RECEIVED
OCT 25 2013
DIVISION OF WATER QUALITY

Attachment E – Notice of Intent

WATER QUALITY ORDER NO. 2013-0002-DWQ
GENERAL PERMIT NO. CAG990005

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL AQUATIC PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM ALGAE AND AQUATIC WEED CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item	A. ☐ New Applicator	B. Change of Information: WDID# 1B05047RSON
	C. ☐ Change of ownership or responsibility: WDID#	

II. DISCHARGER INFORMATION

A. Name Sonoma County Water Agency			
B. Mailing Address 404 Aviation Blvd			
C. City Santa Rosa	D. County Sonoma	E. State CA	F. Zip 95403
G. Contact Person Keenan Foster	H. E-mail address Keenan.Foster@scwa.ca.gov	I. Title Principal Environmental Specialist	J. Phone 707-975-4900

III. BILLING ADDRESS (Enter Information *only* if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip
G. E-mail address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. Algaecide and aquatic herbicides are used to treat (check all that apply):

1. ☒ Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   Name of the conveyance system: see attachment
2. ☒ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   Owner's name: see attachment
   Name of the conveyance system: see attachment
3. Directly to river, lake, creek, stream, bay, ocean, etc.
   Name of water body: _____

B. Regional Water Quality Control Board(s) where treatment areas are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region North Coast RWQCB and San Francisco Bay RWQCB
(List all regions where algaecide and aquatic herbicide application is proposed.)

V. ALGAECIDE AND AQUATIC HERBICIDE APPLICATION INFORMATION

A. Target Organisms: ____

Himalayan blackberry (Rubus armeniacus); cattails (Typha spp); Ludwigia (Ludwigia spp)

B. Algaecide and Aquatic Herbicide Used: List Name and Active ingredients

AquaMaster® by Monsanto Company; main ingredient: glyphosate

C. Period of Application: Start Date June 15, 2014 End Date October 31, 2018

D. Types of Adjuvants Used:
Agri-Dex® (surfactant) by Helena Chemical Company

VI. AQUATIC PESTICIDE APPLICATION PLAN

Has an Aquatic Pesticide Application Plan been prepared and is the applicator familiar with its contents?
☒ Yes ☐ No

If not, when will it be prepared? _____

VII. NOTIFICATION

Have potentially affected public and governmental agencies been notified? ☐ Yes ☒ No

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?
☒ YES ☐ NO ☐ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Grant Davis

B. Signature: _____ **Date:** 10/23/13

C. Title: General Manager, Sonoma County Water Agency

XI. FOR STATE WATER BOARD STAFF USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** **$**	**Check #:**
☐ **Lyris List Notification of Posting of APAP**	**Date** _____	**Confirmation Sent** _____

Notice of Intent Attachment
Part IV. Receiving Water Information

Town	Creek Name	Reach	Owner Name
		Flood Zone 1A	
Santa Rosa	Abramson Creek	Abramson1	SONOMA COUNTY WATER AGENCY
		Abramson2	SONOMA COUNTY WATER AGENCY
Windsor	Airport Creek	Airport1	COUNTY OF SONOMA
		Airport2	AIRPORT BUSINESS CENTER
Santa Rosa	Austin Creek	Austin1	SONOMA COUNTY WATER AGENCY
		Austin2	SONOMA COUNTY WATER AGENCY
		Austin3	SONOMA COUNTY WATER AGENCY
Santa Rosa	Bellevue Wilfred Channel	BellWil1	SONOMA COUNTY WATER AGENCY
		BellWil2	SONOMA COUNTY WATER AGENCY
		BellWil3	SONOMA COUNTY WATER AGENCY
		BellWil4	SONOMA COUNTY WATER AGENCY
Santa Rosa	Brush Creek	Brush1	SONOMA COUNTY WATER AGENCY
		Brush2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Coffey Creek	Coffey1	SONOMA COUNTY WATER AGENCY
Rohnert Park	Coleman Creek	Coleman1	CITY OF ROHNERT PARK
		Coleman2	CITY OF ROHNERT PARK
Santa Rosa	Colgan Creek	Colgan1	SONOMA COUNTY WATER AGENCY
		Colgan2	SONOMA COUNTY WATER AGENCY
		Colgan3	SONOMA COUNTY WATER AGENCY
		Colgan4	SONOMA COUNTY WATER AGENCY
		Colgan5	SONOMA COUNTY WATER AGENCY
		Colgan6	SONOMA COUNTY WATER AGENCY
		Colgan7	SONOMA COUNTY WATER AGENCY
Santa Rosa	College Creek	College1	SONOMA COUNTY WATER AGENCY
		College2	SONOMA COUNTY WATER AGENCY
		College3	SONOMA COUNTY WATER AGENCY
Rohnert Park	Cook Creek	Cook1	CITY OF ROHNERT PARK
		Cook2	SONOMA COUNTY WATER AGENCY
Rohnert Park	Copeland Creek	Copeland1	SONOMA COUNTY WATER AGENCY
		Copeland2	CITY OF ROHNERT PARK
		Copeland3	CITY OF ROHNERT PARK
		Copeland4	CITY OF ROHNERT PARK
		Copeland5	CITY OF ROHNERT PARK
		Copeland6	CITY OF ROHNERT PARK
Cotati	Cotati Creek	Cotati1	SONOMA COUNTY WATER AGENCY
		Cotati2	SONOMA COUNTY WATER AGENCY

Notice of Intent Attachment
Part IV. Receiving Water Information

Rohnert Park	Crane Creek	Crane1	CITY OF ROHNERT PARK
		Crane2	CITY OF ROHNERT PARK
Santa Rosa	Ducker Creek	Ducker1	SONOMA COUNTY WATER AGENCY
		Ducker2	SONOMA COUNTY WATER AGENCY
Windsor	Faught Creek	Faught1	SONOMA COUNTY WATER AGENCY
Rohnert Park	Five Creek	Five1	SONOMA COUNTY WATER AGENCY
Santa Rosa	Forestview Creek	Forestview1	SONOMA COUNTY WATER AGENCY
		Forestview2	SONOMA COUNTY WATER AGENCY
		Forestview3	SONOMA COUNTY WATER AGENCY
Windsor	Fulton Creek	Fulton1	SONOMA COUNTY WATER AGENCY
Rohnert Park	Golf Creek	Golf1	SONOMA COUNTY WATER AGENCY
Rohnert Park	Gossage Creek	Gossage1	SONOMA COUNTY WATER AGENCY
		Gossage2	SONOMA COUNTY WATER AGENCY
		Gossage3	SONOMA COUNTY WATER AGENCY
Rohnert Park	Hinebaugh Creek	Hinebaugh1	SONOMA COUNTY WATER AGENCY
		Hinebaugh2	SONOMA COUNTY WATER AGENCY
		Hinebaugh3	CITY OF ROHNERT PARK
		Hinebaugh4	CITY OF ROHNERT PARK
		Hinebaugh5	CITY OF ROHNERT PARK
		Hinebaugh6	CITY OF ROHNERT PARK
		Hinebaugh7	CITY OF ROHNERT PARK
Santa Rosa	Hunter Lane Channel	Hunter1	SONOMA COUNTY WATER AGENCY
		Hunter2	SONOMA COUNTY WATER AGENCY
		Hunter3	SONOMA COUNTY WATER AGENCY
Santa Rosa	Kawana Springs Creek	Kawana1	SONOMA COUNTY WATER AGENCY
Rohnert Park	Labath Creek	Labath1	SONOMA COUNTY WATER AGENCY
		Labath2	CITY OF ROHNERT PARK
Cotati	Laguna de Santa Rosa	Laguna1	SONOMA COUNTY WATER AGENCY
		Laguna2	SONOMA COUNTY WATER AGENCY
		Laguna3	SONOMA COUNTY WATER AGENCY

Rohnert Park	Laguna de Santa Rosa	Laguna4	SONOMA COUNTY WATER AGENCY
Cotati	Laguna de Santa Rosa	Laguna5	SONOMA COUNTY WATER AGENCY
		Laguna6	SONOMA COUNTY WATER AGENCY CITY OF COTATI
		Laguna7	CITY OF COTATI CITY OF ROHNERT PARK
Santa Rosa	Lorna Dell Creek	Lorna Dell1	SONOMA COUNTY WATER AGENCY
Santa Rosa	Matanzas Creek	Matanzas Creek Reservoir	SONOMA COUNTY WATER AGENCY
Santa Rosa	Middle Fork Brush Creek	MiddleBrush1	SONOMA COUNTY WATER AGENCY
		MiddleBrush2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Moorland Creek	Moorland1	SONOMA COUNTY WATER AGENCY
		Moorland2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Oakmont Creek	Oakmont1	SHIPPEE ROBERT W & JULIA M SMITH JUDITH R UDALL DONNA M BIGGS JOHN G TR & BIGGS DANA R TR JOHNSON JEFFREY M SIMMONS NICHOLAS ET AL MOLLENBERG-JONES MARYLYN JOANNE TR
Santa Rosa	Paulin Creek	Paulin1	SONOMA COUNTY WATER AGENCY
		Paulin2	SONOMA COUNTY WATER AGENCY
		Paulin3	SONOMA COUNTY WATER AGENCY
		Paulin4	SONOMA COUNTY WATER AGENCY
		Paulin5	SONOMA COUNTY WATER AGENCY
		Paulin6	SONOMA COUNTY WATER AGENCY
Santa Rosa	Peterson Creek	Peterson1	SONOMA COUNTY WATER AGENCY
		Peterson2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Paulin Creek Reservoir	Piner Creek Reservoir	SONOMA COUNTY WATER AGENCY
Santa Rosa	Piner Creek	Piner1	SONOMA COUNTY WATER AGENCY
		Piner2	SONOMA COUNTY WATER AGENCY
		Piner3	SONOMA COUNTY WATER AGENCY
		Piner4	SONOMA COUNTY WATER AGENCY
		Piner5	SONOMA COUNTY WATER AGENCY
		Piner6	SONOMA COUNTY WATER AGENCY
		Piner7	SONOMA COUNTY WATER AGENCY
		Piner8	SONOMA COUNTY WATER AGENCY

Santa Rosa	Roseland Creek	Roseland1	SONOMA COUNTY WATER AGENCY
		Roseland2	SONOMA COUNTY WATER AGENCY
		Roseland3	SONOMA COUNTY WATER AGENCY
		Roseland4	SONOMA COUNTY WATER AGENCY
		Roseland5	SONOMA COUNTY WATER AGENCY
		Roseland6	KISTNER LULU BUTCHER ET AL
			MOORE MARK W
			BARRICKLOW TED F & JERI L ET AL
			HOBERG GEORGE III TR
			MARIANI RAYMOND M & MARY ANN
			POOL SHIRLEY M TR
Santa Rosa	Russell Creek	Russell1	SONOMA COUNTY WATER AGENCY
		Russell2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Santa Rosa Creek Diversion	Santa Rosa Div.1	SONOMA COUNTY WATER AGENCY
Santa Rosa	Santa Rosa Creek	Santa Rosa0	SANTA ROSA GARDEN APARTMENTS LP
			SONOMA COUNTY WATER AGENCY
		Santa Rosa1	SONOMA COUNTY WATER AGENCY
		Santa Rosa2	SONOMA COUNTY WATER AGENCY
		Santa Rosa3	SONOMA COUNTY WATER AGENCY
		Santa Rosa4	SONOMA COUNTY WATER AGENCY
		Santa Rosa6	SONOMA COUNTY WATER AGENCY
Santa Rosa	Sierra Park Creek	Sierra Park1	SONOMA COUNTY WATER AGENCY
		Sierra Park2	SONOMA COUNTY WATER AGENCY
		Sierra Park3	SONOMA COUNTY WATER AGENCY
Santa Rosa	Spring Creek	Spring1	SONOMA COUNTY WATER AGENCY
		Spring3	SONOMA COUNTY WATER AGENCY
Windsor	Starr Creek Tributary	Starr Creek Trib1	SONOMA COUNTY WATER AGENCY
Windsor	Star Creek	Star1	SONOMA COUNTY WATER AGENCY
		Star2	SONOMA COUNTY WATER AGENCY
Santa Rosa	Steele Creek	Steele1	CITY OF SANTA ROSA
			SONOMA COUNTY WATER AGENCY
		Steele2	SONOMA COUNTY WATER AGENCY
		Steele3	SONOMA COUNTY WATER AGENCY
		Steele4	SONOMA COUNTY WATER AGENCY
		Steele5	SONOMA COUNTY WATER AGENCY

Santa Rosa	Todd Creek	Todd1	SONOMA COUNTY WATER AGENCY
		Todd2	SONOMA COUNTY WATER AGENCY
		Todd3	SONOMA COUNTY WATER AGENCY
		Todd4	SONOMA COUNTY WATER AGENCY
		Todd5	SONOMA COUNTY WATER AGENCY
Rohnert Park	Warrington Creek	Warrington1	HERNDON YVONNE TR
			HIGGINS PATRICK HUGH & ALLEN-HIGGINS MICH
Cotati	Washoe Creek	Washoe1	SONOMA COUNTY WATER AGENCY
Larkfield	Wikiup Creek	Wikiup1	NELSON THEODORE E & REBECCA K
			WIKIUP VILLAGE HO ASSN INC
			SONOMA COUNTY WATER AGENCY
			ANDERSON STANLEY M & MARY JANE
Rohnert Park	Wilfred Extension	Wilfred Ext.1	SONOMA COUNTY WATER AGENCY
			CITY OF ROHNERT PARK
Rohnert Park	Wilfred Creek	Wilfred1	SONOMA COUNTY WATER AGENCY
Windsor	Windsor Creek	Windsor2	TOWN OF WINDSOR
			WINDSOR MILL HOMES LLC
			WINDSOR WATER DISTRICT
			CONDE VILLAGE LLC
		Windsor3	SONOMA COUNTY WATER AGENCY
		Windsor4	SONOMA COUNTY WATER AGENCY
Flood Zone 2A			
Petaluma	Adobe Creek	Adobe1	CITY OF PETALUMA
		Adobe2	CITY OF PETALUMA
		Adobe3	CITY OF PETALUMA
		Adobe4	CITY OF PETALUMA
Petaluma	Capri Creek	Capri1	SONOMA COUNTY WATER AGENCY
		Capri2	STEPHENS CHARLES ROBERT TR & STEPHENS SUN
			SONOMA COUNTY WATER AGENCY
		Capri3	SONOMA COUNTY WATER AGENCY
		Capri4	SONOMA COUNTY WATER AGENCY
Petaluma	Corona Creek	Corona1	SONOMA COUNTY WATER AGENCY
			CITY OF PETALUMA
		Corona2	CITY OF PETALUMA
		Corona3	CITY OF PETALUMA
		Corona4	CITY OF PETALUMA
		Corona5	CITY OF PETALUMA
		Corona6	CITY OF PETALUMA
		Corona7	CITY OF PETALUMA

Petaluma	East Fork McDowell Creek	East Fork McDowell1	SONOMA COUNTY WATER AGENCY
Petaluma	East Washington Creek	East Washington1	SONOMA COUNTY WATER AGENCY
		East Washington2	SONOMA COUNTY WATER AGENCY
		East Washington3	SONOMA COUNTY WATER AGENCY
		East Washington4	CITY OF PETALUMA
		East Washington5	CITY OF PETALUMA
Petaluma	Jessie Lane Creek	Jessie Lane1	SONOMA COUNTY WATER AGENCY
Petaluma	Lichau Creek	Lichau1	CITY OF PETALUMA
		Lichau2	CITY OF PETALUMA
		Lichau3	CITY OF PETALUMA
Petaluma	Lynch Creek	Lynch1	SONOMA COUNTY WATER AGENCY
Petaluma	McDowell Creek	McDowell1	SONOMA COUNTY WATER AGENCY
		McDowell2	SONOMA COUNTY WATER AGENCY
Petaluma	Thompson Creek	Thompson1	CITY OF PETALUMA
Petaluma	Washington Creek	Washington1	SONOMA COUNTY WATER AGENCY
		Washington2	SONOMA COUNTY WATER AGENCY
		Washington3	SONOMA COUNTY WATER AGENCY
		Washington4	NOVAK PROPERTY LLC
		Washington5	SONOMA COUNTY WATER AGENCY
		Washington6	SONOMA COUNTY WATER AGENCY
			CITY OF PETALUMA
		Washington7	CITY OF PETALUMA
		Flood Zone 3A	
Sonoma	Fryer Creek	Fryer1	SONOMA COUNTY WATER AGENCY
		Fryer2	DAVIS CAROL L TR & DAVIS ROBERT J TR
			SPORRONG JANICE A
			SONOMA COUNTY WATER AGENCY
			CASABONNE DANIEL P J
		Fryer3	SONOMA COUNTY WATER AGENCY
		Fryer4	SONOMA COUNTY WATER AGENCY
Sonoma	Lower East Fork Fryer Creek	Lower East Fork Fryer1	CREEKSIDE COMMUNITY PROP OWNERS ASSOC INC
			SPORRONG JANICE A
			SONOMA COUNTY WATER AGENCY

Aquatic Pesticide Application Plan
for the
Sonoma County Water Agency Stream Maintenance Program

This plan addresses herbicide application activities undertaken by the Sonoma County Water Agency in the effort to control non-native, invasive Himalayan blackberries, cattails and Ludwigia

Plan prepared by

Candace Noel Messner
Sonoma County Water Agency
404 Aviation Boulevard
Santa Rosa, CA 95403

for the

State Water Resources Control Board
Division of Water Quality
NPDES Unit, 15th Floor, Room 15-35A
1001 I Street
Sacramento, CA 95814

August 2013

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1. BACKGROUND

The Stream Maintenance Program (SMP) has been developed by the Sonoma County Water Agency (SCWA) to improve the management of streams and channels in SCWA's jurisdiction by establishing the organizational framework to oversee routine stream and channel maintenance activities. Within its jurisdiction, SCWA maintains engineered flood control facilities to provide a level of flood protection consistent with the level for which the facilities were designed. SCWA also oversees work in natural and modified channels, based on hydraulic maintenance easements. The primary work activities covered under the SMP include sediment removal, vegetation management, bank repair and stabilization, and restoration.

The vision for channels and streams managed by SCWA 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.

One of the approaches towards balancing flood protection needs and habitat enhancement is vegetation management. Within the context of the vision stated above, vegetation is managed for the following outcomes as appropriate for reach specific conditions:

- to develop riparian woodland/forest canopy closure;
- to encourage native vegetation and discourage non-native vegetation, particularly invasive species;
- to control emergent vegetation in the channel;
- to establish optimal boundary conditions that promote stream form and pattern stability
- to minimize flow obstructions; and
- to improve bank stability.

The control of invasive plant species is important because such species limit the success of native, slower-growing vegetation and they can degrade habitat quality over time. Because many invasive species (both native and exotic) grow quickly, they often out-compete more desirable native species. There are a number of ecological characteristics of invasive species that allow them to successfully invade native habitats and to rapidly colonize disturbed areas. Aggressive vegetative colonizers spread either from root or stump sprouts, underground rhizomes, plant fragments, or via air layering. Aggressive seeders produce copious amounts of seed annually and often have fruit that are eaten and dispersed by wildlife. Leaf litter builds up under the plant and inhibits undergrowth. Thick layers of this litter can change the chemical makeup of runoff and soils, and modify soil microbial and abiotic processes. Without proper management, the entire channel can become filled with fast-growing, invasive vegetation that further degrades habitat for native species and water quality.

Many of the channels and streams under the SCWA's management have experienced impacts from riparian and aquatic invasive species. The vegetation that impacts our waterways includes Himalayan blackberries (*Rubus armeniacus*), cattails (*Typha spp*) and Ludwigia (*Ludwigia spp*). In many cases the populations of these weed species have increased to densities that are adversely affecting the flood control and ecological restoration efforts the SMP.

The purpose of this Aquatic Pesticide Application Plan (APAP) is to provide a comprehensive guide that describes the herbicide treatment of aquatic and riparian weeds on SCWA managed waterways as part of an integrated weed management program.

2. DESCRIPTION OF THE WATER SYSTEMS BEING CONTROLLED

The SCWA intends to apply herbicides approved for aquatic use in all of its engineered flood control channels that are part of an integrated SMP (certain creeks are excluded from programmatic permits due to sensitive resource issues, Coho salmon, freshwater shrimp). The SMP includes over 75 miles of engineered channels that occur in the Laguna de Santa Rosa, Petaluma River and Sonoma Creek watersheds. This section provides an overview of the basic geographic and hydrographic features of the individual watersheds. A complete list of the engineered reaches within each watershed is provided for easy reference. Finally, the beneficial uses of these water systems, which the measures of this APAP are intended to maintain, are also discussed. The resource information and water system understanding developed in this section provided the basis to develop the maintenance approaches and measures of this APAP. Maps of the specific watersheds, flood control zones, creeks and reaches, described herein are all provided in Appendix A.

Laguna de Santa Rosa Watershed

The Laguna de Santa Rosa watershed encompasses 253 sq mi providing the largest southern tributary to the Russian River. The highest elevation in the watershed is 2,463 ft mean sea level (msl) along the eastern mountains. Elevations at the confluence with Mark West Creek are 50 ft 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 include: Windsor Creek, Mark West Creek, Santa Rosa Creek (which includes Piner, Matanzas, Spring, Brush, and Oakmont creeks); Roseland Creek; Colgan Creek; Bellevue-Winfred creeks; and the creeks of the upper Laguna subbasin including Gossage, Upper Laguna, Copeland, and Hinebaugh creeks.

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 west side of the watershed are encompassed by public lands, rural residential, agriculture (vineyards), and open ranchlands and woodlands. As the elevation levels towards the east, 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 east across the watershed.

In the Laguna de Santa Rosa watershed, the downstream areas furthest east are heavily influenced by altered storm hydrology and inputs of urban contaminants resulting from dense development upstream. Agricultural influences in the southwest area of the watershed contribute to flooding and poor water quality in downstream areas. Additionally, the location of urban development in the watershed restricts geomorphic functioning, such as floodplain development, and mutes the influence of natural springs and sediment sources in the relatively undeveloped upper watershed on the lower watershed.

Specific details relating to the geographic and hydrographic features of the channels and treatment areas (i.e. engineered flood control reaches) to be controlled within the Laguna de Santa Rosa Watershed are provided in Appendix B. A complete list of channel reaches to be maintained in this watershed is provided below.

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 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 would 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 stretch from Cotati southeast to San Pablo Bay. Primary tributaries to the Petaluma River include Capri, Willow Brook, Lichau, Lynch, Adobe, Ellis, Liberty, Marin, and San Antonio creeks.

The Petaluma River experiences tidal fluctuations from San Pablo Bay 14 miles upstream past downtown Petaluma. 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 SCWA channels including lower Washington, Adobe, Lynch, and MacDowell creeks. In these channels, accumulated sediment and debris conditions that might reduce flood conveyance capacity poses an increased flood concern when combined with the potential influence of high-tide backwatering.

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.

Specific details relating to the geographic and hydrographic features of the channels and treatment areas to be controlled within the Petaluma River Watershed are provided in Appendix B. A complete list of channel reaches to be maintained in this watershed is provided below.

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 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 area has few engineered channels, Fryer Creek supporting the largest segments.

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 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.

Specific details relating to the geographic and hydrographic features of the channels and treatment areas to be controlled within the Sonoma Creek Watershed are provided in Appendix B. A complete list of channel reaches to be maintained in this watershed is provided below.

Complete List of SMP Reaches to be Controlled

Provided below is a complete list of the reaches to be controlled through this APAP. All of the reaches included are engineered flood control channels maintained by the SMP. The list is organized by watersheds (described above), and reaches are listed by creek. Maps of the individual reaches are provided in Appendix A and details pertaining to the geography, hydrology and treatment areas within each reach can be found in Appendix B.

Subbasin Name	Creek Name	Reach Name
Laguna de Santa Rosa Watershed - Zone 1A		
Windsor		
	Airport Creek	Airport1 Airport2
	Faught Creek	Faught1
	Starr Creek	Starr1 Starr2
	Starr Creek Tributary	Star Trib1
	Windsor Creek	Windsor1 Windsor3 Windsor4
Mark West		
	Fulton Creek Wikiup Creek	Fulton1 Wikiup1
Santa Rosa		
	Abramson Creek	Abramson1
		Abramson2
	Austin Creek	Austin1 Austin2 Austin3
	Brush Creek	Brush1 Brush2
	Coffey Creek	Coffey1
	College Creek	College1 College2 College3
	Ducker Creek	Ducker1 Ducker2
	Forestview Creek	Forestview1 Forestview2 Forestview3
	Lorna Dell Creek	Lornadell1
	Middle Fork Brush Creek	MiddleBrush1

		MiddleBrush2
	Paulin Creek	Paulin1 Paulin2 Paulin3 Paulin4 Paulin5 Paulin6
	Peterson Creek	Peterson1 Peterson2
	Piner Creek	Piner1 Piner2 Piner3 Piner4 Piner5 Piner6 Piner7
	Russell Creek	Russell1 Russell2
	Santa Rosa Creek	Santa Rosa1 Santa Rosa2 Santa Rosa3 Santa Rosa4 Santa Rosa5 Santa Rosa6
	Santa Rosa Creek Diversion	Santa Rosa Div.1
	Sierra Park Creek	Sierra Park1 Sierra Park2 Sierra Park3
	Spring Creek	Spring1 Spring2 Spring3
	Steele Creek	Steele1 Steele2 Steele3 Steele5
Roseland and Colgan		
	Colgan Creek	Colgan1 Colgan2 Colgan3 Colgan4 Colgan5 Colgan6 Colgan7
	Kawana Springs Creek	Kawana1
	Roseland Creek	Roseland1 Roseland2 Roseland3 Roseland4 Roseland5 Roseland6
Upper Laguna		
	Bellevue Wilfred Channel	BellWil1 BellWil2 BellWil3 BellWil4

	Coleman Creek	Coleman1 Coleman2
	Cook Creek	Cook1 Cook2 (sediment basin)
	Copeland Creek	Copeland1 Copeland2 Copeland3 Copeland4 Copeland5
	Cotati Creek	Cotati1 Cotati2
	Crane Creek	Crane1 Crane2
	Five Creek	Five1
	Gossage Creek	Gossage1 Gossage2 Gossage3
	Hinebaugh Creek	Hinebaugh1 Hinebaugh2 Hinebaugh3 Hinebaugh4 Hinebaugh5 Hinebaugh6 Hinebaugh7
	Hunter Creek	Hunter1 Hunter2 Hunter3
	Laguna de Santa Rosa	Laguna1 Laguna2 Laguna3 Laguna4 Laguna5 Laguna6 Laguna7
	South Fork Copeland Creek	SFCope1 SFCope2
	Todd Creek	Todd1 Todd2 Todd3 Todd4 Todd5
	Washoe Creek	Washoe1
	Wilfred Creek	Wilfred1
	Wilfred Extension	Wilfred Ext.1
Petaluma River Watershed - Zone 2A		
Petaluma		
	Adobe Creek	Adobe1 Adobe2 Adobe3 Adobe4
	Capri Creek	Capri1 Capri2 Capri3 Capri4
	Corona Creek	Corona1

		Corona2 Corona3 Corona4 Corona5
	East Fork McDowell Creek	East Fork McDowell1
	East Washington Creek	East Washington1 East Washington2 East Washington3 East Washington4 East Washington5
	Jessie Lane Creek	Jessie Lane1
	Lichau Creek	Lichau1 Lichau2 Lichau3
	Lynch Creek	Lynch1
	McDowell Creek	McDowell1 McDowell2 McDowell3
	Thompson Creek	Thompson1
	Washington Creek	Washington1 Washington2 Washington3 Washington4 Wathington5 Washington6
Sonoma Creek Watershed - Zone 3A		
Sonoma		
	Fryer Creek	Fryer1 Fryer2 Fryer3 Fryer4
	Lower East Fork Fryer Creek	Lower East Fork Fryer1

Beneficial Uses of Controlled Water Bodies

The basis for the discussion of beneficial water uses is the requirements of the General NPDES Permit and Section 13050(f) of California's Porter-Cologne Water Quality Control Act, which states:

> *"Beneficial uses of the waters of the state that may be protected against water quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves*."

Beneficial uses include human consumptive, recreational, aquatic life and wildlife uses. The assessment of beneficial water uses was an essential part in the development of this APAP, which includes provisions specifically aimed at protecting such uses. Below is a discussion of the beneficial uses of the water bodies to be controlled, as designated by State Water Resources Control Board.

The Laguna de Santa Rosa watershed (Zone 1A) is part of the larger Middle Russian River Hydraulic Area (HA). Within the Middle Russian River HA, the SMP engineered channels are included within

the Laguna, Santa Rosa, and Mark West Hydrologic Subareas (HSAs). The existing beneficial uses of these HSAs include Municipal and Domestic, Agricultural, Industrial Service and Industrial Process Supply; Groundwater Recharge; Freshwater Replenishment; Navigation; Hydropower Generation; Water Contact and Non-Water Contact Recreation; Commercial and Sport Fishing; Warm and Cold Freshwater Habitat; Wildlife Habitat; Rare, Threatened or Endangered Species; and Spawning, Reproduction and or Early Development. All three of these HSAs also have the potential beneficial use of Shellfish Harvesting and Aquaculture. A detailed breakdown of these beneficial units is provided in Table 3-1B below. An explanation of all designated beneficial uses can be found on the State Water Resources Control Board website www.waterboards.ca.gov.

The Petaluma River (Zone 2A) watershed is included within the Petaluma River HA. The existing beneficial uses of the waterways that the SCWA would be controlling within this HA are Navigation; Water Contact and Non-Water Contact Recreation; Warm and Cold Freshwater Habitat; Wildlife Habitat; Rare, Threatened or Endangered Species; Migration of Aquatic Organisms; Spawning, Reproduction and or Early Development; and Estuarine habitat.

The Sonoma Creek watershed (Zone 3A) is included within the Sonoma Creek HA. Navigation; Water Contact and Non-Water Contact Recreation; Commercial and Sport Fishing; Warm and Cold Freshwater Habitat; Wildlife Habitat; Rare, Threatened or Endangered Species; Migration of Aquatic Organisms; and Spawning, Reproduction and or Early Development are the existing beneficial uses of the waterways within this HA that the SMP would be controlling.

Below is an explanation of the abbreviations used for each beneficial use in Table 3-1.

Abbreviation	Beneficial Use
MUN	Municipal and Domestic Supply
AGR	Agricultural Supply
IND	Industrial Service Supply
PRO	Industrial Process Supply
GWR	Groundwater Recharge
FRSH	Freshwater Replenishment
NAV	Navigation
POW	Hydropower Generation
REC-1	Water Contact Recreation
REC-2	Non-Contact Water Recreation
COMM	Commercial and Sport Fishing
WARM	Warm Freshwater Habitat
COLD	Cold Freshwater Habitat
WILD	Wildlife Habitat
RARE	Rare, Threatened, or Endangered Species
MIGR	Migration of Aquatic Organisms
SPWN	Spawning, Reproduction, and/or Early Development
SHELL	Shellfish Harvesting
EST	Estuarine Habitat
AQUA	Aquaculture

TABLE 3-1B: Beneficial Uses of Waters of the SMP Program Area.

	Hydrologic Area or Subarea	BENEFICIAL USES																			
		MUN	AGR	IND	PRO	GWR	FRSH	NAV	POW	REC1	REC2	COMM	WARM	COLD	WILD	RARE	MIGR	SPWN	SHELL	EST *	AQUA
Russian River Hydraulic Unit	Middle Russian River Hydrologic Area																				
	Laguna Hydrologic Subarea	P	E	E	P	E	E	E	E	E	E	E	E	E	E	E	E	E	P		P
	Santa Rosa Hydrologic Subarea	E	E	E	P	E		E	P	E	E	E	E	E	E	E	E	E	P		P
	Mark West Hydrologic Subarea	E	E	E	P	E	E	E	P	E	E	E	E	E	E	E	E	E	P		P
San Pablo Hydraulic Unit	Petaluma River Hydrologic Area							E		E	E		E	E	E	E	E	E		E	
	Sonoma Creek Hydrologic Area									E	E	E	E	E	E	E	E	E			

E = Existing P = Potential

*EST use applies to estuarine portion of water body only

3. DESCRIPTION OF TARGET SPECIES

The Water Agency's focus for aquatic herbicide spray control is on three plant species, Himalayan blackberries (*Rubus armeniacus*), cattails (*Typha spp*) and Ludwigia (*Ludwigia spp*). The presence of these weeds adversely impacts the habitat value and hydraulic capacity of SCWA channels and streams. The following provides a description of the target species and an explanation for their control.

Himalayan blackberries

Introduced as a crop in the United States in the late 19th century, Himalayan blackberry has since escaped cultivation and invaded a variety of sites, including low-elevation streamside areas throughout Sonoma County. As a vigorous, semi-evergreen shrub it can easily grow 10 feet high, with individual canes reaching over 23 feet in a single season. Himalayan blackberry aggressively reproduces by seed and vegetative means and is difficult to eradicate once established (Bennett 2007). The intense competition for light and moisture in blackberry thickets almost completely prevents new trees and shrubs from establishing. Furthermore, as a sprawling plant, Himalayan blackberry climbs up other vegetation and causes harm by twisting around and constricting it (DiTomaso 1997). The dominance of Himalayan blackberry is one of the most significant obstacles faced by the SCWA in its efforts to enhance riparian habitat along its flood control channels (i.e. develop native, mature trees and understory vegetation along channels and creeks).

Cattails

Cattails have three interlocking reproductive strategies: dominance of local habitats by rhizomatous growth, survival of long inhospitable periods with buried seeds, and spreading to new sites with wind-dispersed seeds (Shipley et al 1989). Cattails are considered to be a dominant competitor in wetlands, often excluding other plants with its dense canopy (Keddy 2010). In Sonoma County, cattails have been observed most commonly in low-gradient reaches with little or no riparian canopy. As is true with blackberries, excessive cattail growth can decrease a channel's flood conveyance capacity. This occurs in three ways. First, excess growth of instream cattails can obstruct the channel by reducing its cross section and conveyance capacity of the floodway as a whole. Second, large cattail stands increase bed and bank friction or hydraulic roughness, slowing down flows and leading to an increased threat of flooding. Third, the subsequent increase in hydraulic roughness can encourage further sediment deposition as flow velocities slow and suspended particles dropout.

Ludwigia

Native to temperate regions of North and South America, Ludwigia is a creeping-emergent, wetland species (Estes and Thorp, 1974). The species has beneficial uses, including food for waterfowl (Whitley et al., 1999) and invertebrates (Harms and Grodowitz, 2009). Despite its benefits, Ludwigia can become problematic in its native range (Barrett and Seaman, 1980; Whitley et al., 1999), spreading by vegetative growth to form dense stands that create habitat for mosquitoes and anoxic conditions in water (Anderson, 2003). Over the past 100+ years, it has been introduced into foreign ranges where it also has proven to be problematic. Its aggressiveness both in native and introduced ranges has led researchers to study its biology and ecology in more depth, including reproduction and spread (Dandelot et al., 2005).

In Sonoma County, Ludwigia is a highly invasive aquatic weed found in increasing occurrence, especially in the Laguna de Santa Rosa and in tributaries to the Laguna system. At least two

Ludwigia species of concern occur in SMP channels: *L. peploides* and *L. hexapetola*. In channels lacking high water flows that would otherwise scour-out annual growth, Ludwigia produces a thick, persistent, mat of woody stems and decaying plant matter. In addition to inhibiting the establishment of other plant species, the decomposition of older Ludwigia material in these mats reduces dissolved oxygen levels in the water, thus impacting fish and invertebrate populations (Sears et al 2010). The buildup of biomass and sediment trapping due to the growth habits of Ludwigia can cause problems similar to cattails by reducing channel capacity and contributing to more frequent and longer duration flooding.

4. CONTROL TOLERANCES

The following explains the acceptable limits for Himalayan blackberry, cattail, and Ludwigia growth within SCWA maintained channels. Overall, the SCWA has determined that maintaining blackberries and cattails as a "background" plant where growth accounts for no more than 10 to 20 percent of the total vegetation cover is appropriate. In the case of Ludwigia, 100 percent control in low-lying channels is necessary for the purposes of the SMP realizing its goals. Details of specific control tolerances are given below.

The aggressive growth rate, hindrance to native vegetation and flood-control issues caused by Himalayan blackberries make it a weed of high concern to the Stream Maintenance Program. As such, the SCWA will strive to treat all identified occurrences that are greater than 10 to 20 percent of the total vegetation cover. With the third season of treating upper-banks for blackberry growth coming to a close, it has become apparent that AquaMaster can successfully eliminate whole blackberry stands, making treatment the following year unnecessary at many sites. In cases where re-growth does occur after the initial spraying, the amount of returning blackberry observed has been a fraction of the original stand size. With this trend in mind, it is clear that the amount of herbicide needed to manage the Himalayan blackberry should decrease exponentially from year-to-year as thickets lining creeks for miles will give-way to occasional canes that require only spot-spraying.

The need for the herbicidal control of cattails for both flood control and restoration purposes is becoming more apparent. On reaches where cattail depletion may eliminate the need for sediment removal (a highly disruptive action) in order to restore channel capacity, the SCWA will not tolerate large stands of cattails. Similarly, the SCWA will have a low tolerance for dominant cattail stands that may hinder the success of native in-channel and toe restoration plantings. Moreover, in all instances where cattail stands are a hindrance to SMP goals, action will be taken to reduce growth to 10 to 20 percent of the total in-channel vegetation cover.

In instances where high water flow scours-out Ludwigia growth and prevents the accumulation of perennial mats, the SCWA does not expect that control activities will be necessary. These circumstances are true for most upland creeks and channels east of highway 101, as well as for SCWA channels in Petaluma and Sonoma. However, in cases where Ludwigia growth is perennial and results in sediment-trapping mats that are both ecologically degrading and flood hazards, the SCWA will aim to eradicate 100 percent of occurrences. In order to maintain 100 percent control in these low-lying channels the SCWA expects that control actions will need to be taken no less than once a year.

5. DESCRIPTION OF HERBICIDES, ADJUVANTS AND APPLICATION METHODS

Herbicides and Adjuvants to Be Used

For all SCWA SMP activities, Aquamaster® will be used with the surfactant Agri-Dex®.

Aquamaster®

According to the specimen label, Aquamaster® is an aquatic herbicide formulation containing 53.8% glyphosate isopropylamine salt and water. Glyphosate works by inhibiting the activity of enzymes essential for protein synthesis (Monsanto Company). The enzymes targeted are specific to plants and thus glyphosate has been shown to have a low toxicity to humans and wildlife (Schuette 1998 and EPA 2005). As a systemic herbicide, Aquamaster® is absorbed at the point-of-contact and is then translocated within the entire plant system (Tu et al. 2001). The systemic property of Aquamaster® makes it especially appropriate for vegetation which may have foliar parts that are partially submerged (i.e. Ludwigia). Another desirable characteristic of glyphosate is that it is readily degraded by soil microbes, with an average half-life of two months in soil and two to ten weeks in water. The major degradation product is aminomethylphosphonic acid (AMPA). AMPA is further degraded in the environment to carbon dioxide and phosphate. The potential for glyphosate to leach into groundwater has been evaluated in a number of studies which reveal that glyphosate is unlikely to cause groundwater contamination (Schuette 1998). In addition to its low environmental toxicity, the Aquamater® glyphosate formulation has proven highly effective in the chemical control of the SMP's three target plants (1) Himalayan blackberries (Bennett 2007), (2) cattails (Linz et al. 2011) and (3) Ludwigia (Sears et al. 2010). A quick reference sheet describing the chemical makeup of AquaMaster and its degradation byproducts is provided in Appendix F.

