on the flood peak or flood storage.	Sediment removal would improve flood conveyance. (Permanent)	Sediment removal activities would also remove wetland species. (Temporary)	Improved sediment management would support wetland habitat and functioning. (Permanent)	Dewatering and maintenance activities would temporarily impact water quality in and around the work site. (Temporary)	Sediment management and creation of low-flow channels would improve water quality functioning. (Permanent)
Bank Stabilization	Spawning does not currently occur in SCWA-maintained channels.	Improved water quality conditions will benefit habitat for salmonids elsewhere in the watershed. (Permanent)	Activities would be conducted during the dry season, so there would be no impact on the flood peak or flood storage.	Stabilized banks would reduce sources of sediment to downstream areas and would be replanted with riparian species to improve floodplain functioning. (Permanent)	Newly stabilized areas would be devoid of vegetation and temporarily covered with erosion controls. (Temporary)	Stabilized banks would reduce sources of sediment to downstream areas and would be replanted with riparian species to improve wetland functioning. (Permanent)	Newly stabilized areas would be devoid of vegetation and temporarily covered with erosion controls. (Temporary)	Stabilized banks would reduce sources of sediment to downstream areas and would be replanted with riparian species to improve water quality functioning. (Permanent)
Vegetation Management	Spawning does not currently occur in SCWA-maintained channels.	Improved riparian quality will benefit habitat for salmonids elsewhere in the watershed. (Permanent)	Activities would be conducted during the dry season, so there would be no impact on the flood peak or flood storage.	The site would be replanted with native riparian species to foster better floodplain functioning, including water quality filtration. (Permanent)	Non-native wetland species would be removed. (Temporary)	Planting of native wetland vegetation would support habitat for a variety of native species. (Permanent)	Removal of in-channel vegetation would reduce sediment trapping. (Temporary)	Improved vegetation management would support development of riparian corridors which enhance water quality functioning while improving channel stability. (Permanent)
Other Activities Access Roads V-ditch Maintenance Culvert Replacement Debris Removal	Spawning does not currently occur in SCWA-maintained channels.	Culvert and debris clearing activities will benefit habitat for salmonids elsewhere in the watershed. (Permanent)	Activities would be conducted during the dry season, so there would be no impact on the flood peak or flood storage.	Maintenance of v-ditches, culverts, and keeping channels free of debris will improve storm runoff and flood flows through channels.	If culvert replacement requires site dewatering, temporary impacts on wetland habitat would result. (Temporary)	Suppression of invasive plants along access roads and in v-ditches will support growth of native species, thus benefiting riparian habitat along the channels. (Permanent)	If culvert replacement requires site dewatering, temporary impacts on water quality would result. (Temporary)	Maintenance activities would improve water quality filtration functions, as well as prevent channel erosion due to culvert or debris blockages. (Permanent)

Table 8-2. Potential Impact of SMP Maintenance Activities on Beneficial Uses

Shaded Beneficial Uses listed below are not present at, or do not apply to, the sites potentially affected by SMP maintenance activities.

MUN	Municipal and Domestic Supply	NAV	Navigation	ASBS	Preservation of Areas of Special Biological Significance	SHELL	Shellfish Harvesting
AGR	Agricultural Supply	POW	Hydropower Generation	SAL	Inland Saline Water Habitat	EST	Estuarine Habitat
IND	Industrial Service Supply	REC-1	Water Contact Recreation	WILD	Wildlife Habitat	AQUA	Aquaculture
PRO	Industrial Process Supply	REC-2	Non-Contact Water Recreation	RARE	Rare, Threatened, or Endangered Species	CUL	Native American Culture
GWR	Groundwater Recharge	COMM	Commercial and Sport Fishing	MAR	Marine Habitat	FLD	Flood Peak Attenuation/ Flood Water Storage
FRSH	Freshwater Replenishment	WARM	Warm Freshwater Habitat	MIGR	Migration of Aquatic Organisms	WET	Wetland Habitat
		COLD	Cold Freshwater Habitat	SPWN	Spawning, Reproduction, and/or Early Development	WQE	Water Quality Enhancement

This impact discussion, as well as the EIR analysis, was used to develop an appropriate mitigation planning process which is presented below in Sections 8.4 through 8.7.

8.3.2 Sediment Removal Activities

Adverse Impacts

Sediment removal activities could adversely impact Beneficial Uses due to disturbance to sensitive species habitat, channel dewatering, and hazards from use of equipment in the channel. Potential adverse impacts on Beneficial Uses are summarized in the first row of Table 8-2.

As discussed in Chapter 7 and the Biological Resources and Hydrology and Water Quality sections of the SMP EIR, sediment removal activities may adversely affect habitat for sensitive wildlife, fish, and plant species. For example, as illustrated in Table 7-3, western pond turtle habitat may be present in the majority of SCWA-maintained reaches, and migratory habitat for steelhead trout is also present in a handful of maintained stream reaches. SMP maintenance activities would be conducted during the dry season when steelhead are not migrating. However, western pond turtles prefer standing water, which occurs in many of the perennial pools and stream reaches throughout the Program Area, and could thus be affected. Impacts on sensitive species from sediment removal activities would potentially result from direct disturbance to the streambed and bank, in-channel vegetation removal, and channel dewatering.

Removal of sediment in the creek channel, for both reach scale and localized culvert clearing projects, would also remove vegetation (small willow trees and cattails) established in the accumulated sediment. Due to the nature of sediment movement in the channels maintained under the SMP, in-channel vegetation quickly reestablishes, largely on an annual basis. Thus, in-channel vegetation will reestablish and the disruption to habitat is temporary.

Temporary channel dewatering for sediment removal activities may adversely impact water quality and biological resources. Installation, operation, and removal of dewatering systems will involve disturbance to the streambed and bank, which can temporarily increase turbidity in the water column surrounding the work site and encourage transport of sediment downstream. Additionally, isolation of the work site and redirection of creek flow could harm aquatic species, such as fish and frogs. Implementation of BMP BR-4 *Impact Avoidance and Minimization during Dewatering* in Table 7-1 will alleviate these impacts. Once maintenance activities are complete, channel flow would be restored as would water quality and biological resources.

Use of mechanized equipment such as bobcats and front-end loaders for sediment removal in the creek channel would present an opportunity for accidental release of hazardous materials to the environment. Spills or leaks of fuel or lubricants could temporarily or permanently contaminate water quality and habitat, as well as harm maintenance workers and residents. This impact would have the potential to occur only during maintenance activities and would be mitigated by implementation of BMPs HAZ-1 through HAZ-8, as described in Table 7-1.

These temporary sediment removal impacts will be avoided or minimized through the maintenance approach described in Chapter 5 and the BMPs listed in Tables 7-1 and 7-2 for sediment removal activities. However, even after implementation of appropriate BMPs, some residual impacts are expected to be unavoidable.

Beneficial Impacts

In addition to the adverse impacts of sediment removal discussed above, long-term permanent beneficial impacts will result from sediment removal activities, as summarized in Table 8-2. Sediment removal activities would not significantly alter creek functioning nor would they reduce the quantity of habitat supported by the reaches. On the contrary, sediment removal activities would improve these functions both at the site and within the larger watershed.

In terms of water quality and biological resources, removal of fine sediment from the channel bed will improve water quality filtration and groundwater recharge functions. Creation and maintenance of low-flow channels will encourage fine sediment to settle on small benches, similar to floodplain functioning. In this way, under small storm events or during the dry season, the low-flow channel will be free flowing as sediment accumulates on the benches, thus enhancing fish passage opportunities and improving instream fish habitat. Removal of invasive in-channel vegetation, such as cattails, will not only improve flow conditions but also provide opportunities for a diverse variety of wetland vegetation to establish in the channel. Having a variety of in stream vegetation enhances overall function by providing a mixture of stream inputs (leaf litter and decomposition, stem runoff, etc) and diverse soil-root-water interactions.

In the absence of sediment removal, most SCWA flood control channels in depositional areas, will develop to cattail dominated and blocked streams. For several reasons previously discussed, large expanses of cattails are not ecologically desirable, nor compatible with flood management objectives. Overall, periodic sediment removal in conjunction with selective tree and shrub removal, thinning, and planting activities are anticipated to provide an overall benefit to native plant and wildlife habitat.

Conclusions

While sediment removal activities will result in several long-term benefits as described above, they will also result in adverse impacts to water quality and biological resources through direct disturbance to instream habitat. As part of ongoing program development and refinement, SMP monitoring efforts will document changes in channel composition and function resulting from sediment removal activities. In this way, the true measure of program impacts and benefits will be better understood over time.

8.3.3 Bank Stabilization Activities

Adverse Impacts

Impacts to Beneficial Uses associated with bank stabilization will be similar to those described above for sediment removal activities. However, bank stabilization activities would also cause disturbance to upslope areas of the channel, and in some cases, hardening of the channel would be necessary where rip-rap is placed as part of slope repairs. Potential impacts on Beneficial Uses associated with bank stabilization activities are summarized in the second row of Table 8-2.

Bank stabilization activities will disturb a different habitat type compared to sediment removal activities because maintenance could extend to upslope areas above the OHWM, up to the top of the bank. Upland areas support a different suite of habitat for plants and wildlife. For example, tree species like bay and oak prefer upland areas as opposed to wetted portions of the channel, and California tiger salamanders may utilize burrows in upland habitat during certain times of the year. Impacts from dewatering and use of equipment in the stream channel will create similar impacts on water quality and wildlife as described above. However, because maintenance would also extend to upland areas, the degree of impact on wildlife, in particular, could be slightly more adverse depending upon wildlife use. As discussed below and in the SMP EIR, implementation of BMPs and complete restoration of the site would minimize short-term impacts, and alleviate all long-term impacts.

Additional impacts from bank stabilization activities may occur through hardening of the natural bank (i.e., placement of rock on the bank) if a project requires rock rip-rap to stabilize the toe-of-slope as part of the bank reconstruction (see Figure 5-6). To begin with, placement of rock rip-rap to stabilize the toe-of-slope during bank stabilization and culvert outfall activities may result in fill to waters of the United States. In all such cases, the minimum amount of fill is placed to the extent necessary to repair the bank. In other words, work is only conducted to maintain the original channel structure, and there would be no permanent fill of waters of the United States beyond the pre-existing footprint of the as-built channel design. The rip-rap would result in minor permanent changes to channel, water quality functioning, and wildlife habitat.

Beneficial Impacts

Bank stabilization projects provide long-term beneficial impacts and mitigation by reducing erosion and sediment loading to the channel and downstream resources. Destabilized banks that are not repaired will continue to erode and shed sediment into the channel. This is particularly sensitive in reaches closest to the Laguna de Santa Rosa (such as Santa Rosa, Bellevue-Wilfred, Hinebaugh, or Copeland creeks) and where sediment may not have the opportunity to settle out before being discharged to the Laguna. Similarly, the Petaluma River and Sonoma Creek are listed as impaired by sediment; as a result, any reduction in sediment loading, such as from unstable banks, is beneficial to the system (see Chapter 3, Section 3.8 for additional details). To further reduce the risk of additional sediment loading to creeks, bank stabilization sites are seeded with grasses and planted with trees which will foster development of riparian overstory. Thus, a site which was devoid of vegetation and exposing bare soil will be stabilized and restored with native riparian vegetation. Remediation of eroding banks will reduce the need for maintenance activities, such as sediment removal, downstream.

Conclusions

Though sensitive species and habitat would be temporarily impacted during maintenance activities, the overall effect of the bank stabilization projects would be long-lasting and beneficial. This is illustrated in photo (a) of Figures 5-5, 5-6, and 5-7 which show bank stabilization projects before and after stabilization. The "after" photos (b) were taken approximately 1 year after the project was completed.

The Maintenance Principles (Chapter 5), Bank Stabilization Framing Considerations (Chapter 6), and Programmatic Avoidance and Minimization Measures (Chapter 7) discussed previously will ensure that potential impacts from bank stabilization activities are avoided and minimized. The maintenance approach and BMP measures implemented for bank stabilization activities would self-mitigate for temporary impacts during maintenance. If necessary, placement of rip-rap in the channel would harden the bank and result in a permanent and residual impact of bank stabilization. Mitigation of this impact is discussed in further below.

As described above for sediment removal activities, SMP monitoring efforts will document changes in channel composition and function resulting from bank stabilization activities. In this way, the true measure of program impacts and benefits will be better understood over time.

8.3.4 Vegetation Management Activities

Adverse Impacts

Vegetation management is generally categorized into three types of activities: vegetation removal, pruning, and planting. Management of both native and non-native or invasive plant species is conducted throughout the SMP Area. Methods for vegetation management vary from use of heavy machinery and chemical controls to selective tree pruning and hand weeding.

Potential impacts associated with vegetation management activities include temporary loss of understory vegetation, channel canopy, and nesting habitat, as well as temporary water quality degradation, as summarized in Table 8-2. Selective pruning and removal activities may result in the short term reduction of canopy provided by understory trees, shrubs, and vines plants. Shrubby vegetation, such as arroyo willow (*Salix lasiolepis*) and Himalayan blackberry (*Rubus discolor*), will be removed to improve flow conveyance and promote taller upright tree species to establish canopy cover over the channel. Pruning and removal of exotic trees or arroyo willow growing on the lower bank may also reduce the existing channel canopy cover. Loss of canopy cover may encourage growth of invasive plants, such as cattails, in the channel. Loss of taller trees could reduce available nesting habitat for birds such as raptors. However, removal of tall exotic trees within the riparian corridor that provide shading over the channel will rarely occur as the benefit provided by their shade and nesting habitat in most cases outweighs their adverse affects. In general, large exotic trees are not removed (unless identified as an immediate hazard) until an appropriate replacement has been planted and has grown large enough to provide similar habitat and wildlife functions (shade, perching, nesting, foraging, etc).

The methods employed for vegetation management will have varying impacts on water quality and biological resources in the channel. Similar to the impacts for sediment removal and bank stabilization activities described above, any vegetation removal work in the channel that involves ground disturbance, such as root wad removal, may result in increased sediment loading to the creek, particularly if heavy equipment is used. Avoidance and minimization measures will be required for any mechanized vegetation removal activities. Hand removal activities, such as tree pruning and invasive species removal, will minimally impact water quality and biological resources. Planting activities will minimally impact channel habitat because the majority of these activities are conducted by hand.

Herbicides used to prevent growth of invasive plants, such as willows and blackberry, or to keep access roads free of vegetation, could impact non-target vegetation or water quality if improperly used. Accidental herbicide spills could adversely impact water quality and biological resources. To prevent these impacts, herbicide use will be restricted to hand application to vegetation in the channel and strictly controlled spray application on access roads. Additional minimization measures for herbicide application activities are described in Chapter 7.

Beneficial Impacts

The longer-term vegetation maintenance approach will achieve incremental habitat lift as portrayed in Figure 5-1 in Chapter 5, whereby larger single-trunked trees are preferentially pruned and planted in place of shrubby bank species or dense trees such as arroyo willow. As a mature canopy develops, less light may reach the channel bed and banks below reducing the presence of shrubby vegetation beneath the canopy. Reduction of shrubby in-channel vegetation improves flow conveyance capacity in the channel, thus reducing the potential for flooding. Wildlife habitat in the majority of stream reaches in the SMP area will benefit from development of upper bank riparian, as opposed to in-channel, vegetation. A developed riparian overstory helps provide water temperature control for the benefit of cold water species, such as steelhead trout. Therefore, loss of understory vegetation that is replaced by other canopy-providing vegetation is not considered adverse. The replanting of in stream overhanging sedges and grasses will also provide some habitat value for frogs and a variety of insects.

Conclusions

Maintenance Principles (Section 5.2), Vegetation Management Approach Framing Considerations (Section 5.4.1), and Programwide Best Management Practices (Chapter 7) including BMPs will assist in avoidance and minimization of potential impacts for vegetation management activities. While Maintenance Principles and other maintenance or BMP measures minimize impacts to vegetation, there may be occasions when vegetation planted as mitigation for SMP activities does perform to the success criteria after 5 years. This would be considered a permanent loss and measures to mitigate this impact are discussed below in Section 8.10.2, bullet 4. However, in general vegetation management activities do not result in residual impacts that require compensatory mitigation, unless they are conducted in coordination with other activities that require such mitigation (e.g., sediment removal, bank stabilization).

As described above for sediment removal and bank stabilization activities, SMP monitoring efforts will document changes in channel composition and function resulting from vegetation management activities. In this way, the true measure of program impacts and benefits will be better understood over time.

8.3.5 Other Maintenance Activities

This section discusses several smaller-scale activities conducted by SCWA as part of ongoing stream maintenance. These activities include vegetation maintenance in modified and natural channels, access road and v-ditch maintenance, culvert repair and replacement, debris removal, fence maintenance, and graffiti removal. Potential impacts associated with each of these additional items are discussed below.

Modified and Natural Channels Maintenance

As described in Section 6.5, though not obligated SCWA may exercise the option to conduct vegetation management in modified and natural channels. These activities are focused on clearing over-grown vegetation, fallen trees, or other debris that is inhibiting flow. These activities are targeted and small scale in nature. Impacts associated with this activity are the same as those identified above under vegetation management except that there is no anticipation of permanent losses to understory vegetation. Work in modified and natural channels is focused on maintaining movement of water through the system. Such maintenance activities are very localized, have a limited footprint (typically less than 50 feet of channel length), and are usually targeted at road crossings and culverts. Permanent impacts to vegetation are not anticipated through these activities.

In development of the SMP, guidance was provided by NMFS staff to the importance of certain natural channels in providing habitat for coho salmon. As a result of that guidance, known coho-bearing streams were removed from inclusion in the SMP. Additionally, in the Biological Opinion (BO) issued by NMFS for maintenance activities in the Russian River watershed, Mark West Creek and its tributaries upstream of the Laguna are identified as coho-bearing streams. The BO issued for this area does not cover SMP activities. Similarly, representatives from CDFG and USFWS identified natural or modified streams in which California freshwater shrimp are known to exist. Creeks that support freshwater shrimp habitat were also removed from the SMP with the exception of Sonoma Creek. Creeks supporting coho salmon and/or California freshwater shrimp are listed in shown in Figures 1-2 through 1-9 and 1-12 as green dashed lines.

Sonoma Creek is mostly a modified or natural channel throughout its extent in Zone 3A. While there are engineered channels within Zone 3A, including tributary channels to Sonoma Creek; there are no engineered reaches along Sonoma Creek proper (Figure 1-4). However, because several homes are near and adjacent to Sonoma Creek, a potential for flooding to cause damage to property or safety hazards exists. As such, Sonoma Creek was not removed from the SMP. A BMP was specifically developed in consideration of potential maintenance activities on Sonoma Creek. This measure is included in Table 7-1, BR-9 *California Freshwater Shrimp Avoidance and Impact Minimization for Vegetation Management*. Any vegetation management in the modified or natural channels of Sonoma Creek will occur above water level and will not disturb vegetation or debris overhanging into pools or glides (with slow or slack water). This measure will reduce potential impacts to California freshwater shrimp on Sonoma Creek.