Agri-Dex®

The Aquamaster® specimen labels recommend the use of a non-ionic surfactant containing at least 50% active ingredient. Agri-dex® is a non-ionic surfactant consisting of a paraffin base petroleum oil, polyol fatty acid esters, and polyethoxylated derivatives of the fatty acid esters (Helena Chemical Company) that meets those recommendations. Studies comparing surfactants labeled for aquatic use have shown Agri-Dex® to be relatively non-toxic in riparian and aquatic ecosystems (Smith et al. 2004). Current SMP use of an Aquamaster® and Agri-Dex® mix has demonstrated its effectiveness on Himalayan blackberries.

Application Methods

All herbicide application activities are 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). Furthermore, the SCWA adheres to all Best Management Practices (BMPs) related to the pre-maintenance training, herbicide application, and hazardous material safety (please refer to Section 11 this APAP for complete BMP details).

Backpack sprayers or a conventional spray truck with a hand-operated spray gun will be used for the treatment of all Himalayan blackberries, cattails and Ludwigia. Application will entail workers walking along the channel banks and spraying the leaves of target plants with a low concentration mixture of AquaMaster in accordance with the species-specific label instructions. Application will occur only under the most effective conditions (i.e. when temperatures are between 60 and 90

degrees F; when wind temperatures are not more than 6mph; and when rain is not expected for at least 72 hours). Care will be taken to insure limited overspray to surrounding plants and/or water surfaces. Further details of BMPs relating to application methods are presented in Section 11 of this APAP.

6. DESCRIPTION OF THE TREATMENT AREA

All herbicide treatments will occur within the Laguna de Santa Rosa, Petaluma River, and/or Sonoma Creek watersheds, as needed. Within these watersheds, all engineered channels may be sites for herbicide application.

Engineered channels are manmade waterways in which the cross section, slope profile, or other facilities have all been designed and constructed. Structures such as drop inlets, outfalls, flap gates, and culverts may be present. Maintenance activities performed by the SCWA in engineered channels include bank stabilization, landscaping, fencing, mowing, sediment removal, debris removal, and vegetation thinning and spraying. For the purposes of this APAP and all related SMP activities, the treatment area will be defined as the specific section, or Reach, within the SMP channel at which the herbicide application takes place (Refer to Appendix A for channel Reach maps). Generally, weed distribution on SMP channels occurs on upper banks, side banks, and instream. Characteristics specific to treatment areas containing Himalayan blackberries, cattails and Ludwigia are described below. Further details relating to the environmental conditions of each Reach are provided in "Reach Sheets" in Appendix B.

The majority of blackberry growth occurs on channel side-banks, with the thickets extending from the top of the bank down to the toe of the waterway. In small channels, growth can extend over and occlude the channel bottom. As such, this is the primary herbicide application area. Since the majority of Himalayan blackberry growth occurs on the side banks, foliar spray is unlikely to result in herbicide landing directly in water. However, there are cases in which blackberries growth up to the water's edge or growth on an inaccessible bank-side may necessitate spraying in, over, or adjacent to standing or slow-moving water. Blackberries occur on over half of SCWA managed waterways and have the potential to be present on all of them.

Cattail growth in some form occurs in almost 100% of SCWA managed channels. The largest, most problematic stands where herbicide application will be required are generally found in shallow channels (<0.5 meters depth) with full sun exposure. Water flow during the time of treatment (i.e. late summer or fall) would be minimal or standing. Since cattail growth out-competes most other aquatic species, the presence of desirable vegetation at application sites would be minimal.

The only sites anticipating immediate herbicidal control of Ludwigia occur in reaches of the Laguna de Santa Rosa and its tributaries west of HWY 101, outside Rohnert Park. The chemical control of Ludwigia in these reaches will not commence until after sediment removal has occurred (See Section 11 BMPs, below). Such excavation activities typically remove the majority of in-channel weedy biomass. As such, herbicide application will be limited to any remaining plant segments that have begun re-sprouting. Previous sediment removal at the Laguna de Santa Rosa has shown that post-excavation re-sprouting generally occurs in small patches along the thalweg. Growth of desirable vegetation is minimal at these application sites and overspray is not an issue.

7. WEED MANAGEMENT OPTIONS AND THEIR LIMITATIONS

The Stream Maintenance Program currently implements a number of non-chemical control methods in its efforts to manage Himalayan blackberries, cattails and Ludwigia. Prevention, manual

and power tool-assisted removal, mechanical excavation, and habitat modification control methods are already incorporated into the SCWA's current stream maintenance activities. In addition to these actively practiced weed control methods, biological control agents, aquatic herbicides, and the option of taking no action are discussed below. In the evaluation of these management options the effects on human health, damage to habitat, impacts on water quality, feasibility/efficacy of applying the method and costs are carefully considered. Taken individually, these alternative methods have significant limitations. However, when combined as part of an integrated weed management program that includes the use of herbicides, these non-chemical control methods can be of great use.

No Action

With aggressive weed infestations being the case on many of the SCWA's Reaches, taking no action would mean forgoing the flood control and habitat restoration goals of the SMP. As such, taking no action is not a viable option. However, at sites where the target species remain within control tolerance levels, the "no action" option will be considered. Instances where weed infestations are allowed to go un-managed will still be monitored each season to evaluate changes in weed population, risk to management objectives, and priorities.

Prevention

The routine channel maintenance and restoration activities of the SMP aid in the prevention of exotic and invasive plant species by promoting habitat that is less conducive to the establishment of weeds. In the case of Ludwigia, maintenance of channel capacity via selective vegetation thinning and excavation of sediment deposits allows for the high winter water flows necessary to scour-out seasonal growth and prevent the establishment of perennial mats at most sites. Furthermore, the SMP's encouragement of mature, closed, canopy over channels via selective vegetation thinning and pruning promotes shaded habitat which is less encouraging of Himalayan blackberry, cattail and Ludwigia growth. Finally, the SMP implements BMPs to minimize the area of disturbance, including erosion and sediment control measures, bank stabilization measures, and seeding and restoration-related measures. With disturbed ground being the most vulnerable to weed invasion, the SMPs efforts to reduce or mitigate for this directly aid in the prevention of new weed growth. The restoration efforts of the SMP and its uses as a method of weed control are discussed further in *Habitat Modification Control* below.

The most obvious drawback to preventative weed control methods is they do not address sites already suffering from weed infestation. With many of the SMP channels and creeks having blackberry, cattail and/or Ludwigia occurrences above the tolerance threshold, prevention in itself is not a realistic form of weed management for the SCWA.

Manual Control

Manual removal of blackberry root crowns and roots using shovels, McLeods and similar hand tools can be effective if done thoroughly, but presents many challenges. Firstly, manual removal is most feasible after an initial mowing or cutting to make the root crowns accessible. Secondly, during the followed work window from Jun 15 thru October 31, the soil is dry and highly compacted, greatly reducing the likelihood of entire root crowns being removed. This results in post-treatment re-sprouting. Furthermore, manual removal can result in unwanted soil disruption, weed and erosion problems. Finally, the costs associated with the time and labor force to manually clear miles of blackberry thickets is extremely prohibitive. The challenges posed by manual removal of

blackberry are also true for cattails and Ludwigia. As such, the SCWA generally reserves manual control methods to sites appropriate for volunteer efforts and educational opportunities and/or to small or isolated infestations.

Power Tool and Machine-Assisted Removal

Power tool methods for Himalayan blackberry control include mowing or the use of gas-powered hedgers. While these methods are less costly and time-consuming than manual removal, they provide only short term relief as the canes and root crowns left behind re-sprout in a matter of weeks. These techniques place personnel at risk of general equipment-operation hazards, risk the spilling of motor oil and fuel and can increase air and noise pollution. The mechanical removal of cattails using mowing/hedging techniques and the removal of Ludwigia using motor-driven aquatic weed harvesters include further environmental impacts such as the creation of water-borne sediment and turbidity due to people and equipment working in the water. Ludwigia easily spreads through fragmentation and thus power-tool driven control has the potential to increase its distribution.

Mechanical Excavation

Mechanical excavation of cattails and Ludwigia as part of sediment removal projects can effectively reduce the immediate occurrence of these plants in waterways. The leading draw-back to excavation is the initial damage and complete disruption it causes to the surrounding environment and the species that live there. Moreover, unless the digging removes the entire channel soil profile containing the viable rhizomes, its effect is equivalent to pruning as re-sprouting will occur. Due to the inherent disruption to systems caused by excavation, it is best utilized in instances of a large-scale infestation.

Biological Control Agents

Herbivorous Insects
Control of undesirable plant species using biological agents such as herbivorous insects has a couple of appealing attributes, namely that such agents are often host specific and their ecosystem impacts can be more gradual, thereby allowing the system to adjust to the loss of the target species. However, the adverse effects of introducing a new species can include competition with native species and uncontrollable movement of the introduced agent to new sites. Furthermore, biological controls tend to have unpredictable success and rates of control that are slower than other weed management options (Greenfield et al 2004). While insect controls for Ludwigia exist, recent trials in the San Francisco Bay Area using weevils (*Neochetina* spp.) and a moth species (*Sameodes albiguttalis*) have proven unsuccessful (CDBW 2003). With the exception of grazing domestic animals (discussed below), no biological control agents are currently approved for Himalayan blackberry or cattail management.

Grazing By Domesticated Animals

Several California agencies currently augment or replace chemical control operations with grazing by domesticated animals. While success of grazing on riparian weeds has been documented (Greenfield et al. 2006), trials specific to Himalayan blackberry, cattails and Ludwigia are lacking. Furthermore, the issue of habitat destruction, damage to non-target plants and water quality degradation due to grazing animals is a huge concern for the SCWA, especially considering that many of our reaches have documented occurrences of endangered Salmonids and/or amphibians, or the presence of suitable habitat for a listed species (refer to Table 7-3 in Appendix C for a

complete listing of engineered channel reaches with potential habitat for, or documented occurrences of federal or state listed species).

The SCWA will continue to assess the viability of including biological control agents into its integrated weed management program as more research related to their use on the target weeds of this APAP becomes available.

Habitat Modification Control

The worst infestations of cattails and Ludwigia appear to be associated with symptoms of riparian habitat degradation: thick sediment deposits in shallow, slow-moving and nutrient rich waters in full sun. Blackberries, similarly, flourish at sites lacking a mature riparian canopy to shade out the excessive growth of thickets. It is a long-term goal of the SCWA to repair the causes of these habitat deficiencies. The establishment of a continuous canopy from the upland banks to the channels edge will shade out excessive Himalayan blackberry growth overtime. Dense shade that reaches across channels will likewise reduce cattail growth and minimize the establishment of Ludwigia. In order for the success of native tree installations, site preparation and maintenance must be sufficient to control competing vegetation until the trees are large enough to dominate the site. The viability of mature canopy development as part of habitat restoration efforts is limited by how naturally supportive a channel site may or may not be of such tree growth.

The manipulation of channel depth is another means of habitat modification that can be used to successfully control cattail and Ludwigia. Generally, at channel depths of one meter or more, cattails will not establish (Sojda and Solberg 1993) and spreading Ludwigia vitality significantly weakens (Grewell et al. 2006). It is already the practice of the SMP to construct a low-flow channel that will have the hydraulic geometry conditions adequate to convey and pass sediments at low-flow conditions. The success of low-flow channels in controlling cattail and Ludwigia growth are limited by two factors: not all channels are eligible for the sediment removal activities that must precede low-flow channel installation and the depth of low-flow channels is limited to the depth of the original channel design.

Aquatic Herbicides

The herbicide weed management option involves the use of chemicals that disrupt key physiological processes in plants, leading to plant death. Approved aquatic herbicides are specifically formulated for use in water and are considered compatible with the aquatic environment when used according to label directions. Aquatic herbicides can offer low-cost, effective and fast control of problem weeds. However, chemical weed control includes the issues of proper herbicide selection, potential damage to non-target species and potential environmental toxicity. The pros and cons of aquatic herbicide use are expanded upon below. While many aquatic herbicides are approved for use in the State of California, the discussion to follow will focus on the glyphosate-based formula AquaMaster®, as it is the proposed product for use in this APAP.

AquaMaster® is a non-selective aquatic herbicide that works systemically through foliar application. The biggest issues associated with its use are efficacy, potential toxicity to non-target organisms and potential environmental impacts, including the degradation of water quality. Current use of AqauMaster® by the SMP has proven its effective control of riparian Himalayan blackberry. With the product also being labeled for use on Ludwigia and cattail (Monsanto 2012), it offers control for all three of the target weed species of this APAP and solves the issue of appropriate herbicide selection. Further potential efficacy issues with AqauMaster® can arise from

improper timing of application and application rates, and application to non-target plants. All of these issues can be addressed with proper training in product use. As such, this APAP includes provisions requiring all applicators to undergo a mandatory herbicide use training at the beginning of each season (See APAP Section 11 *Implemented Best Management Practices (BMPs)*).

Relating to concerns over the environmental impacts of AqauMaster®, it is important to make the distinction between highly toxic, persistent, and fat soluble chemicals (such as DDT) and the relatively low toxicity, quick degradability and fat insoluble nature of glyphosate-based herbicides like AqauMaster® (Monheit 2003). Since its introduction in the 1970s, the low toxicity of glyphosate in both aquatic and non-aquatic environments has been thoroughly documented (California Department of Pesticide Regulation 1998; Giesy *et al* 2000; Perkins 1997). Furthermore, when used in accordance with the product label there is minimal chance that aquatic glyphosate application would result in concentrations in the water that would adversely affect non-target organisms or affect the beneficial water uses (Giesy *et al* 2000). Similar to ensuring AquaMaster® efficacy as described above, the key to ensuring its low toxicity is compliance with all provisions on the product label. This APAP addresses the concern of proper herbicide use through the use of BMPs.

While the SMP already implements an integrated weed management program that includes the use of several non-chemical control options, the SCWA has concluded that the addition of aquatic herbicides into its practiced control methods will further the viability and environmental soundness of its efforts to control unwanted plant species in its engineered channels. The factors influencing the decision to use aquatic herbicides are expanded upon below.

8. FACTORS INFLUENCING THE DECISION TO USE AQUATIC HERBICIDES

There are three main factors that influence the SCWA's decision to use aquatic herbicides: (1) the low-environmental impact as compared with alternative control methods (2) the demonstrated success of herbicidal control methods on the above mentioned target species (especially when used in conjunction with non-chemical controls), and (3) the cost and time effectiveness of using herbicides.

Generally, alternative control methods take a long time and are expensive, labor intensive, not as effective, may cause temporary water quality and ecological degradation, and/or further spread weeds. The equipment and labor required to perform these techniques is not always readily available. This may cause delays in removal leading to increased plant material to remove and increased cost. Furthermore, an extensive review of available literature on the topic of weed management has led the SCWA to conclude that an integrated program that includes a calculated combination of chemical and non-chemical control methods is the most effective and least detrimental to the surrounding environment.

It is the goal of the SCWA to minimize herbicide use overtime, as weed densities decline and other control methods begin to take effect (i.e. riparian canopy development) and/or become more feasible.

9. QUANTITY OF PRODUCT REQUIRED

The quantity of aquatic herbicide product required will be determined by a trained staff that has followed all label directions and recommendations outlined in this APAP. The total amount of

material used is highly variable and depends on the type, location, density of weeds and site specific characteristics of the area to be treated. Since the density of weed growth changes seasonally, it is impossible for the SCWA to forecast total quantities of herbicide needed for the 2014 application season. However, all herbicide applied to SCWA lands and waters will be applied in quantities and such a manner as to achieve the desired results with the least negative impact on other resources.

The exact rates of herbicides and surfactants to be used for all SCWA SMP treatments target species are taken from the AquaMaster label instructions. Rates are outlined Table 9-1 (below).

Table 9-1. Amounts of AquaMaster® Herbicide and Agri-Dex® Surfactant To Be Used*

Perennial Weeds		**AquaMaster®**		**Agri-Dex®**
		Percent Solution	Broadcast Rate	Surfactant Rate
Cattails	*Apply when cattails are actively growing and are at or beyond the early-to-full bloom stage. Best results are achieved when application is made during the summer or fall months.*	0.75 Percent Solution	2.3 Quarts per Acre	3 quarts per 100 Gal solution
Ludwigia	*Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.*	0.75 Percent Solution;	2.5 Quarts per Acre	3 quarts per 100 Gal solution
Woody Brush and Trees				
Blackberries	*Ensure thorough coverage in spray-to-wet treatment. Best results are achieved in spring/early summer when blackberry are at high moisture content and flowering*	0.75 Percent Solution	2.3 Quarts per Acre	3 quarts per 100 Gal solution

* Based on the AquaMaster® specimen label, Monsanto Company 2013

10. MONITORING AND REPORTING PROGRAM

Objectives

The monitoring and reporting program (MRP) in this APAP is intended to answer the following two questions:

Question No 1: Does the residual AquaMaster® aquatic herbicide discharge cause an exceedance of receiving water limitations for the active ingredient glyphosate (i.e. 700 μg/L)?

Question No 2: Does the discharge of the residual aquatic herbicide AquaMaster® and surfactant Agri-Dex®, (the products proposed for use by this APAP) including active ingredients, inert ingredients, and degradation byproducts, in any combination cause or contribute to an exceedance of the "no toxics in toxic amount" narrative toxicity objective of the NPDES permit?

In addition to addressing the above stated questions, this MRP is designed to ensure compliance with all provisions stated in the NPDES permit including the general monitoring conditions as well as the requirements for monitoring locations and sample types, receiving water monitoring, and information collection and reporting.

Discussed below are the herbicide application event, monitoring and data reporting provisions of this MRP. More specific details of the requirements to be followed in this MRP can be found in Attachement C of the General NPDES Permit, which is provided in Appendix D.

Herbicide Application Event Procedures

For each application at each site, the discharger shall prepare a map with a convenient scale showing the application area, treatment area, immediately adjacent untreated areas, and water bodies receiving treated water. The discharger will also provide the surface area or volume of the application site and all information used to calculate dosage and quantity of each herbicide used at each application area. GPS coordinates will also be recorded for each sampling sites.

Visual monitoring will also be performed for all applications at all sites and be recorded by the applicator(s) present. Records from this monitoring will be kept with the application records of the SCWA. Figure 1 in Appendix E is the form used to document visual monitoring.

Herbicide application events will be timed to coincide with the plant-specific lifecycle stage(s) that is/are deemed to have the best results based on the product label (generally, this includes various periods within the spring, summer, and fall seasons).

Monitoring Procedures

Monitoring Locations and Monitoring Frequency

Prior to each field season (in April or May) all SCWA managed waterways will be scouted (see implemented BMPs) and decisions will be made as to exactly what channels require herbicide control (based on winter weed growth and the SCWA's integrated weed management approach outlined by this APAP). After the list of potential treatment areas (i.e. channel Reaches) is evaluated, the exact monitoring sites will be chosen. As required for glyphosate-based herbicides like the one proposed for use in this APAP, two monitoring samples shall be collected per year, one from each environmental setting (flowing water and non-flowing water). The flowing water and non-flowing water treatment areas with the largest instream weed infestation (and thus the highest potential for herbicide discharge into the water) will be selected as the monitoring sites. The sampling will be timed to coincide with the herbicide application events at the chosen monitoring sites.

Sampling Design

Consistent with permit requirements, the monitoring program will include the following monitoring types for each sampling (1) background monitoring, (2) event monitoring, and (3) post-event monitoring.

Background monitoring samples shall be collected at the treatment area, just prior to the application event. Event monitoring samples will be collected immediately downstream of treatment areas in flowing waters or adjacent to the treatment area in stagnant waters. The post-event monitoring samples shall be collected within the treatment area and immediately downstream of the treatment area in flowing waters or adjacent to the treatment area in stagnant water within seven days of the herbicide application.

Field Sampling Procedures

The SCWA SMP will collect its own water quality monitoring samples for 2014. Water samples will be collected using a clean sampling rod and sterile sampling containers supplied by the primary laboratory. At the time of each sample collection, staff will wash hands and put on a new pair of latex gloves to prevent sample contamination from persons. For sample collection, sterile bottles will be attached to the sampling rod, extended out over the water at the herbicide application site and lowered to approximately 50% water depth. During collection, the samples will be gathered in a manner that minimizes the amount of suspended sediment and debris in the sample. When the container is full it is pulled out of the water and sealed. The sample is labeled in permanent ink with a sample ID, location, date, initials of the collector and "PRE," "EVENT," "POST A" or "POST B" to delineate whether the sample is part of background, event, or post-event monitoring, respectively.

In conjunction with each sample collection, temperature will be measured in the field. Turbidity, electrical conductivity/salinity, pH, and dissolved oxygen may be measured in the field using field meters as available or analyzed in the laboratory. All equipment used to take field measurements of the above parameters will be calibrated according to the manufacturer's specifications and will be checked throughout the year to evaluate instrument performance. Figure 2 in Appendix E is that form that will be used to document monitoring events.

Sample Shipment

Immediately following collection, water samples will be stored on ice packs in a sterile, properly sealed, cooler. Care will be taken not to allow the samples to come in contact with persons, equipment or vehicles so as to prevent possible contamination. Delivery to the laboratory should occur on the same day or the next day as the sample collection.

Assessment of Field Contamination and Proper Equipment Calibration

To help assess contamination from field equipment, ambient conditions, sample containers, transit, and the laboratory, one field blank will be collected and submitted for analysis each sampling day. Field blank samples will be obtained by pouring deionized water into a sampling container at the sampling point. Field blank samples will be labeled in permanent ink with a sample ID that includes location, date, initials of the collector and "BLANK" to delineate that the sample is for assessment of field contamination.

To further ensure proper equipment function and calibration, one field duplicate will be obtained by collecting a second receiving water sample (one per monitoring site). The field duplicate may be from a background, event, or post-event monitoring sampling. Field duplicate samples will be labeled in permanent ink with a sample ID that includes location, date, initials of the collector and

"PRE-DUP", "EVENT-DUP" or "POST A/B-DUP" to delineate that the sample is a duplicate of a specific monitoring sampling type.

Sampling Analysis

All samples for analysis shall be taken at the anticipated monitoring locations as specified in this APAP. All laboratory analyses shall be conducted at a laboratory certified for such analyses by the Department of Public Health in accordance with California Water Code section 13176. Laboratories that perform sample analyses shall be identified in all monitoring reports. A manual containing the steps followed in this program must be kept in the laboratory and shall be available for inspection by the State Water Board and the appropriate Regional Water Board staff. The Quality Assurance-Quality Control Program must conform to U.S. EPA guidelines or to procedures approved by the State Water Board and the appropriate Regional Water Board

All analyses shall be conducted in accordance with the latest edition of "Guidelines Establishing Test Procedures for Analysis of Pollutants" (Guidelines), promulgated by the U.S. EPA (40 C.F.R. Part 136). Any procedures to prevent the contamination of samples as described by this APAP shall be implemented.

Data Reporting and Management

All reporting shall comply with the requirements outlined in Section IV of Attachment C of the General NPDES Permit, Water Quality Order No. 2013-0002-DWQ, General Permit No. CAG990005, including the annual information collection, annual report, electronic reporting, reporting protocol, twenty-four hour report and five-day written report provisions (see Appendix D). In addition to the reporting required for herbicide use, the SCWA will keep records of and report on all other weed control methods used each season so that a useful comparison of chemical versus non-chemical treatments may be developed.

Data collected regarding all herbicide use (see Appendix E for MRP data collection forms) and other weed control methods applied during the season, as well information regarding updates and improvements made to weed control methods and program BMPs will be managed by the appropriate staff. Data will be entered into a database and tabulated on a regular basis to facilitate analysis throughout the field season. The regular analysis of this data will make issues or errors more easily recognized and subsequently addressed in a timely manner. This process of maintaining a current database will also ensure that the development of the annual report will be as efficient and well-organized as possible.

Following submittal of the annual report due on March 1 of each year, SCWA's SMP Manager shall invite regulatory agency staff to a summary meeting to discuss the events, weed management activities, and lessons learned over the past work cycle. This meeting can 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.

Retention of Records

The SCWA shall retain records of all monitoring information including all equipment calibration and maintenance records, copies of all reports required by this General NPDES Permit, and records

of all data used to complete the application for this General NPDES Permit. Records shall be maintained for a minimum of three years from the date of the sampling, measurement, or report.

11. IMPLEMENTED BEST MANAGEMENT PRACTICES (BMPs)

The SCWA implements the following BMPs during aquatic herbicide application to eliminate or reduce the discharge of pollutants; to minimize the areal extent and duration of impacts to water quality; and to reduce the impacts to protected wildlife and the surrounding habitat. The BMPs below are categorized as follows: Vegetation Management, General Impact Avoidance and Minimization, Air Quality Protection, Biological Resources Protection, Hazardous Materials Safety, Good Neighbor Policies, and Evaluation of Effectiveness. For a complete list of all the SMP's impact reduction and minimization measures and BMPs, see Appendix C.

I. Vegetation Management BMPs

Use of Herbicides

1. All Aquatic herbicides applications are made in accordance to the product label and with regulations of the U.S. EPA, CalEPA, DPR, and the local Agricultural Commissioner. The SCWA regularly monitors updates and amendments to the label so that applications are always in accordance with current product directions.
2. Prior to treatment, qualified staff scout sites to evaluate the extent to which acceptable riparian and aquatic weeds thresholds have been exceeded. Thresholds are based on maintenance of channel hydraulic capacities and the effects of weeds on native vegetation.
3. Any staff participating in the herbicide application program will attend a yearly mandatory training that covers the conditions outlined in this APAP, including how to avoid any potential adverse effects from aquatic herbicide applications, product label compliance, proper application technique, the BMPS to be implemented as part of the SCWA's integral weed management program, etc.
4. If aquatic and riparian weed thresholds can be maintained at acceptable levels with efficient use of non-chemical control techniques, then these techniques will be considered and implemented as feasible.
5. Herbicide and adjuvant use will be restricted to the minimum amount needed, in accordance with product labels, to ensure adequate control of vegetation.
6. Approximate size of a treatment area will be determined prior to the application event and a corresponding estimate of the amount of herbicide needed (based on the quarts/acre broadcast rate provided on the product label) will be calculated and made available to applicators at the time of treatment.
7. As appropriate, the SCWA staff will consider the use of adjuvants (surfactants, emulsifiers, pH control agents, drift retardants, etc.) to increase the efficiency of aquatic herbicide so that the least possible material is used in the most effective manner possible to control the pest.
8. As needed, staff will modify treatment techniques accordingly. For example, wind speed and air temperature have significant impacts on the transport of herbicides. As needed, restrictions or prohibitions are placed on aquatic herbicide applications to prevent impact to non-target species. Other factors considered by staff include, but are not limited to, day length, existing or anticipated precipitation, current and anticipated water exchange, water depth and water movement.

9. Application of herbicides to upland areas shall not be made within 72 hours of predicted rainfall.
10. Application of herbicides shall not be made in wind speeds over 6mph in order to avoid conditions that exacerbate the possibility of overspray and herbicide damage of non-target vegetation.
11. Herbicide application will occur in temperatures ranging from 60-90 degrees F, or as directed by the label.
12. To reduce the likelihood of fish kill due to receiving water limitation exceedances (as described in the General NPDES Permit) and/or the depletion of dissolved oxygen via treated plant decomposition, initial herbicide treatment of any in-channel (below the ordinary high water mark), Ludwigia, blackberry or cattail infestations shall commence only after mechanical or physical removal of the majority of weedy biomass has occurred to target the remaining roots/rhizomes that have begun re-sprouting
13. Herbicide solutions shall only be mixed at designated fill-up stations, so as to prevent the possibility of herbicide and/or adjuvant spill into waterways (for for spill containment measures, see "Hazardous Materials Safety BMP" below).
14. Glyphosate-containing herbicides 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.
15. As required by the Court-Ordered Stipulated Injunction for pesticide use near Pacific salmon-supporting waters in Sonoma County, pesticides specified in the injunction 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. Currently, glyphosate-based herbicides are not included in this Injunction and are still useable in Salmon-supporting waters.
16. Policies regarding pesticide use in critical wildlife habitat will be continuously reviewed to ensure that the SMP complies with all current regulations.

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 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.
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.

II. General Impact Avoidance and Minimization BMPs

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.

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 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.

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.

III. Air Quality Protection BMPs

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 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.

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.

IV. Biological Resources Protection BMPs

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.

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.

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.

Special Plant Status

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 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.

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.

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

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 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.*

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.
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.

California Tiger Salamander Avoidance and Impact Measures for Vegetation Management

1. For vegetation management 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 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.

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.

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 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;
   - 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.

V. Hazardous Materials Safety BMPs

Spill Prevention and Response Plan

1. Equipment and materials for cleanup of spills be available on site and that spills 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 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.

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.

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.

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.

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 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.

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.

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 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).

VI. Good Neighbor Policies BMPs

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.

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 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.

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.

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.
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.

VII. Evaluation of Effectiveness BMP

The effectiveness of BMPs will be continuously evaluated during the year, as well as in-depth evaluation at the end of the year. Results from the Monitoring and Reporting Program (described herein) as well as feedback from field staff will be used in the evaluation of BMP effectiveness. Furthermore, as appropriate BMPs are identified and demonstrated by outside sources, the SCWA will evaluate and consider them for implementation. Reliable sources include, for example, the University of California Cooperative Extension (UCCE).

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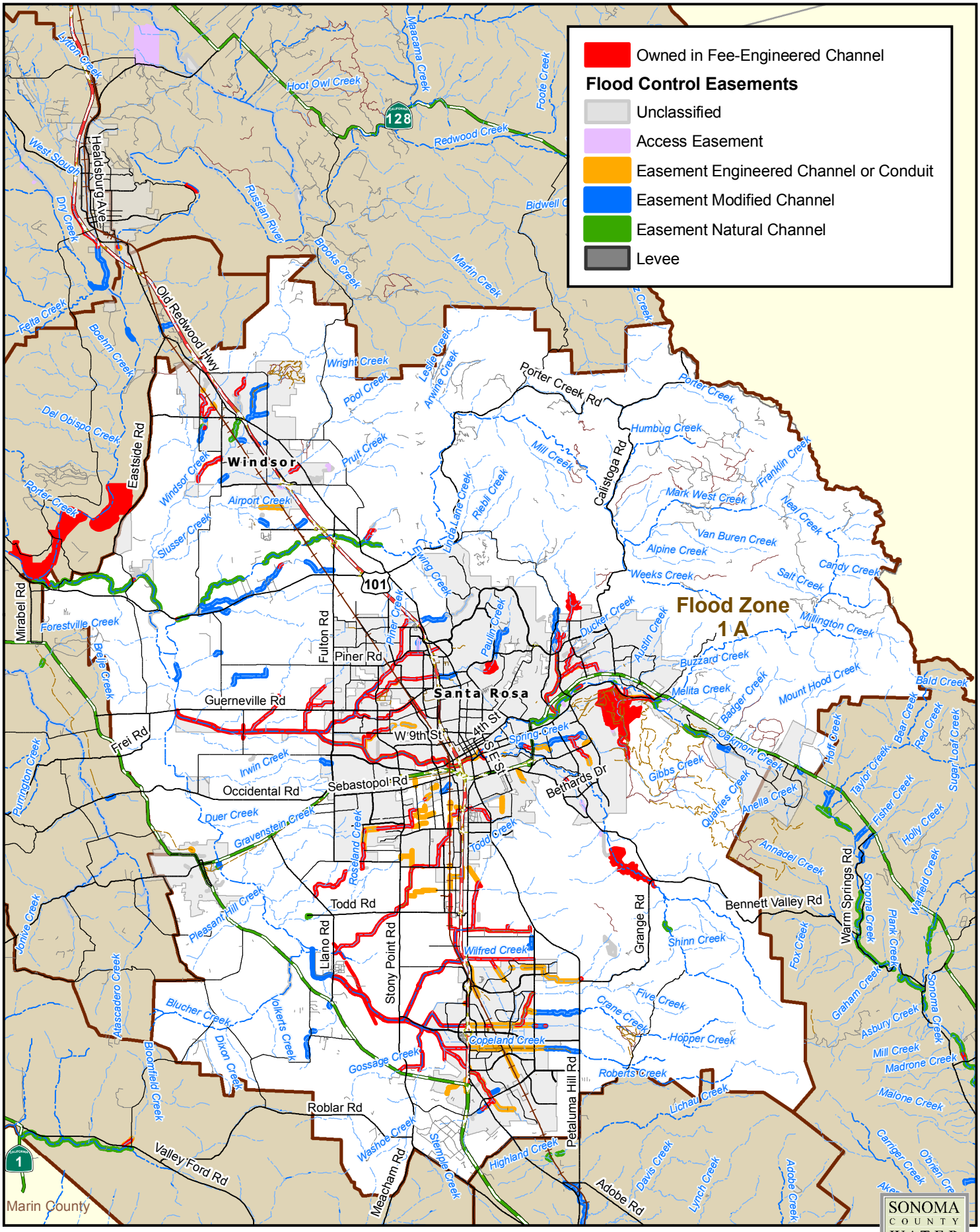
Appendix A

Maps of Water Bodies Being Controlled

- Flood Zone 1A map and supporting maps with Reach designation details
- Flood Zone 2A map and supporting maps with Reach designation details
- Flood Zone 3A map and supporting maps with Reach designation details



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Flood Control
Zone 1A
Sonoma County, CA

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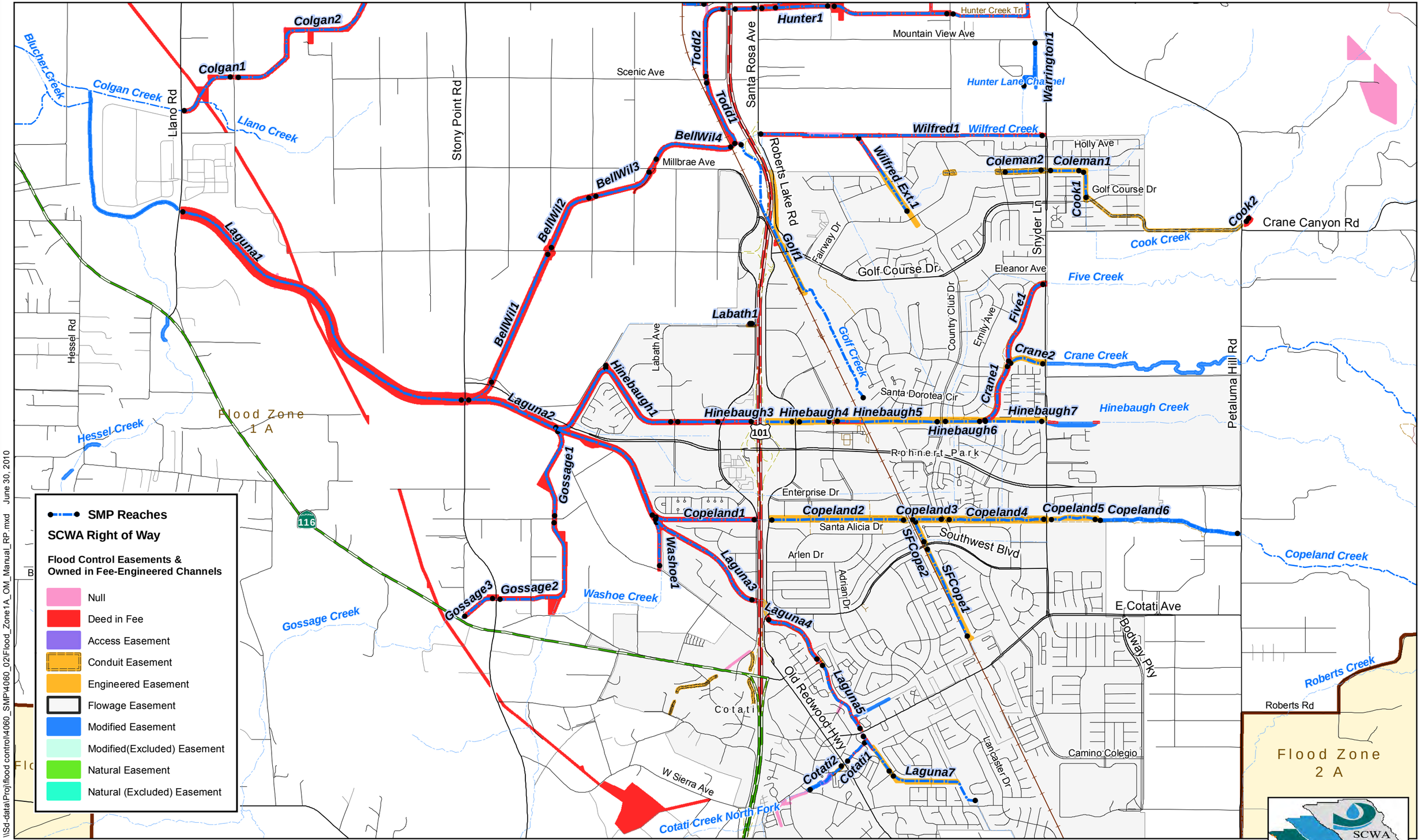

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Stream Maintenance Program
Flood Zone 1A
Rohnert Park/Cotati (1 of 1)

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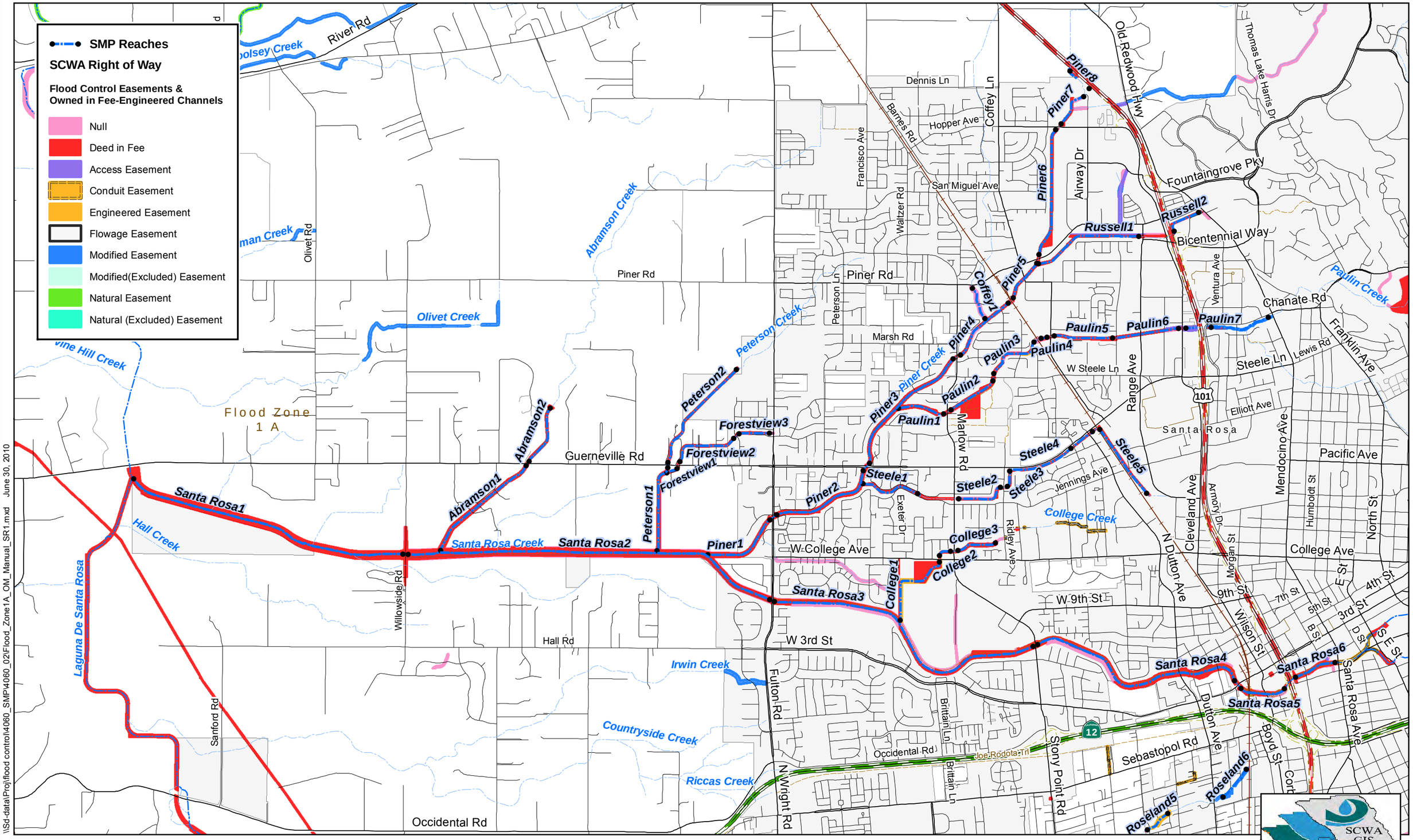

Stream Maintenance Program
Flood Zone 1A
Santa Rosa (1 of 3)

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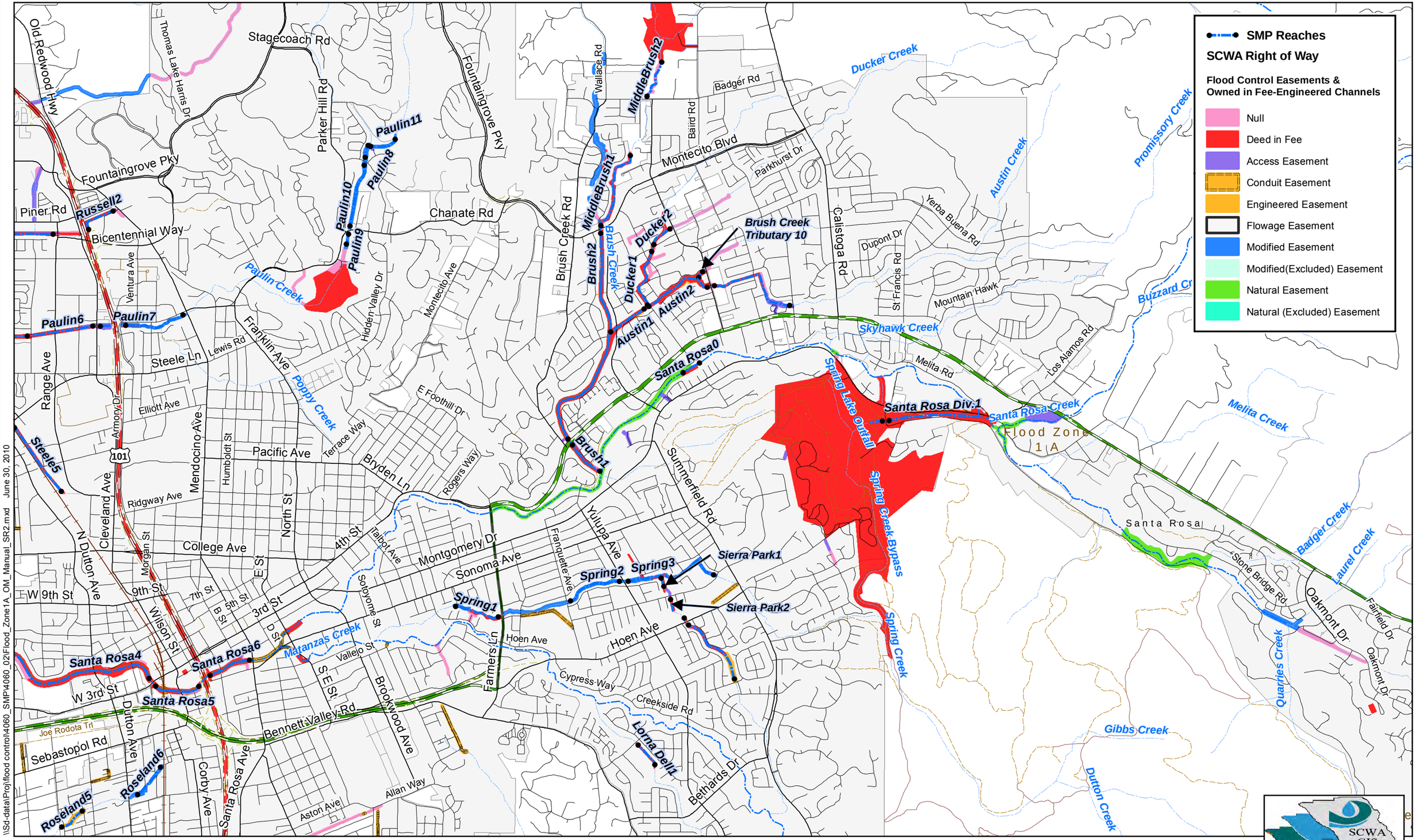

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Stream Maintenance Program

Flood Zone 1A

Santa Rosa (2 of 3)

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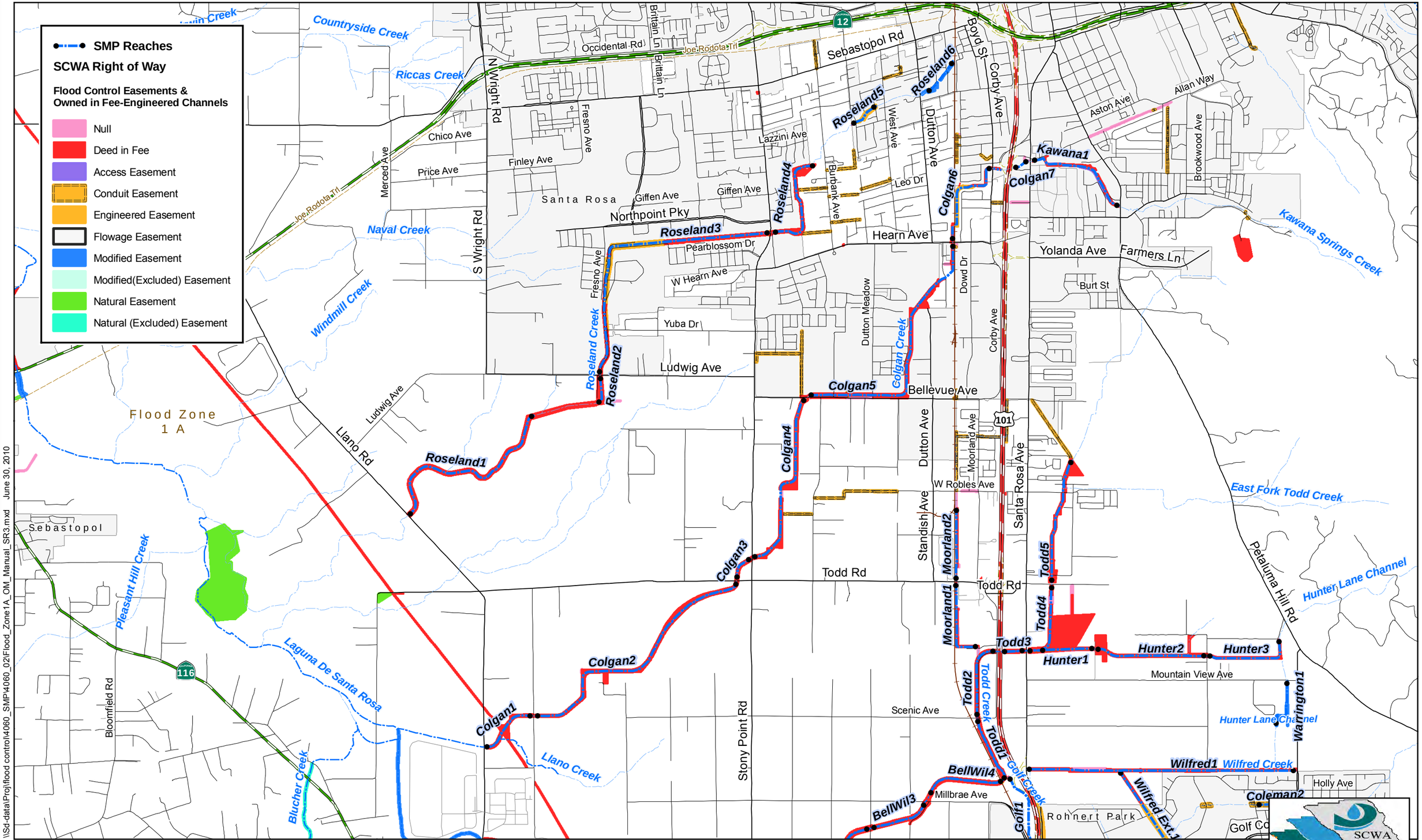

Stream Maintenance Program
Flood Zone 1A
Santa Rosa (3 of 3)

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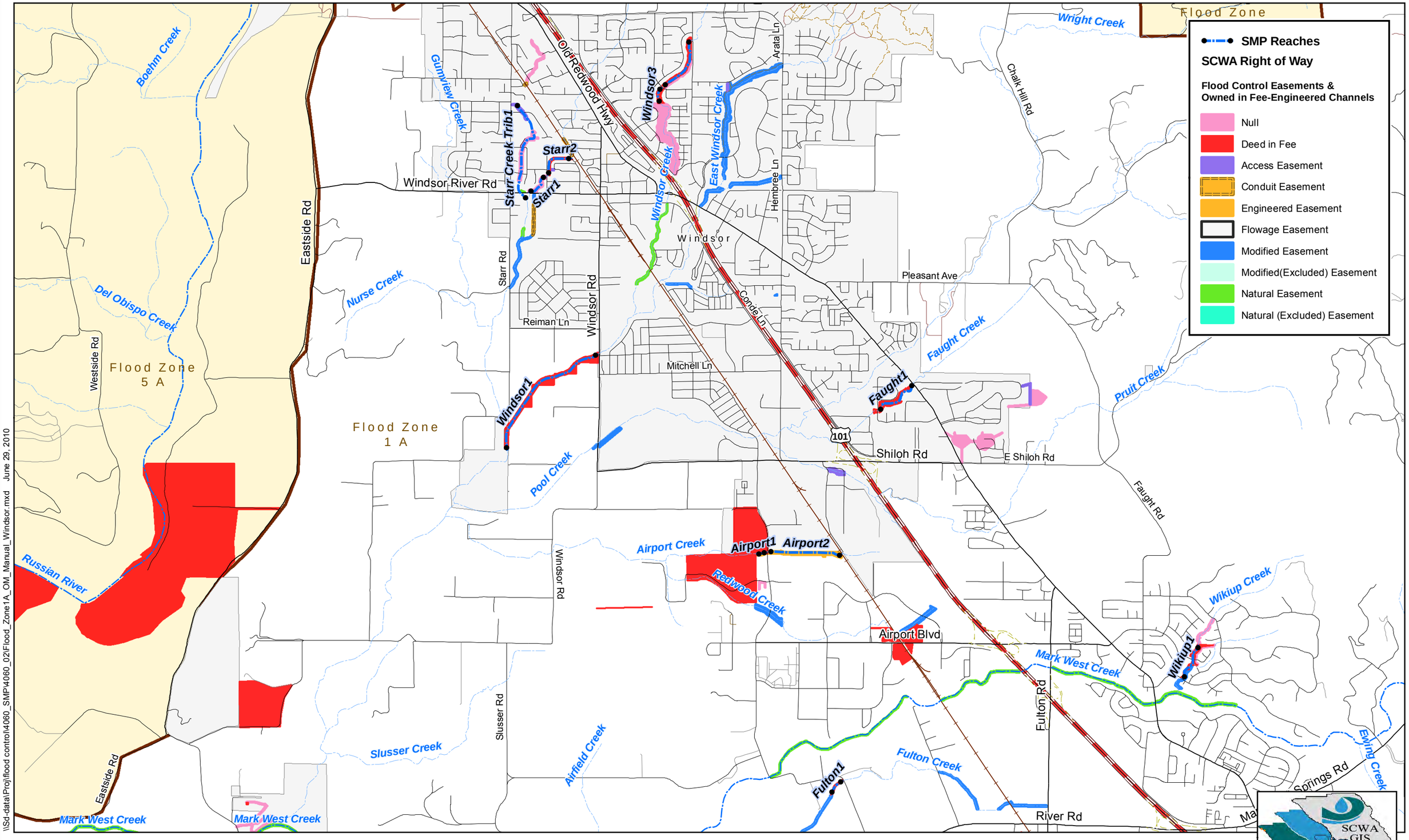

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Stream Maintenance Program
Flood Zone 1A
Windsor (1 of 1)

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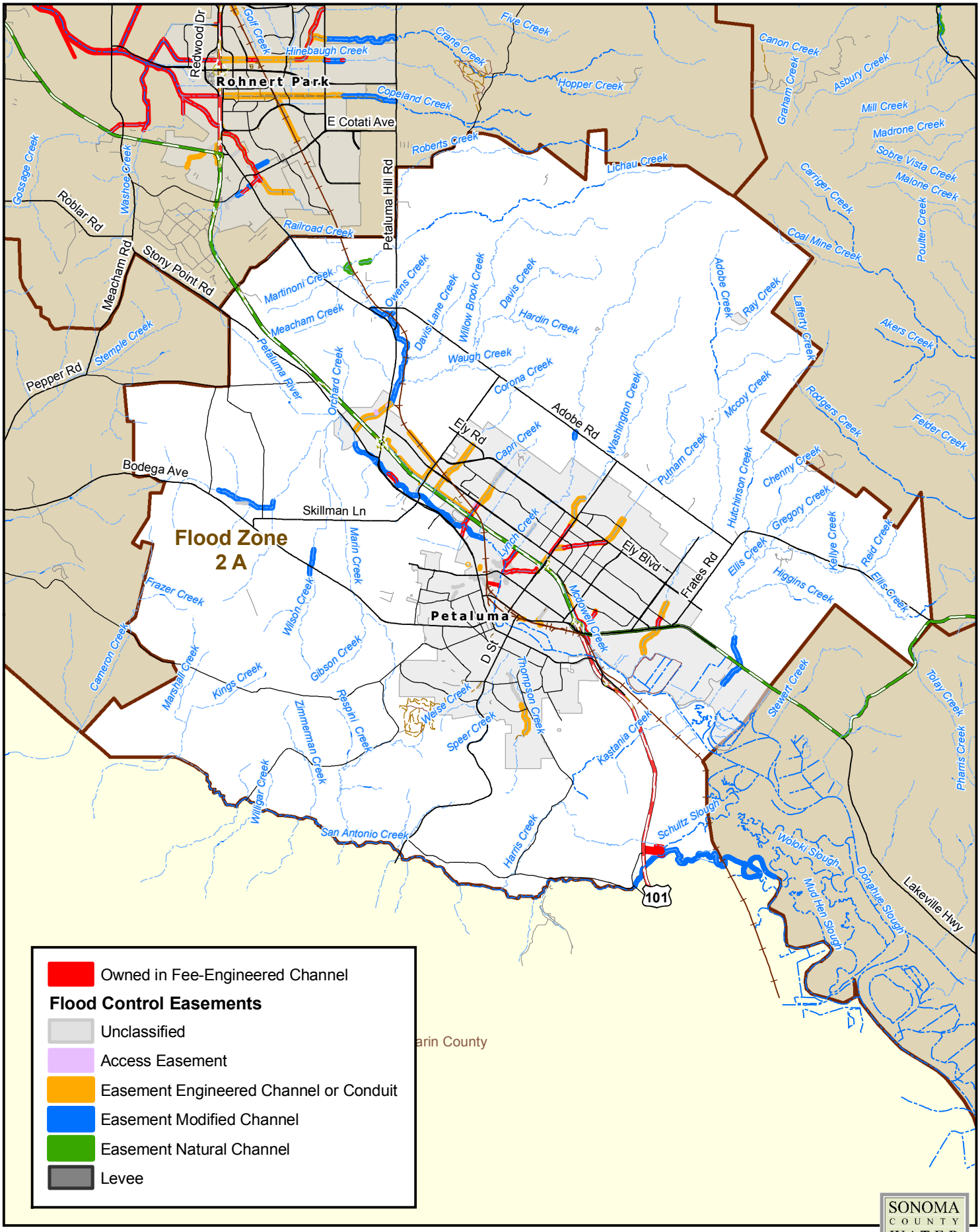
0 0.5 1 Miles

N W E S



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Flood Control
Zone 2A
Sonoma County, CA

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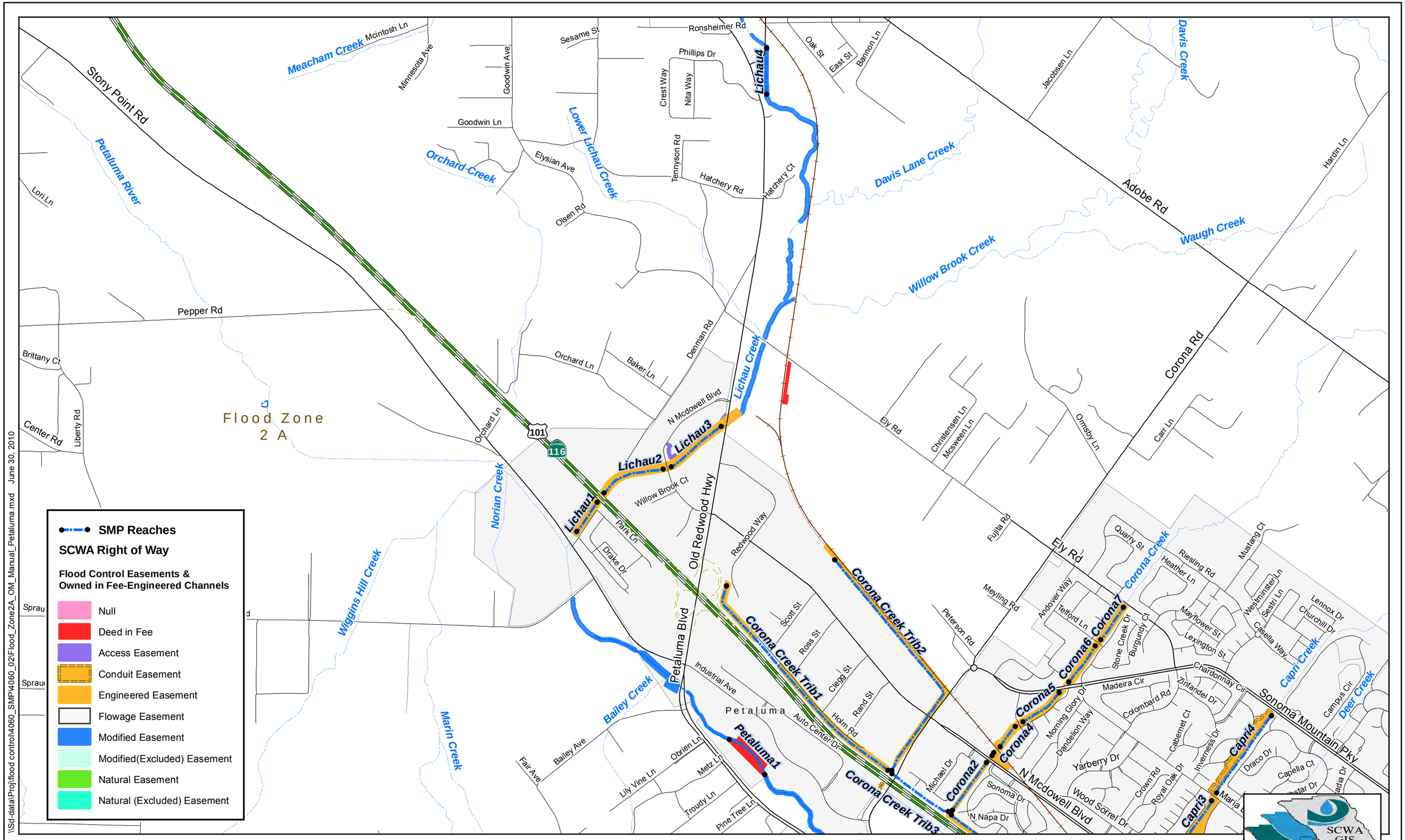
0 5,000 10,000 Feet

N

SONOMA COUNTY WATER AGENCY



Stream Maintenance Program
Flood Zone 2A
Petaluma (1 of 3)

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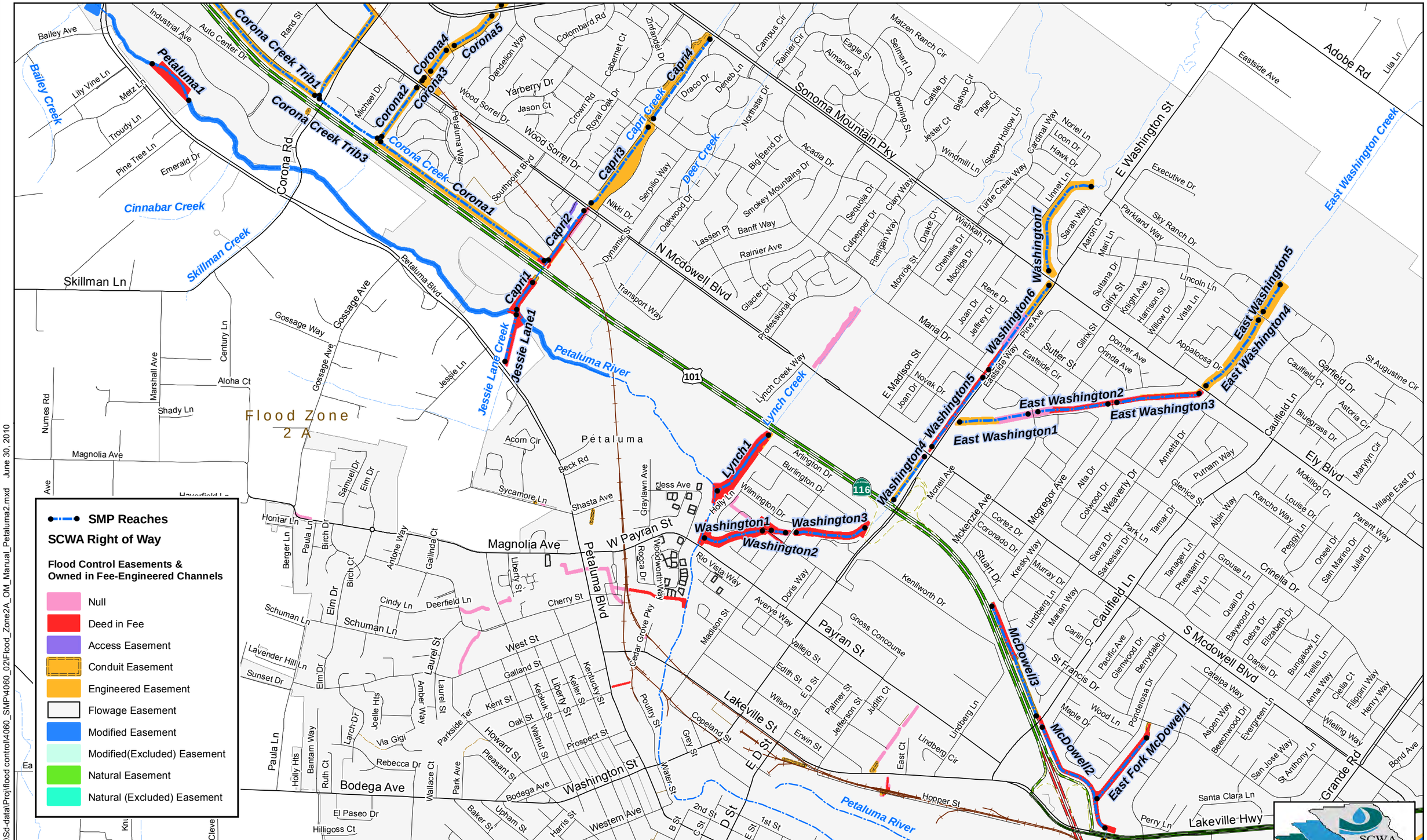

Stream Maintenance Program
Flood Zone 2A
Petaluma (2 of 3)

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0 0.25 0.5 Miles

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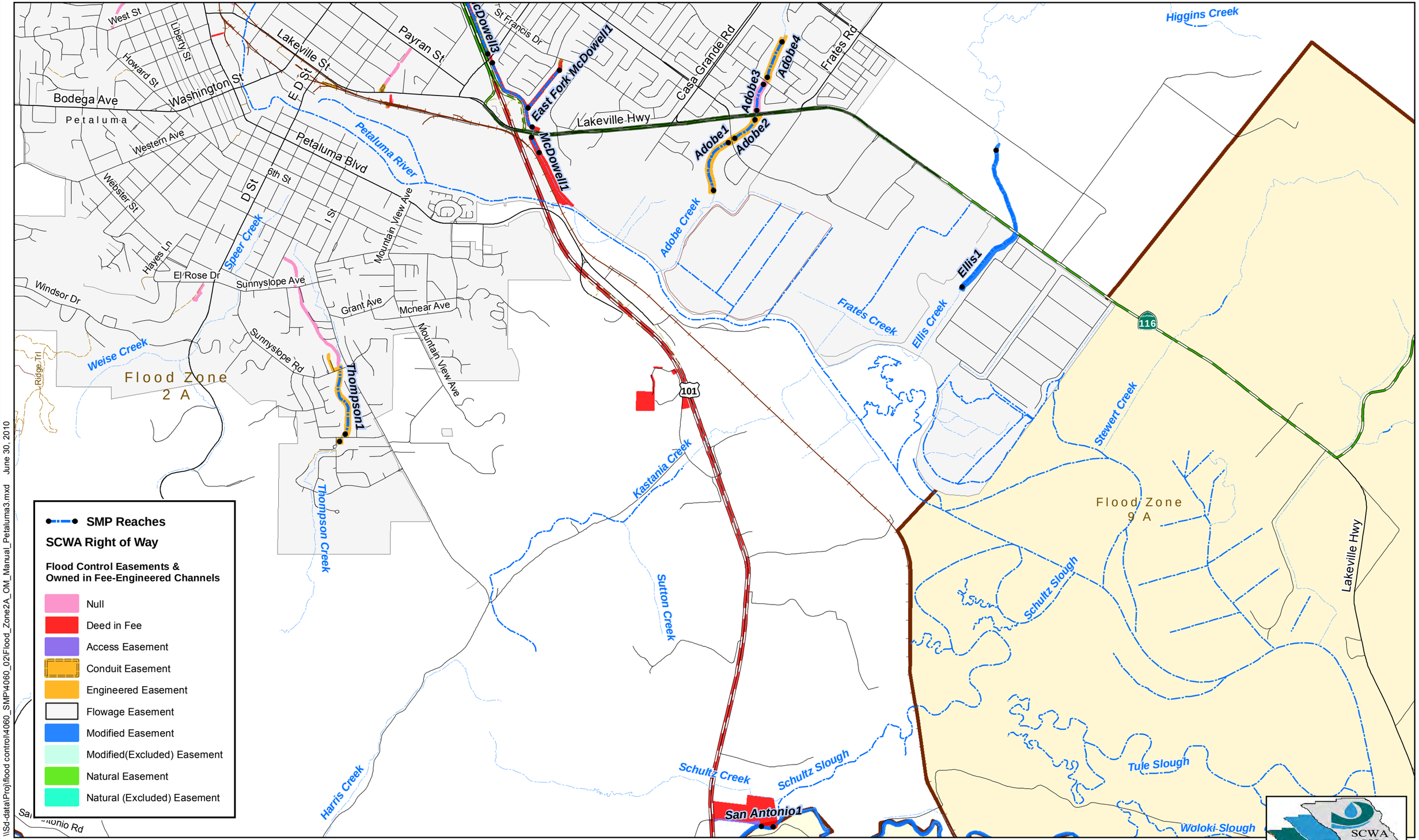

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Stream Maintenance Program
Flood Zone 2A
Petaluma (3 of 3)

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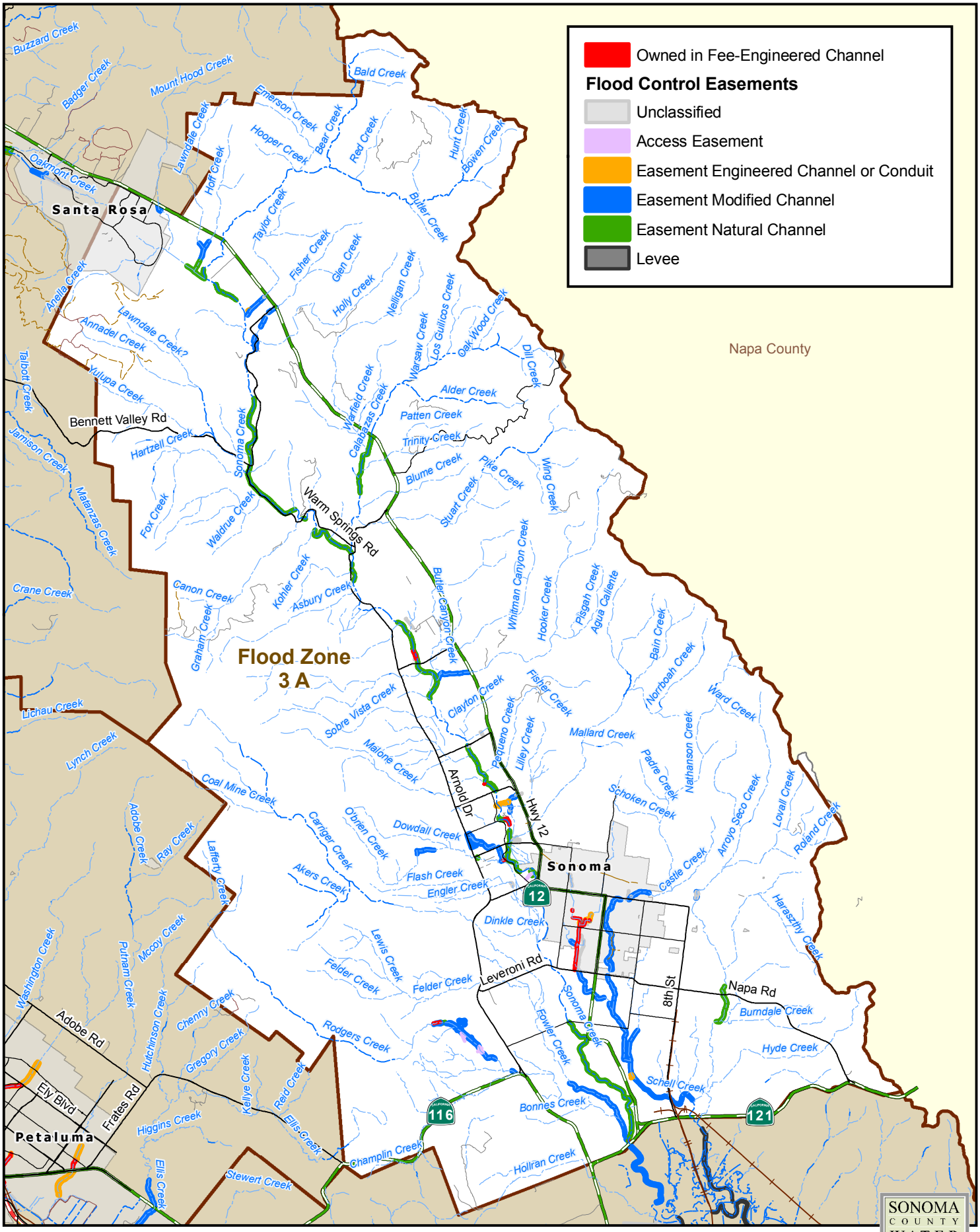

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Flood Control
Zone 3A
Sonoma County, CA

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0 5,000 10,000 Feet

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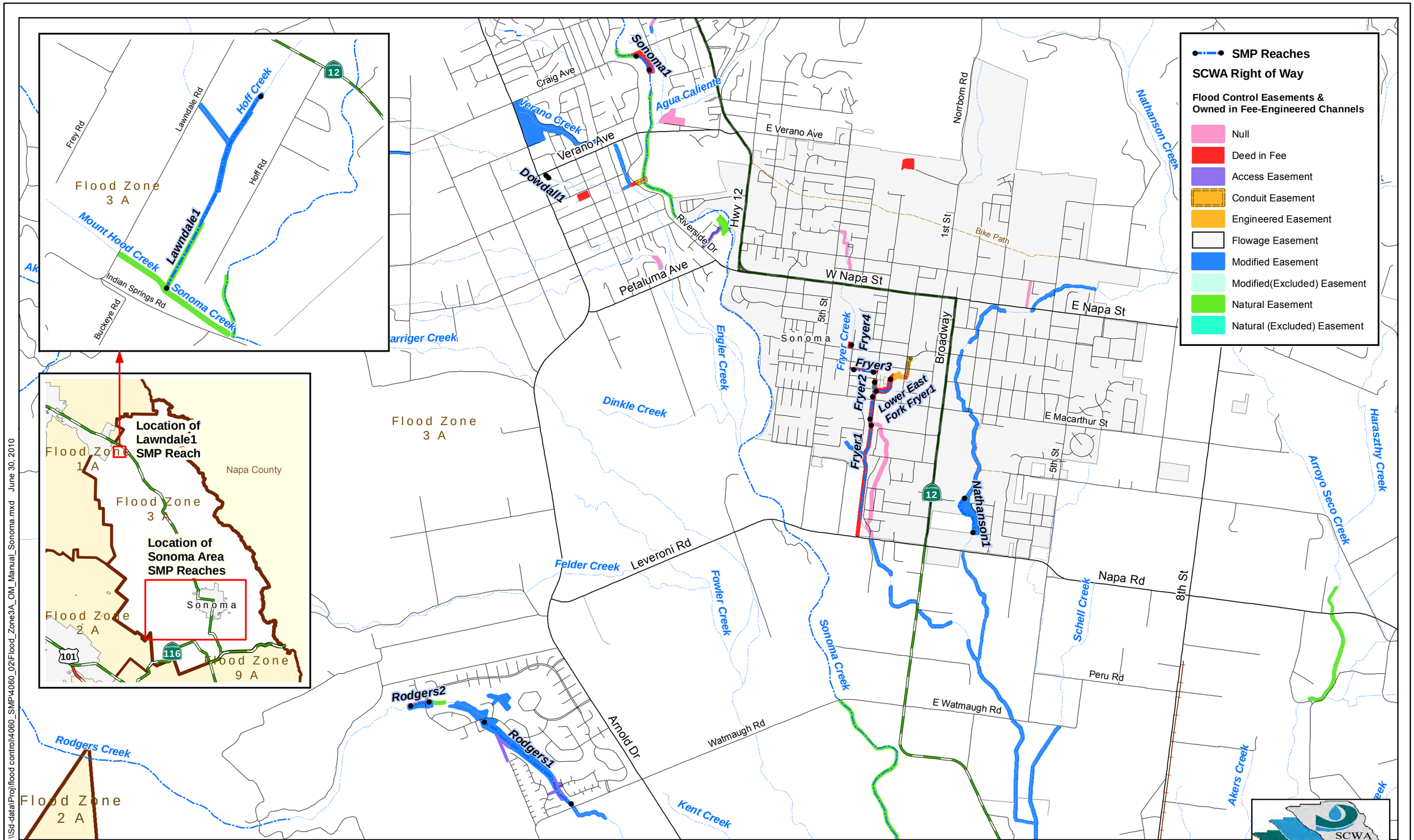
SONOMA COUNTY WATER AGENCY



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Stream Maintenance Program
Flood Zone 3A
Sonoma (1 of 1)

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Appendix B

Stream Maintenance Program Manual, Chapter 4
Channel Characterization

- Zone 1A Reach Sheets
- Zone 2A Reach Sheets
- Zone 3A Reach Sheets

Zone 1A Reach Sheets

Airport Creek – Reaches 2 & 1

JURISDICTION: Owned and maintained by SCWAJURISDICTION: Easement and maintained by SCWA

LOCATION: Airport 2: from Skylane Blvd. downstream approx. 300 ft.

Airport 1: from railroad tracks to Skylane Blvd.

ADJACENT LAND USE: Industrial

UPSTREAM: Localized drainage from developed flats (no clear sign of a channel)

LENGTH: Airport 2: 2,157 ft. (but SCWA maintenance easement only on upper 300 ft. of Reach 2)

Airport 1: 300 ft

CHANNEL EASEMENT CORRIDOR WIDTH:

Airport 2: 89 ft

Airport 1: 71 ft

AVERAGE TOP-OF-BANK WIDTH:

Airport 2: 73 ft

Airport 1: 66 ft

(b) Near the top of the reach looking downstream. Notice the engineered trapezoidal channel configuration and abundance of cattails growing across the flat channel bottom. Although this reach has very little riparian growth, plant poplars and oaks as well as willows appear to be thriving along a small section of creek (see photo c) (May 13, 2008).

MAINTENANCE HISTORY

(a) Upper Reach 2 looking upstream to concrete apron that marks the beginning of SCWA's easement. Area upstream of apron channel appears more like a shallow swale across the lower plain. Broad and wide channel. Note recently cut cattails in the channel re-growing and entering culvert in the lower right (May 13, 2008).

PHYSICAL CONDITIONS

Reach setting: Reaches 1 and 2 of Airport Creek appear to receive much of their flow from a mix of runoff from residential, industrial, and agricultural lands along the flat alluvial plain. The channel upstream of the engineered easement appears to originate west of Highway 101 as a swale across flat pasture. Downstream of the railroad tracks, the channel is fed by numerous storm drains from adjacent industrial complexes.

Active channel: 15-20 ft wide, water depths 0-6 in.

Bed sediments/texture: fine materials such as silt and mud line the channel bottom

Bank/bed structure: straight, trapezoidal engineered channel with earthen banks and some concrete at the upstream end of Reach 2 (photo a); bank slopes are not too steep 2:1 (photo b); channel cross section appears to become more shallow in the downstream direction toward Skylane Boulevard with increased sediment deposition across the channel in the lower reach.

Water quality: while no obvious impairments to water quality were observed, the majority of

flow appears to be runoff from industrial complexes, which may result in impaired water quality; little active flow and shallow conditions could exacerbate these conditions.

Channel processes: This reach has clearly aggraded since it was built, and the Skylane culvert functions effectively as a hydraulic constraint, slowing flows and fostering deposition. There are no observable sediment bars; instead the sediment appears to be building from the culvert upstream.

BIOLOGICAL CONDITIONS

Vegetation composition: Ruderal grassland along most of the creek; in the middle part of Reach 2, some riparian woodland has developed due to willow growth along the channel margins and a variety of past plantings. Cattails fill the entire channel bottom.

Riparian corridor and canopy closure: Lack of tree growth leads to almost no canopy along the channel, except for the patch of willow creating approximately 25% closure for about 200 ft in the middle of Reach 2.

Instream habitat: The channel is straight and uniform with no pools, no shade and no deep water. This channel is likely dry or nearly dry during the summer/fall. It is bounded by the railroad tracks to the east and industrial development to the north and south. Although habitat conditions for fish, amphibians and reptiles are currently poor, wildlife could use this channel as a corridor between the pasture upstream and downstream habitats.

Listed species with potential to occur: Both reaches are potential habitat for western pond turtle; California tiger salamander are unlikely to occur in the upland habitat of either reach. Airport 2 is potential habitat for listed plant species.

(c) Middle of the reach, looking upstream. Although woody riparian species are limited throughout much of this reach, a 200+ft section in the middle of Reach 2 contains a dense patch of willows near the toe of slope and planted oaks and poplars at top of bank (May 13, 2008).