In summary, SCWA has taken precautionary measures to exclude reaches to avoid potential adverse impacts to these two federally and state endangered species. As such we anticipate no adverse impacts to coho salmon or California freshwater shrimp.

Access Road and V-Ditch Maintenance

Maintenance projects in this category may include vegetation pruning or herbicide application on access roads; access road repairs, grading, and/or resurfacing; maintenance of V-ditches; and maintenance of V-ditch culverts and outfalls. Beneficial Use impacts associated with access road and V-ditch maintenance activities potentially include temporary loss of vegetation due to pruning, mowing, herbicide use, or clearing for project access; hardening of channel due to use of rock rip-rap to stabilize or support a culvert; temporary impacts on biological resources during maintenance; degradation of water quality during and following project construction; and degradation of water quality due to the application of herbicides, as summarized in Table 8-2.

The temporary impacts associated with vegetation management on access roads and V-ditches will be the same as those described in Section 8.3.4, above. Likewise, potential impacts to water quality, particularly from use of herbicides, may result for the same reasons as described previously. However, the extent of such impacts is anticipated to be less for access road and V-ditch maintenance because, with the exception of installing a new culvert outfall, these activities occur outside the top-of-bank and channel dewatering is not required.

Similar to bank stabilization, rock rip-rap may be used to stabilize V-ditch culverts and culvert outfalls. Installation of rip-rap above the top-of-bank would minimally impact biological resources or water quality. However, installation of rip-rap for V-ditch outfalls located below the OHWM will result in hardening of the channel at the outfall location. This constitutes a permanent impact and mitigation will be required, as discussed below.

Culvert Maintenance, Repair, and Replacement

Culvert repair and replacement activities are described in detail in Section 6.6.5. These activities include the repair or full re-installation of stream crossings for which SCWA has maintenance responsibilities. Stream crossings for roads, pedestrian trails, and cattle trails are commonly designed with one to three culverts placed just below the bed of the channel and filled on top with gravel. Channel dewatering, temporary loss of vegetation due to clearing for access, hardening of the channel if the stream crossing footprint is expanded, and disturbance to biological resources during culvert maintenance may impact Beneficial Uses, as described in Table 8-2.

Potential impacts for this maintenance activity are similar to those described for localized sediment removal activities, such as at box culverts. Temporary impacts on water quality and biological resources would primarily result from channel dewatering and work in the channel. As discussed previously, BMP measures implemented during maintenance will reduce these temporary impacts.

When possible, culverts for stream crossings will be replaced within the same footprint, resulting in no additional hardening of the channel. However, in some cases it may be necessary to expand the crossing footprint to upgrade the crossing (e.g., because the existing culverts are undersized). This was the case when six cattle crossings at Roseland Creek were replaced in 2008 as part of the interim SMP projects. Each of the crossings had culverts which were damaged or too small in diameter to adequately pass the flow and sediment loads in that creek reach. The culverts were replaced with larger ones, which resulted in the need for additional fill within the channel. Fill and hardening of the channel, such as in the Roseland Creek project, constitutes a permanent impact on biological resources and water quality. This impact will be mitigated according to the process described in Section 8.4 *Mitigation for Residual and Temporary Impacts*, below.

Culvert repair and replacement are a small subset of maintenance activities conducted under the SMP. Though the majority of impacts associated with this activity are temporary, the proper maintenance and design of stream crossings will contribute to beneficial impacts on wildlife habitat and water quality within the SMP Area.

Debris Removal, Fence Maintenance, and Graffiti Removal

Debris removal, fence maintenance, and graffiti removal activities are described in detail in Sections 6.6.6, 6.6.7, and 6.6.8. Few, if any, impacts are anticipated to occur as a result of these activities. In some cases, very minor vegetation removal may be required to access a project site. Similarly, some sediment may be briefly disturbed when debris is removed from within the active channel. Overall, these are minor activities conducted as part of stream maintenance that do not require permits, are generally beneficial in nature, and are mentioned here for reference and discussion purposes.

The removal of garbage and debris from SMP channels is considered an important program benefit. Shopping carts, furniture, electronic equipment, paint cans and other various household products are often found in the program channels. SCWA maintenance crews keep watch for such illegal dumping and clear such trash and debris immediately upon observation or receiving reports from community members. These actions are beneficial for the protection of water quality and Beneficial Uses.

8.4 Mitigation for Residual and Temporary Impacts

Residual impacts are potential impacts that are not fully mitigated through the application of avoidance, minimization, and beneficial activities as described in the preceding sections. As directed by regulatory agencies, these impacts may require additional compensatory mitigation. The residual impacts identified above include:

- Temporary impacts during or immediately following maintenance activities;
- Permanent hardening of the channel due to placement of rip-rap for bank stabilization, culvert replacement, etc.; and
- Placement of fill for culvert repair or replacement projects that require an expanded footprint or culvert size (compared to existing conditions).

Impacts from the latter two types of projects will result in the permanent loss of vegetation and reduction in open channel area. The frequency that these impacts will occur is low due to the fact that SCWA maintains only a small number of stream crossings with culverts. In addition, many of the existing drop-inlet culverts are surrounded by a solid concrete structure. If necessary, such structures will be replaced with rock rip-rap which allows dirt to fill in the cracks and vegetation to establish. Use of rip-rap and removal of concrete structures will beneficially impact water quality and biological resources.

Nonetheless, these activities will result in fill of waters of the U.S. and therefore require mitigation for resulting impacts on Beneficial Uses, as directed by regulatory agency guidance described in Section 8.2. Additional residual impacts occur as temporary impacts due to the time gap between when maintenance activities occur and when the restoration and mitigation actions (as described below) are implemented.

The compensatory mitigation approach for the SMP utilizes three tiers. Mitigation is first and foremost directed to address the maintenance impacts on-site at the specific project reach (Tier 1). Tier 1 mitigation, at a minimum, will restore the beneficial uses and ecological functions and values that were provided by a site in its original (pre-maintenance) condition. In addition, where opportunities exist, it may provide additional benefits. Tier 1 mitigation addresses for the long-term impacts of SMP activities, and is conducted at a 1:1 ratio of acres restored to acres disturbed.

Mitigation opportunities are also considered at other SWCA reaches (Tier 2), and off-site locations within the watershed (Tier 3). These two tiers of mitigation address the temporary loss of Beneficial Uses and ecological functions and values during the time gap between SMP maintenance activities and when Tier 1 mitigation occurs, and the time when Tier 1 mitigation has become fully functional and the temporary impacts have been eliminated. Tiers 2 and 3 are funded though a contribution by SCWA of 10% of the total cost of maintenance activities, and will provide a 0.1:1 ratio of acres restored to acres disturbed, at a minimum. Additional details regarding funding of the mitigation program and mitigation ratios is provided below in Sections 8.7, 8.8, and 8.10.

Note that mitigation for impacts to listed species does not fall specifically within this 3-tiered mitigation system. If species or habitat specific mitigation is required to address additional impacts to listed species, it would be conducted following the terms of the relevant BOs issued for the program. However, where feasible, Tier 2 and Tier 3 mitigation approaches would be first sought to provide the specific species/habitat mitigation functions. If this cannot be achieved through Tier 2 or Tier 3 projects, then additional mitigation will be implemented to address impacts to listed species and fulfill mitigation requirements in the BOs.

8.4.1 Timing of Mitigation

Often, compensatory mitigation must be implemented prior to conducting the activities which will have impacts. This allows for the functions and values lost at the impact area to be concurrently replaced at the mitigation site. In contrast, the SMP mitigation activities will be implemented within a short time period following the SMP activities themselves (typically, within one year). USACE's RGL 02-2 provides guidance and justification for such an arrangement where: (1) financial assurances are provided, and (2) the likelihood of mitigation success is high. Specifically, under RGL 02-2, USACE requires that the following requirements be met before impacts are allowed to occur:

- The mitigation plan has been approved;
- Ownership or demonstrated authority to implement mitigation at the mitigation site has been obtained; and

- Financial assurances to construct and maintain the mitigation site have been established.

All of these criteria will be met by mitigation projects conducted under the SMP. As described in more detail below, contractual arrangements and financial assurances will be provided, all mitigation plans will be approved by the relevant regulatory agencies, and mitigation projects will be monitored for success, and remedial actions taken if necessary.

Further, SMP mitigation will be occurring annually as an ongoing program. As such, the ecological benefits of mitigation activities will be enjoyed on a continual basis. Indeed, certain mitigation projects may exceed that needed for a given year's portfolio of projects, and be banked for future years. In these cases, the impacts of the SMP will have been effectively pre-mitigated. The mitigation monitoring program (described further in Section 8.7 below will provide feedback on the effectiveness of mitigation efforts to inform and improve future mitigation.

For these reasons, this approach is considered an adequate method of providing mitigation for the SMP.

8.5 On-Site Mitigation at SCWA Reaches (Tier 1)

On-site impact mitigation is the highest priority SMP mitigation and is implemented on-site at the specific project reach where the maintenance work was conducted. As described above, the SMP has a 3-tiered mitigation approach comprised of Tier-1 on-site activities, Tier-2 efforts at other SCWA channels, and Tier-3 off-site watershed mitigation projects. Tier 2 and 3 mitigation activities are described below in Sections 8.6 and 8.7.

On-site mitigation is evaluated and designed to address impacts in the immediate maintenance project area. The general approach is to restore habitat that is affected by the sediment removal or bank stabilization activities in the same reach in which the disturbance has occurred. This approach also seeks in-kind or functional agreement between impacts and mitigation. If riparian habitats are affected, then the mitigation strategy is to re-establish riparian habitat. If instream aquatic habitats are impacted, then instream aquatic habitat will be the mitigation target. While mitigation targets will be sought based on in-kind or ecosystem functions, it is important to recognize that due to the constraints of a particular site (e.g., concrete-lined channel), such functions may not be the most appropriate targets for restoration or enhancement activities. Likewise, the on-site mitigation approach considers what the most appropriate restorative activities are for a particular reach, given the design capacity of the channel. For example, would the particular reach benefit more from planting of taller canopy species, or more understory shrubs, or both? Based on engineering evaluations, in larger channels where there is sufficient capacity, both overstory and understory trees and shrubs can be planted. In smaller tributary channel systems, planting may be focused on tall trees on the upper bank with little or nothing but sedges and grasses on the side slopes and in channel. Note that for all project and stream types, the same mitigation ratio will be applied but the types and specific locations of plantings may vary.

As described below, Tier 1 on-site mitigation activities include a robust planting program to develop a fuller riparian corridor, the removal of exotic and invasive species, and the construction of low-flow channels and other geomorphic features to enhance instream habitat and remove migration barriers.

8.5.1 Planting Program and Canopy Development

General Approach and Benefits

SCWA's on-site mitigation program includes a variety of planting and habitat enhancement approaches. These approaches include, nursery stock planting, understory plantings along the bank and channel edge, and the installation of red and Pacific willow cuttings at the toe-of-bank. The primary objective is to enhance riparian habitat through greater canopy cover, shading, and develop a functioning understory along channels that are currently degraded with grass cover dominated by non-native ruderal species. As illustrated in Figure 5-1, the ability to improve riparian canopy reflects existing habitat conditions and prevailing constraints. A riparian canopy can be developed very successfully, as illustrated at Santa Rosa Creek (Figure 6-11). However, the more typical existing condition is for the riparian tree corridor to be lacking or patchy at best (Figure 8-1). Because of these poor existing conditions, riparian planting has the potential to provide great benefits. A more detailed and comprehensive description of vegetation management activities, methodologies for implementation, and impact avoidance, minimization, and mitigation measures is included in Appendix E: *Vegetation Management Plan*.

SCWA will plant trees and shrubs as on-site mitigation at all reach scale sediment removal and bank stabilization projects. Localized sediment removal or culvert repair projects will include a tree planting component if there is available room to plant. Many of those projects are located within concrete facilities where planting is not available. Planting will also occur in conjunction with the removal of exotic and invasive species and the replacement of such species with native riparian vegetation suited to conditions in the Program Area.

Planting new trees along reaches where vegetation was removed during sediment removal or vegetation thinning activities helps mitigate the temporary impacts of vegetation removal from channel bed and banks. As these trees mature they provide shade to the active channel, provide nesting and foraging habitat for many birds and small mammals, moderate water temperatures and provide forage for aquatic species, and help reduce the need for future sediment management as the shade discourages cattail establishment which in turn traps sediment.

When considered at the watershed scale the planting program will help provide connectivity, via a vegetated corridor, from the headwaters of the watershed to the receiving water body at the downstream end of the Program Area. Connected landscapes provide enhanced habitat for local and migrating species. In addition, increased vegetation along the streambanks will improve water quality through shading the stream and cooling water temperatures, and through filtering runoff entering the creek. While the constraints of an urban system (where the majority of SCWA's engineered maintenance reaches are located) may limit the degree to which water quality is improved, even small improvements may provide a more hospitable environment for aquatic invertebrates which in turn provide the food source for birds, bats, and other species.

An important reason behind SCWA's past success in developing functioning riparian canopies at SMP reaches is the involvement of biologists and arborists in designing, implementing, and monitoring the vegetation pruning and planting activities. The tree planting program, together with the exotic and invasive species removal program described below, provides program mitigation and benefits by developing a native riparian canopy and understory along the SMP maintenance reaches over time.

Planting Plan

Revegetation will consist of planting native species in suitable locations in all available channel zones, including: along the channel edge; along the intermediate channel banks; and along the top-of-bank. The intent is to establish vegetation that mimics natural communities found in the Program Area under similar environmental conditions.

Additionally, SCWA's philosophy and approach to restoring habitat in flood control channels integrates habitat opportunities created by the two-stage (low-flow) channel morphology developed (where possible) during sediment removal activities. SCWA's planting strategy focuses on introducing plants and propagules that will be strong competitors for undesirable species such as Himalayan blackberry and cattail species which result in unfavorable ecological and flood management conditions. Similarly, for understory enhancement shrubs, grasses, and vines will be selected for their particular ability to compete and establish despite the existing vegetation.

To further support the planting effort, disturbed soils will be hydroseeded (and covered with erosion control materials (as specified in the design specifications) with native grasses to discourage erosion and encourage a native herbaceous understory. Specific locations for each planting will be determined on-site by a qualified botanist or arborist following the sediment removal and/or bank stabilization activities.

A general on-site vegetation plan with the types and locations of plantings is shown in Figures 8-2 and 8-3. Figure 8-2 illustrates a typical cross section for the engineered flood control channels in the Program Area. Figure 8-2 also distinguishes between higher gradient channels in sand and gravel substrate and lower gradient channels in silt and clay materials. Figure 8-2 illustrates how site conditions and channel zones are used to determine appropriate species and the planting approach.

Figure 8-3 includes the program planting palette and compares vegetation conditions under typical existing channel conditions to the enhanced channel following restoration activities. The planting list in Table 8-3 includes the species generally used for SCWA restoration projects as well, as some of the specific growth and habit characteristics that make the species suitable for use in flood control channels. This planting palette represents selections based on several years of planting experience and adjustments. As shown in Figure 8-3, the mitigated channel has a low-flow inset channel with sinuosity; suitable toe-of-bank, instream, and understory shrubs; and increased riparian canopy through the larger trees planted along the upper banks. Specifics regarding each of these zones are described further below.

Plant densities are calculated by zone and based on area in square feet. To account for the additional area available on sloping channel banks, planting densities are based on the area

Table 8-3: SMP Plant Palette Page 1 of 3

Common Name	Scientific Name	Planting Area/Zone	Habit and Suitability for Flood Control Channels
Trees			
Big leaf maple	*Acer macrophyllum*	Mid to Upper Bank	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Box elder	*Acer negundo*	Mid to Upper Bank	Spreading, well adapted to heavy soils
California buckeye	*Aesculus californica*	Upper Bank	Adds diversity
White alder	*Alnus rhombifolia*	Toe to Mid Bank	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Oregon ash	*Fraxinus latifolia*	Toe to Mid Bank	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
N. California black walnut	*Juglans californica*	Mid to Upper Bank	Adds diversity
Fremont cottonwood	*Populus fremontii fremontii*	Toe to Mid Bank	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
Coast live oak	*Quercus agrifolia*	Upper Bank	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
Valley oak	*Quercus lobata*	Upper Bank	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
Red willow	*Salix laevigata*	Toe to Mid Bank	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Arroyo willow	*Salix lasiolepis* (not preferred but may be used on a case by case basis at the discretion of environmental staff)	Toe to Mid Bank	Fast growth, spreading, use only along upper banks to offset vigorous branching
Pacific willow	*Salix lucida lasiandra*	Toe to Mid Bank	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Coast redwood	*Sequoia sempervirens*	Mid to Upper Bank	Only used in areas redwoods be found naturally
California bay laurel	*Umbellularia californica*	Upper Bank	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
Shrubs			
Marsh baccharis	*Baccharis douglasii*	Toe to Mid Bank	Suitable, may need to control stem density over time
Mulefat	*Baccharis salicifolia*	Toe to Mid Bank	Suitable, may need to control stem density over time

Table 8-3: Cont. Page 2 of 3

Common Name	Scientific Name	Planting Area/Zone	Habit and Suitability for Flood Control Channels
Western spicebush	*Calycanthus occidentalis*	Toe to Upper Bank	Suitable, may need to control stem density over time
Stream dogwood	*Cornus sericea*	Toe to Mid Bank	Suitable, may need to control stem density over time
California hazelnut	*Corylus cornuta californica*	Mid to Upper Bank	Suitable, adds diversity and forage
Toyon	*Heteromeles arbutifolia*	Upper Bank	Suitable, adds diversity and forage
Ocean spray	*Holodiscus dicolor*	Mid to Upper Bank	Suitable
Twinberry	*Lonicera involucrata*	Toe to Upper Bank	Suitable, adds diversity and forage
Coffeeberry	*Rhamnus californica*	Upper Bank	Suitable, adds diversity and forage
California wild rose	*Rosa californica*	Toe to Upper Bank	Suitable, relatively small, bends over in high flows
Blue elderberry	*Sambucus mexicana*	Upper Bank	Suitable, adds diversity and forage, may need to control stem density over time
Snowberry	*Symphoricarpos albus laevigatus*	Mid to Upper Bank	Suitable, adds diversity and forage
Grasses/Sedges			
All the species of grasses and sedges below are perennial and were selected based on soil, moisture tolerance, growth habit, performance in high flows (flexibility, minimal sediment entrainment), and ability to recolonize after being buried. Rhizomatous, spreading and invasive species are preferred.			
Spike bent	*Agrostis exharta*	In Channel to Mid Bank	Rhizomatous, invasive, excellent soil binder
Sloughgrass	*Beckmannia syzgachne*	In Channel to Mid Bank	Rhizomatous, invasive
Santa Barbara sedge (or equivalent)	*Carex barbarae, C. obnupta, C. bolanderi*	Toe to Upper Bank	Rhizomatous, invasive, excellent soil binder
Dense sedge	*Carex densa*	Toe	Tufted, heavy seeder
Torrent Sedge	*Carex nudata*	Toe to In-Channel	Use in higher gradient gravel and cobble substrate
Pale Spikerush	*Eleocharis macrostachya*	Toe to In-Channel	Rhizomatous, invasive
Blue wild rye	*Elymus glaucus*	Mid to Upper Bank	Clumping heavy seeder
California fescue	*Festuca californica*	Mid to Upper Bank	Excellent understory grass for oaks
Red fescue	*Festuca rubra*	Toe	Rhizomatous, invasive, excellent soil binder
Meadow barley	*Hordeum brachyantherum*	Toe to Mid Bank	Tufted, heavy seeder
Wire Rush	*Juncus balticus*	Toe to In-Channel	Rhizomatous, invasive, excellent soil binder
Pacific Rush	*Juncus effusus*	Toe to In-Channel	Clumping heavy seeder
Common Rush	*Juncus patens*	Toe to In-Channel	Clumping heavy seeder
Brown-headed rush	*Juncus phaeocephalus*	Toe to In-Channel	Rhizomatous, invasive, excellent soil binder

Table 8-3: Cont. Page 3 of 3

Common Name	Scientific Name	Planting Area/Zone	Habit and Suitability for Flood Control Channels
Iris leaved rush	*Juncus xiphioides*	Toe to In-Channel	Rhizomatous, invasive, excellent soil binder
Creeping wild rye	*Leymus triticoides*	Toe to Upper Bank	Rhizomatous, invasive, excellent soil binder
Rice cut grass	*Leersia oryzoides*	In-Channel	Rizomatous, possible cattail competitor
Knot Grass	*Paspalum distichum*	Toe to Mid Bank	Rhizomatous, invasive, excellent soil binder
Bulrush, Tule	*Scirpus acutus occidentalis, S. californicus*	Toe to Mid Bank	Rizomatous, possible cattail competitor
Small fruited bulrush	*Scirpus microcarpus*	Toe to Mid Bank	Rizomatous, possible cattail competitor
Vines			
Clematis	*Clematis lasiantha*, *C. ligusticifolia*	Toe to Mid Bank	Suitable, adds diversity and forage
Honeysuckle	*Lonciera hispidula vacillans*	Toe to Mid Bank	Suitable, adds diversity and forage
California blackberry	*Rubus ursinus*	Toe to Mid Bank	Possible Himalayan blackberry competitor
California grape	*Vitus californica*	Mid to Upper Bank	Possible Himalayan blackberry competitor
Ferns/Other			
Horsetail	*Equisetum arvense, E. hyemale affinae, E. telmatieia braunii*	Toe	Rhizomatous, invasive, excellent soil binder
Sword fern	*Polystichum californicum*	Toe	Suitable, adds diversity and forage
Western Chain Fern (in forested locations)	*Woodwardia fimbriata*	Toe	Suitable, adds diversity and forage

Notes

1. Species for each project should be chosen based on native flora (current and historic) of project area.
2. Seeds, cuttings, seedlings and saplings used for revegetation should be obtained from local (Russian River Watershed or North Coast Floristic Province as defined in Jepson 1993) stock (local native plant nurseries should be used, or plants can be collected using appropriate collection techniques from adjacent sites - willow sprigs should be collected from adjacent sites and planted on the same day as collection).
3. Timing of planting should be appropriate for species and source (e.g. broadcast seeding of herbs and grasses in fall before first rains, cuttings planted when soil moist to at least 10 inches from rainfall, etc.).

calculated for a flat surface plus 11 percent. In general, trees will be planted on 30-foot centers relative to each other (1 every 900 square feet) and shrubs on 5-foot centers (1 every 25 square feet). Trees will be distributed regularly on both sides of the channel to encourage canopy closure and increase shading over the water surface. Shrubs will be placed strategically in groups to mimic natural distribution patterns over approximately 20 percent of the area available for planting. In lieu of planting many shrubs on the channel banks which can reduce channel capacity, herbs and grasses such as Santa Barbara sedge will be planted at 10-foot intervals along the toe (on both sides) to provide natural cover and improve stability. Native emergent species will be planted in the channel bottom to help stabilize the low-flow channel and provide close overhanging vegetation. Emergent plantings are generally limited to 20 percent of the channel bottom area but all exposed areas will be hydroseeded with the seed mix indicated in Table 8-4.

Additional effort will be made during maintenance activities to retain or transplant (using oversized cuttings where feasible) some of the existing willows that currently grow in many of the program's streambeds. This may be accomplished during project construction or cuttings will be stored appropriately and planted during the restoration work. Trees established through transplanting and oversize cuttings are provided above and beyond the plant numbers described in this plan.

The plan focuses on using native plant species in densities and compositions that approximate natural plant communities found regionally in riparian areas and blend with nearby natural plant communities. In-channel plantings are discussed further below but follow a similar philosophy with the additional close consideration of species habit, behavior and function in relation to channel capacity, sediment deposition, and future maintenance effort.

Table 8-4. Seed Mix and Application Rates

Scientific Name	Common Name	Application Rate (lbs/acre)
Leymus triticoides	beardless ryegrass	20
Hordeum brachyantherum	meadow barley	20
Festuca rubra	red fescue	10
Lupinus bicolor	bicolor lupine	5
Vulpia microstachys	Nuttall's fescue	5
Total lbs/acre		**60**

Planting Zones

Three planning zones are identified for the project. These zones are Overbank, Channel Side Bank and In-Channel areas (Figures 8-2 and 8-3). These three zones are distinguished based on topography, elevation, and the hydrologic frequency of saturation and inundation.

Overbank Zone

The overbank zone is the area within SCWA's authority that is above top-of-bank (i.e., beyond the upper hinge-point in an engineered channel). This zone is intended to develop into upland and riparian forest approaching 90-100 percent canopy cover. The overbank zone will be planted with upper floodplain and upland species including buckeye, oaks, bay, box elder, walnut, madrone, toyon, coyote brush, and coffeeberry.

Channel Bank Zone

The channel bank zone is the area between the channel bed and top-of-bank (i.e., the upper and lower hinge points). Given sufficient capacity in a given channel, this zone is intended to develop into riparian forest. If sufficient capacity is not anticipated to support side bank plantings, the channel bank zone will be planted with relatively low-profile grasses, sedges, shrubs and vines. The channel bank zone will be further divided during planting into upper and lower zones based on elevation above the channel and differentiated by tree species. The bank zones will be planted with riparian natives adapted to periodically saturated soils. The lower bank zone will be planted with those species typically found immediately adjacent to the stream channel such as willow, alder, and ash. The upper bank will be planted with those riparian species usually occurring on the flood plain (eg. maple and oak).

In-Channel Zone

The in-channel zone is the area within the channel bed. Depending on the specific hydrological conditions present in the channel, this zone is intended to reflect the habitat characteristics ranging from emergent freshwater wetland to a naturally intermittently wet stream. In-channel plantings are developed to capitalize on water when it is available. Most of SCWA's urban streams have water or are at least moist in the channel bottom year round. These wet streams will be planted with wetland species amenable to the hydraulic management needs of a flood control channel (e.g. small in stature, perennial, rhizomatous, and can survive being submerged for long periods) that receives urban runoff during the dry season. These species will be plugged (in appropriate groupings) on 5-10 foot centers in 20 percent of the area above the thalweg. Intermittent channels will be planted in a similar fashion but species selection will vary depending on the degree of saturation (e.g. wet meadow species would be used in these channels instead of emergent wetland species).

Species selected for in-channel use share a number of characteristics common to herbaceous (non-woody) wetland and transitional wetland species. These characteristics include the ability to tolerate long periods of total submergence, having a high capacity for vegetative reproduction, having a high fecundity (produces large quantities of seed), a rhizomatous growth habit, and a relatively diminutive stature. Rapid vegetative growth and the production of large quantities of seed are an important adaptation of instream and streamside plant species, especially for use in restoring aquatic habitat. These species can quickly re-establish after being buried under sediment by either propagating vegetatively, or via abundant seed production. The rhizomatous habit is important as these species spread via creeping underground stems which in high densities effectively knit the substrate together, help armor the toe and channel banks, and reduce (or eliminate depending on flows and location) the need to stabilize using rock.

Plant stature is an important consideration, and is related to how the plant is anticipated to behave during periods of higher flows. Herbaceous species tend to bend over in higher flows, allowing debris and sediment to pass over rather than being caught in unyielding stems. The lower the plant, the less debris and sediment it will catch. Figures 8-2 and 8-3 include a list of the species proposed to be used in SMP flood control channels for restoring aquatic habitat following sediment removal. The species in these figures are all native to Northern California (and more specifically Sonoma County); those used in the in-channel zone are generally less than three feet tall, and have all or most of the desired characteristics anticipated to perform well in the program's flood control channels.

Implementation and Monitoring

Plant material will be obtained from local sources preferentially as feasible. Figures 8-2 and 8-3 list the typical species planned to be established following sediment removal or bank stabilization activities. Trees will be in the five gallon size range. Shrubs will be one gallon size, and herbaceous species will be planted from seed or liners. Overbank and bank zones will also be seeded with native species with the composition and application rates specified in Table 8-4. The seed mixture will either be collected locally onsite or will be obtained from a seed supplier that can authenticate a regionally local source and augmented with additional native perennial grass seed collected locally.

Agency personnel will conduct plant installation or will oversee work done by watershed partners. Plants will be installed in the native soil and top dressed with a one-inch thick layer of certified weed-free fir bark mulch or other commercial planting mix. An irrigation basin one to two feet in diameter will be formed around each hole where feasible. Plants will be installed and mulched so that root crowns are at, or slightly above, the soil/mulch surface. Precise location of trees and shrub plantings in the upland and riparian zones will be determined in the field following completion of sediment removal activities. Planting will be conducted from late summer into early winter. Generally, the majority of planting is done in the fall and winter with the advent of the season's rains. However, toe plantings can be conducted any time of the year if the channel remains moist and flow velocities are amenable. Following maintenance activities, the project botanist will either position the plants themselves or place color-coded pinflags in specific planting locations for each shrub and tree species.

Holes will be prepared using hand tools or a mechanical auger. Over bank and side channel plantings will be installed with "dry water" following the manufactures recommendations to provide additional water reserves in the rooting zone. Additionally, overbank plantings and side channel plantings will be installed to have a "water basin" depression crafted out of the existing soil that will pool water slightly around the collar of the plant. These basins will then be mulched to reduce weed growth and retain moisture. Landscape fabric will be used for erosion control on slopes and disturbed areas.

Trees and shrubs will be irrigated manually during the dry season for three years. Irrigation frequency will be approximately weekly the first year, every two weeks the second year, and monthly during the third year.

Monitoring will be conducted at the project site for five years following construction and planting. Information collected will include the number and species planted at each site, square footage of channel planted, estimated percent canopy cover, number or percent of planted trees and shrubs surviving, and the annual cost for implementing the planting program Site conditions will be documented annually by taking repeat photographs at set reference locations. The monitoring data will be reviewed annually to evaluate the overall success of the revegetation approach.

Success criteria for shrubs and trees planted in overbank and side bank areas will be 85 percent survival. For the in-channel plantings, setting the appropriate criteria for survival is difficult due to lack of reference criteria and the dynamic environment of the channel bottom. Depending upon winter flow conditions, in-channel plantings could be covered in sediment or scoured and eroded by the following next year. Instead of establishing strict survival criteria for the in-channel zone, SCWA will monitor and document the presence of the planted species in the channel. Initial goals for the in-channel plantings will be some level of survival, retention, and successful colonization into the subsequent years. Based on plant monitoring, SCWA will adaptively develop appropriate future criteria for the SMP.

In the event of poor plant survival, corrective measures will include replanting to reach the 85 percent goal in the overbank and side bank areas. For the in-channel zone, selective replanting will be conducted along the low-flow channel to help stabilize it.

8.5.2 Invasive and Exotic Plant Removal Program

SCWA removes invasive and exotic plants as part of its on-site mitigation program. This beneficial activity occurs in tandem while general vegetation maintenance activities are occurring on–site, including vegetation thinning, pruning, and removal. Because the removal of invasive and exotic plants is closely integrated with the general vegetation management activities, it is described in the vegetation maintenance description of Chapter 6, Section 6.5.2.

Specific mitigation activities include the targeted removal of invasive and exotic species such as Himalayan blackberry (*Rubus armeniacus*) and tree of heaven (*Ailanthus altissima*). The removal of invasive and exotic species provides more room for desirable native species to establish. An increase in abundance of native vegetation over non-native vegetation improves overall riparian health. For example, native vegetation can provide more habitat opportunities to insects and birds that show preferential treatment for use of native plant species. Removing exotic species also helps prevent the monoculture common to areas dominated with exotics. When replaced with a diverse selection of native vegetation, the channels of the Program Area can support a more diverse set of species including insects, birds, small mammals, amphibians, and reptiles.

Monitoring of invasive and exotic plant removal will include tracking the number of invasive or exotic trees removed, length of channel of removal activities, area of removal activities for shrub or ground-cover species, observing whether recolonization of invasives occurs after removal, and documenting the annual cost for invasive and exotic removal.

8.5.3 Low-Flow Channel Design

For reach scale sediment removal projects, SCWA designs and implements a low-flow inset channel along the bed of the flood control channel. The low-flow channel provides on-site mitigation through multiple benefits. Because low-flow channels are implemented together with sediment removal activities, they are described above in Chapter 6, Section 6.3.2.

A key objective of a low-flow channel is to successfully transport sediment under lower flow conditions (annual flows and smaller). This is achieved through increased flow depth and velocity under low-flow conditions which are adequate to convey and pass sediments under the smaller flow conditions. This reduces sediment deposition, and ultimately reduces the need to conduct sediment removal activities. A sustainable low-flow channel also provides mitigating benefits of improving water quality, enhancing instream habitats, and preserving a migration corridor for fish.

The latter topic of enabling fish migration is particularly important in the program's steelhead-supporting streams such as Copeland Creek. Copeland Creek's engineered flood control channel is an important transport reach that leads steelhead to spawning areas in the upstream watershed and enhances smolt emigration. Reaches along Copeland Creek where low-flow channels have been developed maintain an open water unblocked corridor. In other reaches without a low-flow channel, the channel bed is typically blocked with deposited sediment and cattails which inhibits migration. Figure 5-3 provides photographs from Copeland Creek before and after sediment removal activities and shows the blocked channel condition prior to development of the low-flow channel.

The habitat and fish migration benefits of low-flow channels are described in the Russian River Watershed Biological Opinion (NMFS 2008). Additionally, the use of low-flow channels is a specifically mentioned term of the BO's Reasonable and Prudent Measures (RPM). RPM 5 includes measures to reduce harm to listed salmonids resulting from activities along the Russian River, Dry Creek, and maintenance activities in Zone 1A of the SMP Area. Condition D of RPM 5 includes the requirement that "at sediment removal sites in Zone 1A, SCWA shall construct a low-flow channel to provide enhanced migration habitat through sediment removal areas" (NMFS 2008 p. 327). The BO also requires that low-flow channels be monitored at least two times between large storms during the winter period to assess their function as migration corridors and the possible effects of the low-flow channel on overall channel conditions. The SMP approach is consistent with the terms and conditions of the BO, and the SMP will comply with those terms. Similarly, the SMP considers the use of low-flow channels as an appropriate mitigation measure to be used with sediment removal projects of the SMP.

8.6 Off-Site Mitigation at Other SCWA Reaches (Tier 2)

Tier 2 mitigation provides in-kind mitigation at neighboring SMP reaches that afford an opportunity for mitigation. Tier 2 mitigation is very similar to Tier 1 on-site mitigation in that the focus is to provide reach-based in-kind habitat, stream function, or water quality benefits. The key difference is that the mitigation occurs at a SCWA reach which is not the subject of SMP maintenance activities during a given year. Tier 2 mitigation, and the Tier 3 mitigation described below, is implemented through a 10% matching contribution of SMP maintenance costs. Monitoring, reporting, and remedial actions (if necessary) will be combined with Tier 1 monitoring and reporting activities. As an example, an SMP reach like Bellevue-Wilfred Channel, Reach 1 (see Station A of Figure 5-1) provides many opportunities for habitat or functional improvement. In any given year such a channel may provide additional mitigation opportunities (Tier 2) beyond what SCWA would be doing on-site at other reaches (Tier 1). Tier 2 provides the mitigation program flexibility in finding other nearby stream channels to restore, in addition to the off-site watershed mitigation (Tier 3).

8.7 Integrated Watershed Mitigation (Tier 3)

8.7.1 Rationale and Purpose

Off-site watershed mitigation (Tier 3), in combination with Tier 1 and 2 mitigation actions, address residual impacts from SMP activities that are not adequately avoided or minimized prior to or during maintenance. As described above, off-site mitigation addresses the temporary loss of Beneficial Uses and ecological functions and values during the time gap between SMP maintenance activities and when Tier 1 mitigation occurs, and the time when Tier 1 mitigation has become fully functional and the temporary impacts have been eliminated. Off-site mitigation projects provide restorative and mitigating watershed solutions that address SMP impacts. Examples of off-site mitigation projects include native riparian plant revegetation, large woody debris installation, invasive plant removal, bioengineering/erosion control, and watershed-based sediment or other contaminant reduction actions.

The great majority of SMP activities and impacts occur in the engineered channels of Zones 1A, 2A, and 3A. These SMP channels typically occupy the developed alluvial plain areas of Santa Rosa, Rohnert Park, Cotati, and Petaluma. The actively maintained SMP channels are typically located downstream of headwater source areas for runoff and sediment (see Figures 3-1 and 3-2) and also downstream of potential steelhead spawning and rearing habitats. However, the SMP channels are also upstream of important watershed lowlands such as the Laguna de Santa Rosa, Petaluma River marsh and baylands, and the Sonoma Creek marsh and baylands. These lower watershed and estuarine systems provide several important natural habitats and flood management functions. From a watershed perspective, the area of most SMP activities is found between headwater source areas upstream and valuable creek, marsh, or estuarine resources downstream.

In recognizing these spatial relationships, the SMP's watershed mitigation approach provides an excellent opportunity to reduce runoff and erosion in the headwater source areas while also reducing sediment loading to downstream systems. Off-site watershed mitigation also provides sustainability benefits. Reducing sediment loads from upstream sources can reduce the overall need for in-channel maintenance over time. This approach is consistent with SCWA's commitment toward environmentally sustainable solutions (Maintenance Principle 6). Looking downstream, Tier 3 mitigation provides the opportunity to preserve, enhance, and restore the most valuable aquatic ecosystems in the Program Area.