(d) Looking downstream at the culvert under Skylane Blvd. This aluminum arch is heavily impacted (as of 11/07) by sediment and cattail growth. It looks as though the culvert has lost at least ¾ of its capacity and the road bed is within a few feet of the top of the culvert. There is also a large sediment wedge on the downstream side of the culvert (May 13, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Airport Creek Reaches 1 and 2 focus on vegetation removal throughout the reach and sediment removal near the Skylane Blvd culvert crossing. Due to lack of sinuosity, complexity, and shade, a number of treatments could be used to improve habitat conditions and reduce in-channel emergent vegetation growth. Aggressive planting with riparian species to provide shade and habitat would help control cattail growth and increase the value of these reaches as a migration corridor.

JURISDICTION: Owned in-fee and maintained by SCWA

LOCATION: Reach 2: Middle Rincon Rd. to Ducker Cr. Confluence

Reach 1: Ducker Confluence to Brush Cr. Confluence

ADJACENT LAND USE: Residential

UPSTREAM: Austin 3

LENGTH: Austin 2: 2,282 ft.

Austin 1: 1,331 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Austin 2: 129 ft.

Austin 1: 101 ft.

AVERAGE TOP-OF-BANK WIDTH: Austin 2: 61ft.

Austin 1: 67 ft.

(b) Reach 2, looking upstream from grade control structure and large pool feature (near Benicia Dr.). Austin 2 and 1 both contain a number of in-stream grade control structures. There are 2 of these structures in Reach 2 and Reach 1 appears to have a number of rock weir structures upstream from the confluence with Brush Cr. (photo d) (March 2008).

MAINTENANCE HISTORY

(a) Reach 2 looking downstream from Middle Rincon Rd. Vegetated sediment bars form in the middle of the channel and stretch across the channel in the background. Channel x-section is trapezoidal and linear (March 2008).

PHYSICAL CONDITIONS

Reach setting: Reach 2 and 1 are both straightened and contain grade control structures to stabilize the profile of the engineered channel; gradient is slowly lessening through these two reaches, but the channel is still steeper than the Santa Rosa Plain downstream.

Austin Creek – Reaches 2 & 1

Active channel: 6-10 ft wide through both reaches, channel depth 6-12 ft below banks, with flow depths ranging from 2-6" along most of the channel with depths of 2-6 ft. at the two large pools below drop structures (photo b).

Bed sediments/texture: mix of gravel, sand, and silt at the top of Reach 2 and then fining to sand and silt in Reach 1.

Bank structure: slopes are generally between 1:1 and 2:1 with either rip-rap and earth or grouted rip-rap (photo b).

Channel processes: gradient appears to be the key control of this reach with 2 concrete grade control structures in Reach 2 and possibly a number of submerged rock weirs in Reach 1; channel maintains its trapezoidal geometry and appears to be aggrading with an increasing trend of in-channel bars formed by a mix of fine sediments. Major sediment wedges are located at confluences with smaller tributaries. Note that the upper section of Reach 2 contains a deep secondary channel that appears to intercept run-off from storm drains on the south side of the channel (photo c)

Water quality (qualitative): moderately clear in March 2008.

Biological Conditions

Instream habitat: Habitat in this reach is limited by the dominance of shallow, uniform runs interspersed by short sections of diffuse flow through in-channel bars and emergent vegetation; in some areas the in-channel bars do create some habitat complexity, although these areas are limited in size and distribution; large deep pools exist downstream of grade control structures, but the pools are devoid of cover, vegetation or complexity.

Vegetation composition: The reaches support a narrow and sparse riparian corridor stretching from the toe of slope to above the top of bank which consists of a mix of shrubs and trees including weeping willows, maples, acacia, arroyo willow and alders (photo b and c). Willow and alders are at the toe of slope when they exist. Understory is dominated by ivy, fennel, cattails, and grasses with little to no large wood species (photo b and d).

Riparian corridor and canopy closure: 10-15 ft. wide corridor on each bank with very limited canopy closure ranging from 0% (dominant case) to 25% (rare).

Listed species with potential to occur: potential habitat for western pond turtle, known occurrence of steelhead, reach is a migratory corridor.

(c) Secondary channel: The top photo shows Austin Cr to the left and the secondary channel to the right, the bottom photo is looking upstream from within the secondary channel (March 2008).

(d) Reach 1 looking downstream toward Brush Cr confluence. Note grouted rip-rap on the right bank, small bars along the channel margin, and the dense cattail bar at the confluence (far center) (March 2008).

Austin Creek – Reach 3

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Austin Creek Reach 2 and 1 range from focused sediment and cattail removal at confluences and upstream of grade control structure to a variety of habitat enhancement opportunities. Enhancements to fish habitat could include installation of a low flow channel and canopy enhancement to increase shade and complexity.

JURISDICTION: Owned and maintained by SCWA

LOCATION: Between Boas Dr. and Middle Rincon Rd.

ADJACENT LAND USE: Residential

UPSTREAM: Non SCWA maintained Austin Cr that continues upstream into Mayacamas hills

LENGTH: 2,958 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 63 ft

AVERAGE TOP-OF-BANK WIDTH: 37 ft

(b) Looking downstream about 600 ft. from Boas Dr. Undercut bank and pool formed under the exposed roots to right. Steep bank slopes on the left, generally dense canopy cover in this portion of Reach 3 (March 2008).

MAINTENANCE HISTORY

(a) Looking downstream from Boas Dr., channel is narrow and confined by rip-rapped banks on both sides. Sloughed rip has eroded in many places and is now part of the stream bed, creating small cobble riffles (March 2008).

PHYSICAL CONDITIONS

Reach setting: Reach 3 is a transition between the narrow, higher gradient and naturalistic reaches of upper Austin Creek and the wider, trapezoidal reaches of lower Austin Cr (2 and 1). The upper portion of this reach maintains some natural channel elements (photos b/ c) while the lower portions of this reach are straightened trapezoidal channels and lack complexity (photo d).

Active channel: 4-6 ft wide upstream and 8-10 ft wide downstream; inset between steep rocked banks from 10-14 ft high; water depth ranges from 4”-2’.

Bed sediments/texture: dominated by coarse gravels near Boas Dr and transitioning into a mix of gravel, sand, and silt by Middle Rincon Rd; small point bars exist in the upper portions of the reach, but have been replaced by cross channel wedges near the bottom.

Bank structure: slopes are generally between 2:1 and 1:1 with either rip-rap and soil (photo a) or grouted rip-rap (photo d).

Channel processes: The slope and channel geometry upstream of Jack London Dr appears to effectively convey fine sediment, while creating small gravel point bars; downstream of Jack London the channel is straightened, maintains a trapezoidal geometry and appear to be aggrading with a mix of fine and coarse sediments.

Water quality (qualitative): moderately clear in March 2008.

BIOLOGICAL CONDITIONS

Instream Habitat: Upstream, gentle meanders and some incision has lead to the formation of gravel bars and undercut banks. These features, in turn, have lead to the creation of riffle-run sequences and small pools. These portions of the reach are also shaded by a dense canopy on steep slopes. Downstream, habitat value diminishes (photo d) and flow is shallow and diffuse through dense emergent vegetation across the wide channel bottom.

Vegetation composition: Upstream the reach supports a narrow riparian corridor stretching from the toe of slope to above the top of bank which consists of a mix of old eucalyptus, oaks, maples, acacia, and alders (photo b/c). Alders dominate the toe of slope. Understory is dominated by a mixes of shrubs and ivy. Downstream of Jack London Dr, vegetation is dominated by ivy, fennel, cattails, and grasses with little to no large wood species (photo d).

Riparian corridor and canopy closure: 10-15 ft. wide corridor on each bank with canopy trees growing from the toe of slope, the mid-bank, and top of bank; canopy closure is high in the upper portion (~75%) and low (between 0%-25%) in the lower portions of the reach.

Listed species with potential to occur: known occurrence of western pond turtle, known occurrence of steelhead, reach is a migration corridor with rearing habitat.

(c) Looking downstream ~900 ft. downstream of Boas Dr. Here the channel makes a gentle meander around a d-shaped depositional bar. The bar is dominated by gravels and supports some instream complexity with the associated riffles and pools surrounding the bar. The canopy is still dense in this portion of the reach.

(d) Looking downstream from Jack London Dr. Notice the extreme change in the character of the stream that occurs just upstream of this crossing (compare to photo c). The canopy has receded, the channel is straightened, and emergent vegetation (cattails) now covers the trapezoidal channel bottom.

Management Considerations and Opportunities

Management considerations for Austin Creek Reach 3 include focused sediment and cattail removal downstream of Jack London Dr. and a variety of habitat enhancement opportunities. Although SCWA has no ownership and maintenance responsibility upstream of Boas Dr, the channel (although confined) appears to continue for at least 1.4 miles and supports additional gravel bars and a dense riparian canopy. As such, there might be value in performing maintenance in the lower portion of Reach 3 that extends the length of higher quality habitat from the headwaters down to Middle Rincon Dr. This could include installation of a low flow channel downstream of Jack London Dr. and a planting plan to increase riparian canopy.

Jurisdiction: SCWA owned and maintained

Location: Unincorporated county area; from Millbrae Ave Crossing to confluence with Laguna de Santa Rosa

Adjacent Land Use: Agricultural: grazing/pasture

Upstream: Bellevue-Wilfred Reach 4

Length: Bellevue-Wilfred 3: 1,822 ft

Bellevue-Wilfred 2: 1,987 ft

Bellevue-Wilfred 1: 3,988 ft

Channel easement corridor width:

Bellevue-Wilfred 3: 149 ft

Bellevue-Wilfred 2: 173 ft

Bellevue-Wilfred 1: 163 ft

Average top-of-bank width:

Bellevue-Wilfred 3: 89 ft

Bellevue-Wilfred 2: 117 ft

Bellevue-Wilfred 1: 142 ft

(b) Reach 3 looking upstream from Whistler Ave Bridge; note channel widens moving downstream; extensive mud deposits flank both side of the channel (March 14, 2007).

Maintenance History

(a) Reach 3 looking downstream from Millbrae Ave Bridge; low gradient stream with mud deposits collect along banks (lower left) (March 14, 2007).

Physical Conditions

Reach setting: low gradient setting nearing Laguna; reaches exhibit stillwater qualities, backwatering effects, and abundant mud deposits.

Active channel: ~30-40 ft wide, widening toward downstream Laguna, bank height averages 6-8 ft, flow depths are 0.5-1.5 ft deep.

Bed sediments/texture: dominated by fine sediments, muds.

Bank structure: 2:1 earthen slopes; wide channel cross-section with smooth muddy channel bed.

Water quality (qualitative): turbidity moderate to high, water flows very slowly, but is not stagnant.

Channel processes: engineered channel, very straight from Reach 2 downstream (photos b/c); deposition occurs along channel margins as toe of slope mud bars; depositional features increase as the channel widens downstream toward the Laguna.

BIOLOGICAL CONDITIONS

Vegetation composition: riparian habitat in reach is dominated by ruderal herbaceous species with occasional riparian trees and shrubs; mapping from 2006-2007 found stretches of this reach are emergent wetlands within the ordinary high water mark. Due to recent removal of ludwigia from the channel, there were many areas of unvegetated mudflats.

Riparian corridor and canopy closure: almost zero woody canopy; riparian corridor is limited to toe of slope to levee hinge point (~10 ft) on each side and generally is without woody species.

Instream habitat: engineered reach is generally straight, limiting formation of point bars and pools; instream habitat is limited to shallow, muddy, and exposed runs/glides.

Listed species with potential to occur: All reaches are potential habitat for western pond turtle; There is a moderate to high likelihood for California tiger salamander to occur in the upland habitat of all three reaches; Reach 1 is potential habitat for listed plant species.

(c) Reach 1 looking downstream from Wilfred Avenue toward Laguna; channel widens, slope decreases, and mud bars along channel margins increase moving downstream; mud deposits indicate backwatering and quiet depositional environment of Laguna system (March 14, 2007).

(d) Reach 1 looking downstream toward confluence with Upper Laguna Reach 2; note the Laguna system characteristics of wide channel, very low slope, still water quiet depositional zone dominated by muds and fine sediments, vegetation grows along banks and toe of slope areas (March 14, 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Future management considerations for the lower Bellevue-Wilfred reaches are not extensive. Recent management actions in these reaches included removal of expansive beds of invasive ludwigia. The effectiveness of ludwigia removal should be monitored with additional plant removal as deemed necessary. Due to the abundant sedimentation issues experienced in the Laguna just downstream, future management opportunities could focus on using the reach as an instream sediment basis to trap and remove fine sediments before they enter the Laguna. The riparian corridor of these lower Bellevue-Wilfred reaches are devoid of woody species; additional planting of riparian tree species could benefit water quality and enhance habitat for a suite of species.

JURISDICTION: SCWA owned and maintained

LOCATION: Unincorporated county area; reach is from Todd Cr./Wilfred Cr confluence (photo a) to Millbrae Ave Crossing (photo d)

ADJACENT LAND USE: Agriculture: grazing/pasture

UPSTREAM: Todd Cr Reach 1 & 2 and lower concrete section of Wilfred Creek

LENGTH: 2,385 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 121 ft

AVERAGE TOP-OF-BANK WIDTH: 79 ft

(b) Reach 4 looking downstream from first bend at railroad crossing; note wide channel, 10-12 ft below banks, with small point bar forming at inside of meander bend; riprap seen along outside bank (lower left); flow depth is 1-2 ft deep (March 14, 2007).

MAINTENANCE HISTORY

(a) Upper end of Reach 4, looking upstream to Todd Cr Reach 1 (left) and Wilfred Cr (at center); note drop structure at base of Wilfred Cr. and sediment wedge at confluence (March 14, 2007).

PHYSICAL CONDITIONS

Reach setting: reach flows through low gradient topography of the lower alluvial plain; receives input flows from Wilfred Cr. and Todd/Hunter systems upstream; reach is northern branch of Upper Laguna system and experiences backwatering.

Active channel: ~30 ft wide, with 10-12 ft high banks, flows observed were 1-2 ft deep.

Bed sediments/texture: mostly silts and muds, with some sands collecting on bars or through thalweg.

Bank structure: 1.5:1 to 2:1 or steeper trapezoidal earthen slopes (photo b); occasional rock slope protection along outer channel bends; concrete reinforcement at Todd/Wilfred confluence.

Water quality (qualitative): turbidity moderate to low, water is generally flowing and not stagnating.

Channel processes: engineered channel with modest sinuosity that may follow historic stream alignment; aside from the depositional wedge at confluence of Todd and Wilfred creeks, deposition is limited to a few point bar formations formed at channel bends; with bars increasing in size and height moving downstream.

BIOLOGICAL CONDITIONS

Vegetation composition: Riparian habitat in reach is dominated by herbaceous ruderal species with occasion riparian trees and shrubs including oaks and walnuts.

Riparian corridor and canopy closure: Limited woody canopy, with interspersed riparian shrubs and trees growing on the banks, has little to no canopy closure; riparian corridor is limited to toe of slope to levee hinge point (~15 ft) on each side.

Instream habitat: Reach maintains some sinuosity with related pools and shallower riffles; the reach contains several wide sections with 1-2 ft deep shallow runs; no coarse substrate observed in the channel; aquatic habitat is limited to shallow submerged bars, long runs, and occasional pools.

Listed species with potential to occur: Potential habitat for western pond turtle; moderate to high likelihood for occurrence of California tiger salamader in potential upland habitat.

(c) Mid Reach 4 looking downstream; note pool formed by large sediment and debris wedge blocking flows. Pool depths are in excess of 6 ft (March 14, 2007).

(d) Lower Reach 4 looking downstream to Millbrae Avenue; note large “D-shaped” bar along base of left bank where sediments collect on inner bend of channel (March 14, 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations and opportunities for Bellevue-Wilfred Reach 4 are not extensive. There is a large sediment and debris blockage in the middle of the reach (photo c) but this dam and pooling do not appear to be creating any immediate flow hazard. This blockage should be monitored and may eventually require some clearing. Upper Reach 4 appears to have a steeper gradient than the lower Reach 4. The upper reach has some sinuosity and stream velocities under lower-flow conditions appear to be adequate to prevent settling and enable transport of finer sediments downstream. Besides the potential removal of sediment/debris at the blockage noted above, another opportunity includes enhancing the woody riparian corridor which is often lacking. Planting of riparian trees along the upper banks could benefit water quality and enhance habitat for a suite of species. Trash, plastic and other debris are observed in the lower reach and may need removal.

JURISDICTION: Owned in-fee and maintained by SCWA

LOCATION: Hwy 12 to Santa Rosa Cr. confluence

ADJACENT LAND USE: Single family residential

UPSTREAM: Brush 2

LENGTH: 1,264 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 90 ft

AVERAGE TOP-OF-BANK WIDTH: 73 ft

(b) Reach 1, approximately 150 ft downstream from the Hwy 12 bridge. This unusual shaped bar formation, demarcated by the ring of gravel stretching from bank to bank and covered with cattails, forms a pool at the downstream terminus of surface flow. Downstream of this bar, the channel was completely dry until its confluence with Santa Rosa Creek (Oct. 2008).

MAINTENANCE HISTORY

Brush Creek – Reach 1

(a) Looking downstream from Hwy 12 crossing. This is the only portion of the channel that maintained surface flow in October 2008. The channel maintained this appearance for approximately 150 ft until the surface flow hits a large gravel bar and goes subsurface until it reemerges at the confluence with Santa Rosa Creek.

PHYSICAL CONDITIONS

Reach setting: Reach 1 flows in a southeasterly direction from Hwy 12 to the confluence with Santa Rosa Creek. This reach is straightened and appears to maintain a moderate gradient as the bed substrate is dominated by cobbles, gravels, and fine sands.

Active channel: 10-14 ft wide between steep rocked banks ~8-16 ft high; water depth between 0-1.5 ft., ~75% of the reach dry in Oct 2008 (photo c).

Bed sediments/texture: local bedrock, boulders, gravels and some course sands (photos b and c).

Bank structure: slopes are generally around 1:1 (photo a) with large rocks and bedrock along the toe of slope and on the banks.

Channel processes: Whereas Reach 2 shows significant signs of deposition, aside from the large bar approx 150 ft downstream of Hwy 12, there are no major bars in Reach 1. It is possible that both the Hwy 12 crossing and the increased gradient in Reach 1 have contributed to this reduction in deposition. Also, the lower portion of Reach 1 was restored to provide habitat for steelhead trout.

Water quality (qualitative): moderate in October 2008.

BIOLOGICAL CONDITIONS

Instream habitat: Although Brush 1 is straightened and highly engineered, recent restoration efforts have created a channel full of complexity. Woody debris has been left intact and at least 4 large wood structures or root wads were observed in the channel. Also, existing bedrock and large boulders throughout the reach create additional complexity and provide refuge for fish during high flows. Aquatic habitat conditions in October 2008 were poor due to lack of water, but the channel has the basic elements for complexity.

Vegetation composition: Channel vegetation is dominated by a line of willows and alders along the toe of the bank. In channel herbaceous vegetation consists of stands of rushes and sedges as well as annual grasses, various forbs and one dense stand of cattails on the sediment bar near the top of the reach. The low flow channel maintained significant bare areas.

Riparian corridor and canopy closure: 15-20 ft. wide corridor on each bank with canopy trees growing from the toe of slope, the mid-bank, and top of bank; canopy closure is moderate and ranges from about 10% to 50%.

Listed species with potential to occur: known occurrence of western pond turtle and steelhead, channel is a migratory corridor.

(c) Looking downstream from the channel bottom just upstream of the pedestrian bridge. Note that the channel is completely dry (October 2008) with no pools or other signs of surface flow. Also notice the size of the substrate in the channel as it is dominated by boulders, cobbles, gravels and bedrock outcroppings.

(d) Just upstream of the confluence of Brush Creek and Santa Rosa Creek. At the confluence, Brush Cr flows over a surface of flat rocks before it enters Santa Rosa Creek. Aside from the surface water observed in the first 75 ft of Reach 1, the only other surface water observed in October 2008 was at the downstream edge of the rock outcrop at the confluence with Santa Rosa Creek.

Coffey Creek – Reach 1

Management Considerations and Opportunities

Management considerations for Brush Creek Reach 1 focus on removal or modification of the sediment bar/wedge just downstream of the Hwy 12 crossing. Other than this, the reach appears to be in good condition from both a flood control and habitat perspective.

Jurisdiction: Owned by City of Santa Rosa; Maintenance easement held by SCWA

Location: Piner Rd. to Piner Cr. confluence

Adjacent Land Use: Residential, except for the last 500 ft

Upstream: Non-SCWA maintained reach

Length: 1,118 ft

Channel easement corridor width: 74 ft

Average top-of-bank width: 60 ft

(b) Upper Coffey Cr Reach 1 about 250 ft. downstream of Piner Rd crossing. Channel has changed from blackberry thicket above (photo a) to cattails growing across the entire channel (Sept. 2008).

Maintenance History

Biological Conditions

(a) Top of Coffey Cr. Reach 1 looking downstream from Piner Rd. crossing. Vegetation management activities were underway when this photo was taken in September 2008. Just downstream the entire cross section is covered by a dense thicket of blackberry with interspersed willows.

Physical Conditions

Reach setting: Coffey Cr. is limited to this reach and a 400 ft non-SCWA maintained reach stretching from Piner Rd to Plum Tree Lane. Upstream of Plum Lane, there is no discernible watershed and flows appear to emanate from the railroad and from industrial and residential areas likely served by stormdrain systems to the west, north, and east.

Active channel: 1-2 ft wide upstream expanding to 2-4 ft wide downstream; dry season depths ranging 0" (dry) to isolated pools to 6" (photo c).

Bed sediments/texture: dominated by a mix of sand, silt, and rip-rap.

Bank structure: slopes are generally very gentle at the upstream end (photo a) and transition to much steeper (~ 1:1 in photo b); with rip-rap overlain by soil throughout.

Channel processes: Coffey Creek is a small system with a limited watershed. This reach is low gradient with a narrow double barrel culvert crossing at its confluence with Piner Cr; this crossing is heavily impacted by deposition of fine sediment as is most of the lower portion of the reach.

Water quality (qualitative): mostly dry in August 2008, with shallow, stagnant, pools with poor water quality.

Instream habitat: Aquatic habitat in this reach is limited by the lack of water in the summer (much of the reach was dry in August 2008). Where surface water exists in the summer, it flows in a diffuse pattern through dense cattails and blackberries. This reach does maintain a few pools through the summer (photo c), but the water quality appears to be very poor and the pools are shallow (max 6”). In channel bars and margin bars do provide a small bit of complexity to the channel, but this system does not appear to provide any high or moderate quality aquatic habitat.

Vegetation composition: The reaches support a narrow and very sparse riparian corridor stretching from the toe of slope to the top of bank which consists of blackberry thicket (recently removed in photo a) with a mix of small arroyo willows, occasional oaks and walnuts growing above the top of bank (photo b and c).

Riparian corridor and canopy closure: woody riparian corridor ranges from 0-25 ft wide on each bank with canopy expanding in width moving downstream; very limited canopy closure ranging from 0% (dominant case) to 10% (rare).

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Bottom of Coffey Cr, just upstream of confluence with Piner Cr. Reach 4. The pool in the center of the photo is one of the only pools observed along Coffey Cr. during September 2008 surveys. Notice the level of stagnation and vegetated sediment wedges both upstream and downstream.

(d) Lower Coffey Cr at culverts that cross access road and enter Piner Creek Reach 4. A large, deep, and heavily vegetated sediment wedge is deposited upstream of the culverts. There is a large pool upstream of this wedge (photo c) and surface flow appears to be almost completely blocked by the sediment wedge during low flow conditions (August 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Coffey Creek Reach 1 range from sediment removal upstream of culverts at the Piner Cr. confluence to significant vegetation management to remove cattails and blackberry choking the channel further upstream. Following sediment and vegetation removal, canopy enhancement efforts would be a valuable tool for increasing shade and riparian habitat while retarding re-growth of cattails in the channel.

JURISDICTION: Owned by City of Rohnert Park, SCWA maintenance easement

LOCATION: Outlet of Cook Creek Conduit at Golis Park (photo a) to Coleman Creek crossing at Snyder Lane

ADJACENT LAND USE: Municipal park and single family residential

UPSTREAM: Coleman Creek culvert and Cook Creek conduit

LENGTH: Coleman1: 923 ft.

Cook 1: 865 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Coleman1: 71 ft.

Cook 1: 77 ft.

AVERAGE TOP-OF-BANK WIDTH:

Coleman1: 45 ft.

Cook 1: 49 ft.

(a) confluence of Cook Creek and Coleman Creek, looking downstream along rip-rapped bank (March 14, 2007).

MAINTENANCE HISTORY

In 2012, 312 cubic yards of sediment were removed from 900 linear feet of Coleman 1. (photo e)

Tier 1 mitigation occurred to revegetation the channel with trees, herbaceous perennials, and graminoids.
These planting are intended to create undesirable growing condition for cattails while increasing species diversity and habitat.

(b) looking downstream from Cook Creek outlet at upper end of reach in Golis Park; note in-channel sedimentation and vegetation directly downstream of outlet (March 14, 2007).

PHYSICAL CONDITIONS

Reach setting: These reaches represent the daylighting at the terminus of the Cook Creek and Coleman Creek conduits. Steeper gradients found in higher alluvial fans upstream now transition to gentler gradients toward the alluvial plain.

Active channel: Open water channel is 4-6 ft wide and 1-2 ft deep; pinched by vegetation in locations downstream of confluence (photo c).

Bed sediments/texture: Medium/fine sands and silts; fines trapped by cattails (photo c); bed and banks include grouted riprap drop

structure just upstream of Snyder crossing (photo d).

Bank structure: Slopes are steep (1:1) and mostly earthen (photo c); riprap reinforced banks near Cook/Coleman confluence (photo b).

Water quality (qualitative): Relatively higher turbidity than other SMP reaches observed in flowing and stagnant sections.

BIOLOGICAL CONDITIONS

Vegetation composition: Upper reach contains a mix of redwoods, oaks, willows, and alders on the north side providing shade and canopy closure; cattails block up to 80% of the channel in areas.

Riparian corridor and canopy closure: In the upper part of this reach, riparian woodland forms a 5-15 ft wide corridor on each bank; canopy closure throughout reach between 25%-75%.

Instream habitat: Reach has limited sinuosity around in-channel bars, some 1-2 ft deep runs are found with occasional backwatering into pools behind bars (dominated by cattails).

Listed species with potential to occur: None.

(c) looking upstream; about 300 ft downstream of Cook/ Coleman confluence and 1000 ft upstream of the Snyder Lane crossing; channel narrows around toe of bank sediment bars (2-3 ft high and 3-4 ft wide), attracting cattails and trapping additional sediment above bar onto bank (March 14, 2007).

Channel processes: Small bars forming in the channel at the toe of banks (photo c); "D" bars (winged shaped) alternate along banks, forming a wedge of sediment that transitions up to the side of the bank; above Snyder crossing, the creek flows beneath the grouted drop structure and bubbles to surface at base of the structure (photo d).

(d) from Snyder Lane crossing looking upstream; creek flows mostly below grouted riprap of drop structure, then collects in a pool at the bridge crossing (March 14, 2007).

(e) looking upstream from Snyder Lane after the completed sediment removal and restoration. (December 4, 2012)

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Coleman/Cook Reach 1 focus on sediment sources, in-channel deposition and vegetation, and maintenance of existing structures. The two tributaries to this reach (Cook Creek and Coleman Creek) drain highly erosive watershed source areas. A large landslide in Cook Creek headwaters sheds sediment to the Cook Creek Sediment Basin (upstream of Reach 1), whereby additional sediments arrive to Coleman/Cook Reach 1 through the Cook Creek conduit (photo a). The landslide and other headwater sediment sources are currently being addressed through the Watershed Partnership Program. The steep and riprapped banks at the bend in channel at the creek confluence (photo b) should be periodically observed for stability and erosion. Downstream in-channel sedimentation and associated vegetation (photo c) should be monitored for potential skimming/removal if needed. Horizontal skimming can maintain some channel sinuosity with a reduced bar profile. Flows appear to backwater at Snyder Lane crossing, yet sedimentation occurs more heavily downstream of crossing (see Coleman Reach 2 description).

JURISDICTION: Owned by City of Rohnert Park, SCWA maintenance easement

LOCATION: Snyder Lane crossing to Hillview Way, and 75 ft to either side of Fairway Drive near golf course

ADJACENT LAND USE: Single family residential and golf course

UPSTREAM: Coleman 1

LENGTH: 1,143 ft.

CHANNEL EASEMENT CORRIDOR WIDTH: 77 ft.

AVERAGE TOP-OF-BANK WIDTH: 42 ft.

(b) upstream of Hillview Way, looking upstream toward Snyder Lane: low-flow channel obscured by cross-channel sedimentation and cattails and other vegetation; lack of riparian trees results in no shade, especially on south bank (right); shade planting as proposed with 2008 restoration activities will help reduce cattail development in channel; note recent high water mark seen at base of northern bank to left; note headwater sediment source areas of Sonoma Mountain in distance (March 14, 2007).

MAINTENANCE HISTORY

(a) looking downstream from Snyder Lane crossing; abundant in-channel sedimentation and cattail growth (March 19, 2008).

PHYSICAL CONDITIONS

Reach setting: depositional reach, transitional from steeper gradient alluvial fan environment upstream to lower gradient alluvial plain downstream, headwater sediment source areas of Coleman Cr. and Cook Cr. seen in distance in photo b.

Active channel: channel bed width is ~16 ft, with active wet channel in the upper reach only 2-4 ft wide and 0.5-1 ft deep, in mid and lower reach active channel is shallow and diffuse (braided) through dense vegetation growing in the channel (photos).

Bed sediments/texture: medium-fine sands and silts; finer than Reach 1 upstream.

Bank structure: banks are earthen, sloped at approx 2:1.

Channel processes: aggradation and deposition of sediment across the channel bed width; individual bars in upper reach transition to sediment wedge that spans the entire channel bottom (photos a, b, c, d).

BIOLOGICAL CONDITIONS

Vegetation composition: dominated by non-native grasses with occasional alders or willows; emergent vegetation fills greater than 80% of the channel for most of the reach.

Riparian corridor and canopy closure: very little woody vegetation in entire reach; 0% canopy closure across the creek.

Instream habitat: linear channel alignment with narrow low flow stream (1-2 ft. wide), sometimes sinuous in upper reach around bars (photo a) but becomes more shallow and diffuse through vegetated sediment wedges that occupy entire channel bottom (photos b, c, d).

Listed species with potential to occur: None.

(c) looking upstream from Hillview Dr. crossing; diffuse flow in a few small and shallow channels; abundant sedimentation across entire channel width; lack of woody riparian species provides no shading, recent high water mark seen along base of banks (March 14, 2007).

(e) looking downstream from Hillview Dr. crossing to golf course; abundant in-channel sedimentation has created shallow cross section with reduced capacity (March 19, 2008).

(d) same view as photo (c) but taken March 19, 2008; note abundant cattail growth and continued sedimentation at Hillview crossing between 2007 and 2008.

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Coleman Creek Reach 2 experiences abundant sedimentation where the entire channel bed is actively aggrading. The channel bed and banks are nearly devoid of any riparian trees or canopy. As a result, the channel has no shading and stream temperatures are elevated. The combination of a low stream gradient, heavy deposition of fine sediments, and lack of shade contribute to excessive growth of cattails and other emergent vegetation within the channel. Management considerations include removal of existing channel bed sediment and cattails and planting of riparian canopy where feasible (particularly along southern bank) to increase shading. Additional sediment source control in headwaters areas is advantageous and is supported through the Watershed Partnerships Program (sediment source area control also described in Coleman Reach 1 & Cook Reach 1).

Colgan Creek – Reaches 2 & 1

JURISDICTION: Owned and maintained by SCWA

LOCATION: Colgan 2: Todd Rd. to Walker Rd.

Colgan 1: Walker Rd. to Llano Rd.

ADJACENT LAND USE: Agriculture, predominantly dairy cow pasture

UPSTREAM: Colgan 3

LENGTH: Colgan 2: 7,918 ft.

Colgan 1: 1,873 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Colgan 2: 122 ft.

Colgan 1: 120 ft.

AVERAGE TOP-OF-BANK WIDTH: Colgan 2: 85 ft.

Colgan 1: 78 ft.

(b) Reach 2, looking upstream from Walker Rd. Channel is dry and filled with cattails and annual grasses. Notice the shallow, wide, and straight channel configuration (Oct 2007).

MAINTENANCE HISTORY

(a) Top of Reach 2 looking downstream from Todd Rd. Channel is dry and covered bank to bank with annual vegetation (grasses and forbs). Channel cross-section is much wider with long sloping banks than upstream Reaches 3/4. In Reach 2, Colgan Cr. begins to take on more of a wider Laguna type channel form (Oct 2007).

PHYSICAL CONDITIONS

Reach Setting: These reaches transition from the mid Santa Rosa alluvial plain to Laguna. Channel is straightened for flood control and agriculture, but is wider and shallower than the upstream reaches and appears to experience backwatering from the Laguna during high flows.

Active Channel: Active channel grows wider through Reach 2 (to 15-20 ft wide), then tapers to 10-12 ft. in Reach 1. Channel is wide with shallow banks and a wide flat bed and is completely covered with grasses through much of the reaches (see photo b).

Bank Structure: Banks are gently sloping, mostly earthen, and shallow (~3-5 ft high).

Bed Sediments/texture: Bed texture is dominated by fine silts and mud (see photo c)

Water Quality: No surface water was present during assessment (October 2007)

Channel Processes: Reach 2, unlike Reach 3, shows no apparent signs of recent incision. Due to the gradient, these reaches appear to be aggrading from fine sediment deposition and/or backwatering of fines from the Laguna.

BIOLOGICAL CONDITIONS

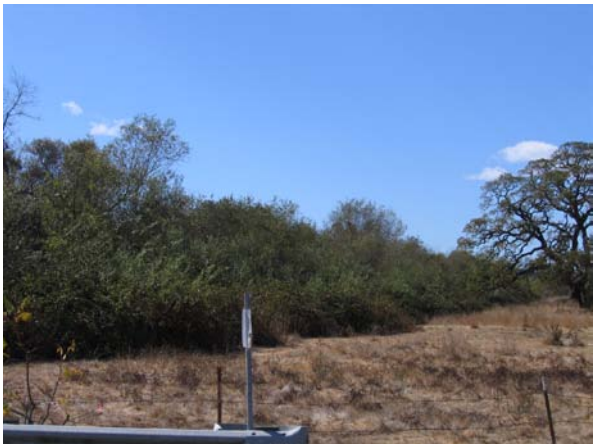
Instream habitat: In October 2007, there was no aquatic habitat observed in either reach due to the lack of surface flow or pools. The channel has been straightened and its current configuration lacks any sort of complexity. There was no evidence of pools, riffles, woody debris, or significant riparian canopy.

Vegetation composition: Riparian canopy is sparse with scattered willows, oaks, and other canopy species throughout most of Reach 2. After the 90 degree southward bend in Reach 2, woody riparian growth becomes more dense down through Reach 1; canopy here is dominated by a narrow band of willow along the toe of slope. Downstream of Reach 1, the final reach of Colgan before it hits the Laguna contains a dense canopy of willows, alders, and oaks with nearly 100% canopy cover (photo d).

Riparian canopy and closure: Sparse canopy in upper Reach 2 (<15%), becoming more dense into lower Reach 2 and Reach 1 (up to 75%, and near complete canopy in some locations).

Listed species with potential to occur: Ponds and mound topography on adjacent pasture land suggest potentially suitable habitat for CTS, which is highly likely to occur. Potential habitat for western pond turtle. Mud swallow nests observed under Walker Rd. bridge. Reach 2 is potential habitat for listed plant species.

(c) Lower Reach 2, under Walker Rd. Bridge. Exposed channel desiccated with dried mud blocks. (Oct 2007)



(d) Looking downstream from Llano Rd. to non-SCWA maintained lower Colgan Creek. This section maintains a dense riparian corridor until it reaches the Laguna proper approximately ½ mile downstream. The channel was dry in October, 2007 from the top of Reach 2 to the bottom of Reach 1 (Oct 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Reach 2 and Reach 1 do not appear to have any immediate maintenance needs. The majority of the in-channel vegetation is annual grasses, which should not create a roughness issue and reduce flow capacity. The bridge heads at Walker and Llano roads appear to have capacity without flow constriction or adverse sediment deposition. Riparian canopy is sparse in many portions of Reach 2 and 1 and additional canopy could provide needed habitat for local and migratory riparian species as well as provide shade to retard growth of in-channel vegetation. Due to the proximity to pastureland with ponds and pools, this reach should be managed with CTS aestivation/underground habitat in-mind.

JURISDICTION: Owned and maintained by SCWA

LOCATION: Colgan 4: Bellevue Ave. to Stony Point

Colgan 3: Stony Point to Todd Rd.

ADJACENT LAND USE: Predominantly agriculture with limited industrial and residential development

UPSTREAM: Colgan 5

LENGTH: Colgan 4: 5,459 ft.

Colgan 3: 816 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Colgan 4: 129 ft.

Colgan 3: 114 ft.

AVERAGE TOP-OF-BANK WIDTH: Colgan 4: 70 ft.

Colgan 3: 65 ft.

(b) Mid Reach 4, looking upstream. Channel is dry with exposed channel bed dominated by rip-rap (angular rocks). Low flow channel is clearly delineated and banks are steep and covered with annual grasses or blackberries. (Oct. 2007)

MAINTENANCE HISTORY AERIAL PHOTOGRAPHS

(a) Reach 4, looking downstream from Bellevue Ave. crossing. Water observed, dry upstream in Reach 5. Open water is murky, but banks have increased riparian cover and shade. (Oct. 2007)

PHYSICAL CONDITIONS

Reach Setting: Low gradient reach in agricultural lands of lower SR Plain; the channel has been straightened and appears slightly incised. Colgan Cr. Trail follows the eastern bank for much of Reach 4.

Active Channel: Active channel ranges from 6-10 ft wide, and 6-10 ft. deep below banks; surface water present in upper portions of

Reach 4, with remaining reach dry in Oct. 2007.

Bank Structure: Banks are rocked at the toe of slope on all banks that could be inspected. Above the toe there is a mix of earth and rip-rap. Banks are steep and covered by blackberry in most places.

Bed Sediments/texture: Channel bed is either dominated by eroded rip-rap (angular cobbles- photo b) or fine silts and mud.

Water Quality: Where surface water exists in the low flow season, flow is slow and often stagnant.

Channel Processes: Throughout reach channel alternating pattern with occasional depositional patches where vegetation grows in the channel, followed by incised section where banks are steep and channel is straight.

BIOLOGICAL CONDITIONS

Instream habitat: For most of this reach instream habitat is intermittent with perennial flows isolated into small stagnant pools. The habitat that exists is devoid of complexity and is limited to steep rocked banks with a rip-rap or silty mud bed.

Vegetation composition: Mixture of native and non-native trees at top of bank and along access road, including coast live oak, Monterey pine, and others. Canopy is generally denser in these reaches than in Reach 5. In addition to the trees at top of bank, banks also support shrubby vegetation dominated by non-natives such as Himalaya blackberry and cotoneaster, with ruderal herbaceous vegetation dominated by Harding grass interspersed. A dense thicket of blackberry covers the banks throughout this reach.