8.7.2 Watershed Grant Program

SMP off-site watershed mitigation is led and funded by SCWA through a grant program to distribute funding to partnering agencies. A Watershed Partnerships Program (WPP) was formed by SCWA to fund and implement projects collaboratively with local non-profit agencies and Resource Conservation Districts (RCDs). The WPP assists non-profit organizations and landowners to implement projects that improve water quality and restore habitats and ecosystem functions. The SMP's Tier 3 mitigation program is a subset of the WPP projects that SCWA will fund, and the WPP projects funded by the SMP will be closely linked to SMP impacts. Note that the WPP may fund other projects that would not be construed as adequate mitigation for the SMP (for instance, education and outreach projects); however, these projects would not be funded by, or counted as mitigation for, the SMP.

SCWA will contribute 10 percent of the annual cost of implementing SMP sediment removal and bank stabilization projects into a fund to distribute annually to WPP partners and the Tier 2 mitigation described above. Watershed projects will be selected based on their ability to provide water quality, habitat, and ecosystem benefits as suitable mitigation for SMP impacts. Section 8.7.3 below provides more information regarding WPP partners. Section 8.7.4 describes how watershed projects will be developed to provide appropriate mitigation for the SMP. Chapter 9, Section 9.8 provides more detailed information on the annual notification and reporting process to regulatory agencies related to the off-site watershed mitigation program. Entities funded through the WPP will be required to sign a contractual agreement with SCWA to ensure that mitigation projects are implemented as described in the application. An example of a WPP partnering agreement and the WPP funding application instructions are provided in Appendix C.

While the SMP mitigation program is a compensatory mitigation program, it bears resemblance to an in-lieu fee arrangement. This is due to the fact that the entities implementing compensatory mitigation projects may not be the same entity that incurred the impacts (namely, SCWA). However, this program is stronger than many of the typical in-lieu fee programs, since: (1) it is administered by SCWA, rather than another entity, providing increased oversight over the use of funds; (2) it funds specific mitigation projects that are directly tied to the specific activities conducted under the SMP, rather than supplying a general fund that will implement projects that are currently undefined; and (3) mitigation projects will be implemented within a specified period after the impact has occurred (typically within the same year), rather than at an unspecified point in the future.

These nuances notwithstanding, regulatory guidance on the use of in-lieu fee arrangements was considered relevant in designing the mitigation program for the SMP. Regulatory guidance on the use of in-lieu fee arrangements is provided under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act in *Federal Register Vol. 65, No. 216, pp. 66914-66917* (November 7, 2000). In-lieu-fee mitigation can be used where funds are paid to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development. In-lieu-fee arrangements differ from mitigation banking in that they typically do not provide compensatory mitigation in advance of project impacts. In-lieu-fees can be used to provide compensatory mitigation under Individual Permits or General Permits issued by USACE. The basic considerations to be addressed in establishing an in-lieu-fee type program include the following eight provisions.

1. **Qualified Organizations.** The natural resource management organizations to receive funding should be qualified to implement projects that replace or restore lost natural functions and processes.
2. **Operational Information.** The organizations to implement in-lieu-fee arrangements should coordinate with USACE to demonstrate that all pertinent state and local permits associated with projects can be demonstrated.

3. **Watershed Planning.** In-lieu-fee mitigation approaches should be planned and developed to address specific resource needs of a particular watershed.
4. **Site Selection.** The resource management organizations should give careful consideration to the ecological suitability of a certain site for achieving the goals and objectives of the compensatory mitigation.
5. **Technical Feasibility.** In-lieu-fee mitigation should be self-sustaining using proven techniques.
6. **Role of Preservation.** The purchasing of wetlands for preservation purposes may be acceptable mitigation in exceptional circumstances.
7. **Collection of Funds.** Funds collected under in-lieu-fee arrangements should be used for replacing wetlands functions and values and not to finance non-mitigating priorities such as education and research.
8. **Monitoring and Management.** The in-lieu-fee sponsor is responsible to adequately fund the operation and management of the mitigation sites and there should be a regular schedule (annual) of monitoring reports to describe how funds were allocated and used.

The WPP was developed to be consistent and uphold these general guidelines and provide a mitigation program that is geographically flexible, pragmatic, and responsive to the entire watershed area of program activities. As program administrator, SCWA will oversee and ensure that all grant recipients are qualified contractors that can provide the needed mitigation. For the SMP, SCWA will coordinate with local partners and the USACE and other agencies to ensure that mitigation projects are permitted accordingly. The off-site mitigation program was developed as a watershed planning approach, but does also consider the site specific conditions of the mitigation. SMP contributions to the WPP will be used to implement mitigation projects and not pay for education and research efforts, though those are also valuable pursuits. SCWA will be responsible, together with the partnering agencies, to monitor the mitigation projects. SCWA will be responsible to provide the relevant regulatory agencies with mitigation reporting as discussed in Sections 8.11 and 9.8

8.7.3 Watershed Partners

Several WPP Partners (or Partners) were identified through an outreach process during the development of the SMP Manual. The list of Partners shown below is considered an initial listing for the WPP. The list of active partners may grow or change over time. The WPP currently includes the following Partners:

- Cotati Creek Critters
- Friends of the Petaluma River
- Laguna de Santa Rosa Foundation
- Natural Resources Conservation Service
- Rohnert Park and Cotati Creeks Council

- Sonoma County Water Agency
- Sonoma Ecology Center
- Sotoyome-Santa Rosa Resource Conservation District
- Southern Sonoma County Resource Conservation District
- The Bay Institute
- United Anglers of Casa Grande High School

Information for these Partners, including their general mission, example project types, and point of contact, is provided in Table 8-5. As shown in the list above, SCWA is included as a WPP Partner. Prior to developing the SMP and watershed mitigation approach of the WPP, SCWA on occasion undertook restoration projects outside of its maintenance channels. These included large-scale bank stabilization and/or erosion control projects in headwater areas, removal of concrete or grouted rip-rap from the channel, or fish passage enhancement projects. In 2003, prior to developing the WPP in 2006, SCWA completed fish passage improvement projects at the Mumford Dam and Crocker Dam sites. These improvement projects opened up 48 miles and 5 miles of previously blocked stream habitat upstream of the Mumford and Crocker dams respectively. Since developing the WPP in 2006, SCWA has conducted two watershed mitigation projects. These are described below in Section 8.7.5. SCWA anticipates conducting future projects through the WPP, and will also look for opportunities to work with WPP Partners to implement such projects.

8.7.4 Matching Impacts with Watershed Mitigation

Off-site watershed mitigation will target projects that provide watershed benefits through wetland and stream restoration, erosion control, invasive species removal and management, and other land management practices. Table 8-5 includes example project types from the watershed partners that are considered appropriate compensatory mitigation for SMP residual impacts. As described above in Section 8.2, USACE guidance from RGL 02-2 recommends mitigation approaches that enhance, restore, or compensate for ecologic functions and processes that are impacted by program activities. Table 8-6 indicates which ecologic functions are supported or restored through the WPP project types.

The WPP was developed to establish partnerships in each of the primary watersheds of the SMP Area, namely the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watersheds. Application of funding as a portion of maintenance costs will be prioritized in the same watersheds that maintenance activities have occurred. For example, contributions to the WPP based on maintenance costs incurred in Zone 1A (Laguna de Santa Rosa Watershed) will be distributed to WPP partners for mitigation project implementation in that same Laguna de Santa Rosa watershed. Funding could be distributed to a WPP Partner serving the Laguna watershed (e.g., Cotati Creek Critters, Laguna de Santa Rosa Foundation, Sotoyome-Santa Rosa Resource Conservation District, and/or the Sonoma Ecology Center) to support restoration activities. The partner might organize a native planting event in a reach upstream of the project site in an area with little existing riparian habitat. Or, the partner might remove invasive exotic plants and install native species in their place, encouraging the establishment of groundcover and overstory. The native grasses planted by WPP Partners might also provide water quality functions in filtering runoff from adjacent areas.

Similar funding conditions and examples would occur to support WPP activities in Zone 2A (Petaluma River watershed) and Zone 3A (Sonoma Creek Watershed). In some cases, more appropriate mitigation opportunities may exist in a neighboring watershed, for instance when only a small portion of a year's portfolio of maintenance projects are in a particular flood control zone, and the funding from these projects could be used to fund a larger project in a neighboring zone. However, every effort will be made to apply funding towards projects in the same watershed, and any deviations would be subject to the approval of the relevant regulatory agencies.

That said, WPP funds contributed from the share of maintenance costs incurred in the other five SCWA zones (outside of Zones 1A, 2A, and 3A) will be collected into a general WPP fund to be used in watersheds as near as possible to the location of maintenance activities. Over time, the WPP may also develop to manage and implement other restoration and enhancement projects that SCWA undertakes outside the scope of the SMP.

8.7.5 2006-08 Watershed Mitigation Projects

During the 2006-2008 interim period while the SMP was under development, four watershed-based mitigation projects were successfully implemented with local RCDs, landowners, or non-profit agencies. These projects were identified, selected, and developed with watershed partners to be directly responsive to residual impacts from stream maintenance activities. These projects demonstrate suitable and appropriate Tier 3 off-site watershed mitigation and serve as good references for future watershed mitigation projects under the SMP. Each of these projects are described below and further details on the projects are included in Appendix D.

Cook Creek Headwater Erosion Control Project (2006)

The Cook Creek headwaters erosion control project was undertaken in 2006 to stabilize an active landslide. The slide generated tremendous sediment yields to an upper tributary of Cook Creek and also destabilized the receiving headwater creek (Appendix D-1). The headwater area leads directly downstream to the Cook Creek sediment basin, a SCWA-owned and maintained facility. The abundant headwater erosion led to rapid filling of the sediment basin and increased sediment loads downstream into the Cook Creek, Coleman Creek, and Wilfred Creek engineered flood control channels.

The erosion control project involved improving drainage of the slide face, moving earth to lessen the over-steepened and eroding slope, and using erosion control techniques in the stream to reduce bank erosion. Following the 2006 erosion control project, sediment removal activities required at the Cook Creek sediment basin (located downstream of the slide area) were drastically reduced. This watershed mitigation project incorporated many of the SMP impact avoidance approaches and had the successful result of reducing the need for additional maintenance. The Cook Creek erosion control project was used as watershed based mitigation for the several bank stabilization projects conducted by SCWA in 2006. This project provided Tier 3 watershed based mitigation for the 30 bank stabilization

Table 8-5. Watershed Partnership Program Partners Page 1 of 6

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
Cotati Creek Critters	Cotati Creek Critters' mission is to enhance natural habitat for native species; organize community workdays to plant native trees and shrubs and to remove invasive species; encourage an appreciation of Cotati's creeks and riparian vegetation; raise awareness that Cotati's creeks are part of the larger Laguna de Santa Rosa and Russian River watersheds; enjoy the natural resources with families, neighbors and the community.	Native plantings, bank stabilization, environmental education	▪ The Critters hold two C**ommunity** Creeks **Days** per month to plant native trees and shrubs along Cotati's reach of the Laguna. ▪ They hold an **Inside/Outside Nature Education Series** where local experts conduct tours and discussions in the watershed.	Laguna de Santa Rosa (Zone 1A)	Jenny Blaker, (707) 792 4422 , jenny@ creeks.cotati.info
Friends of the Petaluma River	Friends of the Petaluma River are a non-profit organization that is dedicated to celebrating and conserving the Petaluma River, its wetlands, and wildlife. Their mission is to promote stewardship of the Petaluma River by providing access opportunities, educational materials, and conservation programs.	Environmental education, invasive species control	▪ **Tomorrow's Leaders Today:** Friends helped to launch a high school enrichment program that introduces high school students to the region's culture, resources, and industry by scheduling monthly day long field trips. ▪ **Invasive Spartina Project (ISP)**: Under a grant from the Coastal Conversancy, Friends teamed up with the ISP to locate and DNA test suspected hybrid alien cord grass of the *Spartina alterniflora* variety. They acquired permits and land owner permissions to	Petaluma River (Zones 2A and 9A)	David Yearsley, (707) 763-7756, dmy@sonic.net, david@ friendsoftheriver.org

Table 8-5. cont. Page 2 of 6

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
			chemically treat the plant.		
Laguna de Santa Rosa Foundation	The Laguna de Santa Rosa Foundation's mission is to preserve, restore and enhance the Laguna de Santa Rosa, and to inspire greater public understanding and appreciation of its natural area. Projects include wildlife habitat restoration, youth environmental education, research, and docent-led tours of the Laguna.	Invasive species removal and control, native plantings	▪ **The Ludwigia Control Project (LCP)**: is a three-year effort (2005-2007) to reduce the extent and density of Ludwigia in two highly impacted areas (Bellevue Wilfred Channel and Laguna Wildlife Area). Treatment includes application of aquatic herbicide followed by mechanical removal of biomass. ▪ **Middle Reach Restoration Project (MRRP):** aims to reestablish and increase the density of native plants along 1.8 miles of the channel, revive a population of endangered Sebastopol meadowfoam through seasonal wetland enhancement, restore 10 acres of oak savannah upland habitat, and control rapidly spreading non-native species.	Laguna de Santa Rosa (Zone 1A)	Dan Schurman, (707) 527-9277 x104, dan@ lagunafoundation.org
Natural Resources Conservation Service	With the mission of "Helping People Help the Land," the Natural Resources Conservation Service provides products and services that enable people to be good stewards of natural resources on non-Federal lands.	Structure installation, conservation planning, livestock management, spring/seep	**Ielmorini Ranch:** assisted private landowner with conservation plan to reduce sediment, organic matter and potential pathogens to riparian areas using planned infrastructure practices	Zone 2A	Kristan Flynn, (707) 794-1242x110, kristan.flynn@ ca.usda.gov

Table 8-5. cont.

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
	They offer technical and financial assistance to protecting natural resources in rural, suburban, urban, and developing areas.	development	including livestock fencing and management, and installation of gravity-fed springs.		
Rohnert Park and Cotati Creeks Council (RPACCC)	RPACCC is a coalition of neighborhood creek groups working together to develop a master plan for the 16-20 miles of creeks in the Rohnert Park-Cotati urban area and its watershed, protect the riparian habitat including native steelhead and salmon populations, maintain a wilderness presence in the urban environment, develop a workable flood control system that does not destroy the creeks, develop educational and recreational programs, and maintain a clean, safe creek environment with connected trails and bike paths.	Environmental education, clean-ups	Advocacy, creek clean-ups	Zone 1A	rpaccc@yahoo.com
Sonoma Ecology Center	The Sonoma Ecology Center works with the community to enhance and sustain ecological health in Sonoma Valley. Their Restoration Program builds site-specific demonstration projects on stream, wetland, and riparian habitats.	Invasive species removal, native plantings, structure installation	▪ **Sonoma Creek Revegetation Project:** control of non-native invasive plant species (target Arundo donax) with revegetation of native species along the middle reach of Sonoma Creek (Maxwell Park to Riverside Drive). Includes two-year monitoring and control program. Also invasives removal, BMP education,	Service area is throughout Sonoma County	Caitlin Cornwall, (707) 996-0712 x105, caitlin@ sonomaecologycenter.org

Table 8-5. cont. Page 4 of 6

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
			LWD placement through Sonoma Valley Habitat Stewards project. ▪ **Nathanson Creek Revegetation Project**: invasive plant species removed, wire revetments removed, and over 400 native plants and 200 willow stakes planted for bank stabilization and native plant diversification.		
Sotoyome-Santa Rosa Resource Conservation District (SRCD)	The SRCD was originally established to aid ranchers and farmers in their soil erosion control efforts and to provide assistance in water conservation. The district has expanded its services to communities, school districts, economic development programs, river basin and watershed projects, and to environmental improvement programs. SRCD is committed to improving the sustainability of natural resources by developing leadership, exchanging of information, providing technical assistance, and implementing projects that balance environmental and economic interests.	Bank stabilization, environmental education	▪ **Rural Roads Sediment Reduction Program:** seeks to improve water quality by working with private landowners in the Russian and Gualala River watersheds to manage unimproved roads. Over 129 miles of road have been treated to date. ▪ **Arundo donax Removal Program:** SRCD is collaborating with Circuit Rider Productions, Inc. in a multi-year effort to remove Arundo donax in the Russian River Watershed. The SRCD is assisting Circuit Riders by providing both education and outreach to landowners about the detrimental effects of Arundo donax and permit assistance for removal projects.	Santa Rosa Creek and northern watersheds including Russian, Dry, Gualala Rivers (1A, 4A, 5A, 6A, 7A)	Greg Fisher, (707) 569-1448 x105, sscrcd@ sonomamarinrcds.org

Table 8-5. cont. Page 5 of 6

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
Southern Sonoma County Resource Conservation District	Their mission is to improve resource management while supporting sustainable agriculture urban communities. They provide technical assistance, education and funding sources to empower landowners to be committed stewards working to improve water quality, prevent soil erosion and improve natural habitat.	Step-pool restoration, bank stabilization, environmental education/ outreach	▪ **Carriger Creek Restoration Projects:** The District lead a fish passage enhancement project to remove a concrete ford and replace it with a series of step pools. The RCD is planning a second project to control an eroding the bank that is threatening a county road. ▪ **SCWA Restoration Projects:** flood control, channel maintenance, and revegetation projects for SCWA include sections of Lichau Creek, Adobe Creek, and the Petaluma River.	Stemple, Petaluma, and Sonoma Creek Watersheds (Zones 2A, 3A, 9A)	Jason Sweeney, (707) 794-1245 x126, sscrcd@ sonomamarinrcds.org
The Bay Institute	The Bay Institute's mission is to protect and restore the ecosystems of San Francisco Bay, the Sacramento-San Joaquin Delta, and the rivers, streams, and watersheds tributary to the Estuary. They use a combination of scientific research, political advocacy, and public education to work toward the environmental restoration of the entire watershed which drains into San Francisco Bay.	Environmental education, native plantings	▪ **Napa-Sonoma Marsh Restoration Project:** The Bay Institute is working with the Department of Fish and Game and SCWA to import reclaimed water from surrounding communities and use the water to dilute the salinity of ponds acquired from Cargill Salt Company. ▪ **Students and Teachers Restoring a Watershed (STRAW) Project:** coordinates and sustains a network of teachers, students, restoration specialists, and other community members as they	Sonoma Creek (Zone 3A). Education programs throughout Sonoma County	Laurette Rogers, (415) 506-0150, rogers@bay.org

Table 8-5. cont.

Organization	Mission/Description	Project Types	Past/Current Project Examples	Watershed (SCWA Zone)	Contact Information
			plan and implement watershed studies and restoration projects in Marin and Sonoma counties. STRAW provides teachers and students with the scientific, educational and technical resources to prepare them for hands-on, outdoor watershed studies, including ecological restoration of riparian corridors. Students typically plant native vegetation for the benefit of native aquatic and terrestrial species and to help control erosion.		
United Anglers of Casa Grande High School	United Anglers is a non-profit organization with four goals: complete ecological restoration of the entire 7-mile Adobe Creek system, protection of the biological diversity and genetic variability, the development of a fisheries research facility/conservation hatchery on the Casa Grande High School Campus, and the education of the entire community.	Environmental education, native plantings	▪ **Conservation Fish Hatchery Research Facility**: students raised over $510,000 to construct the fisheries research facility. Over 30,000 people have toured the research facility since its completion. ▪ **Adobe Creek Restoration**: students plant approximately 1,100 trees per year to provide shade and riparian habitat on Adobe Creek.	Adobe Creek, Petaluma River (Zone 2A)	Tom Furrer, (707) 778-4703, uacg@sonic.net

Table 8-6. Ecologic Functions of WPP Project Types

WPP Project Type	Associated Ecological Function Objectives
Native vegetation plantings	**Biological function:** provide breeding grounds, provide feeding grounds, provide nesting habitat, provide wood source, provide refuge from predation, enhance riparian structure, support biodiversity, support biomass production **Hydrologic and water quality function:** reduce erosion potential, moderate water temperature, increase dissolved oxygen, support nutrient cycling, provide contaminant filtration
Erosion control and sediment reduction	**Biological function:** preserves aquatic habitat through reducing transport and settling of fine sediments, preserves channels as functional migration corridors by preventing sediment blockages **Hydrologic and water quality function:** preserves water quality by reducing transport of fine sediments downstream to SMP channels and impaired water bodies, lessens channel blockages
Invasive species control/eradication	**Biological function:** enhance riparian structure, support biodiversity, support a complex trophic structure
Installation of habitat features (large woody debris; boulders; step-pools, etc.)	**Biological function:** provide wood source, provide breeding grounds, provide feeding grounds, provide nursery areas, provide refuge from predation, provide substrate for attachment, support biodiversity, support biomass production **Hydrologic and water quality function:** improve transport of materials, improve velocity and/or flow, reduce erosion potential, improve sediment transport process, modify chemical water quality, support nutrient cycling, create pools/riffles, modify wave energy
Livestock management (exclusionary fencing, grazing rotation, etc.)	**Biologic function:** enhance riparian structure, support biodiversity **Hydrologic and water quality function:** improve chemical water quality, reduce erosion potential, improve sediment transport process
Bank stabilization	**Hydrologic and water quality function:** reduce erosion, improve sediment transport process

projects completed in 2006. SCWA spent $339,000 implementing the Cook Creek erosion control project.

Washington Creek (Barboni Ranch) Headwaters Grazing and Erosion Control Project (2007), with watershed partner the Natural Resources Conservation Service (NRCS)

Historically, the Barboni Ranch in the upper Washington Creek watershed was grazed year-round. This practice resulted in surface water quality impairments from pathogen, nutrient, and sediment loading, as well as streambank instability and degraded riparian habitat. The 2007 watershed mitigation project was conducted in close collaboration with the NRCS project partner. Project activities included fencing to keep cattle out of the creek zones, and developing gravity-fed springs and planned livestock watering areas to replace the need for livestock to enter the creek (Appendix D-2). The project also involved developing long-term grazing management approaches.

Short-term benefits by this watershed mitigation project included reducing stream and slope erosion from upland areas and water quality protection. Over the longer-term, improving the livestock distribution through planned infrastructure will improve soil quality, as well as vegetation growth, health, and recruitment.

The Barboni Project effectively demonstrated how Tier 3 watershed mitigation projects can be used to match potential maintenance impacts. This project also demonstrated a sustainable mitigation approach that reduces the need for additional downstream maintenance. Additionally, this mitigation project occurred in the headwaters of Washington Creek, directly upstream of where SCWA removed channel sediments in 2007, demonstrating the close spatial relationship between maintenance activities and watershed mitigation.

This project provided Tier 3 watershed based mitigation for the 2007 East Washington Sediment Removal Project. SCWA provided $15,000 for conservation and erosion control activities with watershed partner NRCS.

Upper Laguna Stream Restoration and Planting Project (2008), with the Watershed Partner Cotati Creek Critters (CCC)

The purpose of this project is to restore habitat and ecological functions to the Upper Laguna channel corridor. The project is located along a 5,000-foot reach of the Upper Laguna flood control channel between Liman Way in Rohnert Park and East Cotati Avenue in Cotati. This location is shown as Laguna reaches 6 and 7 in the Upper Laguna channel map, Figure 4-41. A summary project fact sheet is provided in Appendix D-3.

The project goal is to establish an understory layer of native plants including grasses, sedges, rushes, vines and other appropriate herbaceous perennials. CCC will install 1,000 plants in proximity of the 1,500 previously planted trees and shrubs. It is expected that the understory plants will be viably reproducing and spreading by seed, roots and rhizomes within one to two years. The project also includes treating eroded banks and bare soil with a combination of erosion control fabrics and straw mulch. To reduce non-native grass encroachment, the project includes selective mowing of non-native grasses and distributing native seeds in their place throughout the entire project length.

The Upper Laguna channel restoration project, once completed, will provide several direct and indirect benefits. Direct benefits will occur locally on-site where the numerous plantings will reduce bank erosion, enhance riparian habitat, reduce stream temperatures through increased shading, and promote water quality enhancement. The proposed planting plan was designed to create a mature riparian canopy that supports continuous riparian vegetation throughout the reach. Beneath the canopy understory native plants and shrubs will provide improved habitat at the immediate channel banks areas. Downstream indirect benefits include reduced sediment loading to the Laguna and enhanced water quality. The reduction in sediment loading both locally and downstream reduces the need for in-channel maintenance activities, which in turn, reduces future potential impacts to the channel. Beneficial uses of the Laguna de Santa Rosa are currently impaired by sediment. Because the restoration project is located on the Upper Laguna channel (Figure 4-41) it will reduce local sediment loading and also provide benefits to the downstream Laguna system.

The Upper Laguna restoration project is directly responsive to residual impacts associated with the 2008 stream maintenance activities and demonstrates suitable and appropriate Tier 3 off-site watershed mitigation. Cost for the 2008 CCC Upper Laguna restoration project is $43,700. This mitigation project is funded through the WPP grant program. Funding is provided from the 10% matching contribution based on 2008 SCWA maintenance costs.

Cook Creek Headwaters Erosion Control and Sediment Management Project (2008) with watershed partner Sotoyome Resource Conservation District (RCD)

A 2007 landslide in the headwaters of Cook Creek destabilized a slope and moved soil and earth materials toward the tributary stream channel. The 2008 erosion control project was developed to stabilize the slope and reduce the sediment loading to the adjacent stream. The 2008 erosion control project occurred at a different slide location than the mitigation work conducted in 2006. Through SMP mitigation funding, the Sotoyome RCD worked collaboratively with SCWA to stabilize the active landslide and thereby reduce abundant sediment loading to Cook Creek. This project provides multiple benefits and serves as Tier 3 off-site mitigation for 2008 SCWA maintenance activities. Site photos and a project fact sheet are provided in Appendix D-4.

Key project activities included slope grading and vegetation planting to stabilize the soil mass, arrest movement, reduce further erosion and prevent a large volume of sediment from being discharged to Cook Creek and downstream areas. A key activity in landslide treatment is to assess drainage conditions and route potentially slide activating discharge away from the slide face, soils beneath the slide, or the slide toe. The slope face was regraded and compacted, and covered with erosion control fabric. The toe of the slope was anchored with rip rap and a rock/soil mix enabling tree plantings at the base of the slope. The grading design was integrated with upslope drainage improvements to keep the slope face well drained. Because of the steepness of the slope and the proximity to the creek, use of heavy equipment was difficult and was minimized. All work occurred upslope and outside of waters of the U.S./state, with appropriate BMPs implemented to prevent any construction related water, sediment, or other materials from entering the creek zone.

The vegetation plan included planting of shrubs, trees, emergent transplants, and dormant cuttings. These target planting numbers were based on the 2008 site evaluation. Plants will be maintained for 5 years following plant installation. Weeds will have to be removed from a small area (2 inch radius) around the stem of the installed plant two times a year, in late winter and early spring. Hardware may have to be adjusted to accommodate new plant growth.

This project provides several direct and indirect benefits occurring both on-site and to the watershed as a whole. Direct benefits include erosion control and the prevention of a stream section from being buried and inundated with accumulated landslide material. This is particularly important in headwater first-order streams where the transition from the defined channel network to the hillside catchment areas is an important ecotone. Slope stability and erosion reduction were implemented using bioengineered slope stabilization and planting techniques. The on-site functional benefit of sediment source control translates to several downstream benefits including reduced sediment loading to Cook Creek, Coleman Creek, Wilfred Creek, and the Laguna de Santa Rosa downstream. Reducing the sediment load to these channels reduces the need for in-channel maintenance activities, which in turn, reduces net overall SMP impacts.

This watershed mitigation project served as one component of the overall mitigation program for 2008 SCWA stream maintenance projects. Project cost was $67,633 and was funded through the WPP grant program. Funding was provided from the 10% matching contribution based on 2008 SCWA maintenance costs.

8.7.6 Monitoring for Watershed Mitigation

Tier 3 watershed-based mitigation projects will be monitored and reported for five years. Monitoring of site conditions will the responsibility of the respective Partner overseeing a given project. However, it will be SCWA's responsibility to communicate monitoring results annually as part of the SMP reporting process. SMP annual notification and reporting actions are described in Section 8.11 below and in Chapter 9, Sections 9.6 and 9.8.

In the example agreement provided in Appendix C between SCWA and the Sotoyome RCD for the 2008 erosion control project at Cook Creek headwaters, the agreement provides that the RCD will be responsible for monitoring for the first three years following implementation. In this example, SCWA will be responsible for monitoring the remaining two years, providing a total of five years of project monitoring. For all Tier 3 projects, SCWA will be responsible for coordinating monitoring reports to the relevant agencies. As part of establishing work agreements with watershed Partners for individual projects, SCWA will ensure that at least 5 years of monitoring occurs; provided by the Partner and overseen bySCWA.

Monitoring reports for watershed mitigation projects will be prepared by the project partner and submitted to SCWA. The monitoring reports will include a description of how the project achieved objectives identified in the proposal, how the project is developing over time, and if the project requires adaptive management or maintenance. More specifically, data to be tracked and collected for watershed mitigation projects includes:

For erosion control projects: The status of the erosion control treatments and their effectiveness will be monitored annually. Are the treatments working effectively, is sediment actively eroding at the mitigation site beyond and above expected natural rates, are additional management or maintenance actions required? Photographs will be taken annually at consistent and referenced locations to allow comparisons of site conditions.

For planting and habitat enhancement projects: Monitoring will include the number and type of species planted per project site, linear feet of channel planted or acres of area restored per project site, and percent canopy cover. Monitoring will include a complete survival count each year during the five-year maintenance period. The first count will occur at the end of the first growing season. The final count will occur at the end of the fifth year maintenance period. Monitoring will include the survival, percent cover, and height of both tree and planted shrub species. Monitoring will include the number by species of plants replaced, an overview of the revegetation effort, and the monitoring methodology should be described as necessary. Reference photos from designated locations will be taken annually. If invasive species removal is a component of the mitigation project, then monitoring will include: the number and type of invasive trees removed, square feet of removal for shrub or ground-cover species, and the percent of managed area re-colonized by invasives.

8.7.7 Success Criteria and Remedial Actions

Success criteria will be included for mitigation projects as outlined above under Section 8.7.6, and as required for all stream maintenance activities. For vegetation, the goal will be 85 percent survival. For in-channel plantings, setting the appropriate criteria for survival is difficult due to lack of reference criteria and the dynamic environment of the channel bottom. Depending upon winter flow conditions, in-channel plantings could be covered in sediment or scoured and eroded by the following next year. Instead of establishing strict survival criteria for the in-channel zone, projects will be monitored and the presence of the planted species in the channel will be documented. Initial goals for in-channel plantings will be some level of survival, retention, and successful colonization into the subsequent years.

In the event of poor plant survival or failure to meet stated performance criteria, corrective measures will be implemented, including replanting to reach the 85 percent goal. Such remedial measures will be monitored for a 5-year period following implementation to ensure that the project is successful. For instance, if remedial activities were taken during the fifth year after project implementation, monitoring of these remedial measures would continue until year 10. If they did not meet performance criteria at that point, additional measures would be required, triggering another 5-year monitoring period. As a last resort, new mitigation would be provided elsewhere, should a project not be capable of meeting performance criteria.

SCWA will determine if and when a Tier 3 mitigation project is complete based on monitoring and remedial actions, if necessary. A completed and signed termination of contract will be submitted to regulatory agencies with annual reporting. Remedial actions, if outside the scope of funding of the original WPP project, will be funded by SCWA.

8.8 Mitigation Performed During the Interim Period 2006-2008

The interim permitting period (2006-2008) provided several projects that were used as a basis to develop the mitigation approach. The interim permitting period was used to apply and demonstrate the mitigation approach with regulators who were overseeing the SMP permitting. During the interim period, consensus was reached on how the mitigation approach would achieve the mitigation requirements for the program. Over the course of the three year interim period the mitigation approach was revised to reflect additional regulatory agency requests, as well as other improvements developed for the program.

Tables 6-1, 8-7, and 8-8 are referenced to describe mitigation performed during the interim period. Table 6-1 provides a summary of the project types, lengths and areas impacted, and sediment removed for the 46 maintenance projects conducted in the SMP interim period 2006-2008. These projects consisted of reach scale sediment removal, bank stabilization, and localized sediment removal projects. The 46 projects developed, permitted, and conducted during the 2006-2008 period demonstrate well the range of project and mitigation activities of the program.

Table 8-7 provides maintenance costs for the 2006-2008 projects. As described in Section 8.7.2 the WPP is an in-lieu-fee arrangement whereby 10 percent of the cost of SMP activities for sediment removal and bank stabilization are collected to fund off-site watershed mitigation projects. These contributions to the WPP will account for the compensatory mitigation of residual program impacts as summarized in Table 8-7. For example, in 2008, $18,900 was provided to the WPP grant fund to implement off-site suitable watershed from the $189,000 maintenance cost conducted at Copeland Creek Reach 4. In Table 8-7, for each of the three years, mitigation project costs are shown below the listings of the maintenance project costs. For example, in 2008 the Cook Creek Headwaters Erosion Project ($67,633 and the Cotati Creek Critters Project ($43,700) are shown. These watershed mitigation projects are described above in Section 8.7.5.

Note that the 2008 WPP project fund also includes $7,271 of contributed money not used by this year's two watershed mitigation projects. This money will be reserved in the WPP Project Fund for application in the coming year. Rolling over of funds from the current year to be applied in a future year in no way reduces any future funding obligation of the Agency. Under the SMP program, annual notifications to regulatory agencies will include a summary accounting of the WPP project fund, how much money was put into the fund, how much has been spent, and if any funds (such as the $7,271 from 2008) are in holding until future use.

Table 8-8 provides a summary of project impacts, Tier 1 mitigation provided on-site, and Tier 3 mitigation provided off-site. Ratios are provided comparing impacted areas (or lengths) to mitigated and restored areas (or lengths). Table 8-8 includes sub-tables (a), (b), and (c) comparing impacts and mitigation for the Coleman Creek, Copeland Creek, and Todd Creek reach scale sediment removal projects respectively. Table 8-8(d) provides a summary combining information for the three reach scale projects. Table 8-8(e) shows a summary of impacts and mitigation conditions for all the sediment removal projects in 2008, including the smaller localized sediment removal projects.

8.9 Environmental Commitments for Mitigation

In the process of working with the regulatory agencies overseeing the development of programmatic permits, the following environmental commitments were established.

8.9.1 Environmental Commitments for Sediment Removal Activities

- Through implementing the SMP, SCWA shall seek to minimize the need for reach-scale sediment removal projects wherever possible. SCWA shall prioritize the development and use of targeted sediment removal areas to reduce the need for reach-scale sediment removal projects. The use of limited sediment removal areas is most effective at known and recurring depositional zones, whereby removal of sediment at the targeted location reduces the dispersal of sediment throughout the downstream reach. Mitigation requirements for the targeted sediment removal areas are discussed below.
- To avoid and minimize potential impacts related to stream maintenance, SCWA will follow the Maintenance Principles, framing considerations, goals and maintenance triggers described in Chapter 5 of the SMP Manual. For sediment removal projects this includes understanding the relative causes of excess sedimentation and the relative reduction in channel capacity prior to conducting any repeated reach-scale sediment removal activities within a 5-year period.
- SCWA shall generally only conduct reach-scale sediment removal once within a given reach over the duration of the 5-year permit term of the ARM. However, if and when large stream discharges occur (e.g. equaling or exceeding the 10-year magnitude flow event), SCWA may review reaches to evaluate the need for additional reach-scale sediment removal activities. Large magnitude events may cause significant sediment accumulation that reduces flow conveyance capacity. As such, large events may result in the need to review and consider reach-scale sediment removal even for reaches where sediment removal activities had occurred within the past 5 years. Under these situations following a significant depositional event, SCWA will evaluate the reach in question carefully for reduced conveyance capacity. If sediment removal activities are required to maintain flood conveyance capacity, SCWA will provide demonstrated evidence to the pertinent regulatory agencies overseeing the SMP to demonstrate that channel capacity has been significantly diminished. Evidence of diminished channel capacity may include channel cross-sections, photographs, modeling, and/or other field-based evidence or observance of a heightened flood risk.
- If repeated reach-scale sediment removal activities are necessary, SCWA shall restore any associated on-site restoration activities that occurred as original mitigation for the initial sediment removal project. If restoration activities are damaged due to the occurrence of a large flow event as described above, the restoration activities shall be replaced on-site at a 1:1 ratio. If on-site restoration activities are not successful due to other reasons (beyond the occurrence of a large

Table 8-7. Maintenance Costs and Mitigation Contributions Page 1 of 3

Year	Project Reach	Project Type	Linear Feet	Sediment Removed (Cubic Yards)	Project Cost	Contribution to WPP (10% of project cost)
2006						
	Bloomfield (Zone 8A)	Localized Sediment Removal	184	800	$20,000	$2,000
	Adobe 1	Bank Stabilization	20	-	$5,000	
	Austin 1	Bank Stabilization	90	-	$5,000	
	Austin 2	Bank Stabilization	30	-	$5,000	
	Austin 3	Bank Stabilization	20	-	$5,000	
	Colgan 1	Bank Stabilization	25	-	$5,000	
	Colgan 2	Bank Stabilization	30	-	$5,000	
	Colgan 3	Bank Stabilization	50	-	$5,000	
	Colgan 4	Bank Stabilization	100	-	$5,000	
	East Washington 1	Bank Stabilization	75	-	$5,000	
	Gossage 1	Bank Stabilization	18	-	$5,000	
	Gossage 2	Bank Stabilization	38	-	$5,000	
	Gossage 3	Bank Stabilization	75	-	$5,000	
	Gossage 4	Bank Stabilization	100	-	$5,000	
	Gossage 5	Bank Stabilization	25	-	$5,000	
	Gossage 6	Bank Stabilization	100	-	$5,000	
	Peterson 1	Bank Stabilization	50	-	$5,000	
	Peterson 2	Bank Stabilization	50	-	$5,000	
	Peterson 3	Bank Stabilization	35	-	$5,000	
	Peterson 4	Bank Stabilization	20	-	$5,000	
	Peterson 5	Bank Stabilization	70	-	$5,000	
	Piner 1	Bank Stabilization	15	-	$5,000	

Table 8-7. Cont. Page 2 of 3

Year	Project Reach	Project Type	Linear Feet	Sediment Removed (Cubic Yards)	Project Cost	Contribution to WPP (10% of project cost)
	Piner 2	Bank Stabilization	18	-	$5,000	
	Piner 3	Bank Stabilization	35	-	$5,000	
	Piner 4	Bank Stabilization	30	-	$5,000	
	Russell 1	Bank Stabilization	90	-	$5,000	
	Russell 2	Bank Stabilization	90	-	$5,000	
	Russell 3	Bank Stabilization	120	-	$5,000	
	Russell 4	Bank Stabilization	85	-	$5,000	
	Steele 1	Bank Stabilization	50	-	$5,000	
	Steele 2	Bank Stabilization	25	-	$5,000	
		Total Maintenance Cost			**$170,000**	**$17,000**
	2006 Mitigation Projects					
	2006 Cook Creek Erosion Control and Landslide Stabilization Project				$339,000	
		Total Mitigation			**$339,000**	
2007						
	East Washington 4 and 5	Reach-Scale Sediment Removal	1,390	3,800	$151,500*	
	East Washington 1 and 2	Localized Sediment Removal	315	380	*	
		Total Maintenance Cost			**$151,500**	**$15,100**
	2007 Mitigation Projects					
	Barboni Fencing Project				$15,000	
		Total Mitigation			**$15,000**	

Table 8-7. Cont.