Riparian canopy and corridor closure: Upper Reach 4, canopy closure is patchy, up to 25% of channel, lower Reach 4 little canopy closure with mostly ruderal bank vegetation, Reach 3 – up to 25% closure

Listed species with potential to occur: High likelihood for occurrence of California tiger salamander, potential habitat for western pond turtle

(c) Mid Reach 4, looking upstream, downstream of photo b. Channel in near ground blocked with cattails, then becomes open water section in distance, then blocked again with cattails - with pattern repeating through reach. Banks are steep and completely covered in blackberry. (Oct. 2007)

(d) Colgan 3, looking upstream from Todd Rd. channel is dry. Low flow channel is obscured by willows and emergent vegetation. Where vegetation opens, the low flow channel is defined, mix of gravel, fine sand and caked mud. (Oct. 2007)

Colgan Creek – Reach 5

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Like Colgan Cr. Reach 5, assessment of bank conditions in Reaches 4/3 was difficult based on the thicket of blackberry covering most banks. Vegetation management will likely be necessary in the near future to increase channel capacity and assess bank conditions. Current maintenance efforts should focus on clearing the sediment wedge and willows growing at the upstream end of the Stony Point crossing. Removal of blackberries and replacement with native trees and shrubs could improve habitat conditions for a suite of riparian species along much of the reaches.

(b) Mid Reach 5, looking upstream. Concrete banks narrow the channel, vegetation growing throughout low flow channel. Just downstream of this site there are 2 access roads (one on each bank) that enter the stream channel (Oct 2007).

MAINTENANCE HISTORY

JURISDICTION: SCWA owned and SCWA easement; maintained by SCWA

LOCATION: Hearn Ave. to Bellevue Ave.

ADJACENT LAND USE: Agriculture at the top and bottom of the reach with industrial development in the middle of the reach

UPSTREAM: Colgan 6

LENGTH: 7,720 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 106 ft

AVERAGE TOP-OF-BANK WIDTH: 46 ft

Colgan Creek – Reach 5

(a) Looking downstream from Hearn Ave. Banks are hardened with grouted rip-rap. Recent blackberry removal (2007) exposes a wedge of sediment along the toe-of-bank on right (Oct 2007).

PHYSICAL CONDITIONS

Reach Setting: Reach 5 is generally a linear trapezoidal channel, with several sections of hardened bank, channel is confined by access/service roads, and heavily impacted by sediment deposition and vegetation growth in locations throughout channel.

BIOLOGICAL CONDITIONS

Active Channel: Channel bed is 6-12 ft wide depending on level of sediment aggradation, ~8-12 ft deep, surface flow is generally absent in downstream sections and less than 18" deep when present.

Bank Structure: Hardened in most places, with either concrete or grouted rip-rap. Where earthen, generally steep (<2:1), covered by blackberry, with small patches of instability apparent in some locations.

Bed Sediments/texture: Dominated by fine materials such as silts and muds with some sloughing rip-rap providing coarser substrate along areas with earthen banks.

Channel Processes: This reach has been significantly modified, contains two grade control structures (downstream of Victoria Ct. and adjacent to High School); the pattern of increased deposition of fine sediment continues until the channel turn 90 degrees to the west at Bellevue Ave.

Water Quality: In areas where open water was present in October 2007, water was stagnant and full of algae and/or duckweed.

Instream Habitat: Generally poor habitat due to highly constrained system, extensive sediment deposition, and isolated and stagnant open-water sections make for poor instream habitat conditions. In the upper 2/3 of the reach, the channel is choked with cattails or blackberries

Vegetation Composition: Band of willows (native Arroyo willows and non-native weeping willows) along the toe of the slope throughout most of reach. Fringe of emergent wetland vegetation adjacent to willows, with rice cutgrass, watercress, and patches of cattails. Mixture of native and non-native trees at top of bank and along access road, including coast live oak, Monterey pine. Upper banks support shrubby vegetation dominated by non-natives such as Himalaya blackberry and cotoneaster, with ruderal herbaceous vegetation dominated by Harding grass interspersed.

Riparian corridor and canopy closure: where riparian woodland is present canopy is sparse and discontinuous, generally less than 25%.

Listed species with potential to occur: potential habitat for western pond turtle, highly likely occurrence of CTS.

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Much of Reach 5 contains steep hardened banks. Due to the amount of blackberry covering most banks and stretching across the channel, assessment of bank stability was difficult. Between the dense blackberry and dense stands of cattails, future management of this reach is likely to focus on vegetation maintenance. There are numerous vegetated sediment wedges that may need to be removed if they continue to expand and present flood capacity issues. Although there is scattered canopy throughout the reach, additional planting of canopy trees would restrict growth of emergent vegetation in the channel and provide habitat for a variety of riparian species. Sediment removal activities are focused to downstream of Hearn Ave. (photo a) and upstream of Bellevue Ave (photo e) where a crossing is significantly blocked.

Photo (e) at right: Lower Colgan 5, looking downstream to Bellevue Ave. crossing near the High School. Aggrading sediment along bank to left and in mid-channel bar block entrance to box culverts beneath Bellevue Ave.

(c) Mid-reach, looking upstream, downstream of photo b. Typical non-concrete section of Reach 5. Note rip-rap at the toe of slope on the left and the steep blackberry covered bank on the right. Cattail choked section in the background and open-water in the foreground. This sequence is common throughout the reach (Oct 2007).

(d) Lower Colgan 5, looking downstream from Dutton Meadow crossing, near the High School. The channel is dry in this section and the low flow channel is clearly defined by a fine sand and caked mud substrate. Notice that the banks are wider and more gently sloped in this section than upstream.

Colgan Creek – Reach 6

JURISDICTION: SCWA owned and SCWA maintained easement

LOCATION: Corby Ave. to Hearn Ave.

ADJACENT LAND USE: Residential development to the north and east, with agriculture to the west.

UPSTREAM: Colgan 7

LENGTH: 3,182 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 73 ft

AVERAGE TOP-OF-BANK WIDTH: 46 ft

(b) Mid Reach 6, looking downstream. Banks are steep and composed of earth and rip-rap; this is a straight section with limited in-channel deposition and open water; most of this reach looks more like photos a, c, and d, with open areas scattered in between (10/2007).

MAINTENANCE HISTORY

(a) Top of Reach 6, looking downstream from Corby Ave. In-channel cattails have been recently cut (photo from 10/5/07) and that the banks are concrete.

PHYSICAL CONDITIONS

Reach Setting: Downstream of Hwy 101, Reach 6 flows through the Santa Rosa plain toward the Laguna and is constrained by residential development on both sides in the upper portions of the reach and a mix of agriculture and residential in the lower reach.

Active Channel: The active channel is between 8-12 ft wide, 6-8 ft deep below banks, with flow depths 0.25 -1.5 ft. Low flow channel is either entire width of active channel (where instream veg and sediment are not clogging the channel) or as narrow as 2 ft in choked sections.

Bank Structure: This reach contains two dominant bank forms; steep 1:1 earthen with rip-rap at toe (photo b) or fully concrete banks (photo a).

Bed Sediments/texture: Bed material is a mix of eroding rip-rap (angular cobbles) and fine sand, silt and mud.

Water Quality: Surface water appears either murky or stagnant and algal in most places.

Channel Processes: Reach 6 appears to be a strongly depositional reach with bars forming along bends as well as punctuated in-channel bars throughout the reach, and upstream of Hearn Ave. crossing.

BIOLOGICAL CONDITIONS

Instream Habitat: Reach 6 exhibits a classic pattern of straight sections with slow moving, open water runs interrupted by sediment wedges or bars extending partially or completely across the channel. These bars are heavily vegetated (cattails had just been cut when the field assessment took place) and create diffuse flow, while the open water sections are backwatered by sediment and appear to provide limited quality habitat.

Vegetation Composition: The riparian corridor is narrow along the entire reach as both sides contain service roads. While willows (mostly arroyo) are found growing on bars and at the toe of slope, occasional oaks and other mesic riparian woodland trees exist along the top of bank. The earthen banks are generally covered by a thicket of blackberry.

Riparian corridor and canopy closure: 20-30 ft. wide corridor on each bank with sparse to poor closure (up to 25%).

Listed species with potential to occur: potential habitat for western pond turtle, moderate to highly likely occurrence of California tiger salamander.

(c) Mid Colgan Cr. Reach 6 looking downstream. Banks are hardened with concrete (at bends), cattails across the channel bottom have just been cut back, and a depositional bar is forming on the inside of the bend (Oct 2007).

(d) Lower Colgan Cr. Reach 6, looking upstream from Hearn Ave crossing. Channel is choked with cattails in the foreground with a backwater pool upstream in the background (Oct 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

During October 2007, SCWA conducted cattail removal throughout much of this reach (photos a, b and c). Limited canopy and significant deposition of fine sediments has created a situation that is conducive to explosive re-growth of cattails. Although no signs of recent bank overtopping were observed, channel capacity has been reduced by deposition and growth of emergent vegetation. Vegetation and sediment accumulation at the Hearn Ave. crossing should be carefully monitored and addressed to provide appropriate conveyance through the culvert. In addition to regular vegetation maintenance, focused sediment removal will likely be necessary at some point in the future. Although the creek cross-section is constrained by service roads, preliminary surveys suggest that there is room for canopy enhancement in areas where the banks are earthen (lower reach has the best opportunities).

JURISDICTION: Owned by SCWA, eastern margin owned by City of Santa Rosa

LOCATION: West College Ave. to confluence with Santa Rosa Creek

ADJACENT LAND USE: SCWA maintenance yard and open space on north/west side; wastewater ponds on south/east side

UPSTREAM: College Creek Reach 2

LENGTH: 2,675 ft

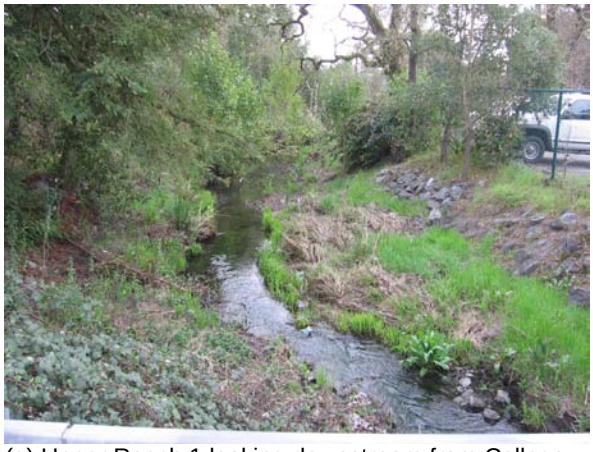
CHANNEL EASEMENT CORRIDOR WIDTH: 73 ft

AVERAGE TOP-OF-BANK WIDTH: 52 ft

(b) Mid Reach 1 looking downstream; cobbles and small boulders from bank protection on right are sloughing down into channel, note small instream rock drop structure in mid-distance, and emergent vegetation above sediment and rocks collecting in far distance in channel, access road provides recreation path to right (May 6, 2008).

MAINTENANCE HISTORY

College Creek – Reach 1



(a) Upper Reach 1 looking downstream from College Ave.; rip- rapped banks downstream of crossing, note sediment wedge developing on inner bank (right) with emergent vegetation, and next downstream bar on opposite bank providing some channel sinuosity; reach includes canopy of mature trees including oaks (May 6, 2008).

PHYSICAL CONDITIONS

Reach setting: Reach 1 is the downstream portion of College Creek prior to its confluence with Santa Rosa Creek. The reach is uniform with a linear and narrow low-flow channel. Some sediment deposition was observed to the south of the West College Avenue overcrossing at the upstream end of the reach. Slope is gentle, with key gradient change occurring at culvert outfalls that join Santa Rosa Creek, through a 10 ft. drop in elevation at the south end of reach.

Active channel: 4-12 ft wide, ½ -2 ft deep

Bed sediments/texture: mostly sand, some gravels, and some cobbles where sloughed from banks.

Bank structure: trapezoidal engineered channel with gently sloped banks (2:1 or less); rip-rapped banks along much of reach; some undercut banks.

Water quality (qualitative): no problems observed, although land uses in watershed could contribute contaminants typical of urban runoff.

Channel processes: With the exception of the upstream end, where sediments collect at the College Ave. culvert, the reach has no excessive channel aggradation or incision. The downstream end of the reach is hardened at the culverted confluence with Santa Rosa Creek.

BIOLOGICAL CONDITIONS

Vegetation composition: riparian woodland is limited along both banks. Understory is dominated by large areas of Himalayan blackberry, non-native grasses, and other ruderal species. In-channel vegetation is minimal.

Riparian corridor and canopy closure: Riparian woodland has approximately 25% canopy closure across the creek; the riparian corridor consists of a mix of native and non-native species such as redwood, oak, pine, buckeye and eucalyptus.

Instream habitat: The reach has an established low-flow channel, with some channel sinuosity in portions. There are few riffle-pool sequences, and undercut banks with overhanging vegetation provide some instream complexity. However, channel complexity is generally low and the lack of riparian canopy closure limits this reach's quality as aquatic habitat.

Wildlife habitat and listed species: potential habitat for western pond turtle.

(c) Lower Reach 1 (near Santa Rosa Creek confluence) looking upstream, very linear channel, 10 ft. wide below steep banks (1:1) (May 6, 2008).

(d) Lower Reach 1 looking downstream to Santa Rosa Creek confluence, note abundant blackberry on left bank, Eucalyptus trees in distance mark Santa Rosa Creek (May 6, 2008).

College Creek – Reaches 3 & 2

Management Considerations and Opportunities

Channel maintenance activities at College Creek Reach 1 focus on sediment and debris removal downstream of the College Ave. culverts, where materials are deposited and accumulate. The remainder of the reach showed no urgent maintenance needs. Opportunities to remove blackberry and Eucalyptus near the Santa Rosa Creek confluence in favor of more suitable native riparian species should be evaluated periodically. The adjacent waste water treatment ponds may provide longer term opportunities for multi-objective uses.

Jurisdiction: Owned and maintained by SCWA

Location: College 3: ~250 ft downstream from Ridley Ave. to Marlow Dr.

College 2: Marlow Dr. to West College Dr.

Adjacent Land Use: Residential

Upstream: Piped stormdrain system

Length: College 3: 1,302 ft.

College 2: 542 ft.

Channel easement corridor width:

College 3: 87 ft.

College 2: 67 ft.

Average top-of-bank width: College 3: 57 ft.

College 2: 43 ft.

(b) Lower Reach 3 looking downstream. Steep and near vertical banks result in bank sloughing. During the assessment conducted in November of 2007, there were at least 2 other areas of similar bank instability (May 6, 2008).

Maintenance History

(a) Middle of Reach 3 looking downstream. Sediment wedges and bars develop along toe-of-banks; channel has gentle sinuosity and dense bank vegetation (May 6, 2008).

Physical Conditions

Reach setting: College Creek is a small local tributary to Santa Rosa Creek with a small catchment size; upstream of Reach 3 flows collect in a stormwater drain system with no open channel; channel slope is gentle throughout.

Active channel: 8-10 ft wide and 8-12 ft depth from top of bank at upper end of Reach 3 (photo b) and 2-4 ft depth at lower end of Reach 3 and Reach 2 (photos c/d); water depths range from 0.5-1.5 ft; flow is perennial.

Bed sediments/texture: coarse sands and gravel dominate the bed in much of Reach 3 and Reach 2; at lower end of Reach 3 some fine sands upstream of crossing.

Bank structure: engineered trapezoidal channel with earthen banks throughout most of the reach; bed and banks are hardened at road crossings; banks are steeper upstream (photo b), and become gentler downstream (photo d).

Water quality: generally running clear; dominated by moving open water.

Channel processes: downstream of Ridley Ave., the channel alternates between newly developing sediment bars (photo a) and incised areas with bank erosion (photo b); gradient lessens downstream thru Reach 2; hydraulic constriction at West College Dr. creates depositional environmental (photo d).

BIOLOGICAL CONDITIONS

Vegetation composition: Reach 3 contains a dense and diverse canopy and understory along the channel. The understory is dominated by a mix of annual grasses and non-native herbeaous species. Woody species in Reach 3 include a broad array of ornamental species including privet, acacia, cotoneaster, and eucalyptus with some native species such as oaks and/or redwoods (photo a). Vegetation composition changes dramatically in Reach 2 with almost no understory present and a continuous line of native and non-native trees species. Neither reach contains significant emergent vegetation in the channel.

Riparian corridor and canopy closure: Canopy closure increases moving downstream from Reach 3 to Reach 2; average canopy closure is around 25% in Reach 3 and 50% in Reach 2.

Instream habitat: Reach 3 exhibits a moderate degree of channel complexity with local bar/pool sequences, undercut banks, and submerged root masses. In general, Reach 3 is mainly glide habitat and Reach 2 is an even more uniform glide/run for its entire length.

Wildlife and listed Species: both reaches are potential habitat for western pond turtle.

(c) Middle of Reach 2, just downstream of Marlow Dr. crossing, looking downstream through straightened section. Notice the dense riparian canopy covering the channel and the lack of emergent vegetation in the active channel (May 6, 2008).

(d) Bottom of Reach 2 looking downstream at West College crossing. A large (15 ft and 100 ft long) wedge of sediment has accumulated upstream of this crossing. 2 of the 3 cells are dramatically reduced in capacity (May 6, 2008).

Management Considerations and Opportunities

At the time of channel assessment, the most pressing consideration is the need for sediment removal at the W. College Dr. crossing where accumulated sediment and debris is severely blocking the culverts (photo d). Additionally, several smaller local culvert outfalls that drain to College Cr. are blocked due to sediment accumulation in the College Cr. channel. These outfalls should be inspected for their operation. Three to four sites along upper Reach 3 with steep banks show erosion and may require future stabilization. These sites should also be monitored. Reach 3 includes several bars which may be aggrading and should also be monitored. No evidence of overbank flows or imminent flood hazards associated with these instream bars in upper Reach 3 were observed. When and if either the instream bars or the sloughing banks are addressed, additional canopy plantings could benefit the existing riparian habitat along Reach 3.

Jurisdiction: SCWA owned and maintained, located in Rohnert Park

Location: Highway 101 to Laguna Channel confluence

Adjacent Land Use: Residential trailer park to north and commercial buildings to south

Upstream: Copeland 2

Length: 2,851 ft

Channel easement corridor width: 105 ft

Average top-of-bank width: 54 ft

(b) Mid Reach 1 looking downstream channel beneath shade of willow in lower right (May 29, 2007).

Maintenance History

(a) Reach 1 looking downstream from Redwood Dr; cattails grow in non-shaded channel portion just downstream of the Hwy 101 crossing (May 29, 2007).

PHYSICAL CONDITIONS

Reach setting: lowest Copeland Creek reach, between Hwy 101 and Upper Laguna, in lower alluvial plain, linear channel with increasing channel incision towards its lower end.

Active channel: linear throughout, 8-10 ft wide

Bed sediments/texture: in upper/mid reach small bars and sediment wedges forming at toe of bank comprised of sands/silts; small sand bars in channel in lower reach (photos c, d).

Bank structure: upper and mid reach has earthen banks 4-6 ft high (2:1 or 1.5:1); in the lower reach, the bank on south side heightens and steepens (photo c) as channel incises deeper beneath banks.

Water quality: debris and trash collect just downstream of Hwy 101 crossing.

Channel processes: upper and mid reach exhibits some mild deposition, including immediately downstream of the Hwy 101 crossing where cattails, sediment, and debris/trash can accumulate; in lower reach channel has downcut, most likely due to elevation/gradient adjustments towards the Laguna 3 confluence (photos c, d).

BIOLOGICAL CONDITIONS

Vegetation Composition: Canopy closure is 25-50%, increasing downstream as the channel narrows and deepens. At breaks in the canopy, cattails grow in isolated patches on bars.

Riparian Corridor: A band of willows (native Arroyo willows and non-native weeping willows) grows along the toe of the slope throughout most of reach. A fringe of emergent wetland vegetation is adjacent to willows, with rice cutgrass, watercress, and patches of cattails. A mixture of native and non-native trees are at top of bank and along access road, including coast live oak and Monterey pine. Upper banks support shrubby vegetation dominated by non-natives such as Himalayan blackberry and cotoneaster, with ruderal herbaceous vegetation dominated by Harding grass interspersed.

Instream Habitat: Reach includes some riffles/run sequences between shallow sand bars. Willows provides for additional habitat complexity through rootwads along lower banks. Willows also provide good shade of channel (photo b) in locations.

Listed species with potential to occur: known steelhead occurrence (reach is a migration corridor); potential habitat for western pond turtle.

(c) lower Reach 1 (near confluence with Laguna 3 and Washoe 1 reaches) looking upstream; note steep eroding bank on right and overall depth from top-of-bank; channel has incised in its lower zone to adjust for elevations at Laguna channel confluence (May 29, 2007).

(d) Lower Reach 1 (just upstream of Laguna 3 confluence) looking downstream (May 29, 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for the upper section of Copeland Creek Reach 1 focus on monitoring cattail growth downstream of the Hwy 101 crossing. This area downstream of the Hwy 101 crossing also collects debris and trash that will likely need periodic removal. In the mid reach area, willow vegetation provides nice canopy shading over channel, but will need to be monitored if willow growth in the channel becomes excessive. For now, the willow growth is mostly on the banks and does not require much maintenance. In the lower reach, bank erosion along the south banks near the Laguna 3 channel confluence should be monitored (photo c). If the bank erosion were to become worse and impact the access road, then bank stabilization/repair activities may be required.

JURISDICTION: City of Rohnert Park owner, SCWA maintenance easement

LOCATION: Seed Farm Drive to Hwy 101

ADJACENT LAND USE: Residential (single family and multi occupancy) to north and south

UPSTREAM: Copeland 3

LENGTH: 3,772 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 127 ft

AVERAGE TOP-OF-BANK WIDTH: 91 ft

(b) Mid Reach 2 looking downstream (March 6, 2007).

MAINTENANCE HISTORY

(a) Reach 2 looking downstream from Seed Farm Dr. (March 6, 2007).

PHYSICAL CONDITIONS

Reach setting: long reach, upper reach has large in-channel bars, aggrading, that alternate along banks (photo b); lower reach has less sinuous deeper channel incised along higher bars (photo c, d).

Active channel: upper/mid reach has sinuous shallow low flow channel (6-8 ft wide), lower reach is a more linear channel, both deeper (2-4 ft) and wider (up to 15 ft) (photo c, d).

Bed sediments/texture: upper/mid reach channel bed/bars are medium sand dominated, downstream channel bed/bars are finer. In March 2007 water in channel was similar in turbidity to Reach 3 and less clear than Reaches 4/5.

Bank structure: upper/mid reach earthen banks of 4-6 ft height (1:1) adjacent to the in-channel sediment wedge and low flow channel (photo b), in lower reach banks are often steeper than 1:1 and 4-6+ ft high (photos c/d).

Channel processes: large low benches and alternating bars of mid reach store aggraded sediment, with occasional pools in main channel, lower reach becomes finer texture depositional environment, increased trash/debris in this reach and moving downstream.

BIOLOGICAL CONDITIONS

Vegetation composition: canopy closure is 25-50%, increasing downstream as the channel narrows and deepens. At breaks in the canopy, cattails grow in isolated patches on bars.

Riparian corridor: A solid band of willows (native Arroyo willows and non-native weeping willows) are found along the toe of the slope throughout the reach. A fringe of emergent wetland vegetation is present adjacent to willows, with rice cutgrass, watercress, and patches of cattails. A mixture of native and non-native trees is present at the top of bank and along the access road, including coast live oak and Monterey pine. The upper banks support shrubby vegetation dominated by non-natives such as Himalaya blackberry and cotoneaster, interspersed with ruderal herbaceous vegetation dominated by Harding grass.

Instream Habitat: channel sinuosity occurs between bars. The channel in the mid-reach is complex with riffles, runs, and isolated pools. Willows provides for additional habitat complexity through rootwads and overhanging roots, which have created a few larger pools with some woody debris.

Listed species with potential to occur: Steelhead are known to occur (reach is a migration corridor); potential habitat for western pond turtle.

(c) Lower Reach 2 looking downstream (March 6, 2007).

(d) Lower Reach 2 looking upstream (March 6, 2007).

Management Considerations and Opportunities

Management considerations include selective bar grading/skimming where necessary, but should include alternating bar forms that provide sinuosity as currently observed (photo b). Other considerations include potential removal of cattails, and planting of more riparian vegetation (if capacity allows) to provide additional shade to retard cattail growth where the canopy is not entirely closed. Though not currently observed, removal of potential vegetation, debris blockages in the lower reach, toward Hwy 101, could be necessary in the future.

Jurisdiction: City of Rohnert Park owner, SCWA maintenance easement

Location: Country Club Drive to Seed Farm Drive

Adjacent Land Use: Residential to north and south

Upstream: Copeland 4

Length: 926 ft

Channel easement corridor width: 142 ft

Average top-of-bank width: 83 ft

(b) Mid Reach 3 looking downstream (March 6, 2007).

Maintenance History

(a) Upper Reach 3 looking upstream to Country Club Dr. (March 6, 2007).

Physical Conditions

Reach setting: short reach between road crossings, well defined low-flow channel with higher depositional benches to either side of the channel.

Active channel: single low flow channel (6-8 ft wide) excavated to 1-4 ft depth (photo a).

Bed sediments/texture: low flow channel has fine sands and silts, benches to either side comprised of medium sands mostly, likely coarser material at depth, in March 2007 water in channel was more turbid, less clear, than upstream Reach 4.

Bank structure: earthen banks of low flow channel comprised of past deposited sediment (wedge that crossed entire channel), the higher banks rising to the access road slope gently on north side (approx 3:1) and steeper on south side (approx 1:1).

Channel processes: low flow channel contains small flows, larger events flow onto adjacent benches and deposit sandy sediment, uncertain if excavated low flow channel is self sustaining and able to transport sediment or will need additional maintenance.

BIOLOGICAL CONDITIONS

Vegetation Composition: woody riparian vegetation (arroyo and weeping willows) is confined to the toe of the bank and forms a discontinuous band; isolated oaks, eucalyptus, and other upland woody species occur along the top of bank. Canopy closure less than 10% in most places, channel 80% filled with emergent vegetation.

Riparian Corridor: approx 20 ft wide vegetation corridor on each bank dominated by arroyo willow, mature oaks, and eucalyptus.

Instream Habitat: low flow channel provides run/glide habitat, with small riffles, and some deeper pools (3-4 ft deep).

Listed species with potential to occur: Known occurrence of steelhead; potential habitat for western pond turtle.

(c) Lower Reach 3 looking upstream (March 6, 2007).

(d) Lower Reach 3 crossing at Seed Farm Dr. (March 6, 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Excavation of low flow channel into adjacent sediment benches occurred in 2003 along with extensive vegetation removal. SCWA is monitoring this reach to determine if the low flow channel design is sustainable. Currently (2007), no additional comprehensive maintenance measures are identified. In future, skimming of high benches on other side of the channel may be necessary if those benches aggrade significantly, or low flow channel itself may need occasional dredging of collected sediment. Monitoring and adaptive management will occur on this reach to better identify where and how much deposition continues. This reach does not have significant canopy closure over the channel and would benefit from additional plantings of woody canopy species, if capacity allows.

JURISDICTION: City of Rohnert Park owner, SCWA maintenance easement

LOCATION: Snyder Lane to Country Club Dr

ADJACENT LAND USE: Primarily residential to north and south, community center to north by Snyder Ln

UPSTREAM: Copeland 5

LENGTH: 2,769 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 136 ft

AVERAGE TOP-OF-BANK WIDTH: 86 ft

(b) Mid Reach 4 looking upstream from footbridge; multiple individual bars transitioning to sediment wedge across entire channel bed (March 6, 2007).

MAINTENANCE HISTORY

(a) Top of Reach 4 looking downstream from Snyder Ln; abundant deposition in multiple bars with finer sediments than Reach 5 (March 6, 2007).

PHYSICAL CONDITIONS

Reach setting: depositional reach, multiple mid-channel bars in upper reach transition to a continuous wedge of sediment that fills the entire channel bed width, overall channel width doubles in size from Reach 5 upstream, to about 40 ft.

Active channel: in upper reach, multiple low flow channels (~6 ft wide) pass around individual sediment bars, in lower reach, channel is diffuse, shallow (<6") and spread across in-channel sediment wedge (photos c, d).

Bed sediments/texture: upper reach dominated by sands and silts, large sediment wedge in lower reach shows fines at surface, but is likely coarser with sands/gravels below.

Bank structure: earthen banks 2:1 to 1:1 (4-6 ft high), no apparent bank stabilization issues

Channel processes: deposition and channel infilling occurs in multiple bars in the upper reach and more homogenous wedge in the lower reach, positive feedback cycle with cattails capturing fine sediments leading to the formation of bars/wedges.

BIOLOGICAL CONDITIONS

Vegetation Composition: depositional wedge supports dense cattails in approximately 90% of the channel, canopy closure generally 25% or less.

Riparian Corridor: confined to narrow band of willows (arroyo and weeping) growing along toe of bank slope.

Instream Habitat: some channel sinuosity around multiple bars of upper reach, with small pools to side of bars, gives way to homogeneous sediment wedge w/cattails in lower reach. Cattail density may provide good bird habitat but is poorer in-channel aquatic habitat.

Listed species with potential to occur: Considered the best viable steelhead tributary in the Rohnert Park area. Known occurrence of steelhead (reach is a migration corridor); potential habitat for western pond turtle.

(c) Mid Reach 4 looking downstream from foot bridge: similar to photo (b) sedimentation now occurs as broad wedge across entire channel bed, dense cattails on bars trapping more fine sediment (March 6, 2007).

(d) Bottom of Reach 4 looking upstream from Country Club Dr, similar to photo (c) wedge of sediment across entire channel bed, abundant vegetation trapping more fine sediment (March 6, 2007).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

The primary management issues in this reach are abundant sediment deposition and in-channel vegetation (cattails), which are collectively impairing the flow conveyance capacity and ecologic functioning of this reach. Sediment removal methods can increase flow conveyance while also improving in-channel habitat through creating a more defined and sinuous low-flow channel and bar sequence as appropriate for this reach. This reach has a thin riparian canopy with limited channel shading. Planting of more woody riparian species along the top of bank and along the toe of slope could both improve shading and inhibit cattail development. Additionally, the watershed projects upstream could identify and treat upstream sediment through erosion control and land-use treatments.

JURISDICTION: City of Rohnert Park owner, SCWA maintenance easement

LOCATION: Rohnert Park, Snyder Ln Bridge to 1500 ft upstream

ADJACENT LAND USE: Residential to the north, recreational/school to the south

UPSTREAM: Copeland 6 (not actively managed); Copeland Creek Restoration Project above Petaluma Hill Road

LENGTH: 1,368 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 77 ft

AVERAGE TOP-OF-BANK WIDTH: 89 ft

(b) Mid Reach 5 looking upstream; channel sinuosity increases with presence of “D-shaped” bar features adjacent to inner bend of channel (March 6, 2007).

MAINTENANCE HISTORY

(a) Reach 5 looking upstream; note pool-riffle sequence with cobble bar in foreground and distance (March 6, 2007).

PHYSICAL CONDITIONS

Reach setting: transitional reach between the steeper alluvial fan areas upstream to more gentle gradient alluvial plain setting below Snyder Lane.

Active channel: 8-10 ft wide in upper reach (photo a) increasing to approx 20 ft wide at Snyder crossing (photos b, c, d), average flow depth 6-12 in.

Bed sediments/texture: upper reach dominated by small cobbles (photo a), pebbles, coarse sands; sediments fine toward Snyder Bridge to medium/fine sands and silts.

Bank structure: earthen banks 2:1 to 1:1 (5-8 ft high) in upper reach, less steep and shallower banks in lower reach, no apparent bank stabilization issues.

Channel processes: riffle-pool sequences in upper reach (photo a), depositional bars adjacent to the bank increase toward lower reach (photos b, c), aggradation and widening of mid-channel bars upstream of Snyder Bridge (photo d).

BIOLOGICAL CONDITIONS

Vegetation Composition: mapping from 2006-2007 indicates 75% canopy closure for narrow 10-foot wide channel sections, 25-50% canopy closure for 20-ft wide sections.

Riparian Corridor: 20-30 ft wide on each bank; dominated by mature trees with dense blackberry understory (photo a); toe of slope supports dense stands of willow; bank shade, lack of fines, shallow depths result in limited emergent vegetation (photo c).

Instream Habitat: upper reach has low sinuosity, long shallow runs/glides, occasional riffles and pools; transition to lower reach has "D-shaped" cobble bars (photos b, c) at channel bends related to channel bends and mild sinuousity; further downstream more mid-channel bar aggradation occurs (photo d).

Listed species with potential to occur: Considered the best viable steelhead tributary in the Rohnert Park area. Known occurrence of steelhead, reach is migration corridor with known or potential rearing habitat; potential habitat for western pond turtle and foothill yellow-legged frog.

(c) Mid Reach 5 looking downstream, similar to (photo b) cobble bars run along inner channel bend, and mid channel riffle sequence (March 6, 2007).

(d) Reach 5 looking upstream from Snyder Lane crossing, multiple in channel bar features and fine sediments indicate increased depositional environment towards bridge (March 6, 2007).

Management Considerations and Opportunities

Due to general channel gradient, excessive deposition is not problematic through reach. Bars that are adjacent to bends in the channel in the mid-to-lower reach provide valuable bar-riffle-pool habitats. D-shaped bars reflect increased channel sinuosity in mid-reach, and do not appear to significantly reduce channel capacity. In lower Reach 5, 300 ft directly upstream of Snyder crossing, a more depositional environment emerges with larger and more prominent mid channel bar features (d), general deposition across the channel cross-section, and increased presence of fine sediments. Increased deposition is related to slope reduction and channel transition toward the Snyder Lane crossing.

The lower section of the reach near the Snyder crossing may need occasional sediment removal through its cross-section based on observed depositional bars. Key management opportunity at the lower reach is to maintain and mimic (where possible) the current sequence of elongate mid-channel bars, but simply skim the tops of the bars leaving the root of the bar in place. Keeping these channel forms and flow processes in place supports in-stream habitats. Additionally, removal of dense blackberry understory and limbing of dense willows in upper reach can maintain channel capacity and improve habitat.

Location: Reach 2 begins ~2000 ft upstream of Guerneville Rd. crossing and continues to Guerneville Rd. Reach 1- Guerneville Rd. south to confluence with Santa Rosa Creek.

Adjacent Land Use: Vineyard, agricultural, undeveloped

Upstream: Abramson headwaters not maintained by SCWA

Length: Abramson 2: 1,922 ft.
Abramson 1: 3,701 ft.

Channel easement corridor width: Abramson 2: 66 ft.
Abramson 1: 117 ft.

Average top-of-bank width: Abramson 2: 55 ft.
Abramson 1: 82 ft.

(b) Mid Reach 2 looking downstream; note channel is inset 8-10 ft. below top of banks, abundant blackberry on left bank; flow is stagnant with dense algae due to cattails blocking channel (in distance) causing stagnant flow conditions (Nov, 2007).

Maintenance History

(a) Upper Abramson Reach 2, looking downstream (south); steep banked trapezoidal channel with blackberry encompassing entire left bank, right bank has eroded (to left of person) and requires stabilization (Nov, 2007).

Physical Conditions

Reach setting: Abramson Cr. is a local tributary to lower Santa Rosa Creek, draining agricultural areas on the Santa Rosa Plain; reach is a trapezoidal linear channel; upper Reach 2 begins at rip-rapped drop structure.

Active channel: bed width ranges from 8 to12 ft., generally 10-12 ft. below top of banks; water depth 1 ft.

Bed sediments/texture: upper Reach 2 includes some sand and gravel at drop structure, then finer bed material of sands/silts throughout downstream. Grouted riprap at Guerneville crossing and at Santa Rosa Cr. Confluence.

Bank structure: Reach 2 steep earthen banks, generally 1:1 slope, with some bank erosion near location of photo a; Reach 1 less steep earthen banks at 2:1 (photos c/d).

Water quality: stagnant pools with dense algae in mid Reach 2 where cattails block flow (photo b); downstream in Reach 1 cattails also impede flow across channel (photos c/d).

Channel processes: At upper Reach 2, fast velocities past drop structure may have eroded right bank; otherwise channel is linear and trapezoidal down to Santa Rosa Creek confluence with uniform flow conditions.

BIOLOGICAL CONDITIONS

Instream habitat: poor and limited instream habitat due to: large drop structure at head of Reach 2, Reach 2 has generally poor circulation and water quality with algae collecting (photo b), upper Reach 1 is blocked with abundant cattails (photos c/d), and drop structure at Santa Rosa Cr. confluence creates barrier.

Vegetation composition: ruderal vegetation, including grasses and star thistle, and blackberry dominate banks; willow scrub and riparian cover interspersed along reaches. Between 70% and 80% of the in-channel area is comprised of wetland vegetation. Of this wetland growth, emergent species dominate the lower portion of Reach 1 (photos c/d), while more riparian species are found from the upper portion of Reach 1 through the top of Reach 2 (photo a).

Riparian corridor and canopy closure: Tree cover is sparse and found mostly at the upstream portion of Reach 1 and along upper Reach 2. Willow scrub and oaks provide approximately 10-15% cover along the reaches.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Abramson 1 looking downstream from Guerneville Rd. crossing, cattails become abundant downstream of crossing, crossing has grouted riprap downstream for bank stabilization, (Oct. 2, 2008).

(d) Mid Reach 1 looking upstream, abundant cattails continue into mid Reach 1, with little riparian canopy cover, homogonous channel environment, trapezoidal banks sloping at 1:1 (Oct. 2, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Abramson Creek Reaches 2 and 1 are focused toward the following activities: repair of eroding bank in upper Reach 2 (near location of photo a); clearing of cattails in lower Reach 2 that are creating poor water circulation and algae development; and clearing of cattails in upper Reach 1 (photos c/d) which are covering entire channel bed. Opportunities to plant and create a greater riparian canopy exist throughout reaches, especially lower Reach 2 and upper Reach 1. Opportunities to remove other non-native chocking vegetation including blackberry and thistle exist as well at these reaches.

Zone 2A Reach Sheets

Adobe Creek – Reaches 4 & 3

JURISDICTION: Reach 4: Owned in-fee and maintained by SCWA. Reach 3: Owned by City of Petaluma, maintained through easement agreement by SCWA

LOCATION: Reach 4: ~250 ft upstream Calle Ranchero to Sartori Dr.
Reach 3: Sartori Dr to Lakeville Hwy.

ADJACENT LAND USE: Reach 4: Residential and Park
Reach 3: Residential

UPSTREAM: Adobe Creek Watershed

LENGTH: Adobe 4: 1,062 ft.

Adobe 3: 781 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Adobe 4: 125 ft.

Adobe 3: 114 ft.

AVERAGE TOP-OF-BANK WIDTH: Adobe 4: 77 ft.

Adobe 3: 54 ft.

(b) Looking downstream approximately 500 ft from the top of Reach 4. Although most of both Reach 4 and 3 are dry, both reaches support a handful of pools, this being the longest (approx 50 ft long) and deepest (max 3 ft). Three foothill yellow legged frogs were observed in this pool on 07/03/08. Just downstream the channel goes dry again.

MAINTENANCE HISTORY

(a) Top of Reach 4 looking downstream into the area where SCWA's maintenance easement begins (after the bend). Stream bed comprised of gravel, cobles, coarse sand. Chanel is dry with shallow subsurface flows likely. Bedrock outcrop observed to left (07/03/08).

PHYSICAL CONDITIONS

Reach setting: Adobe Creek is perhaps the most ecologically intact watershed in Zone 2A. Upstream of Reach 4 at the Adobe Cr Golf Course the channel transitions from steep rocky topography into an alluvial fan; Reaches 4 and 3 represent the transition from the alluvial fan into the flatter alluvial plain; downstream Reach 2 transitions from a fluvial dominated system to a tidal system.

Active channel: 8-10 ft wide through both reaches with a narrower low flow channel 2-4 ft wide, channel 2-5 ft. deep; water depths ranging from 0-3 ft (photos a and b) with multiple dry sections and a few pools; largest pool is in Reach 4 (photo b).

Bed sediments/texture: coarse gravel bed stream with cobbles and sand matrix (photo a), fining to a mix of pebbles, gravels and coarse sand in Reach 3 (photos c and d);

Bank structure: banks are generally earthen at ~ 2:1 slopes with a mix of toe-of-slope bars forming intermittently; mild channel erosion undercuts banks in some locations (photo b).

Channel processes: Channel receives flows from headwater lands that are undeveloped and have intact riparian corridor; these reaches are dominated by coarse material with little deposition of fines. Reaches 4 and 3

show limited signs of bank stability or problematic sediment aggradation.

Water quality (qualitative): Channel was dry in many places, pools and other surface waters do not appear stagnant in August 2008.

BIOLOGICAL CONDITIONS

Instream habitat: Instream habitat in Reach 4 displays a high degree of complexity with pools, undercut banks, root wads, riffles, and proper size salmonid spawning gravels at a few locations. The channel becomes straighter and more uniform downstream into Reach 3 (photo d). Large pool in upper Reach 4 supports adult FYLF as well as possible juvenile steelhead (observation not confirmed). Smaller pools in Reach 4 contained significant numbers of pacific tree frog tadpoles, warm water fish, etc.

Vegetation composition: Both reaches support a narrow, but dense riparian corridor stretching from the toe-of-bank to above the top-of-bank; vegetation ranges from willows and alders along the toe of slope to oaks and maples further up the bank (photos a and d); in areas where the canopy is broken (photo c) grasses, sedges, and cattails are found along the toe-of-bank and into the dry channel bed.

Riparian corridor and canopy closure: 10-20 ft. wide corridor on each bank with canopy closure ranging from 50%-75% in Reach 4 and 0%-50% in Reach 3; in reach 3 the right bank (looking downstream) becomes void of riparian cover as you move downstream.

Listed species with potential to occur: Steelhead are known from these reaches with over summering pools in Reach 4 and perhaps some possible spawning and rearing in Reach 4 (though better spawning habitat is further upstream); adult FYLF were observed in the large pool in Reach 4 during site visit in Aug 2008, Reach 3 is potential FYLF habitat. Both reaches are potential habitat for California red-legged frog and western pond turtle.

(c) Lower Adobe Cr. Reach 4 looking downstream at Sartori Bridge and into upper Reach 3. Coarse gravel and cobbles are seen along the drier low flow channel upstream of the bridge, downstream of the bridge a large mass of cattails and willows are observed (background) (07/03/08).

(d) Adobe Cr. Reach 3 looking upstream from the Lakeville Hwy bridge. About 200 ft upstream of Lakeville Hwy the channel transitions from a gravel and cobble dominated system to a sand dominated system. Note the uniform wide, flat, bed at the bottom of reach (07/03/08).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Adobe Creek Reach 4 and 3 focus on improving habitat conditions for steelhead and FYLF. Additional canopy development along sections of Reach 3 could make this reach more hospitable for aquatic and riparian species as well. In mid Reach 4, mid channel depositional bars are observed to be collecting sediment and have substantial vegetation growth on them in the mid-channel location. These mid-channel bars have been graded in the past, and may require additional sediment removal and vegetation removal in the future. The incising sections of Reach 4 further upstream that are undercutting banks and exposing roots are not so severe as to warrant treatment at this time. It should be noted that base of bank depositional bars along Reach 4 and to a lesser degree Reach 3 may be reducing some channel capacity and/or impairing flow from drainage outfalls. If this issue continues, these bars may need to be reduced. Although photo a shows an eroding bank, this bank is upstream of SCWA's ownership/easement and chronic bank erosion was not noted from other sites within these reaches. Importantly, neither the Sartori Crossing nor the Lakeville Crossing appear to be heavily impaired by sediment during site visits in August and December 2008.

JURISDICTION: Owned and maintained by SCWA

LOCATION: Capri 1: Highway 101 to Petaluma River confluence

Jessie 1: Petaluma Blvd. to Petaluma River confluence.

ADJACENT LAND USE: Capri 1: commercial retail (outlets) to north, open space to south

Jessie 1: commercial, car repair lot to south and storage unit facility to north

UPSTREAM: Capri 1: upstream is Capri 2

Jessie 1: culvert beneath Petaluma Blvd.

LENGTH: Capri 1: 591 ft.

Jessie 1: 827 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Capri 1: 100 ft.

Jessie 1: 83 ft.

AVERAGE TOP-OF-BANK WIDTH: Capri 1: 50 ft.

Jessie 1: 36 ft.

(b) Capri Cr. Reach 1 looking upstream from lower reach near Petaluma River confluence; abundant in-channel emergent vegetation, and some sediment accumulation (October 23, 2008).

MAINTENANCE HISTORY

(a) Capri Cr. Reach 1, looking downstream from culvert outfalls just downstream of Hwy 101 (at factory outlet mall); trapezoidal channel with cattail growth and some bars of fine sediment deposited; deep channel within steep banks (Jan 8, 2009)

PHYSICAL CONDITIONS

Reach setting: Capri Reach 1 and Jessie Lane Reach 1 join the Petaluma River very near each other (see Figure 4-44); Capri Cr. is a

west flowing creek draining parts of Petaluma east of Hwy 101, but does not have an extensive headwaters in the hills to the east. Jessie Lane Cr. is a very local drainage channel, only collecting runoff from the immediate Petaluma Blvd. area.

Active channel: Capri Cr. Reach 1 channel bed is 12-16 ft wide and is 10-12 ft. deep in upper reach (photos a/b), and has an approximate low-flow water depth of 1-2 ft. Jessie Lane Cr. is 4-8 ft. wide, 3-6 ft deep, and is ephemeral with no water flowing between storm events.

Bed sediments/texture: Capri Cr. Reach 1 has sands and silts through most of the reach with some sloughed riprap and large boulders at Petaluma River confluence. Jessie Lane Cr. has mostly sand and fine sand sediments.

Bank structure: Capri Cr. Reach 1 banks are earthen and steep, generally 1:1 in photo a, and 2:1 in photo b. Jessie Lane Cr. banks are earthen, sloped 2:1 with max. height of 6 ft.

Water quality: Capri Cr. Reach 1 has stagnant pools upstream of cattail and sediment deposits (photos a/b). Jessie Lane Cr. had no flow, but concern regarding disposed trash and refuse from adjacent auto shop (photo c).

Channel processes: Capri Cr. Reach 1 is a linear trapezoidal channel, somewhat incised below steep banks in upper reach, with sequence of cattail/sediment deposits that becomes more continuous downstream (photo b). Jessie Lane Cr. is essentially a small ephemeral drainage mostly covered in blackberry with riparian scrub growth blocking most of the channel (photo c).

BIOLOGICAL CONDITIONS

Vegetation composition: Capri Cr. Reach 1 banks are vegetated with ruderal growth (photos a/b). Emergent wetland species, mostly cattail and tule cover 80% of the in-channel area (photo b). Jessie Lane Cr. supports areas of dense riparian scrub (blackberry) covering both banks and the entire channel in locations (photo c), and with some ruderal growth along banks in the lower reach. Jessie Lane reach is characterized as having 95% emergent wetland vegetation growth in-channel (photo c).

Riparian corridor and canopy closure: In Capri Cr. Reach 1 occasional oak trees along banks provide some canopy cover, but not much (0-15%, photo b). In Jessie Lane Cr. woody riparian growth is limited and provides approximately 0-15% cover along the reach (photos c/d), with canopy cover increasing downstream.

Instream habitat: in-stream habitat along Capri Cr. Reach 1 is impacted due to excessive cattail growth which is blocking flows to and from the Petaluma River. Similarly, Jessie Lane Cr. is impacted from excessive blackberry growth, though this is a small ephemeral channel and would not support as much habitat as Capri Cr.

Listed species with potential to occur: potential habitat for western pond turtle. Known occurrence of steelhead in Petaluma River downstream of Capri and Jessie Lane Creeks.

(c) Jessie Lane Creek, near Petaluma Blvd. looking downstream; abundant blackberry covers banks and the entire channel; auto shop to right is potential source of trash and refuse that enter the channel (Jan 8, 2009).

(d) Jessie Lane Creek, looking downstream toward confluence with Petaluma River. Ephemeral channel is dry, leaf litter across channel bed, adjacent trees provide cover (October 23, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Capri Cr. Reach 1 focus on removing cattails and associated sediment deposits, especially in the lower reach where cattails and accumulating sediment become more prominent. Capri Cr. Reach 1 would also benefit from additional riparian plantings along the high banks, particularly on the south side to provide more shading to the channel to inhibit in-channel emergent vegetation growth where no canopy currently exists. Management considerations for Jessie Lane focus on blackberry removal and thinning to improve flow conveyance. Importantly at Jessie Lane Cr. potential threats to water quality are observed from trash and refuse apparently transported from the auto shop. May be worthwhile for SCWA to contact the auto shop to describe the problem and seek their commitment to improve trash conditions.

JURISDICTION: N. McDowell to railroad crossing: SCWA owned and maintained.

Railroad to Hwy 101: City of Petaluma owned, SCWA maintained.

LOCATION: N. McDowell Blvd. to confluence with Corona 1 at Highway 101

ADJACENT LAND USE: Commercial and multi-family residential

UPSTREAM: Capri 3

LENGTH: 1,030 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 47 ft

AVERAGE TOP-OF-BANK WIDTH: 28 ft

(b) Reach 2 at N. McDowell Blvd., looking downstream; earthen bank slopes with mature riparian trees (August 26, 2008).

MAINTENANCE HISTORY

(a) N. McDowell Blvd. crossing of parallel culverts entering Reach 2; looking upstream to reach Capri 3 and headwater areas (August 26, 2008).

PHYSICAL CONDITIONS

Reach setting: above ground portion of reach is linear trapezoidal channel between N. McDowell Blvd. and railroad. Channel flows in a culvert beneath the railroad and parking lots before day-lighting at confluence with Corona Creek.

Active channel: active channel is 6-12 ft wide, 4-6 ft. deep (photos a/c). Reach is perennial, likely due to surrounding urban development and being lower in the watershed than reaches 4/3 upstream.

Bed sediments/texture: sands and silts collecting in patches with some loose riprap cobbles that have locally eroded (photo c).

Bank structure: asymmetrical bank slopes with steeper (1:1) slopes on one side and gentler (2:1) slopes on the opposite side.

Water quality: relatively trash free; sediment deposits in patches with emergent wetland; vegetation slows groundwater infiltration and contaminant filtration functions.

Channel processes: linear channel alignment with flows contained within engineered banks; cattail growth and associated sedimentation in sequences; southern bank observed to be undercut in one location; (photo d).

BIOLOGICAL CONDITIONS

Vegetation composition: banks exhibit ruderal grasses and large mature trees throughout the reach (photos b/c); in-channel vegetation is dominated by patches of cattail growth where the channel is exposed to sunlight (photo d); wetland vegetation comprises 95% of in-channel growth (photo b).

Riparian corridor and canopy closure: canopy closure between 0-50% is provided by willow, oak, and eucalyptus trees primarily along the northern channel banks.

Instream habitat: some aquatic habitat supported in pools and slow moving water within the channel. Surrounding residential and industrial areas likely deter species from this reach; culverts downstream at railroads and Hwy 101 and upstream at N. McDowell Blvd bound this reach.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Mid Reach 2 looking downstream, locally eroded riprap found on channel bed and banks of the trapezoidal channel (August 26, 2008).

(d) Reach 2 at railroad crossing, looking upstream. Dense cattails and emergent wetland vegetation fill the channel; ruderal grasses and shrubs are established along bank areas (August 26, 2008).

Management Considerations and Opportunities

Management considerations for Capri Reach 2 focus on removal of in channel cattail vegetation in the lower reach, upstream of the railroad crossing (photo d). Much of the reach is shaded by mature riparian trees, preventing abundant cattail development in the channel, but this is not the case at the lower reach. The lower portion of the reach would benefit from the planting of additional riparian vegetation to inhibit cattail growth.

Jurisdiction: Owned and maintained by SCWA

Location: Reach 4: Sonoma Mountain Parkway to Maria Drive

Reach 3: Maria Drive to N. McDowell Blvd.

Adjacent Land Use: Single family residential and recreational open space

Upstream: Capri Creek headwaters

Length: Capri 4: 1,601 ft.

Capri 3: 1,573 ft.

Channel easement corridor width:

Capri 4: 168 ft.

Capri 3: 146 ft.

Average top-of-bank width: no data

(b) Reach 4 at Maria Drive, looking upstream; willow scrub observed along banks of the entire reach, note sand, gravel, and cobble in streambed (August 26, 2008).

Maintenance History

(a) Reach 4 at Sonoma Mountain Pkwy, looking downstream; Wide channel easement, with gently sloping banks; channel is ephemeral and dry, but abundant emergent vegetation in the channel indicates shallow groundwater or high soil moisture (August 26, 2008).

Physical Conditions

Reach setting: Upstream of Reaches 4 and 3, Capri Cr. tributaries drain undeveloped headwater slopes on Sonoma Mtn.; Reaches 4 and 3 are engineered trapezoidal channels that take Capri Cr. through the suburban Petaluma neighborhood. The engineered Capri Cr. likely follows close to the historic stream course.

Active channel: Channel bed is 6-12 ft and 3-4 ft. below top of banks; channel is shallow with no pools, but retains shallow groundwater at the base of the channel, as noted by abundant emergent vegetation (photos a/d).

Bed sediments/texture: sand, pebbles, and cobbles in Reach 4 (photo b), fining to sands and silts downstream in Reach 3.

Bank structure: symmetrical trapezoidal channel, with earthen banks, gently sloped at 3:1.

Water quality: dry channel, no flow observed, no trash, earthen bed, banks, and wide channel easement provide filtering functions during higher flow conditions.

Channel processes: linear channel alignment, wide easement provides ample higher bank and floodplain areas to convey flows. Cattails and other in-channel vegetative growth encourage sedimentation in the channel.

BIOLOGICAL CONDITIONS

Vegetation composition: Reach 4 supports a mix of oak, redwood, and willow trees which provide some canopy cover over the channel area (photo a); Reach 3 is devoid of shade-providing riparian vegetation (photos c/d). Ruderal grasses dominate the channel banks along both reaches. In-channel vegetation is comprised of nearly 85% wetland species.

Riparian corridor and canopy closure: Channel corridor is maintained as open space with little riparian vegetation, primarily grasses. Canopy cover is between 0-25%, decreasing downstream.

Instream habitat: Instream habitat is limited by linear channel homogeneity and influence of surrounding development; aquatic habitat is limited by ephemeral nature of stream; reaches however are near to headwaters areas and provide an important conduit from the lowland areas upstream.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Reach 3, looking downstream from Maria Dr.; very wide channel easement, gently sloping banks, and in-channel scrub willow vegetation, with a lack of any woody riparian canopy over the channel (August 26, 2008).

(d) Mid Reach 3 looking downstream; linear channel alignment and wide gently sloping banks (August 26, 2008).

Management Considerations and Opportunities

Management considerations for Capri Creek Reaches 4 and 3 focus on in-channel vegetation removal to reduce resistance and reduce instream sediment accumulation. Currently, there is ample conveyance capacity due to the broad channel alignment in Reaches 4 and 3. However, the sediment load from upstream of sand appears high and may accumulate over time in the channel. Planting of riparian trees to provide additional canopy cover in Reach 3 would be advantageous.

Jurisdiction: City of Petaluma owner; SCWA maintenance easement

Location: Reach 3: Railroad crossing to N. McDowell Blvd.

Reach 2: N. McDowell Blvd. to Reach 1 (near Sonoma Ct)

Reach 1: Near Sonoma Ct. to conduit confluence with Capri Creek Reach 2 at Highway 101

Adjacent Land Use: Reach 3: pasture, open space

Reach 2: residential

Reach 1: freeway, commercial

Upstream: Corona 4

Length: Corona 3: 138 ft.
Corona 2: 1,022 ft.
Corona 1: 3,240 ft.

Channel easement corridor width:

Corona 3: 111 ft.
Corona 2: 52 ft.
Corona 1: 82 ft.

Average top-of-bank width: Corona 3: no data
Corona 2: 45 ft.
Corona 1: 60 ft.

(b) Reach 2 looking downstream from the N. McDowell Blvd crossing; riprap covers the bank walls at the crossing and trees provide shade (August 26, 2008).

Maintenance History

(a) Reach 3, looking upstream from the N. McDowell Blvd. crossing; note pooling, dense willow scrub and in-channel vegetation (August 26, 2008).

Physical Conditions

Reach setting: lowest portions of the engineered Corona Cr. system; transitional from higher alluvial sections upstream (Reaches 5 and 4) moving toward valley bottom confluence with Petaluma River (downstream of Capri Cr. confluence).

Active channel: Active channel bed width is 4-10 ft wide, 4-6 ft deep, with flow depths 6 inches to 1 ft deep (Photo b)

Bed sediments/texture: mostly silts and fine sands with Reach 1 becoming finer in texture and a depositional environment

Bank structure: symmetrical earthen banks with slopes at 2:1 and 1:1, with riprap near crossings and conduits (photo a); confluence with Capri Creek Reach 2 is grouted and rip rapped

Water quality: Slow moving perennial flows and stretches of no canopy cover encourage growth of algae and duckweed, as seen in the photos.

Channel processes: low flow channel reaches with occasional pools; lower reach has large in-channel benches supporting cattail growth; a small sediment wedge is forming at the south side of the confluence with Capri Creek Reach 2.

Biological Conditions

Vegetation composition: banks are vegetated with ruderal vegetation including Himalayan blackberry, iceplant, ivy, and grasses; wetland vegetation comprises approximately 75% of the total channel reaches and is dominated by cattail growth.

Riparian corridor and canopy closure: 0-25% canopy closure provided by a mixture of mature willows, ash, eucalyptus oaks, redwoods, and maple riparian vegetation along top of banks (photo b).

Instream habitat: poor quality instream habitat due to overgrowth of algae and urban contaminants potentially conveyed in runoff from surrounding development.

Listed species with potential to occur: All three reaches are potential habitat for western pond turtle.

Management Considerations and Opportunities

Management considerations include selective bar grading/skimming where necessary, but should include alternating bar forms that provide sinuosity as currently observed in Reach 1. Other considerations include removal of cattails and planting of more riparian vegetation (if capacity allows) to provide additional shade to inhibit cattail growth where no canopy cover currently exists.

Jurisdiction: City of Petaluma owner; SCWA maintenance easement

Location: Reach 5: Sonoma Mountain Pkwy to Wellington Place

Reach 4: Wellington Place to Railroad tracks (north of N. McDowell Blvd.)

Adjacent Land Use: Single family residential; park open space

Upstream: Corona Reach 6

Length: Corona 5: 845 ft.

Corona 4: 487 ft.

Channel easement corridor width:

Corona 5: 107 ft.

Corona 4: 121 ft.

Average top-of-bank width: no data

(b) Mid Reach 5 looking upstream at pedestrian footbridge; dense cattail growth through the channel bed with thick willow growth at the toe of the stream banks and the channel margin (August 26, 2008).

Maintenance History

(a) Reach 5 looking downstream from Sonoma Mountain Parkway crossing; like upstream reaches, large stands of cattails in channel, but unlike upstream reaches, now with willows too (August 26, 2008).

Physical Conditions

Reach setting: mid-portion of the engineered Corona Creek system; like upstream

Reaches 7 and 6, linear engineered trapezoidal channel continues in Reaches 5 and 4. Reaches 5 and 4 are wider than upstream reaches to convey larger flows.

Active channel: both reaches - channel bed 8-12 ft wide, 6-10 ft deep, with flow depths about 1 ft deep. Reach 4 includes a secondary parallel channel to the south of the primary channel, with the two channels joining near railroad crossing.

Bed sediments/texture: silts and fine sands throughout both reaches.

Bank structure: symmetrical earthen bank slopes with 1:1 slopes; riprap is located along banks near crossings and culverts.

Water quality: perennial with slow flows exhibiting good water clarity, except in spot locations with abundant duckweed growth (photo d).

Channel processes: cattail and other vegetative growth in channel traps sediment (see photos); pool feature with duckweed located west of crossing on Reach 4 (photo d).

BIOLOGICAL CONDITIONS

Vegetation composition: woody vegetation dominated by willow scrub is present in channel and along banks; wetland vegetation, including cattails, is abundant throughout both reaches (particularly Reach 5); wetland vegetation comprises 20-60% of the channel growth, increasing downstream as riparian vegetation becomes less dominant; ruderal vegetation is observed on top of bank areas.

Riparian corridor and canopy closure: abundant riparian growth (mostly willows) provides 50-75% canopy cover across the channels (photo b).

Instream habitat: small riffle pool feature located in Reach 5 provides in-channel habitat for amphibians, otherwise abundant cattail stands limits aquatic habitats.

Listed species with potential to occur: Reach 4 is potential habitat for western pond turtle.

(c) Lower Reach 5 looking upstream from Wellington Place crossing; abundant instream cattail vegetation and willow growth obstructs the channel (August 26, 2008).

(d) Reach 4 looking downstream from Wellington Place. Large pool with abundant duckweed growth (August 26, 2008).

Management Considerations and Opportunities

Management considerations for Corona Reaches 5 and 4 focus on selective vegetation removal and/or thinning to improve flow conveyance and maintain canopy closure. Other considerations include providing low-flow channel features to improve transport of fine sediments, with potential alternating bar forms to provide sinuosity to this linear channel.

Jurisdiction: City of Petaluma owner; SCWA maintenance easement

Location: Reach 7: N. Ely Road to Telford Lane

Reach 6: Telford Lane to Sonoma Mountain Pkwy.

Adjacent Land Use: Single family residential

Upstream: Corona Creek headwaters

Length: Corona 7: 713 ft.

Corona 6: 799 ft.

Channel easement corridor width:

Corona 7: 111 ft.

Corona 6: 106 ft.

Average top-of-bank width: no data

(b) Lower Reach 7 looking upstream from Telford Lane; similar to upper Reach 7, abundant cattail vegetation in linear channel; lack of canopy cover with no woody riparian vegetation along banks (August 26, 2008).

Maintenance History

(a) Upper Reach 7 looking downstream from N. Ely Road; linear trapezoidal channel with abundant in-channel emergent vegetation growth of cattails; banks have willow scrub and grass vegetation (August 26, 2008).

Physical Conditions

Reach setting: upstream of Riesling Rd. Corona Cr. is a natural headwater tributary; downstream of Riesling Rd, and into Reach 7 (downstream of Ely Rd.) the creek becomes a linear trapezoidal channel that drains runoff from the neighboring residential areas.

Active channel: active channel width is consistent in both reaches; bed is 6-12 ft wide and 4-6 ft deep, with flow depths less than 1 ft. Sediment has likely accumulated to a depth of 1 foot throughout both reaches, at the base of the cattails. Bed gradient is stabilized by hardened crossings at both ends of the reaches.

Bed sediments/texture: pebbles and coarser sands observed in Reach 7, with sediments fining to mostly silts and fine sands downstream in Reach 6.

Bank structure: symmetrical earthen banks sloped at 2:1 or 1.5:1 throughout; banks are approx 4-6 ft high from channel bed.

Water quality: perennial in both reaches with flows exhibiting good water clarity observed on August 26, 2008. Stagnant areas within cattails encourage growth of algae (photo d). Earthen bed and banks provide some filtration of runoff.

Channel processes: linear channel alignment for both reaches; cattail and other in-channel vegetative growth trap and cause sedimentation. Ample space for conveyance of flood flows.

BIOLOGICAL CONDITIONS

Vegetation composition: active channel is characterized by 100% wetland emergent vegetation, dominated by cattail growth; ruderal vegetation including fennel, annual grasses, and star thistle grow along bank areas (photos b/ c); a mixture of willow scrub, oak, and willow trees are also located on bank areas (photos a/d).

Riparian corridor and canopy closure: riparian growth is minimal and provides 0-25% shading along the reaches.

Instream habitat: Habitat denuded by overabundance of cattails in the channel.

Listed species with potential to occur: None

(c) Upper Reach 6 looking downstream from Telford Lane; similar to upstream in Reach 7, in-channel abundant cattail conditions continue in Reach 6 (August 26, 2008).

(d) Reach 6 looking upstream from Sonoma Mountain Pkwy. Similar to upstream reaches, abundant cattail growth continues through Reach 6. Note algae growth around the cattails (bright green in the channel) toward the crossing (August 26, 2008).

Management Considerations and Opportunities

Management considerations for Corona Creek Reaches 7 and 6 focus on removal of instream cattail vegetation to reduce instream flow resistance and improve flood conveyance. Planting of additional riparian trees along the streambanks that could mature and provide shade to channel would particularly benefit these two reaches. Other considerations include providing a potential low-flow channel (with alternating bar forms to provide sinuosity) to enhance in-channel habitat and improve sediment transport functions.

Jurisdiction: Reaches 2: SCWA owned and maintained channel

Reach 1: Owned by City of Petaluma, SCWA maintenance easement

Location: McGregor Ave. downstream to Washington Cr. confluence

Adjacent Land Use: Single and multi-family residential in Reach 2. Mix of commercial and residential in Reach 1

Upstream: East Washington Creek 3

Length: East Washington 2: 1,183 ft.

East Washington 1: 1,153 ft.

Channel easement corridor width:

East Washington 2: 65 ft.

East Washington 1: 79 ft.

Average top-of-bank width:

East Washington 2: 32 ft.

East Washington 1: 40 ft.

(a) mid Reach 2 looking upstream from McGregor Ave. note steep banks beneath access road and in-channel sediment and vegetation; in terms of depth and height of banks, mid Reach 2 is transitional between the deeper channel upstream and the shallower channel downstream (May 2007)

Maintenance History

Vegetation removal work at Maria Drive (photo a and b) occurred in 2005. In Summer 2012 vegetation removal took place within Reaches 2 and 1. Immediately following the 2012 vegetation removal, 2,908 cubic yards of sediment were removed from 1,820 linear feet within both Reaches. A total of 21 valley oaks were planted on the north upper bank of Reach 2 as part of California Transportation Department Tier 3 mitigation re-plant in November 2012. Tier 1 mitigation plantings were completed within Reaches 2 and 1 (at the sediment removal site) in December 2012 and established upper bank trees, upland and riparian graminoids and shrub analogs.

(b) Reach 1, looking downstream from Maria Dr. bridgehead; channel cross section shallowed and

filled from abundant deposition; finer sediments (sands, silts, mud) accumulate here compared to coarser sediments upstream; cattails and other vegetation recently cut, but stalks show return (Jan. 2007)

Physical Conditions

Reach setting: broad and gentle sloping cross-section of Reach 4 upstream changes dramatically at Ely Blvd. crossing where Reach 3 becomes a very linear and narrow trapezoidal channel. This trapezoidal channel continues into Reaches 2 and 1. Historically, deposition near Maria Dr. crossing reduces and fills the channel cross section (photo b), but the 2012 sediment removal cleared such deposits and reset the channel cross section (photo c).

Active channel: 6-8 ft wide, 1-2 ft deep; historically constricted by sediment wedges and cattatils (photos a); or significant deposition of fine sediment further downstream (photo b). Reaches 1 and 2 are perennial, though flows diminish into summer/fall

Bed sediments/texture: medium and fine sands upstream fining to silts and mud downstream;

Bank structure: steep armored and earthen slopes; bank slopes ~ 1:1; Reach 2 banks lessen in height and steepness (photo a)

Water quality: Historically lower reaches impacted from stagnant water, high in-channel sedimentation and turbidity (observed 1/12/07 and 7/16/12).

Channel processes: linear channel alignment creates mostly a straight run with some blockage from a sequence of depositional bars upstream in Reach 3; deposition of fines increases downstream until more blockage and aggradation occurs (photos a, b).

Biological Conditions

Vegetation composition: Historically, vegetation in Reaches 2 and 1 has been primarily ruderal along the creek banks with sparse occurrences of riparian woodland that ranges from 0 to 50% canopy closure over the creek. In Summer 2012 just prior to vegetation removal activities, it was observed that Reaches 2 and 1 were dominated by fennel, Himalayan blackberry and bushy exotics; the in-channel zone contained large stands of cattails and other undesirables; and, there was an extremely low occurrence of channel shading, as the banks largely lacked mature trees (especially on Reach 2). The 2012 vegetation removal within Reaches 2 and 1 cleared the majority of existing toe and side-bank trees as well as all woody shrubs (photos c and d); also, no more than 50 native trees remained on the upper banks. The subsequent Tier 1 mitigation (December 2012) filled the top-of-bank gaps with upland tree species (namely valley and coast live oaks) at spacings of 20-30 feet. It is expected that these trees will mature and shade the channel, helping to eliminate excessive growth of undesirables. Native riparian and upland graminoid and shrub analog species were also planted at the site to enhance current habitat (refer to Section 3 of the 2012 SMP Annual Report for further detail regarding the 2012 Tier 1 mitigation planting).

Riparian corridor and canopy closure: 5-15 ft wide corridor on each bank; canopy closure between 25%-50%.

Instream habitat: Reaches 2 and 1 remain perennial in most years; habitat is limited by generally shallow flow through emergent vegetation growth across the channel bottom and by lack of canopy.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Reach 1 looking downstream from Maria Dr. after Summer 2012 sediment removal. note narrow cross-section and steep banks. All toe and mid bank tree and woody shrub growth has been removed (October 2012).

(d) Reach 2 looking downstream from McGregor Ave bridgehead after the Summer 2012 sediment removal activities (October 2012).

East Washington Creek – Reach 3

Management Considerations and Opportunities

Management considerations for East Washington Creek Reaches 2 and 1 focus on sediment management. These reaches are historically depositional due to the lessening of channel slope moving downstream along the Petaluma Plain toward the Washington Creek confluence and the Petaluma Valley floor. Opportunities for bank strengthening through planting appropriate bank vegetation also exist. In general, Reaches 2 and 1 are far more constrained due to their very narrow easement width compared to Reaches 4 and 5 upstream and have fewer opportunities for corridor enhancement than do upstream reaches. Moreover, Reaches 2 and 1 have been identified as a section where the acceptable roughness thresholds could be surpassed if trees and perennial shrubs are present below the original high water mark. Likewise, the existence of toe trees and perennial woody shrubs on the side banks could greatly reduce the capacity of this relatively narrow channel. Given these concerns, vegetation management should focus on improving instream conditions (i.e. reduction of cattail growth and subsequent sedimentation) and increasing channel shading through upper bank canopy development.

Jurisdiction: SCWA owned and maintained channel

Location: Ely Blvd. downstream to McGregor Ave.

Adjacent Land Use: Single family residential

Upstream: East Washington Creek 4

Length: 1,379 ft.

Channel easement corridor width: 58 ft.

Average top-of-bank width: 30 ft.

(a) looking downstream from Ely Blvd.; note armored banks, steeper trapezoidal channel, and much narrower easement width than Reach 4 upstream (Jan. 2007).

Maintenance History

Bank erosion was repaired in Fall 2006 near location of photo (b), repair work was permitted through 2006 interim agreements, site work occurred on non-jurisdictional waters above OHW. Vegetation removal work (namely blackberry hedging on the north bank and removal of exotics and instream willow growth) occurred in Summer 2012.

(b) Reach 3 looking upstream; note steep banks undercut at base provides potential for bank slumping and failure, sequences of cattails and sediment bars, overall narrow easement and close proximity to homes and backyards (Jan. 2007)

Physical Conditions

Reach setting: broad and gentle sloping cross-section of Reach 4 upstream changes dramatically at Ely Blvd. crossing where Reach 3 becomes a very linear and narrow trapezoidal channel (photo b)

Active channel: 6-8 ft wide, 1-2 ft deep; constricted by sediment wedges and cattails (photos b); or significant deposition of fines further downstream. Reach 3 is perennial though flows diminish into summer/fall

Bed sediments/texture: medium and fine sands upstream fining to silts and mud downstream;

Bank structure: steep armored and earthen slopes; bank slopes ~ 1:1; (photos a, b);

Water quality: Reach 3 impacted from stagnant water, some in-channel sedimentation and turbidity (observed 07/17/12).

Channel processes: linear channel alignment creates mostly a straight run with some blockage from a sequence of depositional bars; deposition of fines increases downstream in Reaches 2 and 1 until more blockage and aggradation occurs. Steep banks with little strengthening vegetation that are undercut by creek flows at base have potential to slump and erode into creek

BIOLOGICAL CONDITIONS

Vegetation composition: Vegetation in this reach is primarily ruderal along the creek banks, with sections of riparian woodland that ranges from 0 to 50% canopy closure over the creek. Small areas of willow scrub are also present. Most channel shading occurs in the lower half of the Reach, where a substantial stand of upper bank trees is present (namely Lombardi poplar, sycamore, and coast live oak. Approximately 35% of this reach has emergent wetland vegetation (primarily tule and cattail) blocking the channel. In summer 2012 prior to vegetation removal activities it was observed that Himalayan blackberry, ivy and fennel growth dominated the channel banks. Also, several dense patches of young privets and plums were observed, though efforts were made to remove these via clipping and herbicidal stem treatment.

Riparian corridor and canopy closure: 5-15 ft wide corridor on each bank; canopy closure between 0%-50%.

Instream habitat: Reach 3 remains perennial in most years; habitat is limited by generally shallow flow through emergent vegetation growth across the channel bottom and by lack of canopy.

Listed species with potential to occur: potential habitat for western pond turtle.

Management Considerations and Opportunities

Management considerations for East Washington Creek Reach 3 focus on sediment management, bank stabilization and reduction of in-channel persistent growth. Steep, relatively unvegetated banks, are weakened and undercut by the stream below. Where banks have slumped they have been recontoured and strengthened using bio-engineered stabilization approaches though additional opportunities for bank strengthening through planting appropriate bank vegetation exist. In general, Reach 3 is far more constrained due to its very narrow easement width compared to Reaches 4 and 5 upstream and has fewer opportunities for corridor enhancement than do upstream reaches. Vegetation management should focus on improving channel shading through the development of mature upper bank trees.

Jurisdiction: Owned by City of Petaluma, SCWA maintenance easement

Location: Reach 5: Downstream of Petaluma Airport (photos a/d) to Garfield Dr.

Reach 4: Garfield Dr. (photos b/c) downstream to Ely Blvd.

Adjacent Land Use: Single family residential

Upstream: Culverts beneath airport, headwater slopes further upstream (photo a)

Length: East Washington 5: 589 ft.

East Washington 4: 1,408 ft.

Channel easement corridor width:

East Washington 5: 180 ft.

East Washington 4: 125 ft.

Average top-of-bank width:

East Washington 5: 65 ft.

East Washington 4: 36 ft.

(d) Reach 5 looking downstream to Garfield Dr. (Oct 1, 2007); photo taken after maintenance activities in Sept. 2007 removed accumulated sediment, thinned in-channel vegetation, and excavated low-flow channel.

Maintenance History

(a) Reach 5 looking upstream toward airport (May, 2007) prior to Fall 2007 maintenance central channel occluded with ample willow and blackberry vegetation (compare to photo d)

(b) Reach 4 looking upstream to Garfield Dr. culvert (May 2007); prior to Fall 2007 maintenance

culvert capacity reduced over 50% by deposited sediment (compare to photo e)

(c) Reach 4 looking downstream from Garfield Dr. (May 2007); prior to Fall 2007 maintenance (compare to photo e)

PHYSICAL CONDITIONS

Reach setting: uppermost engineered reach of E. Washington Creek; reach occupies alluvial fan zone downstream of headwater slopes; reaches occupy a wide channel easement, which is favorable in reducing the flood threat to adjacent structures; historically these reaches have been highly depositional downstream of the airport and Garfield Dr.; the lower reach maintains an open low-flow channel and appears somewhat steeper and less depositional.

Active channel: following Sept. 07 maintenance activities, low-flow channels excavated to be 4-8 ft. wide and 2-3 ft. deep; low-flow active channels reside within a very wide overall channel easement. Reach 5 and upper Reach 4 are intermittent in most years and run dry in the summer months with isolated pools remaining year round.

Bed sediments/texture: medium and fine sands; vegetation traps sandy sediments.

Bank structure: slopes are earthen, grass covered, and gently sloped in Reach 5 and upper Reach 4 (< 3:1) (photos d/e); in lower Reach 4 banks steepen and heighten (photo f).

Water quality: upper reaches are largely ephemeral; more intermittent/perennial flows begin in lower Reach 4, beside sediment accumulation in upper reaches, no other water quality issues observed, most of watershed upstream of reaches and airport is undeveloped.

Channel processes: Reach 5 below airport and upper Reach 4 below Garfield Dr. are highly depositional, Sept. 2007 maintenance activities addressed the past sediment accumulation (photos d/e); more open channel environment persists toward Ely Rd. crossing without as much deposition.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat is limited due to ephemeral nature of flows, but excavated low-flow channel aids in collecting flows into channel rather than previous condition of shallow diffuse flows across deposited sediment. Lower Reach 4 with a more defined channel (4-6 ft wide and 1-2 ft deep) provides some run potential (photo f).

Vegetation composition: Vegetation includes areas of riparian woodland on the outer banks with no canopy closure over the creek and small stretches of riparian woodland along the creek with 25-75% canopy closure. The upper reach is dominated by willow scrub and ruderal vegetation occurs along the banks. Prior to the Sept. 07 maintenance, approximately 50% of the channel was filled with emergent plants (cattail and tule) that partially or fully blocked water flow. That degree of coverage is far less now following the 2007 maintenance (photos d/e).

Riparian corridor and canopy closure: 5-15 ft. wide corridor on each bank; canopy closure between 25%-50%

Listed species with potential to occur: limited potential for listed amphibians and/or fish during the dry season when maintenance is likely to occur due to dry channel conditions. Potential habitat for western pond turtle.

East Washington Creek – Reaches 5 & 4

(e) Reach 4 looking upstream to Garfield Dr. (9/28/07); photo taken after maintenance activities in Sept. 2007 removed accumulated sediment from culvert and channel, thinned in-channel vegetation, and excavated low-flow channel. Note channel sinuosity and preserved riparian trees following maintenance activities.

(f) Lower Reach 4 looking upstream from Ely Blvd. (May, 2007); open low flow channel emerges in lower reach; channel slope appears to steepen toward Ely Blvd. crossing; reaches 5 and 4 both have wide easements.

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for East Washington Creek, Reaches 5 and 4 focus on monitoring the channel sections that underwent sediment removal, vegetation thinning, low-flow channel formation, and culvert clearing in Sept. 2007. Understanding the rate of willow colonization and re-growth, as well as sediment accumulation following the past maintenance work will help SCWA managers forecast future maintenance needs better. As of Fall 2008, the maintenance work conducted in Fall 2007 still looks very good and the channels are in good working condition. In general, the very wide easement provided in Reaches 5 and 4 presents an opportunity to enhance the corridor through other channel restoration efforts including additional tree plantings and shading on the higher banks.

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: From bridge over Petaluma Hill Rd., Penngrove, extending ~250 ft downstream

ADJACENT LAND USE: Mixed-use residential/commercial on W. bank, openspace on E. bank

UPSTREAM: Lichau 5

LENGTH: 395 FT

CHANNEL EASEMENT CORRIDOR WIDTH: 73 ft

AVERAGE TOP-OF-BANK WIDTH: 30ft

(b) Lichau Cr looking upstream from the Petaluma Hill Rd overpass; example of near 100% canopy coverage. Seen here: red willow, box elder, with Himalayan blackberry and cattails in the midground. (Jan. 08, 2009).

MAINTENANCE HISTORY

Lichau Creek – Reach 1

(a) Lichau Cr. upper Reach 1 looking upstream toward Hwy 101 from top of southern bank; channel is linear and deep within hardened incised banks; riparian trees grow along toe of southern bank inset within channel; top of southern bank has been augmented/heightened 5 ft. with additional gravel placement, seen to right (Jan 08, 2009).