Year	Project Reach	Project Type	Linear Feet	Sediment Removed (Cubic Yards)	Project Cost	Contribution to WPP (10% of project cost)
2008						
	Copeland 4	Reach-Scale Sediment Removal	1,270	8,142	$189,000	$18,900
	Coleman 2	Reach-Scale Sediment Removal	1,337	2,990	$81,806	$8,181
	Hinebaugh 1	Reach-Scale Sediment Removal	6,932	7,350	$358,000	$35,800
	Hinebaugh 2 and 3**	Reach-Scale Sediment Removal	2,400	4,785	$278,000	$27,800
	Todd 5	Reach-Scale Sediment Removal	1,270	2,570	$151,506	$15,151
	Airport 2	Localized Sediment Removal	252	140	$11,275	$1,128
	Colgan 6	Localized Sediment Removal	135	115	$11,275	$1,128
	College 1 and 2	Localized Sediment Removal	170	110	$11,275	$1,128
	Ducker 1	Localized Sediment Removal	174	205	$13,828	$1,383
	Steele 3	Localized Sediment Removal	131	75	$9,007	$901
	Washington 2 and 3	Localized Sediment Removal	197	145	$13,828	$1,383
	Gossage 1 and 2	Bank Stabilization	540	-	$12,939	$1,294
	Roseland 1	Culvert Replacements	7,200	-	$44,298	$4,298
		Total Maintenance Cost			**$1,186,037**	**$118,604**
	2008 Mitigation Projects					
	Cook Creek Headwaters Erosion Control and Sediment Management Project (0.207 acres)				$67,633	
	Cotati Creek Critters Restoration Activities on the Upper Laguna de Santa Rosa Channel (4.6 acres)				$43,700	
	WPP Project Fund				$7,271	
		Total Mitigation			**$118,604**	

* The costs for maintenance work in East Washington Reaches 1, 2, 4, and 5 are combined.

** Maintenance work conducted in reaches Hinebaugh 2 and 3 were permitted in 2007, but mitigation contributions were calculated in the 2008 permit year.

Table 8-8a. Impacts and Mitigation Summary, Coleman Creek Project

Impact or Restoration	Units	Project Impact	On-Site (Tier 1) Mitigation	Off-Site (Tier 3) Mitigation			Tier 3 Mitigation Provided by Project's 7% Contribution to WPP	Total Restored (On-Site plus Off-Site)	Ratio of Mitigation to Impact
				Cook Creek	Cotati Critters	Total			
Total Area	**Acres**	**0.73**	**0.73**	**0.207**	**4.6**	**4.81**	**0.33**	**1.06**	**1.5:1**
Habitat Type									
Riparian, non-wetland	Acres	0.12	0.73	n/a	4.6	4.6	0.32	1.05	8.7:1
	Linear Feet	1,323	1,323	n/a	5,000	5,000	345	1,668	1.3:1
Riparian wetland	Acres	0.61	0	n/a	n/a	0	0	0	0
	Linear Feet	1,323	0	n/a	n/a	0	0	0	0
Upland	Acres	0	n/a	0.207	n/a	0.207	0.01	0.01	n/a
Vegetation									
Trees	# or Acres	130	55	50	0	50	3	58	0.4:1
Shrubs	# or Acres	0.01 acres	396	164	0	164	11	407	high
Herbs/Grasses	# or Acres	0.74 acres	245	40	1,000	1,040	72	317	high
Other	# or Acres	0	0	40	0	40	3	3	n/a

Table 8-8b. Impacts and Mitigation Summary, Copeland Creek Project Page 2 of 5

Impact or Restoration	Units	Project Impact	On-Site (Tier 1) Mitigation	Off-Site (Tier 3) Mitigation			Tier 3 Mitigation Provided by Project's 16% Contribution to WPP	Total Restored (On-Site plus Off-Site)	Ratio of Mitigation to Impact
				Cook Creek	Cotati Critters	Total			
Total Area	**Acres**	**4.62**	**4.62**	**0.207**	**4.6**	**4.81**	**0.77**	**5.39**	**1.2:1**
Habitat Type									
Riparian, non-wetland	Acres	1.62	4.62	n/a	4.6	4.6	0.73	5.35	3.3:1
	Linear Feet	3,050	3,050	n/a	5,000	5,000	797	3,847	1.3:1
Riparian wetland	Acres	3	0	n/a	n/a	0	0	0	0
	Linear Feet	3,050	0	n/a	n/a	0	0	0	0
Upland	Acres	0	n/a	0.207	n/a	0.207	0.033	0.033	n/a
Vegetation									
Trees	# or Acres	130	0	50	0	50	8	8	0.1:1
Shrubs	# or Acres	0.7 acres	0	164	0	164	26	26	medium
Herbs/Grasses	# or Acres	0.2 acres	1,700	40	1,000	1,040	166	1,866	high
Other	# or Acres	0	0	40	0	40	6	6	n/a

Table 8-8c. Impacts and Mitigation Summary, Todd Creek Project Page 3 of 5

Impact or Restoration	Units	Project Impact	On-Site (Tier 1) Mitigation	Off-Site (Tier 3) Mitigation			Tier 3 Mitigation Provided by Project's 13% Contribution to WPP	Total Restored (On-Site plus Off-Site)	Ratio of Mitigation to Impact
				Cook Creek	Cotati Critters	Total			
Total Area	**Acres**	**0.875**	**0.875**	**0.207**	**4.6**	**4.81**	**0.61**	**1.49**	**1.7:1**
Habitat Type									
Riparian, non-wetland	Acres	0.476	0.875	n/a	4.6	4.6	0.59	1.46	3.1:1
	Linear Feet	805	1,270	n/a	5,000	5,000	639	1,909	2.4:1
Riparian wetland	Acres	0.399	0	n/a	n/a	0	0	0	0
	Linear Feet	715	0	n/a	n/a	0	0	0	0
Upland	Acres	0	n/a	0.207	n/a	0.207	0.026	0.026	n/a
Vegetation									
Trees	# or Acres	10	73	50	0	50	6	79	8:1
Shrubs	# or Acres	0.03 acres	131	164	0	164	21	152	high
Herbs/Grasses	# or Acres	0.875 acres	600	40	1,000	1,040	133	733	high
Other	# or Acres	0	0	40	0	40	5	5	n/a

Table 8-8d. Impacts and Mitigation Summary, 2008 Three Reach Scale Projects

Impact or Restoration	Units	Project Impact	On-Site (Tier 1) Mitigation	Off-Site (Tier 3) Mitigation			Tier 3 Mitigation Provided by Projects' 36% Contribution to WPP	Total Restored (On-Site plus Off-Site)	Ratio of Mitigation to Impact
				Cook Creek	Cotati Critters	Total			
Total Area	**Acres**	**6.23**	**6.23**	**0.207**	**4.6**	**4.81**	**1.17**	**7.94**	**1.3:1**
Habitat Type									
Riparian, non-wetland	Acres	2.22	6.23	n/a	4.6	4.6	1.64	7.87	3.5:1
	Linear Feet	5,178	5,643	n/a	5,000	5,000	1780	7,423	1.4:1
Riparian wetland	Acres	4.01	0	n/a	n/a	0	0	0	0
	Linear Feet	5,088	0	n/a	n/a	0	0	0	0
Upland	Acres	0	n/a	0.207	n/a	0.207	0.07	0.07	n/a
Vegetation									
Trees	# or Acres	270	128	50	0	50	18	146	0.5:1
Shrubs	# or Acres	0.74	469	164	0	164	58	527	high
Herbs/Grasses	# or Acres	1.82	2,545	40	1,000	1,040	370	2,915	high
Other	# or Acres	0	0	40	0	40	14	14	n/a

Table 8-8e. Impacts and Mitigation Summary, 2008 All Projects Page 5 of 5

Impact or Restoration	Units	Project Impact	On-Site (Tier 1) Mitigation	Off-Site (Tier 3) Mitigation			Tier 3 Mitigation Provided by Projects' Contribution to WPP	Total Restored (On-Site plus Off-Site)	Ratio of Mitigation to Impact
				Cook Creek	Cotati Critters	Total			
Total Area for All Projects	Acres	11.1	11.1	0.207	4.6	4.81	4.81	15.91	1.4:1

flood event) than they will be replaced at a 2:1 ratio as described below in the mitigation requirements.

- SCWA will consult with the pertinent regulatory agencies overseeing the SMP on any potential repeated reach-scale project and use the SMP guidance to reduce all potential impacts resulting from implementation to the greatest extent feasible.
- SCWA will conduct sediment removal activities in engineered channels in accordance with the Biological Opinion for the Russian River Watershed (National Marine Fisheries Service 2008) which states under Incidental Take Statement 7c that for the following creeks and stream distances, sediment removal activities are restricted to:
    - Laguna de Santa Rosa – 2,400 feet of sediment removal three times during the next fifteen years, and 12,000 feet of vegetation removed annually;
    - Copeland Creek – 3,270 feet of sediment removal six times during the next fifteen years, and 9,625 feet of vegetation removed annually;
    - Windsor Creek – 500 feet of sediment removal two times during the next fifteen years, and the annual removal of 3,000 feet of vegetation during the next fifteen years;
    - Santa Rosa Creek – 4,000 feet three times during the next fifteen years, and 12,100 feet of vegetation removal annually.

These restrictions apply to reach scale sediment removal projects. For localized sediment removal at culverts and road crossings at the following creeks or areas: Laguna de Santa Rosa, Santa Rosa Creek, Copeland Creek, and Windsor Creek; no more than three sediment removal actions will occur annually in these engineered channels.

Additionally, annual reach scale sediment removal activities at Adobe Creek will be limited to 1,000 linear feet per year. Within SCWA Zones 2A/3A, (under the jurisdiction of RWQCB Region 2) the SCWA maintenance reaches along Adobe Creek are noted as the engineered reaches with the highest value for steelhead habitat.

The Adobe Creek in-stream basin is not restricted within this limitation and may be maintained annually.

8.9.2 Environmental Commitments for Vegetation Management Activities

- SCWA will describe their vegetation management strategies in a *Vegetation Management Plan* that will be included as an appendix to the SMP Manual. This plan will include a discussion of relevant impact avoidance and minimization measures undertaken when planning and implementing vegetation management activities. Additionally, the vegetation management strategy will describe the criteria used to identify and determine vegetation management actions and also describe the protocols used to remove, trim, thin, or limb bank and in-stream vegetation. The *Vegetation Management Plan* has been completed and is included in Appendix E.

- SCWA shall limit the removal of vegetation to plants and trees that directly affect the hydraulic capacity of the channels as described in the SMP Manual. SCWA will avoid and minimize impacts to the beneficial uses that vegetation provides including cover, shade, and aquatic habitat support.
- The SMP vegetation management approach includes developing and enhancing the riparian canopy throughout the SMP program area. This is achieved through the planting of native and suitable riparian vegetation, and the thinning and selective removal of non-suitable species. If and when vegetation thinning and removal are to occur, such actions should be implemented in a phased approach such that channel areas are not left wholly void of vegetation that provides shade. Mitigation requirements for vegetation removal are described below.

8.10 Mitigation Accounting and Requirements

8.10.1 Overview of Mitigation Ratios

Compensatory mitigation under the SMP will be provided at a minimum of 1.1:1 (acres restored to acres disturbed). The first increment of 1:1 will be provided by on-site Tier 1 mitigation, which will directly restore the area disturbed and address on-site impacts. Due to the degraded nature of many of the SMP channels, in most cases Tier 1 mitigation will result in improved conditions on these sites over the long term (ecological lift concept). As such, they functionally will provide a greater than 1:1 mitigation ratio when considering functions and values, not just acreage.

The next increment of 0.1:1 will be provided by Tier 2 and Tier 3 off-site mitigation. In other words, at a minimum, the 10% contribution described above will provide a 0.1:1 acreage ratio. Should a 10% contribution not be sufficient to provide this ratio, additional funds would be applied until the ratio is met. However, as shown in the example below, the 10% contribution will typically provide a ratio which greatly exceeds 0.1:1 (in the example below, it results in a ratio of 0.4:1, or a total ratio of 1.4:1 considering Tier 1 mitigation). This increment mitigates for the temporary impacts that persist while Tier 1 mitigation is becoming fully established. This approach was developed and demonstrated through the mitigation projects implemented during the 2006-2008 interim permitting period while the SMP was under development.

The example provided above shows how this would work in practice. As shown in the component tables of Table 8-8, project impacts are shown by total acreage, and also by habitat and vegetation types. The two Tier 3 off-site mitigation projects for 2008 include the Cotati Creek Critters and Cook Creek Headwaters Erosion Control projects as described above. Through the $43,700 and $67,633 of funding provided to the Cotati Creek Critters and Cook Creek Headwaters projects (see Table 8-7), 4.60 and 0.21 acres will be restored respectively.

Mitigation ratios are developed by combining the on-site and off-site mitigation areas provided and comparing that to the acreage of maintenance project impacts. For the three reach scale sediment removal projects shown in Table 8-8(d), the net mitigation provided is 7.94 acres and the net wetlands area impacted is 6.23 acres. This resulted in a ratio of 1.3

acres mitigated for every 1 acre impacted, or 1.3:1. Table 8-8(e) summarizes the impacts and mitigation areas for all the 2008 projects, including the smaller localized sediment removal projects. The net mitigation ratio for all 2008 projects is 1.4:1, meaning impacted areas are mitigated at 140%.

Taken together, the on-site reach-based mitigation activities, and the watershed mitigation activities through the WPP was determined to provide adequate and substantive compensatory mitigation for temporary and permanent residual impacts of the 2008 stream maintenance projects. This mitigation approach was reviewed by the relevant regulatory staff and agencies participating in the development of the SMP and approved as part of the permit conditions. As such, it serves as a demonstration of the mitigation approach in the SMP.

8.10.2 Specific Mitigation Requirements for Sediment Removal Activities

This section includes more specific mitigation requirements for sediment removal activities that were developed for the program in coordination with the North Coast and San Francisco Bay Regional Water Quality Control Boards (RWQCBs).

- Localized, intermediate-scale sediment removal, reach-scale sediment removal, and bank stabilization projects shall include on-site habitat enhancement and restoration activities (as described in Section 8.4) at no less than a 1:1 ratio for areas impacted to areas restored.
- On-site restoration activities need not occur within concrete flood control channels or other concrete/hardened flood control facilities. However, the cost of removal of sediment from such concrete facilities will be included in the calculation of SCWA's contribution to the off-site watershed restoration projects fund (described below).
- On-site and off-site mitigation activities shall be observed and monitored for 5 years as described in Sections 8.5.1, 8.7.6 and 8.7.7.
- Should on-site mitigation activities not perform to the success criteria as described in the SMP Manual, then corrective measures shall be taken. The portion of the mitigated area that was unsuccessfully restored after 5-years shall be mitigated at a 2:1 ratio. Due to the higher mitigation requirement for past unsuccessful areas, SCWA may use other channel reaches (as suitable) in addition to (or in place of) the on-site reach area to fulfill the mitigation requirement. All mitigation monitoring and reporting requirements as described in Chapter 9 shall be followed.
- Annual costs for the implementation of localized sediment removal, intermediate-scale sediment removal, reach-scale sediment removal, reservoir inlet clearing sediment removal, and bank stabilization projects shall be used as the basis to fund off-site mitigation projects. Off-site mitigation projects will be selected and funded that provide beneficial watershed functions of restored habitat, erosion control, or other suitable watershed benefits as described in the SMP Manual. Ten percent of the annual costs for the sediment removal and bank stabilization projects shall be contributed to a mitigation fund to be used by watershed partners as described in the SMP Manual. The area to be restored or enhanced off-site as mitigation shall not be less than 10% of the impacted on-site sediment removal area (resulting in a

total mitigation ratio of 1.1:1, considering both on-site and off-site mitigation). For example, if the impact to the SMP channel is 1 acre, then the off-site mitigation area should not be less than 0.1 acre.

- The rationale for the additional 10% compensatory off-site mitigation rate is to provide for the temporary loss of beneficial uses during the time gap between when on-site impacts occur and when on-site restoration activities occur. Due to this "temporal gap" the North Coast RWQCB assigned an additional 10% mitigation requirement to interim stream maintenance projects, and because this could not be achieved on-site where complete restoration was occurring (at 1:1 ratio), the additional mitigation requirement was applied off-site.
- Targeted sediment removal areas that are used as a preferential approach to reduce the need for reach-scale sediment removal projects shall be included in the cost basis for calculating the annual off-site mitigation fund. While maintenance costs at targeted sediment removal areas shall contribute to off-site mitigation, the area of impact within the targeted sediment removal zones does not require compensatory mitigation.

8.10.3 Specific Mitigation Requirements for Vegetation Management Activities

This section includes more specific mitigation requirements for vegetation management activities that were developed for the program in coordination with the North Coast and San Francisco Bay Regional Water Quality Control Boards (RWQCBs) and the California Department of Fish and Game (CDFG).