PHYSICAL CONDITIONS

Reach setting: Reach is in an urban setting, connecting Lichau 6 to to Lichau 4 via a confined, well-vegetated, and relatively short channel. The adjacent parcels include multiple-use developments, a few residential lots, and a large vacant lot which claims the majority of creek frontage. This lot has been completely suffocated by Himalayan blackberry.

Active channel: The active channel is very narrow (5-7 feet), with intrusion from blackberry reducing the navigable width even further. It sits 7-10 ft below the top-of-bank. The water is deep (3 ft) – at it's deepest in the narrowest parts of the creek, with more variation in depth occurring as the active channel widens out.

Bed sediments/texture: Mostly fine silt downstream of bridge, with some gravel and small boulders (30-40lbs) observed 25ft-50ft upstream of the bridge; possibly remnants of past attempt to armor the bank. The boulders observed were limited to the bed of the low-flow channel, however they may comprise of a larger portion of the substrate and were not visible due to accumulated sediment or overgrown vegetation.

Bank structure: Both banks are earthen except within 15-25ft of the Petaluma Hill Rd. overpass, where the banks are supported by concrete. It appears there may have been a previous attempt to armor the bank, as small boulders were observed in the active channel bed as the bank composition transitioned from concrete to earth. The south bank was heavily eroded in sections, however a thorough analysis of bank structure was prevented by a thick blackberrry groundcover.

Water quality: In narrow, canopied sections of the reach, the water was cool and deep. Flows were nearly undetectable through the entirety of the channel. Water clarity was above average, with less algae growth observed than in reach 4.

Channel processes: slow curving channel directs water from south to south east, directly into the engineered 90 degree turn which delineates the beginning of Lichau reach 4. This results in the deposition of sediment in an inopportune area.

BIOLOGICAL CONDITIONS

Vegetation composition: The most pervasive herbaceous species on the reach is Himalayan blackberry, covering an area from the toe to the top-of-bank and beyond into neighboring properties. In sections of the reach, it is the only observable type of vegetation in the channel. Immediately upstream of the Petaluma Hill Rd. bridge, there are several mature riparian trees, both native and non-native. The native species include buckeye, coast live oak, box elder, and Oregon ash, while the non-natives include acacia and sycamore. Instream vegetation includes cattails and several native graminoids.

Riparian corridor and canopy closure: All the elements of a healthy and effective riparian corridor are present in reach 5, but they are not consistent throughout the channel. There is almost 100% canopy coverage for the first 225 ft upstream of the of the Petaluma Hill Rd. overpass (more than half the length of the reach), but it dissipates quickly into blackberry brush with 0-5% canopy cover

Instream habitat: Relatively confined active channel limits the quality of instream habitat, although shade coverage creates cooler water temperatures. There are several instances of potentially beneficial woody debris.

Listed species with potential to occur: Reach is a migratory corridor for steelhead, potential habitat for western pond turtle.

(c) Example of uncontrolled Himalayan blackberry growth (here with arroyo willow) on the property which borders the creek to the south/southwest

Management Considerations and Opportunities

Management considerations for Lichau Cr. Reach 5 should include the removal of Himalayan blackberry through the application of herbicide, according to the applicable BMP's described in the SMP manual, and as permits allow. The blackberry is outcompeting every other type of plant, which limits biological diversity and may impede stormwater conveyance. The spraying regime should be performed in conjunction with a tree planting program, as quick growing riparian trees – and the associated shade – will help deter the reestablishment of invasive blackberry.

Some instream woody debris was observed, and although this has the potential to provide habitat for migrating salmonids, it should be removed to help retain the reach's function as a flood conveyance channel. This is particularly important considering the streams urban context – downtown Penngrove has the potential to flood if the channel isn't maintained effectively.

There is a large acacia which may be removed, as there are several surrounding natives which will provide adequate canopy. It is located on the north/east bank, roughly 50 ft upstream from the Petaluma Hill Rd. overpass. While this action would be beneficial, the priority for vegetation management on this reach is Himalayan blackberry and cross-sectional branch removal.

Sediment deposition may be a management consideration for this reach, but the hydraulic characteristics of the channel would likely create more sediment accrual in the 90 degree bend of Lichau reach 4. The overpass should be monitored regularly for any blockage or occlusion0 that would impede stormwater flows.

Jurisdiction: City of Petaluma owned, SCWA maintenance easement

Location: Highway 101 to Stony Point Rd crossing

Adjacent Land Use: Manufactured homes to south, open-space/agriculture to north

Upstream: Lichau 2

Length: 652 ft

Channel easement corridor width: 73 ft

Average top-of-bank width: 49 ft

(b) Lichau Cr looking upstream from near Stony Point Rd.; linear and incised channel conditions continue through reach downstream of photo a to photo b site; riprap seen along both northern and southern banks, with gravel augmented southern top-of-bank area seen to right (Jan. 08, 2009).

Maintenance History

Lichau Creek – Reach 1

(a) Lichau Cr. upper Reach 1 looking upstream toward Hwy 101 from top of southern bank; channel is linear and deep within hardened incised banks; riparian trees grow along toe of southern bank inset within channel; top of southern bank has been augmented/heightened 5 ft. with additional gravel placement, seen to right (Jan 08, 2009).

PHYSICAL CONDITIONS

Reach setting: lowermost section of Lichau Creek, where Lichau Cr. crosses lower Petaluma River floodplain and joins the mainstem river; Lichau Cr. is confined within a linear alignment flowing directly to Petaluma River; agricultural area to north and trailer type home park to south. Wide bench-floodplains observed in Reaches 3/2 upstream no longer present.

Active channel: active channel is wide (20-25 ft) incised within overall channel, 15-20 ft. deep below top-of-banks in upper reach (photo a) and 10-15 ft. deep in lower reach (photo c), slow moving water, depths 1-3 ft. observed in Jan. 2009.

Bed sediments/texture: some sands observed along lower banks of upper reach, and finer sediments and silts observed within emergent vegetation in lower reach (photo c).

Bank structure: northern banks are generally earthen with some rip-rap support; southern banks are rip-rapped throughout with gravel extension (photos a/b); bank slopes are steep to north (1:1) and near vertical, and less steep to south (2:1) (photo c).

Water quality: stagnant pools were observed in both reaches in Oct. 08, with shallow slow moving water in Jan 09, no trash observed.

Channel processes: linear "shooting" reach where fast moving stormflows enter the confined and linear channel from upstream Reach 2 and "shoot" straight downstream toward the Petaluma River; some backwatering may occur depending upon Petaluma River level when flows merge.

BIOLOGICAL CONDITIONS

Vegetation composition: Outer bank vegetation is primarily ruderal (photo c), though riparian woodland growth is observed along the toe of the southern active channel bank (photo a). Density of riparian trees is greatest in upper reach and decreases downstream. Emergent wetland vegetation comprises 70% of the in-channel area, most strongly in the lower reach (photo c).

Riparian corridor and canopy closure: Dense riparian forest in upper reach provides up to 75% canopy cover; this corridor gradually becomes more of a riparian woodland, and canopy is decreased to approximately 25%. The area nearest to the Stony Point Rd crossing has little to no cover (0-5%).

Instream habitat: linear "shooting" reach provides wet instream habitat, though not as complex or varied as the broader floodway upstream in Reaches 3 and 2; best habitat occurs at confluence with Petaluma River, where areas along the river margin provide a mix of wetted conditions and bank forms.

Listed species with potential to occur: Reach is a migratory corridor for steelhead, potential habitat for western pond turtle.

(c) Looking upstream from Stony Point Rd. crossing; note steep near vertical banks to left (north) and banks to right (2:1) not quite as steep; rip-rap supports banks to both sides; riparian trees seen inset within channel in distance, in near ground more emergent in-stream channel vegetation; in Jan 09, channel flows are generally less than 2 ft. deep (Jan. 08, 2009).

(d) Lichau Cr. confluence with Petaluma River, downstream of SCWA maintenance reach (Jan. 08, 2009).

Management Considerations and Opportunities

Management considerations of Lichau Cr. Reach 1 focus on the potential flooding to the neighborhood immediately south of the channel. The southern channel bank has been heightened 5 ft. with placement of gravel, though this gravel is unconsolidated. No cross limb vegetation is observed in the channel. Some moderate development of cattails at the lower end of reach near Stony Point Rd. crossing. These cattails and any accumulated sediment depositing there should be evaluated for potential removal if conveyance capacity is reduced. Riparian tree plantings along the top of the northern and southern banks would benefit by making the riparian vegetation corridor denser and linking the corridor between the Petaluma River mainstem downstream and the wider riparian sections of Lichau Cr. observed upstream in Reaches 3 and 2.

Jurisdiction: Engineered Easement

Location: From 101 to Old Redwood Highway

Adjacent Land Use: Industrial Zone and open space

Upstream: Lichau Creek, routinely maintained by SCWA

Length: Lichau 3: 1,115

Channel easement corridor width:

Lichau 3: 115 ft.

Average top-of-bank width: 45.5 ft.

(a) Reach 2 looking downstream from McDowell Blvd. crossing; steep bank (1:1) to left, wide active channel (+20 ft.), and wide bench-floodplain to right (+50 ft) with mature riparian trees. (Jan 8, 2008).

Maintenance History

In Summer 2012 sediment removal occurred on 2,000 linear feet within Reaches 3 and 2 (photos c and d, respectively). Tier 1 mitigation intended to: increase channel shading through toe canopy development; establish a functioning understory shrub zone and; establish instream graminoids that contribute to the stabilization of the low-flow channel occurred in December 2012.

(b) lower Reach 2 looking downstream toward Hwy. 101; elevated floodplain seen to center-right of photo constricts lower Reach 2 channel from north; lower Reach 2 channel becomes straighter, narrower, and deeper in final section of reach toward Hwy 101 (October 26, 2008).

Physical Conditions

Reach setting: Lichau Creek is a tributary to the Petaluma River, draining an area northwest of the town of Petaluma; engineered and straightened in the 1950's.

Active channel: low-flow channel is narrow (8-10 ft) set within broad floodway channel (~45 ft.); the water level is 10 ft below top-of-bank; flow depths of 6-24 in. observed in May 2012;

Bed sediments/texture: array of sediment textures distributed across floodway cross-section, with silts, sands, some gravels in active low-flow channel, and mix of sands/silts across bench-floodplain within overall floodway (photo a).

Bank structure: banks are earthen, and historically have been heavily eroded. The southern bank of both reaches is steeper than the northern bank; south bank ranges from 1:1 in upper/mid Reach 3 and Reach 2 with some vertical sections to 2:1 in lower Reach 3; northern bank is generally 1:1 and stepped down onto bench-floodplain north of active channel (photo a).

Water quality: Relatively clear with some industrial runoff.

Channel processes: one of the larger floodways seen in entire SMP Program Area; floodway is wide enough to experience floodplain type depositional processes in the wide bench north of the active channel; secondary back channels are observed in bench-floodplain that convey flows under higher river stages.

Biological Conditions

Vegetation composition: after the vegetation removal activities and subsequent sediment removal projects of 2012 it was observed that riparian trees spaced 10-40 feet line the majority of the low flow channel and consist mainly of arroyo and red willow, cottonwoods and ashes. Upper bank tree growth is most mature on the south side of reaches 3 and 2 and consists mainly of coast live oak and pines. Understory vegetation on the south bank is dominated by large thickets of Himalayan blackberry extending from the top-of-bank to the toe. The north bank within reaches 3 and 2 largely lacks any understory shrub growth and is covered mostly by grasses. In December 2012 small pockets of native riparian graminoids including tule, spike rush, and several species of Juncus were observed colonizing the bench floodplain of Reaches 3 and 2. See Section 3 of the 2012 Annual SMP Report for details regarding the 2012 Tier 1 mitigation activities that aims to improve the long-term vegetation composition within these Reaches.

Instream habitat: low-flow channel provides a series of riffles/runs throughout; adjacent bench-floodplain (best seen in photo a) provides wide expanse of riparian habitat suitable for a myriad of birds, amphibians, etc. The instream area is largely clear of persistent vegetation growth. Bench-floodplain is inundated with moderate storm events and provides a wet environment for some duration following storms.

Riparian corridor and canopy closure: the perennial riparian corridor along the active channel is 5-15 wide on each bank; canopy closure is between 0-50%. The water flow is inconsistent during the dry season and portions of the channel are completely desiccated during summer months. In some sections of the channel, small puddles of water filled with decaying fish were observed (May 2012).

Listed species with potential to occur: known migratory habitat for steelhead, potential habitat for western pond turtle.

(c) Reach 3 looking downstream from Old Redwood Hwy. after sediment removal (October 2012).

(d) Reach 2 looking downstream from Mcdowell Blvd. crossing after sediment removal (October 2012).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations at Lichau Creek Reaches 3 and 2 include the development of a mature riparian canopy to shade the low-flow channel. Opportunity to continue the development of a diverse understory that provides better habitat for migrating birds and other wildlife also exists. In December 2012 it was observed that the floodway is large enough and the McDowell Blvd. Bridge is set high enough that a loss of channel capacity does not appear to yet be an issue. However, over the longer-term sediment accumulation will continue on the bench-floodplain, so hydraulic conditions and available flood capacity should be evaluated annually. Other considerations include the shearing and vertical sections of the southern bank, which may need stabilization over time. The lower section of Reach 2 becomes narrow and incised heading toward Hwy. 101 and should also be inspected annually for additional bed and bank erosion.

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: Highway 101 to Petaluma River confluence

ADJACENT LAND USE: Single family residential to south and open space to north

UPSTREAM: Non-SCWA maintained reach of Lynch Cr.

LENGTH: 1,277 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 132 ft

AVERAGE TOP-OF-BANK WIDTH: 51 ft

(b) Stagnant water between areas of in-channel vegetation growth. Mid-reach, looking upstream (October 26, 2008).

MAINTENANCE HISTORY

Lynch Creek – Reach 1

(a) Lynch Cr. Reach 1, upper reach looking upstream to Hwy 101 crossing; abundant cattail growth blocks channel bed; steep banks and relatively deep channel (Jan. 8, 2009).

PHYSICAL CONDITIONS

Reach setting: Similar to Washington, Corona, and Lichau creeks, Lynch Cr. drains Sonoma Mtn. westward toward the Petaluma River; Reach 1 is the lowermost stream reach, just above the Petaluma River confluence.

Active channel: active channel bed is 12-20 ft wide, 12-16 ft. below top of banks.

Bed sediments/texture: silts and mud are deposited among cattail stands downstream of Hwy (photo a); but reach includes sands too and some pebbles and coarser sediments mixed with sloughing riprap at Petaluma River confluence (photo d).

Bank structure: banks are earthen and generally steep (1.5:1 – 2:1) with trapezoidal form; bank heights of 12-16 ft.

Water quality: water moves slowly; stagnant pools form between areas of in-channel vegetation growth (photos a, b, c)

Channel processes: Reach 1 is a straight connecting reach to the Petaluma River confluence; channel profile is governed by hardened drop structure at Petaluma River confluence (photo d) which maintains a gentle gradient upstream through the reach, resulting in deposited sediments and cattail growth through reach (photos a/b).

BIOLOGICAL CONDITIONS

Vegetation composition: bank vegetation is primarily ruderal (grasses) along the northern bank and mixed riparian scrub (willow scrub and blackberry) along the southern bank and in some channel locations. Emergent wetland vegetation, primarily cattails, covers approximately 75% of the in-channel area.

Riparian corridor and canopy closure: Willow and mixed riparian scrub provide a 15-20% cover along the reach, increasing near the upstream Hwy 101 crossing (photo a).

Instream habitat: high drop structure at Petaluma River (photo d) controls connectivity to the River either during higher tide stages or otherwise higher river stages; instream habitats are limited by several cattail thickets which block flows.

Listed species with potential to occur: Reach is a migratory corridor for steelhead, potential habitat for western pond turtle.

(c) Rip-rapped and grouted confluence with Petaluma River (October 26, 2008).

(d) Looking downstream at banks and canopy cover near upstream end of reach (October 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Lynch Cr. Reach 1 focus on vegetation and sediment removal downstream of the Hwy 101 crossing where a thick and tall cattail stand has developed (photo a). Additional cattail and sediment removal may be warranted further downstream. Opportunities to plant riparian trees along the southern bank that would mature and provide increased canopy closure should be evaluated in combination with any vegetation and sediment removal project.

JURISDICTION: Owned and maintained by SCWA

LOCATION: Reach 2: Caulfield Lane to Lakeville Hwy
Reach 1: Lakeville Hwy to ~250 ft downstream

ADJACENT LAND USE: Reach 2: Residential on east and Hwy 101 on west
Reach 1:Parking lot on east and field on west

UPSTREAM: McDowell 3- underground conduit

LENGTH: McDowell 2: 2,051 ft.

McDowell 1: 525 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

McDowell 2: 54 ft.

McDowell 1: 112 ft.

AVERAGE TOP-OF-BANK WIDTH: McDowell 2: 61 ft.

McDowell 1: 71 ft.

(b) Mid Reach 2 looking upstream. The active channel is distinguished by the green band of rushes, sedges, and grasses. There was shallow surface water flowing through the dense emergent vegetation in this section of the reach (Aug 2008).

MAINTENANCE HISTORY

(a) Top of Reach 2, looking downstream. The concrete beam in the foreground is the top of the culvert system that marks the beginning of "daylighted" McDowell Cr. Channel is straight and confined between an access road on east side and Hwy 101 on the west side (Aug, 2008).

PHYSICAL CONDITIONS

Reach setting: McDowell Cr. appears to have a limited watershed with most surface flow coming from localized urban runoff from the immediate surrounding areas; Reach 2 is not tidally influenced due to tide gates downstream of Lakeville Hwy, while Reach 1 is strongly tidal and hydraulically connected to the Petaluma River throughout the year.

Active channel: 2-8 ft wide through Reach 2 with wider sections in the upper reach and below the East Fork confluence, and narrower sections in the middle reach; channel depth 4-6 ft., below banks; flow depths ranging from 2-4" along vegetated portions and 6-18" in open areas. Reach 1 active channel is ~20 ft wide with water depth depending on tides.

Bed sediments/texture: Silt and fine muds dominate the bed in both reaches.

Bank structure: In Reach 2 slopes are generally between 2:1 or 1:1, 4-6 ft.; banks are earthen with riprap support (photo b). In Reach 1 the banks are closer to 3:1 of 4:1 with soil over riprap (photo d).

Channel processes: This channel has been straightened in both reaches and maintains a trapezoidal geometry. Reach 2 contains a common pattern of longer runs dominated by shallow diffuse flow, punctuated by smaller pools that are clear of emergent vegetation. Reach 2 appears to be aggrading with small bars visible at bends and wedges, visible where emergent vegetation covers the channel.

Water quality (qualitative): either green and turbid (runs) or covered with algae (pools).

BIOLOGICAL CONDITIONS

Instream habitat: Habitat for fish is limited by the dominance of shallow dry season flows; degraded water quality, lack of habitat complexity and a lack of a physical connection to the Petaluma River and marsh due to tide gates at Reach 1 (photo d). Reach 2 does maintain some aquatic habitat that could be used by amphibians, there is no deep water refuge and the channel contains almost no complexity. Reach 1 habitat is more similar to a tidal slough than a fluvial system and likely supports an assemblage of warm water fish and other aquatic species known from the Petaluma River.

Vegetation composition: The reaches support a very narrow and sparse riparian corridor along the upper 500 ft of Reach 2 consisting of a mix of shrubs (coyote brush, etc) and coast live oaks, liquid amber, and arroyo willow (photos a and b). Most of the riparian corridor and channel is dominated by herbaceous species with rushes, sedges, curly doc, and hairy willow herb in the channel and fennel, teasel, annual grasses and an array of other weedy species along the upper banks and beyond (photo b and c).

Riparian corridor and canopy closure: very limited canopy closure ranging from 0% (photos c and d), which is the dominant situation to 25-50% in the upper portions of Reach 2 (photo a).

Listed species with potential to occur: salmonids are not known from these reaches, but juvenile steelhead could be found in Reach 1, potential habitat for western pond turtle.

(c) Reach 2 downstream of the confluence with the East Fork of McDowell Cr, looking downstream. Active channel is distinguished by the green tules, sedges, and grasses. This part of the Reach supported shallow surface water in August 2008, which was diffused through the dense vegetation.

(d) Reach 1 looking downstream from above the tide gates. Channel form and vegetation in this reach reflects tidal processes and is much different than the upstream channel forms which are protected from tidal action by the tide gates. SCWA ordinarily does not perform maintenance activities in the area subject to tides below the tide gates (Aug 2008).

Management Considerations and Opportunities

Management considerations for McDowell Creek Reach 2 and 1 focus on Reach 2 due to the historically limited management by SCWA in the tidally influenced Reach 1. In Reach 2 future management will likely include vegetation and/or sediment removal at key deposits and sediment wedges to increase channel capacity (if capacity is compromised). Sediment deposits in Reach 2 should be evaluated for their potential removal. Reach 2 would also be a good candidate reach for canopy enhancement as there is virtually no canopy along most of the reach.

Jurisdiction: Owned in-fee and maintained by SCWA

Location: St Francis Dr. to McDowell Creek confluence

Adjacent Land Use: 75% Residential with a vacant field occupying 25% along the lower southern side of the channel

Upstream: Series of Storm Drains

Length: 1,311 ft

Channel easement corridor width: 73 ft

Average top-of-bank width: 34 ft

(b) Middle of East Fork Reach 1 looking across the channel. This was just one of a few storm drain outfalls entering the channel from both sides. Most of the outfalls are surrounded by sacrete or grouted rip-rap (Aug 2008).

Maintenance History

East Fork McDowell Creek – Reach 1

(a) East Fork looking downstream from pipe at the top of Reach 1 near St. Francis Dr. This pipe is the conduit for all flows into the reach and appears to be 60" in diameter. Note the dense vegetation all around the pipe outlet. In August 2008, a steady trickle of water was coming from the pipe and feeding the downstream channel,

PHYSICAL CONDITIONS

Reach setting: East Fork Reach 1 is a tributary to McDowell Creek. The East Fork drains runoff from the residential neighborhood upstream to the north/east, but does not drain a large watershed; East Fork, Reach 1 has its confluence with McDowell Cr. in the lower portion of McDowell Cr. Reach 2, which then drains south toward McDowell Reach 1 and the Petaluma River marsh.

Active channel: 10 ft wide, 6-8 ft. deep below banks, with flow depths ranging from 6- 12". (photos c and d).

Bed sediments/texture: dominated by a mix of gravel, sand, and silt.

Bank structure: bank slopes are generally between 2:1 or 1:1 with rip-rap and/or soil; sacrete and grouted rip-rap are found around the primary culvert outfall (photo a) as well as a number of secondary outfalls (photo b) and at the confluence.

Channel processes: this channel has been straightened and is not connected to any headwater lands, but rather drains the local developed watershed. Channel appears to be aggrading in some areas with in-channel gravel bars (photo c) and a depositional wedge just above the McDowell Cr. confluence.

Water quality (qualitative): degraded with a strong brown coloration (photo d) and multiple algae clumps.

BIOLOGICAL CONDITIONS

Instream habitat: Habitat in this reach is limited by the dominance of shallow, uniform runs broken up by occasional mid-channel bars. Most of the channel has maintained its shallow flat trapezoidal geometry which leads to a lack of complexity in the channel; however the mid-channel bar and some undercut banks create some habitat complexity. Should be noted that the lower reaches (photo d) where flows were wider and deeper were teeming with *Gambusia* and other warm water fish.

Vegetation composition: The reaches support a narrow, but dense riparian corridor along most of its length, which is dominated by oaks along the banks (photo b and d). There are very few willow or alders along the toe of slope and understory is dominated by ivy, fennel and grasses with some tules in the channel at breaks in the canopy (photo b and d).

Riparian corridor and canopy closure: 10-15 ft. wide corridor on each bank with canopy closure ranging from 0-50% with about half the channel nearing 50% closure.

Listed species with potential to occur: salmonids are not known from this reach and occurrence is highly unlikely due to lack of spawning or rearing habitat upstream and the presence of tide gates downstream; potential habitat for western pond turtle.

(c) Middle of East Fork Reach 1 looking downstream at a small mid-channel gravel bar. Three small bars, including this one, were observed along the Reach 1 during surveys in August 2008.

(d) Lower East Fork Reach 1 just upstream from the confluence with McDowell Creek Reach 2. Note both the wide flat channel and amount of water in the channel. The lower portion of the East Fork appears to be controlled by the sediment wedge at the confluence with McDowell Cr. which seems to be backing-up water from the East Fork (Aug. 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for the East Fork of McDowell Creek focused on removal of sediment and emergent vegetation at the top of the channel directly downstream from the 60" culvert (primary outfall) and removing sediment at the confluence with McDowell Cr. where the sediment wedge appears to be causing backwatering. The numerous culvert outfalls entering the East Fork from adjoining residential areas should be checked regularly and maintained as necessary. Additional canopy planting at the upper end and lower end of the reach could increase the habitat viability for riparian species.

JURISDICTION: Owned by the City of Petaluma, SCWA maintenance agreement

LOCATION: Westridge Drive downstream to Sunnyslope Road

ADJACENT LAND USE: Public parkway and single family residential

UPSTREAM: non-maintained Thompson Cr. headwaters

LENGTH: 1,856 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 94 ft

AVERAGE TOP-OF-BANK WIDTH: 44 ft

(b) Upper Reach 1, downstream of photo (a); actively eroding bank seen with 5 ft. vertical face; this section of upper reach is steeper than the middle and lower reach sections downstream (Dec. 16, 2008).

MAINTENANCE HISTORY

Thompson Creek – Reach 1

(a) Thompson Cr. Reach 1, looking downstream from below Westridge Dr. Wide channel easement along parkway, gentle sloping banks, channel includes emergent cattails and willow vegetation (Dec. 16, 2008).

PHYSICAL CONDITIONS

Reach setting: Thompson Cr. is a north-flowing tributary of the Petaluma River, draining a relatively small watershed; Reach 1 collects runoff from the residential neighborhood immediately upstream (via culvert) and the immediately adjacent neighborhoods (Figure 4-47); further upstream the watershed is undeveloped; moving downstream the watershed is entirely developed.

Active channel: Reach 1 has a very wide corridor parkway easement (photos a/c); active channel within wide cross-section is relatively small, widths ranging from 2-8 ft. and generally 3-4 ft deep, with flow depths of 6-18 in; channel profile is noticeably steeper in upper reach than lower reach

Bed sediments/texture: mostly medium and fine sands, with some fines collecting in slow moving zones where cattails have developed downstream; sloughing riprap contributes cobbles near Sunnyslope crossing.

Bank structure: earthen slopes are very gentle (3:1 or greater, photo a); streambank at erosion spot of photo b is comprised of mostly clay with some sand and appears cohesive.

Water quality: generally clear and slow current observed (Oct. and Dec. 2008); stagnant water and algae growth between areas of emergent vegetation in lower reach.

Channel processes: upper Reach 1 is a steeper reach that shows some higher velocity conditions (including bank erosion, photo b); channel slope lessens in the mid reach zone and the channel becomes more depositional, including pooling behind cattail blocks toward its lower end.

BIOLOGICAL CONDITIONS

Vegetation composition: the reach supports a narrow riparian corridor along most of the length, which is predominantly willows and oaks (photos c/d). The upper banks are mostly parkland grasses, with more scrub/ruderal grasses nearer to the channel (photo a); channel has sections of extensive blackberry growth in the mid reach (photo c), with some limited areas with blackberry growth (photo b). Emergent wetland vegetation is limited, though covering approximately 20% of the in-channel area in discrete blocks throughout the reach.

Riparian corridor and canopy closure: 10-15 ft. narrow corridor on each bank with canopy closure ranging from 15-20% through most of the reach and increasing to 75% at the far upper and lower ends of the reach.

Instream habitat: Culvert draining Thompson Cr. to the upper reach disconnects open stream to its headwater areas upstream; within reach, instream habitats include steeper channel chutes in the upper reach, and then more of a pool/run sequence in the mid and lower reach with pools being defined by cattail blocks.

Listed species with potential to occur: Potential habitat for California red-legged frog and western pond turtle.

(c) Mid Reach 1, looking downstream; central reach area has wide easement with gently sloping banks; active low flow channel is relatively narrow here (3-4 ft and 2-3 ft deep) with adjacent banks covered in blackberry (Dec. 16, 2008).

(d) Lower Reach 1, 500 ft upstream of Sunnyslope Rd.; channel is 4-6 ft. wide and 2-3 ft. deep; blackberry persists along with sections of dense cattails. Willows and other trees provide riparian canopy along the immediate channel zone (Dec. 16, 2008).

Management Considerations and Opportunities

Flood management considerations at Thompson Cr. Reach 1 do not appear critical at the time of the channel assessment. The wide parkway easement provides a wide corridor with gently sloping banks that appears to accommodate stormflows from this smaller watershed. The culvert crossing downstream at Sunnyslope Rd. is not currently impacted by sediment accumulation, but should be assessed annually for potential build up of sediments. In the upper reach there is one 50 ft. section of eroded bank (photo b). This bank erosion does not appear to present a flooding concern, but SCWA may want to monitor this erosion for additional bank retreat. Additionally, because this is a park area, the bank erosion presents a vertical 5+ ft. face that may pose a danger for park users. Vegetation management of reach may focus on blackberry removal in the mid reach locations (photo c) and also removal of cattail stands which are trapping sediment. These cattail stands occur as discrete 15-30 ft. sections throughout the reach.

Jurisdiction: Owned and maintained by SCWA

Location: Reach 2: Madison St. downstream to Holly Lane

Reach 1: Holly Lane downstream to Petaluma River confluence

Adjacent Land Use: Single family residential, toward Petaluma River some parkland along northern bank area

Upstream: Washington Creek Reach 3

Length: Washington 2: 310 ft.

Washington1: 1,027 ft.

Channel easement corridor width:

Washington 2: 70 ft.

Washington 1: 68 ft.

Average top-of-bank width:

Washington 2: 33 ft.

Washington 1: 44 ft.

(b) Mid Reach 1, man is pointing toward failed culvert outfall that is destabilizing southern bank, sheet-piled flood wall runs along southern bank above failed culvert, on northern banks, grassy access road area provides overbank capacity, with recently deposited sands observed beneath man (May 06, 2008).

Maintenance History

(a) Reach 2 looking downstream from Madison St. crossing to Holly Lane crossing. Note in channel willow growth and sediment accumulating at downstream end of crossing, hardened banks (May 06, 2008)

Physical Conditions

Reach setting: Reach 2 is an intermediate short reach between the Madison St. and Holly Ln. crossings, Reach 1 is the lowest section of Washington Creek that meets the Petaluma River. Importantly, Reach 1 experiences tidal flows, Reach 1 is also part of the large USACE Petaluma River flood control project and has large flood walls along its far upper southern bank.

Active channel: upper reach 12-15 ft wide bed, narrowing to 8-10 ft wide channel in mid reach, and then widening again at Petaluma River confluence. Water depth 1-2 ft. deep under low flow conditions, Reach 1 is a wide channel corridor.

Bed sediments/texture: some large cobbles and boulders in upper reach eroded from local riprap, most of channel bed is sand, with sand also deposited on overbank bench (photo b), downstream toward Petaluma River confluence, finer muddy sediments observed in areas experiencing tidal flows.

Bank structure: large channel cross-section, with hardened flood wall along southern edge of channel corridor, inset within corridor, riprap and other hardened culvert outfalls (photo b), northern bank is earthen and more gently sloped (photo b).

Water quality: expected that salinity of lower Reach 1 reflects brackish conditions of fluvial/tidal transition.

Channel processes: estuarine condition where creek flows meet fluctuating tidal base level, higher streamflows emerging above bank on to northern bench, failed culvert (photo b) causing flow deflection and bank erosion on opposite bank.

BIOLOGICAL CONDITIONS

Vegetation composition: Bank vegetation is primarily ruderal (grasses) along the northern channel margin and bank, and more riparian woodland along the southern channel margin. Channel canopy is not well developed, with 25 to 50% canopy closure over the creek. There are also areas of willow scrub and blackberry (along southern bank). Approximately 10% of this reach has emergent wetland vegetation (primarily tule and cattail) and the lower reach has brackish-tolerant vegetation that sustains under tidal flow conditions.

Riparian corridor and canopy closure: In upper reach, large oaks and riparian woodland vegetation provide some channel canopy closure (up to 50% max).

Instream habitat: Lower Washington Creek is perennial due to its lower watershed setting and its tidal condition at its lower end. Connection to the larger Petaluma River provides habitat corridor to baylands downstream. Crossing at Holly Lane may pose barrier to fish.

Listed species with potential to occur: salmonids are not known from these reaches, but are known from the Petaluma River downstream, potential habitat for western pond turtle.

(c) mid Reach 1 looking downstream, bank erosion next to man caused by flow deflection from failed culvert seen in photo b (May 06, 2008).

(d) mid Reach 1 looking downstream, channel shows sign of tidal flows, as seen in cut-bench on bank to left – transitional area with vegetation that is brackish tolerant (May 06, 2008).

(e) lower Reach 1 at confluence of Washington Creek and Petaluma River, flood wall protection of Petaluma River seen in distance above opposite bank (May 06, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Reach 1 Washington Creek focus on the immediate priority of repairing the failed culvert outfall noted in photo (b). This failed culvert is causing bank erosion in its immediate location along the southern bank and is also deflecting flows to the northern bank and causing erosion there (photo c). Maintenance of that culvert is likely the responsibility of the USACE as part of their flood management improvements to the reach. SCWA may inquire to USACE as to the status of maintenance or repair of the failed culvert.

Washington Creek – Reach 3

JURISDICTION: SCWA owned and maintained channel

LOCATION: Upstream of Madison St. to the Hwy 101 off-ramp to E. Washington St. (see Figure 4-45)

ADJACENT LAND USE: Single family residential north of creek and multi-family residential and open space south of creek

UPSTREAM: CalTrans owned reach between Reach 3 and Hwy 101; Reach 4 upstream of Hwy 101

LENGTH: 1,195 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 101 ft

AVERAGE TOP-OF-BANK WIDTH: 44 ft

(b) Mid Reach 3 at westward bend in channel, bend zone characterized by much deposition along bed and abundant cattail growth. Man on right of photo is standing on 2-4 ft of accumulated sediment on channel bed (May 06, 2008).

MAINTENANCE HISTORY

(a) Upper Reach 3 downstream of Hwy 101 off ramp - looking downstream. Note grouted riprap and steep bank; 12-15 ft channel width at bed, stagnant water with algae (May 06, 2008)

PHYSICAL CONDITIONS

Reach setting: Reach 3 is bound by the large concrete drop structure beneath the Hwy 101 off ramp (upstream) and the hardened culvert crossing at Madison St. (downstream); between these structures the reach is characterized by sediment deposition at the westward channel bend (photo b), cattail growth (photos b, c, d), and large trash items.

Active channel: upper reach 12-15 ft wide bed, narrowing to 8-10 ft wide channel in lower reach, water depth ~ 1 ft. deep, with stagnant backwatering behind 3 dense cattail stands

Bed sediments/texture: some large boulders downstream of drop structure, but mostly medium and fine sands with some fining to sands and silts downstream.

Bank structure: steep armored banks in upper reaches; bank slopes ~ 1:1; (photo a), transitioning to earthen banks in lower reach with broad upper bench (occupied by access road) as seen in the left side of photo d.

Water quality: reach is impacted from stagnant water, algae growth, and large trash items (couches and computer monitors in creek or along banks) (observed 5/06/08).

Channel processes: flows are accelerated through drop structure at upper reach, downstream toward channel bend, flows overtop low flow channel on to northern bank – reducing velocity – and causing deposition within low flow channel (photo b), above the

crown of northern bank, and on to access road (photo d).

BIOLOGICAL CONDITIONS

Vegetation composition: Vegetation in this reach is primarily ruderal areas along the adjacent uplands and higher banks, and some intermittent riparian woodland along the banks. Channel canopy is not well developed with 0 to 25% canopy closure over the creek. There are also areas of willow scrub and blackberry (along southern bank). Approximately 25% of this reach has emergent wetland vegetation (primarily tule and cattail) located in 3-4 large stands that block the channel.

Riparian corridor and canopy closure: thin and intermittent woodland corridor; canopy closure between 0-25%.

Instream habitat: Reach 3 in lower watershed remains perennial in most years; habitat is limited by generally shallow and stagnant flow through emergent vegetation growth across the channel bottom, lack of canopy, and large drop structure and hardened banks at upper reach.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) mid Reach 3 looking downstream, exemplifies typical reach section with dense cattail stand blocking flow creating a stagnant pool in channel, steep bank to left covered in blackberry, most of bank to right covered in grasses with occasional riparian woodland like oak tree seen to right (May 06, 2008).

(d) lower Reach 3, looking upstream from Madison St., abundant sediment and vegetation shown upstream of crossing causes partial blockage of culvert entrance; in distance access road provides bench and shows evidence of flows exceeding the low-flow channel (May 06, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

In the fall of 2008 sediment and vegetation were removed from the immediate Madison St. crossing area (area of photo a). SCWA maintenance crews also removed trash from the channel. Maintenance considerations for Reach 3 now focus on removing the accumulated sediment that is collecting at the bend in the channel, downstream of the drop structure (area of photo b). Sediment removal at this location is not extensive or reach-scale, but rather, is smaller and more focused to reduce the accumulated sediment just at the channel bend. The accumulated sediment is causing some flows to exceed the channel and flow out on the adjacent bench where the access road passes. The sediment removal work will incorporate retaining and enhancing the existing geomorphic in-channel features while reducing down the accumulated sediments. Recommended sediment removal at the location shown in photo b can be integrated with additional on-site restoration and planting activities.

JURISDICTION: Owned by City of Petaluma with SCWA maintenance easement

LOCATION: N. McDowell Blvd. to Hwy 101

ADJACENT LAND USE: Shopping center and parking area to north, E. Washington Blvd. to south

UPSTREAM: Washington Creek Reach 5

LENGTH: 903 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 30 ft

AVERAGE TOP-OF-BANK WIDTH: 60 ft

(b) Reach 4 looking downstream, just downstream of photo a; this area flooded in 2005/06 into the parking lot and Big 5 store to the right; in-channel emergent vegetation of cattails and water plantain has vigorously returned, along with some renewed sediment deposited (Aug. 26, 2008).

MAINTENANCE HISTORY

Washington Creek – Reach 4

(a) Reach 4 looking downstream from N. McDowell; this section has experienced past flooding in 2005/6 with overbank flows out of channel to right into parking lot and Big 5 store; channel was cleared of sediment and vegetation in 2006, cattail growth and some sediment has returned (Aug. 26, 2008).

PHYSICAL CONDITIONS

Reach setting: Similar to Reaches 6/5 upstream, Reach 4 is bound to the south by E. Washington Dr. (photo a); this reach historically accumulates sediment and has flooded previously in 2005/06.

Active channel: 12-16 ft wide, 3-5 ft. deep beneath northern bank at shopping center parking lot in upper reach (photo b), and 2-4 ft. deep in lower reach (photo d);

Bed sediments/texture: channel bed contains a mix of mostly sand, with some silt; lower reach has more even distribution of deposited sediments across the entire bed width.

Bank structure: southern bank hardened along E. Washington Dr.; otherwise earthen banks of 2:1 slope along northern side of channel.

Water quality: in late Aug. 2008, Reach 4 had some ponding downstream of McDowell, but became dry further downstream; potential sediment quality concerns due to gas station concentrations along McDowell Blvd.