- SCWA shall mitigate for the loss of beneficial uses due to SMP vegetation management activities.
- To help clarify the mitigation requirements for the vegetation removal activities of the SMP, the following three vegetation classes have been identified:

  Class 1: Native Riparian Vegetation: Class 1 native vegetation (except for those species listed under Class 2, below) shall be retained wherever possible, and pruned or thinned where necessary so as to foster the development of a riparian canopy. Examples of native riparian vegetation include: white alder (*Alnus rhombifolia*), box elder (*Acer negundo*), big leaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia),* red willow (*Salix laevigata*), Pacific willow (*Salix lucida lasiandra*), Fremont's poplar (*Populus fremontii*), and oaks (*Quercus spp*.) as appropriate. Additionally there are a number of native understory riparian shrubs suitable for flood control channels (depending on location) including: American dogwood (*Cornus sericea*), Western spicebush (*Calycanthus occidentalis*), elderberry (*Sambucus spp*.), snowberry (*Symphoricarpos spp.),* hazelnut (*Corylus cornuta californica*), and a number of others. Most of these shrub and tree species are included in the SMP plant palette included in Figures 8-2 and 8-3 of the SMP Manual. The removal of such native vegetation will be avoided to the greatest extent possible. Where such native vegetation has to be removed due to flood management considerations, the following limitations and mitigation shall apply. The removal of native vegetation with any single stem greater than 4" dbh (diameter at breast height) will be monitored, recorded, and mitigated at a 2:1 ratio, whereby 2 trees are replaced for every tree removed. Replacement trees shall include, but not be limited to, suitable riparian species such as alder, willow, Oregon ash, etc.

Class 2: Problematic In-Channel Vegetation: This class of vegetation is particularly problematic for flood management purposes and ecologically, inhibits and prevents the establishment of a native riparian canopy. This class of vegetation includes the following species:

1. Cattails (*Typha sp.)*
2. Himalaya blackberry (*Rubus discolor*)
3. Arroyo willow (*Salix lasiolepis*)
4. Giant reed (*Arundo donax*)
5. Pampas grass (*Cotaderia selloana*, and *C. jubata*)
6. Indian bean (*Catalpa bignoniodes*)
7. Privet (*Ligustrum sp*.)
8. English and Algerian ivy (*Hedera helix, H. canariensi*s)
9. Periwinkle (*Vinca major*.)
10. Red clusterberry (*Contoneaster sp.*)
11. Brooms (*Spartium* and *Genista spp.*)
12. Sweet fennel (*Foeniculum vulgare*)
13. Harding grass (*Phalaris aquatica*)
14. Water primrose (*Ludwigia peploides montevidensis*)
15. Eucalyptus (*Eucalyptus ssp*.)
16. Tree of heaven (*Ailanthus altissima*)
17. Acacia (*Acacia ssp*.)
18. White poplar (*Populus alba*)
19. Lombardy poplar (*Populous nigra 'Italicia'*)
20. Tamarisk (*Tamarix spp*.)
21. Rattlebox (*Sesbania punicea*)

These Class 2 species are identified as particularly problematic for flood management purposes and because they limit the beneficial uses that can be achieved in the riparian zone. Impact avoidance and minimization approaches applied for the removal and thinning of these species is described in the SMP Manual. Regulatory provisions for the removal and management of these species are included in the Agreement for Routine Maintenance (ARM) with the California Department of Fish and Game (CDFG). The thinning and removal of these species do not require any additional specific mitigation requirements.

Class 3: Other Non Native Vegetation: Class 3 vegetation consists of non-native species that are not listed under Class 2, above. Examples of Class 3 vegetation include: various landscaping Ash species (green ash, raywood ash), London plane (Sycamore), and Carolina poplar. While these species are not as ecologically preferred as Class 1 vegetation, it is acknowledged that they may provide beneficial uses. As such, the removal of Class 3 vegetation with any single stem greater than 4" dbh (diameter at breast height) will be monitored, recorded, and mitigated at a 1.5:1 ratio.

- When replacing Class 1 and Class 3 trees, replacement trees shall consist of native riparian species such as alder, willow, Oregon ash, or other suitable species. The mitigation replacement of trees may either occur at the reach under maintenance or at another suitable SCWA channel reach in need of riparian canopy. The number of removed trees will be reported in the annual summary report of maintenance activities and the replacement of trees as mitigation will be reported through the annual maintenance reports as well. Similar to the requirements for on-site and off-site mitigation and restoration activities, the performance criteria for replacement planting for vegetation mitigation shall be 85% success, and mitigation plantings shall be monitored for 5 years. In addition to overall success, planted trees shall be evaluated for their overall health and vigor.
- The pruning of trees, including native trees, in order to promote a more upright, mature riparian canopy does not require mitigation.
- Grass mowing and shrub thinning activities are not anticipated to adversely affect shade or habitat benefits, and as such, do not require mitigation.

8.11 Mitigation Notification and Reporting

Mitigation planning, design, implementation, and monitoring activities will be notified and reported to the relevant permitting agencies through the course of the regular program communications. Notification and reporting details for the overall program are described in Chapter 9, Sections 9.6 and 9.8. SCWA will submit an annual maintenance project workplan notification in the spring of each year. This notification will include a description of maintenance project details, including locations, activities, and impact avoidance and minimization measures. The notification packet will also include information regarding the annual mitigation process.

Mitigation information to be included in the annual notification packet will include:

- A description of on-site (Tier 1) restoration activities planned for the coming year including locations, lengths, areas, and other project details;
- A description of Tier 2 restoration activities (if occurring) on other SCWA channels planned for the coming year including locations, lengths, areas, and other project details;
- The proposed off-site watershed mitigation plan (Tier 3), including:
    - a description of each candidate off-site restoration project, including the project name, project partners, project cost, length and area of mitigating activities;
    - a description of how the proposed off-site watershed projects will address watershed processes and functions to provide suitable mitigation for the year's maintenance activities (relating the short term temporary residual

impacts that are to be addressed through the watershed mitigation as described above to the proposed projects);

- schedule for implementation of mitigation activities;
- a statement describing the status of permit approvals necessary to perform project (if applicable); and
- a monitoring and reporting plan.

Permitting agencies will have the opportunity to review and comment on the proposed annual mitigation plan. The SMP annual mitigation plans will be consistent with the mitigation approaches and requirements described in this manual. Annual mitigation projects are envisioned to be consistent with the types of projects developed during the SMP interim period, as described above.

In the fall of each year, SCWA will submit an annual report on SMP activities including summary descriptions of the maintenance activities conducted in the past year. The annual report will also include status reporting on the program's mitigation activities, including the submittal of follow up monitoring reports. Topics to be addressed in the monitoring reports are described above in Section 8.7.6.

Chapter 9
PROGRAM MANAGEMENT

9.1 Stream Maintenance Program Work Cycle

This chapter outlines and describes how the Stream Maintenance Program (SMP) will be implemented and administered by the Sonoma County Water Agency (SCWA). The management and operation of the SMP occurs as an annual cycle of activities described in this chapter as the "work cycle." As shown in Figure 9-1, the work cycle begins each year with a field based stream reconnaissance and assessment. The components of the SMP work cycle are described in greater detail in Table 9-1 and in the sections below.

The work cycle begins with the program wide stream assessment. The stream assessment guides the development of that year's workplan. Projects such as vegetation maintenance, localized sediment removal at culvert crossings, or minor bank repairs do not generally require additional engineering or design details. Such routine maintenance activities which do not require additional engineering design represents the large majority of SMP projects. Reach-scale sediment removal projects and some larger scale bank stabilization projects may require site assessment and/or detailed engineering drawings. In these cases, the physical site conditions, erosion or deposition causes, and the maintenance requirements will guide the appropriate project design. As described previously in Chapter 6, activities or projects that require this level of analysis and engineering will be designed with a consideration of sustainable solutions that can reduce future maintenance needs.

Sediment disposal planning will also occur in the work cycle, with annual disposal plans developed and implemented yearly in support of planned maintenance projects. Longer-term sediment disposal planning will also occur beyond the annual work cycle, as described previously in Chapter 5. All maintenance activities will utilize the appropriate programmatic impact avoidance, minimization, and mitigation programs outlined in this manual.

The anticipated calendar sequence for maintenance projects is shown in Figure 9-2. Stream reconnaissance and assessment begins in late winter or early spring with the development of the project workplan in the spring. Project descriptions are then developed, and mitigation planning occurs through the remainder of the spring. The relevant regulatory agencies are notified of the year's projects in late spring and provided information on project locations, activities, mitigation, sediment disposal, and any other key issues. Projects are then implemented during the summer season with follow up annual reporting activities occurring in the fall.

SCWA will administer and oversee the SMP throughout all steps of the work cycle. It is recognized that a successful program will be based on continuous management and oversight. SCWA has appointed an SMP Manager whose central responsibility is to supervise and guide the program. A key responsibility for the SMP Manager will be to provide communication and coordination between SCWA and the relevant regulatory agencies throughout all steps of the work cycle. The SMP will be administered consistently with the goals, principles, and activities as described in this manual. In addition to the annual work cycle, every five years the SMP will be reviewed for its overall effectiveness and adequacy.

Another key element to supporting an effective stream maintenance program is to establish and maintain a comprehensive data management system. Data management is required throughout the SMP work cycle from organizing the initial stream assessment and inventory, to charting reach conditions and project requirements, to providing post project monitoring and reporting. Data management for the SMP is described below in Section 9.9. Data to be tracked for each stage in the work flow process is shown in Table 9-1.

9.2 Stream Reconnaissance and Assessment

In the late winter or early spring, SCWA will initiate a reconnaissance of the engineered channels included in the SMP on a reach-by-reach basis to assess potential maintenance needs.

Conditions in natural and modified channels will be assessed on an as-needed basis. As described in Chapter 6, Section 6.6, maintenance activities in natural and modified channels occur less frequently and typically follow specific landowner requests. When requested or planned, maintenance activities in natural and modified channels will be included in the annual workplan along with other SMP maintenance activities.

SCWA staff familiar with the guidelines and principles of the SMP will conduct the stream channel assessments. During the survey, the channel characterization sheets (provided in Chapter 4) will be referenced in the field, reviewed for their accuracy, and updated as appropriate. SCWA will also use an assessment checklist to help organize and prioritize maintenance activities. A sample assessment checklist is shown in Figure 9-3.

The assessment process will evaluate the need for maintenance and follow the guidance questions and maintenance triggers described in Chapter 5. Conditions and resources will be assessed in terms of the potential need for sediment removal, bank stabilization, and vegetation management. As shown in the sample assessment sheet in Figure 9-3, assessment categories will receive rankings ranging from 1 (high priority) to 4 (low priority). Channel vegetation conditions will be assessed for the presence of cattails, blackberries, willows, exotics, etc. and need for vegetation removal or management. Photographs will be taken of each reach and archived in the SMP database. The stream assessment process will also be supported by information provided by the reach sheets, GIS mapping, and aerial photography.

Information from the assessment sheets will be integrated into the SMP data management system ("SMP Tracker"). The data system will be accessed during the stream assessment process to query past maintenance activities, identify specific resource conditions, and prioritize maintenance activities by reach to develop the year's workplan.

Based on the field reconnaissance, review of the channel characterization sheets, completion of the reach assessment checklist, and subsequent prioritization using the SMP

Table 9-1. Data Management and Tracking Through SMP Work Cycle Page 1 of 4

Step 1. Stream Assessment	
Maintenance Work	▪ Review photo history of reach ▪ Review historic x-sections of reach ▪ Review maintenance history of reach ▪ Complete Creek Assessment Sheets
Sediment Disposal	▪ Conduct pre-disposal outreach to locate interested landowners in need of sediment ▪ Conduct pre-disposal outreach to landfills to identify quantity and quality of sediment they will accept for landfill cover
Resources	▪ Review sensitive species/habitats maps ▪ Review Reach Sheets ▪ Survey for presence of sensitive species and habitat
Permitting/Compliance	▪ Review history of any past permitting and permit conditions at reach
Restoration/Mitigation	▪ Review history of any past restoration/mitigation work at reach
Step 2. Develop Workplan	
Maintenance Work	▪ Identify potential projects for given year (identify project type) ▪ Map project locations for given year ▪ Identify extent (area and stream length) of projects (survey x-sections)
Resources	▪ Evaluate project locations, types, and existing resources ▪ Identify potential impacts on species ▪ Identify area and length of impacts (including waters of the US/state delineation)
Permitting/Compliance	▪ Identify whether the project is covered under any permit conditions, including BOs ▪ Identify whether the project is subject to use restrictions for herbicides, if applicable
Restoration/Mitigation	▪ Develop restoration concepts for on-site restoration activities ▪ Review WPP off-site project options (and locations) for given year ▪ If WPP options are limited, announce "call for projects" for WPP members

Table 9-1. Cont. Page 2 of 4

Step 3. Project Design and Description	
Maintenance Work	▪ Refine project list (types and locations) ▪ Identify locations of vegetation to be removed ▪ Select specific treatments for bank stabilization projects ▪ Calculate volume and exact locations of sediment and vegetation to be removed ▪ Collect sediment samples from maintenance sites according to Appendix B *Sediment Sampling and Analysis Guidelines*. ▪ Estimate project costs
Sediment Disposal	1) Identify the total amount of sediment for off-site disposal 2) Identify the sediment disposal options: A. On-site reuse B. Other SCWA Channel Reuse C. Wetland or Floodplain Restoration or Enhancement D. Upland Agricultural or Commercial Reuse (dry) E. Upland Agricultural or Commercial Reuse (wet) F. Landfill Disposal G. Hazardous Waste Disposal 3) Conduct sediment testing at disposal site according to Appendix B *Sediment Sampling and Analysis Guidelines*.
Resources	▪ Refine project designs based on resource considerations ▪ Review specific BMPs according to reaches and potential resources
Permitting/Compliance	▪ For steelhead bearing streams in Zone 1A, document number of times maintenance has been conducted in this reach and the linear feet of maintenance. Compare this to Russian River BO Compliance table.
Restoration/Mitigation	▪ On-site restoration: develop restoration design (planting palate and locations) ▪ Off-site restoration: review WPP project designs
Step 4. Develop Mitigation Plan	
Sediment Disposal	▪ Verify that sediment disposal is consistent with existing requirements at the disposal site (pre-established BMPs), if appropriate.
Resources	▪ Identify the species/resources and area impacted by the projects ▪ Review species, habitat, or other environmental sensitivities of off-site mitigation areas
Permitting/Compliance	▪ Consider any special permitting or environmental compliance requirements for off-site mitigation projects
Restoration/Mitigation	▪ Refine on-site restoration planning based on finalized project designs ▪ Identify area and length of on-site restoration activities (if different than maintenance areas/lengths) ▪ Finalize off-site mitigation projects contributions based on maintenance cost calculation ▪ Identify area and length of off-site mitigation areas
Step 5. Agency Notification	

Table 9-1. Cont. Page 3 of 4

Maintenance Work	▪ Provide agencies with a notification package containing details of project locations and types ▪ Provide agencies with reach specific and species/habitat specific BMPs for given year's workplan ▪ Submit sediment sampling results to Regional Water Quality Control Board (RWQCB) ▪ Submit notification package at least 60 days prior to implementation (Russian River BO requirement)
Sediment Disposal	▪ Include location and characteristics of disposal sites, as well as BMPs implemented, in the notification package, as appropriate. ▪ Submit results from sediment sampling to the RWQCB for review and disposal site approval
Resources	▪ Provide agencies with maps relating given year's workplan to sensitive species/habitat locations ▪ Provide agencies with maps of potential impact zones ▪ Provide agencies with pre-construction survey information, what surveys are necessary, etc.
Permitting/Compliance	▪ Collect and organize information within Agency Notification into a concise and easy to follow Agency Notification Package ▪ Track sent and received dates of Notification Packages sent to agencies
Restoration/Mitigation	▪ Provide agencies with on-site and off-site mitigation plan (as developed above) ▪ Describe each candidate off-site restoration project includes project names, project partners, project costs, length and area of mitigating activities ▪ Describe how proposed off-site watershed mitigation projects will address watershed functions and processes to provide mitigation ▪ Provide agencies with timeline for completion of on-site and off-site restoration and mitigation activities ▪ Provide agencies with timeline for monitoring of on-site and off-site mitigation activities ▪ Provide agencies statement describing status of permit approvals if necessary for mitigation projects
Step 6. Project Implementation	
Maintenance Work	▪ Track dates of project implementation activities (beginning and completion) ▪ Photos of pre and post project implementation ▪ Channel x-sections after sediment removal projects ▪ Document deviations from original project design ▪ Track implementation and monitoring of BMPs (RWQCB requirement)
Resources	▪ Implement resource protective BMPs ▪ Conduct resource surveys, track results, and input any updated results to resource database ▪ Conduct fish relocation activities according to terms/conditions of the Russian River BO

Table 9-1. Cont. Page 4 of 4

Permitting/Compliance	▪ For steelhead streams in Zone 1A, monitor low flow channels at least two times in-between large storms during the winter period (Russian River BO requirement) ▪ Track frequency of maintenance activities at specific creeks to comply with creek specific conditions of the RR BO ▪ If dewatering, conduct monitoring according to RWQCB Discharge Order.
Restoration/Mitigation	▪ Track on-site and off-site mitigation activities ▪ Pre and post photos of restoration and mitigation activities ▪ Confirmation (or mapping) of completed on-site and off-site mitigation activities

Step 7. Annual Reporting	
Permitting/Compliance	▪ Prepare Annual Report summarizing work completed, on-site and off-site mitigation performed, the initiation of monitoring activities, and any other relevant information. Include summary photographs of work completed, results of resource surveys, cross sections as needed, and any final mapping of activities as necessary. ▪ The Annual Report will contain a description of construction related activities, any effects on salmonids, steps taken to minimize impacts, number of salmonids killed/injured, photographs before, during, and after; and a description of fish relocation, if necessary (Russian River BO requirements) ▪ Annual Report can include program updates and recommendations such as modifications in BMPs, anticipated projects or issues for the coming maintenance year, etc. ▪ Annual Report will include a summary of monitoring efforts for past maintenance activities (from 2009 forward), including monitoring of revegetated areas and bank stabilization projects. (RWQCB requirements) ▪ Submit Annual Report to agencies by December 31st of that work year, or no later than February 15th of the following year (Russian River BO requirement)

database, an initial listing of reaches requiring maintenance for the current work cycle will be compiled. Based on past experience it is anticipated that in a typical year, approximately 40-60 (out of 170 total reaches in the SMP Area) may be identified as potential candidates for maintenance activities through the first round assessment process.

9.3 Develop Workplan

The preliminary list of project sites developed during the reconnaissance process will be reviewed and further prioritized based on:

- guidance provided by SMP Maintenance Principles (Chapter 5);
- the relative severity of reach conditions and need for maintenance;
- SMP framing considerations, management goals, and management triggers, as described under the corresponding approach in Chapter 5;
- consideration of past/recent flooding conditions; and
- SCWA overall maintenance needs in the Program Area.

Following this prioritization, the SMP program manager will consolidate the list of potential projects into a smaller set of projects to serve as the workplan for the given year. As described in Chapter 6, the number of projects prioritized in any given year is dependent on several factors, most notably climatic conditions of the preceding years. Projects that are marked as low priority and not included in the current cycle's workplan will be noted for inspection and assessment during the next work cycle.

The following list provides an estimated range and number of project types anticipated to be conducted annually. This list is based on the maintenance activity descriptions provided in Chapter 6, and informed by three years of interim permitting experience during 2006-2008. As described above, actual maintenance needs in any given year are largely dictated by climate conditions in the given year or recent years. It is expected that annual workplans may include:

- 4-6 reach scale sediment removal projects per year,
- 6-10 localized sediment removal projects at culverts and crossings per year,
- 2-4 intermediate scale sediment removal projects per year,
- 3-5 bank stabilization projects per year,
- 1 reservoir sediment removal project every 5 years,
- 2 sediment basin sediment removal project every 3 to 5 years,
- vegetation management at multiple reaches on an ongoing, annual basis.

Maintenance activities are expected to generate from 10,000 to 25,000 cubic yards of sediment and debris per year. Because the amount of sediment requiring offsite disposal and the disposal locations may vary, annual sediment disposal planning will occur concurrently with developing the workplan. Selection of disposal sites will also occur as part of long-term planning efforts, described in Chapter 5. Following the approach described in Chapter 5, the workplan will identify disposal locations available for use in the given year and the associated criteria for disposal at those locations. A preferred location and alternate locations may be identified to allow disposal flexibility and ensure adequate capacity as the projects are implemented. The annual workplan will identify sediment sampling locations at the sites and obtain representative sediment samples from each to characterize the existing sediment conditions at the site. The sampling methodology is described in the *Sediment Sampling and Analysis Guidelines* included in Appendix B. As required by the Waste Discharge Order issued by the Regional Water Quality Control Board (RWQCB), the sediment disposal sites must be approved by the RWQCB Executive Officer prior to use.

9.4 Project Design and Description

Once the workplan is developed, projects that require engineering design, including reach-scale sediment removal or large bank stabilization projects, will undergo a design process whereby site conditions are analyzed, more specific maintenance requirements are identified, and treatments and BMPs are conceptualized, designed, and then refined. These steps are described in more detail below.

It is anticipated that approximately three to four reach-scale sediment removal projects that require this level of design would be planned and implemented annually. As discussed in Chapter 6, the number of bank stabilization projects implemented annually, as well as the severity of the failure, will vary depending on weather and hydrologic conditions of the current and previous winter. Vegetation management activities are described in Chapter 6 for anticipated maintenance needs. Vegetation management project do not require any pre-work engineering design. The annual workplan will identify reach locations for vegetation management activities, the general type of vegetation to be worked on, and a reference to the standard SMP maintenance activities from Chapter 6.

9.4.1 Identify Site Context

Project design begins with considering the reach setting and context, as discussed in Chapter 5. Relevant site information to be reviewed (as available) includes reach descriptive sheets, reach assessment database entries, channel engineering designs and as-built designs, the most recent channel cross section surveys, hydraulics and flow capacity conditions, and information on environmental resources and adjacent land uses. If necessary, these existing data sources will be updated, or data gaps completed as needed. For example, reach sheets will be updated based on current conditions of the site, maintenance work from the previous year, and any changes in occurrence data for special-status species.

For reach-scale sediment removal projects, understanding the reach context in relation to sediment supply and delivery in the overall subbasin or watershed is very important. Also necessary is to understand the governing physical processes influencing flows and sediment deposition in the reach. The *Framing Considerations*, *Sediment Management Goals*, *Sediment Management Triggers*, and *Design Guidance for Sediment Removal Projects* provided in

Chapter 5, Section 5.3 (*Sediment Management Approach*), will be used to assess sediment and geomorphic conditions to provide appropriate design guidance.

To further guide the design process, reach- and site-based constraints will be identified. For example, site- or reach-scale constraints such as a narrow corridor width, the presence of infrastructure like pipelines or road crossings, the presence of threatened or endangered species, or the existing channel already being in a degraded or incised condition could all influence the maintenance approach and which treatments to use. Site and reach constraints may also influence the need for special access or equipment that may differ from the approaches described in Chapter 6. If site constraints and environmental considerations result in the need to use equipment or approaches other than those described in Chapter 6, a detailed description of the necessary approach will be included in the project description and discussed with regulatory agency staff during the notification process (see Section 9.6 *Agency Notification* for more detail on this process).

The SMP channel design engineer will make use of all relevant information including the observed field conditions, understanding of sediment and reach processes, results of channel cross section surveys, hydraulic analysis (as available), and the consideration of site constraints to design an appropriate approach to either sediment removal or bank stabilization.

9.4.2 Identify Treatments and BMPs

Based on the identified site conditions, the key fluvial process, and other influencing constraints, treatment approaches will be identified. Reach-scale sediment removal project descriptions will include information on the amount of sediment to be removed and the target locations for removal. Based on the Framing Considerations and Maintenance Goals identified for each activity type (sediment removal, vegetation management, bank stabilization) in Chapter 5, site-appropriate treatments will be selected based on the design approaches described in Chapter 6 (i.e., low-flow channel, meandering channel, south bank alignment, sediment reduction across the full bed of the channel, etc.). For example, depending upon reach conditions, sediment removal projects may be designed to include a low-flow channel or other in-channel features such as bars, benches, or meanders. Vegetation management projects will be designed to remove enough vegetation to provide necessary channel capacity while maintaining as much habitat and creek shading as possible. Bank stabilization projects will utilize bioengineered treatments that respond to the cause and degree of the bank failure to develop a sustainable design.

Following the identification and selection of initial concept level approaches, the design of maintenance activities will then be refined to provide specific sizing and location of treatments.

Following design refinement, activity-specific Best Management Practices (BMPs) will be identified based on the practices listed in Table 7-2. For example, if sediment removal activities will occur, a cofferdam BMP may be identified and selected to prevent any sediment from entering the active channel during removal activities. Or during vegetation removal, tree trimming may be required to take place outside the migratory bird and raptor nesting period. All projects will utilize appropriate programwide BMPs for impact avoidance and minimization as identified in Chapter 7 and Table 7-1.

Identification of the specific project treatments and locations for sediment removal will assist SMP Managers in selecting sediment testing locations and disposal options. As described in Chapter 5, locations for sediment disposal will depend on sediment characteristics. For example, if sediment is removed from the base of a culvert outfall which conveys stormwater from an industrial neighborhood, concentrations of metals may be higher such that the sediment may require disposal at a hazardous waste facility. The workplan will identify sampling locations within each work site or reach to adequately characterize the sediment to be removed. Samples of the sediment to be removed will be collected and sent to a lab for analysis. The level of analysis conducted will be determined by the land disposal criteria established by regulatory agencies and landowners for the selected sediment disposal sites. The lab analysis will inform or affirm the appropriateness of disposal at these sites for that year's maintenance activities. If the quality of sediment is deemed hazardous, it will be taken to an appropriate hazardous waste facility for disposal.

9.4.3 Develop Project Description

Following the analysis of site context and the development of treatment designs, a summary project description will be developed for each sediment removal or bank stabilization project. The project description serves as the formal characterization of project activities and supports permitting requirements. The project description will include the following information:

- Project type (i.e., sediment removal, bank stabilization, or vegetation work)
- Project location address and/or location description
- Project site map
- Updated channel characterization sheet for project reach (as needed)
- Short description of activities including treatments selected, equipment used, access, staging, etc. If activities will be conducted differently from the activity description in Chapter 6, identify differences and provide an explanation of why the different approach is required.
- Short description of why the selected treatment is appropriate for the reach (e.g., sinuous low-flow channel in areas where such design is appropriate to transport sediment and provide aquatic habitats)
- Linear feet of creek and acres of channel that will be disturbed by activities.
- Acres of waters of the United States and waters of the State that will be affected
- For sediment removal projects, identify quantity of sediment to be removed and provide cross section of existing channel condition vs. as-built condition
- For bank stabilization projects, identify how much material will be placed in the bank slope
- For all projects, identify how much sediment and other debris requires disposal

- Identify sediment sampling locations on a map
- Test the sediment samples according to the *Sediment Sampling and Analysis Guidelines* (Appendix B). Based on results from the sediment samples, select the final sediment disposal sites and identify the available capacity at each site. Also, identify the routes for vehicle transport from the maintenance sites to the disposal sites. Submit the sampling results from the maintenance sites and the disposal sites to the RWQCB for review and approval.
- Any appropriate figures including cross sections, design details of structures to be maintained, and plan view maps for activities as appropriate.
- A brief summary of the activity-specific BMPs that will be utilized in the project, including BMPs for sediment handling, transport, and disposal activities.
- Project cost estimate to develop a fee assessment for permitting agencies and a basis for mitigation calculation (Watershed Partnership Program, etc.).

Figures 9-4a and 9-4b provide a template for developing project descriptions. This template is designed to identify necessary site-specific project information while relying on the SMP Manual to provide information on maintenance activities and approach. In this manner, project descriptions are informative while being kept relatively brief and consistent.

9.5 Develop Mitigation Plan

In parallel with developing the annual project workplan, SCWA will develop the annual mitigation plan. The mitigation plan will describe the on-site and off-site planned mitigation activities for the given work cycle. The mitigation plan will include the topics described in Chapter 8, Section 8.11 regarding the information to be notified to the regulatory agencies. This information includes:

- A description of on-site (Tier 1) restoration activities planned for the coming year including locations, lengths, areas, and other project details;
- A description of Tier 2 restoration activities (if occurring) on other SCWA channels planned for the coming year including locations, lengths, areas, and other project details;
- The proposed off-site watershed mitigation plan (Tier 3), including:
    - a description of each candidate off-site restoration project, including the project name, project partners, project cost, length and area of mitigating activities;
    - a description of how the proposed off-site watershed projects will address watershed processes and functions to provide suitable mitigation for the year’s maintenance activities (relating the short-term temporary residual impacts that are to be addressed through the watershed mitigation as described above to the proposed projects);

- schedule for implementation of mitigation activities;
- a statement describing the status of permit approvals necessary to perform project (if applicable); and
- a monitoring and reporting plan.

As described in Section 8.11, permitting agencies will have the opportunity to review and comment on the proposed annual mitigation plan. The SMP annual mitigation plans will be consistent with the mitigation approaches and requirements described in this manual. Annual mitigation projects are envisioned to be consistent with the types of projects developed during the SMP interim period, as described above.

9.6 Agency Notification

During spring, by April 30th, SCWA will notify the relevant regulatory agencies about the planned projects for that year's workplan (see Figure 9-2) through submittal of a workplan notification packet. The notification packet will contain the workplan, project descriptions, sediment disposal plan, and supporting materials described above in Section 9.4. The notification packet will also contain a cover letter directing each regulatory agency to the projects and project descriptions that fall within their jurisdiction. This notification packet will contain a complete project list (i.e., the workplan) including vegetation management planned for modified and natural channels. The notification packet will include details of the annual mitigation plan as described above and in Section 8.11. An outline for the annual notification is provided in Appendix F-1.

The notification packet will also provide details if any of the planned maintenance activities should deviate from the description of routine activities as described in this manual. If such deviations are anticipated to implement the annual workplan, then they will be described in detail along with any relevant impact avoidance measures, BMPs, or mitigation considerations that are necessary. Similarly, if during the implementation of maintenance activities, something arises during the course of executing the maintenance work that requires a different treatment or approach than described in the notification package, then the SMP Manager will send an updated notification to the relevant agencies with this project change.

The relevant regulatory agencies will have 30-days to review the notification packets and will respond back to SCWA by June 15th to confirm the annual workplan and provide a notice to proceed. Sediment removal activities will not proceed until the disposal site has been approved by the RWQCB.

The SCWA SMP Manager will also invite agency representatives to a pre-implementation field tour and meeting. The purpose of this field tour will be to ensure understanding by the regulatory agency staff of the project setting and scope of maintenance activities for the given year. Any residual questions regarding the submitted notification packet can be addressed during this meeting or through subsequent communication and information exchange.

9.7 Project Implementation

Once SCWA receives a notice to proceed from the relevant regulatory agencies, maintenance activities may be initiated. If SCWA does not receive a response to the notification packet by June 15th, SCWA will assume that the workplan was reviewed and will proceed with initiating the planned maintenance work. All maintenance activities will be conducted in accordance with the project description, programwide and activity-specific BMPs, and terms of the SMP programmatic permits. This includes conducting preconstruction surveys for fish and wildlife and other resources if activities may affect these resources.

An on-site project supervisor trained in the SMP Manual will oversee and guide all maintenance activities and will ensure that the proper Maintenance Principles and avoidance and minimization approaches as described in Chapters 5 and 7 are employed.

When projects are implemented, data will be collected at the project site prior to, during, and immediately after, project implementation, as required by regulatory permits. Data collected will include: water quality monitoring data; before, during, and after photos; cross section surveys after sediment removal is conducted; quantification of material removed (for sediment removal projects) or placed (for bank stabilization projects); length of stream channel maintained; sensitive species or other resources encountered at the site during preconstruction surveys or during project implementation; quantity, characteristics, and location of any debris disposed off-site; and any additional information as required to update the SMP database. Recording and monitoring data collected following project implementation will be collected within seven working days of final maintenance activities.

9.8 Annual Reporting

At the conclusion of the maintenance season (soon after October 31st), SCWA will send the relevant regulatory agencies a summary announcement describing the workplan status and confirming which projects from the workplan were completed in the maintenance period.

During the fall, SCWA will also develop an annual report describing the maintenance activities recently conducted in the previous work period. This annual report will be submitted to the relevant regulatory agencies by December 31st. The report will include the following information and will comply with permitting requirements issued by relevant regulatory agencies. An outline for the annual report is provided in Appendix F-2.

- The extent to which the workplan was completed (i.e., identify projects that were or were not implemented). If projects were not implemented, note why and if the project will be incorporated into the following year's workplan or if the project will be placed on a watch list.
- If activities were conducted according to the project description, and if not, how the actual project varied from the project description.
- Site photos before and after project completion.
- Total length of stream channel that was maintained for the individual projects in the workplan.

- How much sediment and vegetation was removed and acres affected, if applicable.
- How much material was placed on-site and acres affected, if applicable.
- How much material was disposed off-site, disposal locations, and acres affected, if applicable. A sediment sampling report will be submitted. An outline for the annual sediment sampling report is provided in Appendix F-3.
- If any species or other sensitive resources were encountered during construction and if so, what impact avoidance steps SCWA took in response.
- A brief description of on-site and off-site mitigation enacted.
- A brief description of site monitoring, including bank stabilization and revegetation monitoring requirements established in the RWQCB permit.
- Any lessons learned from that year's activities including treatments that were not effective, administrative difficulties, and proposed steps to facilitate the process.
- Recommended updates (if any) to the BMPs identified in the BMP Manual.

Following submittal of the annual report, SCWA's SMP Manager will invite regulatory agency staff to a summary meeting to discuss the events, maintenance activities, and lessons learned over the past work cycle. This meeting may also include a site visit to see the project sites after project completion. In this way, the SMP manger can adaptively manage and improve program effectiveness based on past experience.

The annual report will also include status reporting on the program's mitigation activities, including the submittal of follow up monitoring reports. Topics to be addressed in the monitoring reports are described in Chapter 8, Section 8.7.6.

At the conclusion of the annual work cycle, SCWA shall also update and verify the SMP database, and the BMP list (Table 7-1) as appropriate to include any updates or changes made over the recent work cycle. In this way, developing the following year's workplan will be built on updated information across the program.

9.9 Data Management

Data collection and monitoring efforts are critical to measuring the success of SMP implementation. In order to properly track the progress of management activities towards achieving the SMP's goals and compliance with programmatic permit conditions, a database will be created. This database will serve as the central storage location for multiple types of information gathered as part of annual and long-term SMP implementation. SCWA currently maintains an extensive GIS database which includes location data on stream channels managed under their authority. The majority of the maps included in this SMP Manual were generated from SCWA's GIS database. The SMP database, also referred to in this document as the "SMP Tracker," is a Microsoft Access® database and is linked to SCWA's existing GIS database so that data, such as new species occurrences, are mapped and compared against SMP activities. The following data will be collected or updated at various stages in the implementation process, as shown in Table 9-1:

- GIS reach mapping
- maintenance activities to date
- BMP tracking
- pre- and post-project photos
- channel characterizations
- channel cross sections
- mitigation projects
- sediment disposal sites
- specific data required by permits (including Biological Opinions)
- notification packages
- annual reports

Data or documentation of the maintenance projects will be entered into the SMP database during each cycle of the work plan, as described in Section 9.1 above. The database can be queried to chronicle past maintenance activities or prioritize future actions. The database will store many types of files, including photos (.jpeg), Acrobat (.pdf), and Word (.doc) and will serve as the central data repository for all SMP activities. Photographs from maintenance sites are particularly important information sources in tracking maintenance needs, effectiveness of past actions, and success of on-site planting and restoration work.

The SMP database will serve as an important tool for the SMP Manager. The database will contain back-up technical information documentation for the agency notification packages and annual reports. The SMP database will include checklists to ensure all conditions of programmatic permits are met. As described in Chapters 5 and 7, SMP implementation requires tracking of important items or tasks to protect sensitive species and for permit compliance, such as pre-construction survey dates, meeting the terms and conditions of issued Biological Opinions, and tabulating annual mitigation funding and implementation. The SMP database will ensure this information is gathered, used, and documented to meet permit compliance. The regulatory agencies will receive the necessary information on the maintenance activities (based on the permit requirements and the description of activities in this manual). Information saved in the database will also provide insight into future SMP updates, as discussed in Section 9.10 below.

9.10 Five-Year Program Review

Every 5 years, SCWA and the relevant regulatory agencies will review the Stream Maintenance Program for its overall effectiveness. This review will include an assessment of maintenance activities conducted to date, BMPs employed, adequacy of the SMP Mitigation Program, SMP data management, adequacy of SMP adaptive updates and revisions, and overall program coordination and communication between SCWA and the regulatory agencies.

The SMP Manager will collect and organize the above review information and provide a summary report to the regulatory agencies. These findings will be discussed at an Inter-Agency Working Group (IAWG) meeting collectively and at individual agency meetings as necessary. As a result of these discussions, potential program changes or updates shall be integrated into the SMP Manual through an addendum or revision process. The updated SMP Manual will be redistributed to regulatory agencies and program partners. SMP program changes or updates made at the 5-year reviews may require additional California Environmental Quality Act (CEQA) review. SMP Manual revisions may also require an updating of permit terms, which would occur through a collaborative process between SCWA and the relevant permitting agencies.

Chapter 10
REFERENCES AND PREPARERS

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10.2. Report Preparation

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