Channel processes: linear channel with few bed features, vigorous cattail growth in upper reach and renewed sediment deposition throughout reach; in lower reach sediments deposit as planar feature across entire bed width.

BIOLOGICAL CONDITIONS

Vegetation composition: In-channel emergent vegetation in the upper reach consists of cattails , tule, and water plantain that grow in the wet/moist environment with pools downstream of N. McDowell Blvd. Vegetation along banks includes oaks, eucalyptus, and Lombardy poplars; there are also areas of willow scrub and ruderal vegetation along the banks of the lower reach.

Riparian corridor and canopy closure: thin and intermittent woodland corridor; canopy closure between 0-25%.

Instream habitat: Reach 4 is constrained in each direction, immediately downstream is Hwy 101, beyond that there is a large drop structure (10-15 ft. high) at the top of Reach 3 which presents a barrier, similarly the culvert crossing at N. McDowell Rd above the reach is also hardened; areas to the north (parking lot) and south (E. Washington Dr.) are also hardened surfaces with traffic. As such the habitat surrounding of the reach is quite constrained. In-stream, the channel is historically depositional with the low-flow channel often being filled with sediment and creating a planar depositional channel bed.

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Lower Reach 4 looking upstream; tall Lombardy poplar trees seen in distance; in the lower reach the low-flow channel is less defined, and recently deposited sediments are distributed more evenly across the entire channel bed; willow scrub and ruderal vegetation fill channel bed (Aug. 26, 08).

(d) Lower Reach 4 looking downstream to Hwy. 101 crossing; soil to right is from a non-SCWA transportation project during the summer of 2008; sediment has been collecting in channel to left (Aug. 26, 2008).

Management Considerations and Opportunities

Management considerations for Reach 4 of Washington Creek focus on sediment removal immediately downstream of the N. McDowell crossing and further downstream throughout the reach. As described above, this reach is historically depositional (possibly due to the gentle gradient upstream of the large drop structure downstream in Reach 3) and has experienced past flooding (2005/06); due to this heightened propensity to collect sediment and flood, this reach requires careful evaluation each season. Current recommendation is to remove sediment throughout the reach including at the upper end just downstream of McDowell, but also at the lower end of the reach near Hwy. 101.

Jurisdiction: Owned by City of Petaluma-SCWA has maintenance easement

Location: Reach 2: Lakeville Hwy. to South McDowell Blvd.
Reach 1: South McDowell Blvd. to upper edge of salt marsh plain

Adjacent Land Use: commercial / office parks

Upstream: Adobe 3

Length: Adobe 2: 797 ft.

Adobe 1: 1,513 ft.

Channel easement corridor width:

Adobe 2: 140 ft.

Adobe 1: 157 ft.

Average top-of-bank width: Adobe 2: 97 ft.

Adobe 1: 116 ft.

(b) Mid Reach 2 - on the sandy, heavily vegetated bench/bar adjacent to the active channel. Debris lines mark past high water events; dense willow thicket provides good canopy but also presents flow obstructions; more fine sediment here than upstream reaches, but still pockets of gravels and coarse material. Reach 2 instream sediment basin is just downstream of this photo (Aug 2008).

Maintenance History

(a) Mid Reach 2, looking upstream: Low flow channel is dry, with evidence of recent flow or shallow subsurface flow present with dark, wet, muds in lower pools; Higher depositional bench seen to left in photo with abundant vegetation growth (Aug 2008).

Physical Conditions

Reach setting: Reach 2 and 1 continue the progression from a fluvial dominated system to a fluvial/estuarine system. Reach 2 includes an instream sediment basin and sediment removal area, just upstream of S. McDowell Blvd. Reach 1 extends to the Petaluma River Marsh, just beyond which the

channel drains into the wide flat marsh plain. These lower Adobe Cr. reaches are low gradient depositional environments.

Active channel: 10-12 ft wide, when there is only a single channel in Reach 2 (photo a), lower Reach 2 and Reach 1 both contain multiple channels morphology (photos b/c); only a few isolated pools of shallow (1-2") standing water were observed in August 2008.

Bed sediments/texture: Reach 2 – mostly sand/silt with occasional gravel lens, fining downstream; Reach 1 – sand and silt, and organic matter.

Bank structure: slopes are generally earthen, 2:1 and often gentler at 3:1 or less. There may be rip-rap below the soil, but it was not exposed.

Channel processes: From Reach 2 to Reach 1 the channel transitions from fluvial dominated to tidally dominated; the channel is approximately 60ft wide from toe to toe and resembles a backwater swamp with braided channels, multiple 2-3 ft high bars, and dense willows and organic matter covering the bar surfaces. Unlike Reaches 4 and 3 upstream, these reaches appear to be actively aggrading with significant sediment deposits and bars formed throughout both reaches.

Water quality (qualitative): There was very little surface water present in August 2008.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat in these reaches was limited to a few shallow, isolated pools during field surveys in August 2008. During dry season the dense leaf litter and shade likely provide habitat for a wide suite of riparian and wetland species. During the rainy season, these reaches are key migration corridors for steelhead as they migrate upstream to spawning habitat in the upper watershed. The dense riparian canopy also provides habitat for a wealth of birds and other riparian species.

Vegetation composition: The reaches support an active bench-floodplain approximately 40-60 ft wide, stretching from the toe of one bank to the toe of the other bank. This bench-floodplain is dominated by an even age stand of willows with an understory of rushes, sedges, and a number of wetland obligate herbs. There were also a few stands of ludwigia observed in Reach 1 in August 2008.

Riparian corridor and canopy closure: 60-75 ft wide corridor from top of bank to top of bank with a dense bench-floodplain between the banks; canopy closure ranges from 50%-100% with most areas falling within the 50%-75% range.

Listed species with potential to occur: steelhead are known to migrate through this reach, but no rearing or spawning habitat exists; both reaches are potential habitat for California red-legged frog and western pond turtle; salt marsh harvest mice, clapper rail, and a number of other marsh species are known from locations nearby Reach 1.

(c) Lower Abobe Cr. Reach 1 looking upstream: channel is recently dried and the substrate is dominated by mud and organic matter. The depositional bench/bar to left in photo extends 50 feet (off photo) and is regularly inundated by riverine and estuarine flows (Aug 2008).

(d) Lower Adobe Cr Reach 1 looking upstream from below SCWA easement. SCWA's easement appears to extend to the edge of the willows in the background. The channel in the foreground, packed with cattails, is within the marshland complex adjacent to the Petaluma River (Aug 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Adobe Creek Reaches 2 and 1 focus on sediment removal at the instream sediment removal basin at the lower end of Reach 2, upstream of S. McDowell Blvd. Sediment removal at the basin was initiated during September 2008 and will continue in the summer 2009 maintenance season. In addition to sediment removal, many of the willow thickets that grow on the sediment deposits will also be thinned and removed. According to SCWA, they generally do not maintain Reach 1 below the drop structure downstream of S. McDowell Blvd. due to its proximity to the Petaluma Marsh, the wide cross-section, tidal influence, and lack of infrastructure downstream.

Zone 3A Reach Sheets

Fryer Creek – Reaches 4, 3, 2 & East Fork – Reach 1

JURISDICTION: Owned and maintained by SCWA, small portion of E. Fork is maintained through easement

LOCATION: Downtown Sonoma between Andriex St. and MacArthur St.

ADJACENT LAND USE: Residential

UPSTREAM: Non-SCWA maintained drainage/swale (~1000 ft)

LENGTH: Fryer 4: 124 ft.

Fryer 3: 602 ft.

Fryer 2: 478 ft.

East Fork 1: 683 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Fryer 4: 67 ft.

Fryer 3: 26 ft.

Fryer 2: 68 ft.

East Fork 1: 101 ft.

AVERAGE TOP-OF-BANK WIDTH: Fryer 4: 41 ft.

Fryer 3: no data

Fryer 2: 49 ft.

East Fork 1: 80 ft.

(b) Reach 3, looking downstream (east) from 4th St W. Sediments collect at the toe of the bank, along the channel margin, pinch the active channel, creating a confined low flow channel (Nov 2008).

MAINTENANCE HISTORY

In 2012, accumulated instream sediment was removed from East Fork Fryer 1. The Sonoma Ecology center replanted the channel with riparian trees, shubs, and graminoids.

(a) Reach 4, looking downstream toward Andriex St. crossing. Erosion scar on the right bank adjacent to the box culvert. Also note small bars forming in this reach just upstream of the culvert (Nov 2008).

PHYSICAL CONDITIONS

Reach setting: Fryer creek runs north to south through the southwestern portion of the City of Sonoma. This creek system appears to be completely disconnected from a larger watershed, as upstream of Reach 4 the channel quickly turns to a small swale and then ends at W. Napa Street. Through these reaches the channel is heavily confined by development on both sides of the creek. Fryer Creek is a tributary to Nathanson Cr, which drains into Sonoma Cr.

Active channel: 8-10 ft wide in most locations (photo b and d), with the exception of the confluence area in photo c and downstream to Reach 1 where the channel opens to ~16-18 ft wide; depths range from 2”-2’ (photo a and c, respectively).

Bed sediments/texture: generally dominated by fine sands and silts.

Bank structure: mostly earthen with isolated areas of rip-rap and gently sloping banks.

Channel processes: Channel receives flows and sediment from a small urbanized catchment. Most of Reaches 4, 3, 2, and the E. Fork Reach 1 show signs of deposition with a low flow channel flowing through a

vegetated channel bottom (photos a and d) or a low flow channel cutting through in-channel deposits.

Water quality (qualitative): moderate in November 2008, with limited stagnation and flows somewhat turbid or greenish.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat is limited by a lack of complexity in these reaches. Most areas have shallow diffuse flow with no pools or riffles and no other features that would provide aquatic habitat. The confluence of Reach 2 and the E. Fork is the only area with deep water and significant stands of emergent vegetation (cattails). This system also appears to be completely disconnected from any upstream watershed, so it is unlikely to function as a migration corridor for aquatic species.

Vegetation composition: These reaches support only scattered trees, most of which are planted redwoods (photo b) or other landscaped varieties. Most of the vegetation is herbaceous with grasses dominating the banks (photo b and d) and an array of grass and blackberries with some sedges and other herbs growing in the active channel.

Riparian corridor and canopy closure: none

Listed species with potential to occur: potential habitat for western pond turtle.

(c) Fryer Cr. Reach 2, at the confluence with the East Fork. The section of channel downstream of the confluence is unique within the Fryer system as this is one of the only areas where the channel is wide, open, and full of cattails (Nov 2008).

(d) East Fork of Fryer Creek, Reach 1, looking downstream from 2nd Street W. Flow is diffuse through vegetation covering the active channel; there is no canopy of trees in this reach. Also note the relatively narrow channel easement and proximity to residences (left) (Nov 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Fryer Creek Reaches 4, 3 and 2 and Reach 1 of the E. Fork should be determined based on flood conveyance. Observations in November 2008 did not suggest that the current extent of sediment bars and in-channel vegetation are presenting a flood capacity issue. These observations should be checked and at least Reach 2 should be monitored annually for future consideration of sediment removal. Also, sediment bars upstream of the crossing at the confluence of the E. Fork and Reach 2 should be checked periodically as the wedge of sediment at this site appears to be aggrading and may pose a flood management issue in the future. The same is true for the crossing at Reach 4, although this site does not appear to receive much flow. These reaches could all benefit from canopy enhancement and removal of non-native vegetation species.

JURISDICTION: Owned by City of Sonoma, maintained via easement

LOCATION: Adjacent to Fine Ave. and parallel to Dewell Dr.

ADJACENT LAND USE: Nathanson Cr. Park, and Residential

UPSTREAM: Modified reaches, non-maintained by SCWA

LENGTH:

CHANNEL EASEMENT CORRIDOR WIDTH:

AVERAGE TOP-OF-BANK WIDTH:

(b) From top of Nathanson Bypass, looking downstream. Notice the bypass is simply a wide trapezoidal channel. SCWA conducted vegetation maintenance in the summer of 2008 leading to the conditions observed in November 2008.

MAINTENANCE HISTORY

Nathanson Creek – Bypass

(a) Nathanson Creek looking downstream to inlet of the bypass channel (to left) and the Nathanson Cr. channel (to right) Nov, 2008.

PHYSICAL CONDITIONS

Reach setting: Nathanson Creek is a modified channel flowing north to south through the City of Sonoma. The bypass channel (located in Nathanson Cr. Park) provides stormwater diversion when flood waters are high enough to enter the inlet (photo a) and inundate the wide gradient bypass (photo b).

Active channel: ~30-40 ft from toe to toe, shallow depth 2-4 ft.

Bed sediments/texture: generally a mix of gravel and coarse sand with finer material deposited behind stumps.

Bank structure: very wide channel with gentle trapezoidal banks, banks are earthen.

Channel processes: The inlet elevation is set by the bed elevation of the inlet (photo a) when water rises in Nathanson Cr and enters the inlet, flows then enter the bypass. The bypass is wide and maintains a very low gradient (photos b and c); at downstream end of bypass, the channel narrows, steepens, and meets the creek again (photo d).

Water quality (qualitative): dry unless flooding, channel mostly collects leaf litter

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat is limited to punctuated events when the bypass floods and is temporarily inundated. Observations suggest that inundation does not last long enough to support aquatic habitat. None the less, various aquatic species might migrate through or forage in the bypass either in dry or wet conditions.

Vegetation composition: The bypass was generally devoid of vegetation during field reconnaissance in November 2008. In previous site visits, extensive thicket of blackberry with occasional willows covered major sections of the bypass.

Riparian corridor and canopy closure: none

Listed species with potential to occur: The bypass does not currently contain suitable habitat for listed aquatic species.

(c) Lower Nathanson Bypass, looking downstream. Notice the recent vegetation management, with the clearing of larger willows (see stump in the foreground) (Nov 2008).

(d) From the bottom of the Nathanson Cr. Bypass looking upstream. Earthen berm on the left of the photo, to the left of this berm is the mainstem of Nathanson Creek. Also notice that the x-section of the bypass narrows significantly and grade increases significantly at the outlet where flows are returned to the mainstem (Nov 2008).

Management Considerations and Opportunities

The Nathanson Cr Bypass requires periodic vegetation maintenance, as was conducted in 2008. In addition, since the bypass functions as a slack water environment during flooding, significant sediment deposition occurs. Depending on impacts to capacity, SCWA will need to remove sediment periodically.

Jurisdiction: Owned and maintained by SCWA

Location: W. MacArthur St. to Todd Ave. pedestrian bridge

Adjacent Land Use: Residential

Upstream: Non-SCWA maintained drainage/swale (~1000 ft)

Length: 2,805 ft

Channel easement corridor width: 70 ft

Average top-of-bank width: 51 ft

(b) Middle of Fryer 1, looking downstream. Sediment collects at toe of bank, along channel margin to left; sediment also collects in mid-channel bar in distance; channel cross-section is much larger here than upstream sections in Reaches 3 and 2 (Nov. 2008).

Maintenance History

(a) Fryer Cr. top of Reach 1, looking downstream from MacArthur St. crossing. Cobble bar on the left extends into channel. Large cobbles locally derived from sloughed banks. Bank on the right is grouted for at least 150 ft (Nov. 2008).

Physical Conditions

Reach setting: Fryer creek runs north to south through the southwestern portion of the City of Sonoma. This Reach is straight and runs to the southern boundary of the City. Although the gradient is generally gentle, it appears to flatten near the lower end of the reach with sediment deposition increasing downstream.

Active channel: 16-18 ft wide with a low flow channel ranging from 14 ft (photo b) to 6 ft (photo d); channel depths are 8-14 ft; flow depths range from 2”-3 ft.

Bed sediments/texture: generally dominated by fine sands and silts, with sloughed cobbles in locations (photos a/c).

Bank structure: earthen with rip-rap cover throughout; some sections with grouted rip-rap (photo a) and sacrete (photo c).

Channel processes: Reach 1 is receiving urban runoff from upstream reach, due to its straight alignment and moderate gradient, channel appears to effectively convey sediments through its upper sections. Moving downstream, sediment deposition and bar formation increase with alternating d-bars through the bottom of the reach (photo d). Periodic grade control features are common in this reach and it is not clear whether they were engineered or developed in-situ (photo a, c and d) from sloughing local rock materials.

Water quality (qualitative): moderate in November 2008, with limited stagnation and flows generally clear.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat complexity and function increases moving downstream. In the upstream sections of Reach 1, the channel is confined between grouted banks and aside from eroded rip-rap displays little in the way of complexity. In the middle and lower sections, deep runs (photo b), pools, and riffles occur in relation to sediment bars. Also, unlike the upstream reaches, Reach 1 maintains shaded conditions for much of its length.

Vegetation composition: Reach 1 supports a dense, narrow, riparian canopy for much of its length. The only area that is devoid of riparian canopy is the western bank at the top of the reach (photo a). Riparian trees include maples, alders, redwoods, firs, and other conifers. Understory is generally limited to grasses and duff under the dense canopy. In channel vegetation is also limited to shade tolerant herbaceous species thriving on the channel margins and on the sediment bars.

Riparian corridor and canopy closure: Riparian canopy closure is around 50% through most of the reach, with some areas of between 25%-50% (photos a and b) and some areas higher than 50% (photos c and d).

Listed species with potential to occur: potential habitat for western pond turtle and listed plants.

(c) Fryer Creek Reach 1, looking upstream from mid reach. Sacrete used to strengthen bank to left, rock and log creating gradient break in stream (near ground) with pooling upstream, and faster flow downstream (Nov, 2008).

(d) Lower Fryer Cr. Reach 1, looking upstream from the pedestrian bridge adjacent to Todd Ave. Riparian canopy now greatly expanded; in-channel sediment/bar formations also more strongly developed in the lower reach (Nov, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Fryer Creek Reach 1 focus on sediment management in the lower sections of the reach. Field observations suggest that current conditions are not problematic for flow conveyance and capacity, but if sediment bars continue to aggrade they could be problematic in the future. Very few other maintenance issues were observed during field reconnaissance in November 2008.

Appendix C

Stream Maintenance Program Manual, Chapter 7
SMP Impact Reduction, Minimization Measures and BMPs

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.

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

Table 7-1. Cont.

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

Table 7-1. Cont.

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

Table 7-1. Cont.

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.

BMP	Name	Sediment Removal	Bank Stabilization	Vegetation Management									Other Activities								
				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

Appendix D

Monitoring and Reporting Program Requirements
General NPDES Permit, *Attachment C*

ATTACHMENT C – MONITORING AND REPORTING PROGRAM

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ATTACHMENT C – MONITORING AND REPORTING PROGRAM

Title 40 of the Code of Federal Regulations (C.F.R.), § 122.48 requires that all NPDES permits specify monitoring and reporting requirements. California Water Code sections 13267 and 13383 also authorize the State Water Board and Regional Water Quality Control Board to require technical and monitoring reports. This Monitoring and Reporting Program (MRP) establishes monitoring and reporting requirements which implement federal and California laws and regulations.

This MRP is designed to address the two key questions shown below. It also encourages Dischargers to form monitoring coalitions with others doing similar applications within a given watershed or doing applications of similar environmental settings (agricultural, urban, and wetland). The Coalition or Discharger may select sites representing worst case scenarios or high use areas for each active ingredient in each environmental setting. If the Discharger elects in its Pesticide Application Plan (PAP) to undertake monitoring and reporting through a Coalition, then the Coalition will prepare and implement a MRP (pursuant to this Attachment C) and act on behalf of the Discharger with respect to monitoring and reporting. Otherwise, the Discharger will prepare and implement an individual MRP.

Question No. 1: Does the biological or residual pesticide from applications cause an exceedance of receiving water limitations or monitoring triggers?

Question No. 2: Does the biological or residual pesticide, including active ingredients, inert ingredients, and degradation by-products, in any combination cause or contribute to an exceedance of the “no toxics in toxic amount” narrative toxicity objective?

If the Discharger elects in its PAP to undertake monitoring and reporting through a Coalition, then the PAP should reference and attach the Coalition’s monitoring plan.

I. GENERAL MONITORING PROVISIONS

A. Samples and measurements taken as required herein shall be representative of the nature of the monitored discharge. All samples shall be taken at the anticipated monitoring locations specified in the Discharger’s or Coalition’s PAP.

B. All laboratory analyses shall be conducted at a laboratory certified for such analyses by the Department of Public Health (CDPH, formerly Department of Health Services). Laboratories that perform sample analyses shall be identified in all monitoring reports. A manual containing the steps followed in this program must be kept in the laboratory and shall be available for inspection by the State Water Board and the appropriate Regional Water Board staff. The Quality Assurance-Quality Control Program must conform to U.S. EPA guidelines or to procedures approved by the State Water Board and the appropriate Regional Water Board.

C. All analyses shall be conducted in accordance with the latest edition of “Guidelines Establishing Test Procedures for Analysis of Pollutants” (Guidelines), promulgated by the U.S. EPA (40 C.F.R. Part 136). Any procedures to prevent the contamination of samples as described by the PAP shall be implemented.

D. Records of monitoring information shall include the following:

1. The date, exact place, and time of sampling or measurements;
2. The individuals who performed the sampling or measurements;
3. The dates analysis were performed;
4. The individuals who performed the analyses;
5. The analytical techniques or methods uses; and
6. The results of such analyses.

E. All monitoring instruments and devices used by the Discharger or Coalition to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their accuracy.

F. Monitoring results, including noncompliance, shall be reported at intervals and in a manner specified in this MRP.

G. Laboratories analyzing monitoring samples shall be certified by CDPH, in accordance with the provision of California Water Code section 13176, and must include quality assurance/quality control data with their reports.

II. MONITORING LOCATIONS AND SAMPLE TYPES

A. Monitoring Locations

Each Discharger or Coalition shall establish monitoring locations specified in the Discharger's or Coalition's PAP, to demonstrate compliance with the receiving water limitations, discharge specifications, and other requirements in this General Permit. The number and location of samples shall be selected to answer the two key questions. A Coalition or Discharger may use representative monitoring locations to characterize water quality for all waters of the US within the Discharger's boundaries for each environmental setting (agriculture, urban, and wetland). However, the Coalition or Discharger must provide justification for the selection of the representative monitoring locations. To be considered "representative," at a minimum, a location must be similar in hydrology, pesticide use, and other factors that affect the discharge of biological and residual pesticides to surface waters as a result of applications to the areas being represented in that environmental setting. Each Coalition or Discharger must provide technical justification and identify which areas are to be considered representative. Monitoring location information shall include a description of the treatment area, GPS coordinates, and pesticides being applied.

B. Sample Types

1. **Background Monitoring.** Background samples shall be collected in the application area or target area, just prior (up to 24-hours in advance of application) to the application event.

2. **Event Monitoring.** Event monitoring samples shall be collected in the application or target area for adulticide applications and downstream of the application or target area for larvicide applications immediately after the application event but shall not exceed 24 hours after the application event.
3. **Post-Event Monitoring.** Post-event samples shall be collected within the application area or the target area for larvicide applications within one week after project completion, as determined by the Coalition or Discharger.

III. RECEIVING WATER MONITORING REQUIREMENTS – SURFACE WATER

A. General Monitoring Requirements

The PAP shall be designed to answer the two key questions stated above. The PAP shall describe the tasks and time schedule in which these two key questions will be addressed. Monitoring shall take place at locations that are planned for pesticide applications or locations at which pesticides may be applied, as described in the Discharger's PAP.

The PAP must consider watershed specific attributes and waste constituents, based on the characteristics of applications within the Coalition's or Discharger's area, as well as the receiving water quality conditions. Developing the details of a monitoring design requires clearly defining several inputs to the design and then organizing these in a logical framework that supports effective decision making about indicators, monitoring locations, and monitoring frequency. The logical framework should describe:

1. The basic geographic and hydrographic features of the area, particularly application points and the pathways(s) of residue flows;
2. Pesticide application practices and how they are distributed in space and time;
3. Relevant knowledge about the transport, fates, and effects of pesticides, including best- and worst-case scenarios;
4. Description of the designated uses in each water body;
5. Relevant knowledge about the action of cumulative and indirect effects, and of other sources of impact;
6. Mechanisms through which pesticide applications could lead to designated use impacts, given the basic features of the area;
7. Known and potential impacts of pesticide applications on water quality, ranked in terms of relative risk, based on factors such as magnitude, frequency and duration;
8. Sufficient number of sampling areas to assess the entire Discharger's or Coalition's area of influence; and
9. The approach, including a schedule, to sample monitoring areas.

In conducting the receiving water sampling, a log shall be kept of the receiving water conditions throughout the reach bounded by the treatment area. Attention shall be given to the presence or absence of:

1. Floating or suspended matter;
2. Discoloration;
3. Bottom deposits;
4. Aquatic life;
5. Visible films, sheens, or coatings;
6. Fungi, slimes, or objectionable growths; and
7. Potential nuisance conditions.

Notes on receiving water conditions shall be summarized in the monitoring report.

B. Monitoring Requirements for Larvicides

Monitoring locations for larvicides must include frequent and routine monitoring on a pre-determined schedule, as summarized in the Table C-1. The active ingredient temephos is the only larvicide that requires chemical testing, including dissolved oxygen.

Table C-1. Monitoring Requirements for Larvicides

Sample Type	Constituent/Parameter	Units	Sample Method	Minimum Sampling Frequency	Sample Type Requirement	Required Analytical Test Method
Visual	1. Monitoring area description (pond, lake, open waterway, channel, etc.) 2. Appearance of waterway (sheen, color, clarity, etc.) 3. Weather conditions (fog, rain, wind, etc.)	Not applicable	Visual Observation	1	Background, Event, and Post-Event Monitoring	Not applicable
Physical	1. Temperature[2]	ºF	Grab[4]	5	Background, Event, and Post-Event Monitoring	6
	2. pH[3]	Number				
	3. Turbidity[3]	NTU				
	4. Electrical Conductivity[3] @ 25°C	µmhos/cm				
Chemical	1. Active Ingredient[7]	µg/L	Grab[4]	5	Background, Event, and Post-Event Monitoring	6
	2. Dissolved Oxygen[3]	mg/L				

[1] All applications at 10% of all application areas or six application areas, whichever is greater, unless inappropriate. If applying to less than six application areas, monitor at all application areas, unless inappropriate.
[2] Field testing.
[3] Field or laboratory testing.
[4] Samples shall be collected at three feet below the surface, or mid-depth if water body is less than six feet deep.
[5] If applying six or more times a year, collect six samples for each active ingredient in each environmental setting (urban, agricultural, or wetland). If applying less than six times a year, collect a sample during each application for each active ingredient in each environmental setting (urban, agricultural, or wetland).
[6] Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. Part 136.
[7] Active ingredient required to be tested is temephos.

C. Monitoring Requirements for Adulticides

Monitoring locations for adulticides must include frequent and routine monitoring on a pre-determined schedule, as summarized in Table C-2 below:

Table C-2. Monitoring Requirements for Adulticides

Sample Type	Constituent/Parameter	Units	Sample Method	Minimum Sampling Frequency	Sample Type Requirement	Required Analytical Test Method
Visual	1. Monitoring area description (pond, lake, open waterway, channel, etc.) 2. Appearance of waterway (sheen, color, clarity, etc.) 3. Weather conditions (fog, rain, wind, etc.)	Not applicable	Visual Observation	[1]	Background and Event Monitoring	Not applicable
Physical	1. Temperature[2]	ºF	Grab[4]	[5]	Background and Event Monitoring	[6]
	2. pH[3]	Number				
	3. Turbidity[3]	NTU				
	4. Electrical Conductivity[3] @ 25°C	µmhos/cm				
Chemical	1. Active Ingredient[7]	µg/L	Grab[4]	[5]	Background, and Event Monitoring	[6]
	2. Dissolved Oxygen[3]	mg/L				

[1] All applications at 10% of all application areas or six application areas, whichever is greater, unless inappropriate. If applying to less than six application areas, monitor at all application areas, unless inappropriate.
[2] Field testing.
[3] Field or laboratory testing.
[4] Samples shall be collected at the surface of the water body.
[5] If applying six or more times a year, collect six samples for each active ingredient in each environmental setting (agricultural, urban or wetland). If applying less than six times a year, collect a sample during each application for each active ingredient in each environmental setting (agricultural, urban, or wetland). The remaining samples required to meet the minimum of six shall be collected subsequently the following year(s).

[6] Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. Part 136. For pyrethrin and pyrethroids, the Coalition or Discharger may use alternative analytical methods in which analytical methods used must be capable of achieving the MDLs below the Receiving Water Monitoring Trigger for each active ingredient analyzed if the analytical methods described in 40 C.F.R. Part 136 are not capable of achieving these MDLs.

[7] First year sampling shall include pyrethrin, permethrin, resmethrin, sumithrin, prallethrin, etofenprox, PBO, PBO (in PBO/Pyrethrin mixture), and PBO (in PBO/ Resmethrin mixture). Second year sampling shall include naled and malathion. Third year sampling shall include MGK-264. If applying six or more times a year, collect six samples for each environmental setting (agricultural, urban, or wetland). If applying less than six times a year, collect a sample during each application for each environmental setting (agricultural, urban, or wetland). The remaining samples required to meet the minimum of six shall be collected subsequently the following year(s).

IV. REPORTING REQUIREMENTS

A. General Monitoring and Reporting Requirements

1. The Discharger or Coalition shall inform the State Water Board and the appropriate Regional Water Board 24 hours before the start of its first application of the year or at the earliest feasible time.
2. The Discharger or Coalition shall comply with all Standard Provisions (Attachment B) related to monitoring, reporting, and recordkeeping.
3. Upon written request of the State Water Board or the appropriate Regional Water Board, the Discharger or Coalition shall submit a summary monitoring report.
4. The Discharger or Coalition shall report to the State Water Board and appropriate Regional Water Board any toxic chemical release data it reports to the State Emergency Response Commission within 15 days of reporting the data to the Commission pursuant to section 313 of the "Emergency Planning and Community Right to Know Act" of 1986 (42 U.S.C. §11001 et. seq.)
5. Monitoring frequencies may be adjusted by the State Water Board Deputy Director of the Division of Water Quality (Deputy Director) to a less frequent basis if the Discharger or Coalition makes a request and the request is backed by statistical trends of monitoring data submitted.
6. Additional monitoring and reporting requirements may be added to the MRP by the Deputy Director.

B. Annual Reports

Each Coalition or Discharger, including members of a Coalition, shall submit an Annual Report. Dischargers, who are members of a Coalition, may reference monitoring information in the Coalition's Annual Report.

1. Annual reports shall contain the following information:
   a. An Executive Summary discussing compliance or violation of this General Permit and the effectiveness of the PAP to reduce or prevent the discharge of biological and residual pesticides for vector control;

b. A summary of monitoring data, including the identification of water quality improvements or degradation, and recommendations for improvements to the PAP (including proposed BMPs) and monitoring program based on the monitoring results. All receiving water monitoring data shall be compared to applicable water quality standards or Receiving Water Monitoring Triggers;

c. Identification of BMPs currently in use and a discussion of their effectiveness in meeting the requirements in this General Permit;

d. A discussion of BMP modifications addressing violations of this General Permit;

e. A map showing the location of each application area and the target area;

f. Types and amounts of pesticides used at each application event during each application;

g. Information on surface area and/or volume of application and target areas and any other information used to calculate dosage, concentration, and quantity of each pesticide used;

h. Sampling results shall indicate the name of the sampling agency or organization, detailed sampling location information (including latitude and longitude or township/range/section if available), detailed map or description of each sampling area (i.e., address, cross roads, etc.), collection date, name of constituent/parameter and its concentration detected, minimum levels, method detection limits for each constituent analysis, name or description of water body sampled, and a comparison with applicable water quality standards, description of analytical QA/quality control plan. Sampling results shall be tabulated so that they are readily discernible; and

i. Recommendations to improve the monitoring program, BMPs, and PAP to ascertain compliance with this General Permit.

j. Pesticide Application Log

2. The Discharger or the Coalition shall include in the Annual Report any updated information regarding specific monitoring locations from its PAP.

3. At any time during the term of this General Permit, the State Water Board or the appropriate Regional Water Board may notify Dischargers or Coalition of the requirement to electronically submit Self-Monitoring Reports (SMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). Until such notification is given, each Coalition or Discharger shall submit hard copy SMRs. The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal.

4. The Discharger or Coalition shall report the results for all monitoring specified in this MRP in the SMR. The Discharger or Coalition shall submit annual SMRs including the results of all required monitoring using U.S. EPA-approved test methods or other test methods specified in this General Permit. If a Discharger or Coalition monitors any pollutant more frequently than required by this General

Permit, the results of this monitoring shall be included in the calculations and reporting of the data submitted in the SMR.

5. Monitoring reports shall be submitted to the Deputy Director and the appropriate Regional Water Board Executive Officer in accordance with the following schedule:

Table C-3. Reporting Schedule

Reporting Frequency	Reporting Period	Annual Report Due
Annual	1 January through 31 December	1 March

C. Reporting Protocols

The Discharger or Coalition shall report with each sample result the applicable reported Minimum Level (ML) and the current Method Detection Limit (MDL), as determined by the procedure in 40 C.F.R. Part 136.

The Discharger or Coalition shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

1. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).
2. Sample results less than the Reporting Limit (RL), but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

   For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (plus a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.
3. Sample results less than the laboratory's MDL shall be reported as "<" followed by the MDL.
4. Dischargers or Coalition are to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Discharger or Coalition to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.
5. Multiple Sample Data: If two or more sample results are available, each Discharger or Coalition shall compute the arithmetic mean unless the data set contains one or more reported determinations of "Detected, but Not Quantified"

(DNQ) or "Not Detected" (ND). In those cases, the Discharger or Coalition shall compute the median in place of the arithmetic mean in accordance with the following procedure:

a. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

b. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

6. Dischargers and Coalition shall submit the Annual Report in accordance with the following requirements:

a. The Discharger or Coalition shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the facility is operating in compliance with effluent and receiving water limitations. The Discharger or Coalition is not required to duplicate the submittal of data that is entered in a tabular format within CIWQS. When electronic submittal of data is required and CIWQS does not provide for entry into a tabular format within the system, the Discharger or Coalition shall electronically submit the data in a tabular format as an attachment.

b. Each Discharger or Coalition shall attach a cover letter to the Annual Report. The information contained in the cover letter shall clearly identify violations of the permit; discuss corrective actions taken or planned; and the proposed time schedule for corrective actions. Identified violations must include a description of the requirement that was violated and a description of the violation.

c. Annual Report must be submitted to the State Water Board and the appropriate Regional Water Board, signed and certified as required by the Standard Provisions (Attachment B).

Appendix E

Sample MRP Forms

- Aquatic Pesticide Application Log
- Aquatic Pesticide Field Monitoring and Sampling Form

Example Data Sheet for Herbicide Application events. Includes Visual Parameters to be sampled (as outlined by the Monitoring and Reporting Program NPDES requirements).

Aquatic Pesticide Application Log

****IMPORTANT**To Be Completed EVERY TIME an Aquatic Pesticide Application is Made**
****THIS FORM IS NOT COMPLETE UNTIL A MAP WITH A CONVENIENT SCALE SHOWING THE APPLICATION AREA AND RECEIVING BODIES OF WATER IS ATTACHED****

1. GENERAL

Date:_____ Location:_____ Start Time:_____ Stop Time:_____

Agency: ___**SCWA**___ Personnel:_____

Weather (temp, cloud cover, wind, humidity, etc):_____

Total Area Treated (Area or linear feet)_____ Target Weed(s):_____

2. PESTICIDE AND ADJUVENT INFORMATION

Pesticide # 1 Used:_____ Rate or Concentration:_____ Total Amt. Applied:_____

Pesticide # 2 Used:_____ Rate or Concentration:_____ Total Amt. Applied:_____

Adjuvant # 1 Used:_____ Rate or Concentration:_____ Total Amt. Applied:_____

Adjuvant # 2 Used:_____ Rate or Concentration:_____ Total Amt. Applied:_____

Adjuvant #3 Used:_____ Rate or Concentration:_____ Total Amt. Applied:_____

3. TREATED WATER BODY INFORMATION

Water Body Type (Engineered, Modified, or Natural Channel):_____

Water Flow:_____ Approximate Water Depth:_____ Water Temp:_____

Percent Weed Cover/Description:_____

Water Color:_____ Visible films/Sheen? (yes/no):_____ Clarity (good, fair, poor):_____

Aquatic Life:_____ Bottom Desposits/Floating matter:_____

Other Information (potential nuisance conditions, etc):_____

NOTES (location details, notable spray application information, etc)**:**

By signing below I hereby certify that all conditions of the current SCWA Aquatic Pesticide Application Plan were followed.

Signature:_____ **Date:**_____

Aquatic Pesticide Field Monitoring and Sampling Form SIDE A

Sample Site Name (Creek, Reach, points of reference):_____

Sample Site GPS Coordinates:_____

SAMPLE #1: BACKGROUND MONITORING

Collect inside the treatment area <24 hours before treatment

Date:_____ Time:_____ Collected By:_____

Site Details (include water flow, appearance, weed and treament area description):_____

_____

Sample ID (XXX-YY-Z)*:_____-PRE_____ Sample Depth (meters):_____

Sample Collected From (circle):____at application site____upstream____downstream____ **Blank Collected (✓):_____**

Physical and Chemical Parameters (field or laboratory testing)								
Air Temp	Water Depth	pH	Dissolved Oxygen	Water Temp	Conductivity	Salinity	Meter Used	Lab or Field?
° C	Meters		mg/L	° C	mS	ppt		

Date and Time Sample Sent to Lab/Shipment Method:_____

***XXXX-YY-Z** (e.g. Corona1-09/25/12-EVENT)= **XXX**: Location (creek name and reach #), **YY**: Date, **Z**: Monitoring Sample Type ("PRE", "EVENT" or "POST A", "POST B")

SAMPLE #2: EVENT MONITORING

Collect immediately downstream of treatment area in flowing water or adjacent to treatment area in non-flowing water, but after sufficent time has elapsed such that treated water will have entered the adjacent or downstream area

Date:_____ Application Start/End Time:_____ Collected By:_____

Herbicides/Adjuvants Used:_____

Site Details (include water flow, appearance, weed and treament area description):_____

_____ **Size of Treated Area:_____**

Sample ID (XXX-YY-Z)*:_____-EVENT_____ Sample Depth (meters):_____

Sample Collected From (circle):____at application site____upstream____downstream____ **Blank Collected (✓):_____**

Physical and Chemical Parameters (field or laboratory testing)								
Air Temp	Water Depth	pH	Dissolved Oxygen	Water Temp	Conductivity	Salinity	Meter Used	Lab or Field?
° C	Meters		mg/L	° C	mS	ppt		

Date and Time Sample Sent to Lab/Shipment Method:_____

***XXXX-YY-Z** (e.g. Corona1-09/25/12-EVENT)= **XXX**: Location (creek name and reach #), **YY**: Date, **Z**: Monitoring Sample Type ("PRE", "EVENT" or "POST A", "POST B")

SEE BACK SIDE OF FORM

Aquatic Pesticide Field Monitoring and Sampling Form SIDE B

SAMPLE #3A: POST-EVENT MONITORING @ Treatment Site

Collect within treatment area within one-week after application

Date:_____ **Time:**_____ **Collected By:**_____

Site Details (include water flow, appearance, weed and treament area description):_____

_____

Sample ID (XXX-YY-Z)*:_____**-POST_A**____ **Sample Depth (meters):**_____

Sample Collected From (circle):____at application site____upstream____downstream____ **Blank Collected (✓):**_____

Physical and Chemical Parameters (field or laboratory testing)								
Air Temp	Water Depth	pH	Dissolved Oxygen	Water Temp	Conductivity	Salinity	Meter Used	Lab or Field?
° C	Meters		mg/L	° C	mS	ppt		

Date and Time Sample Sent to Lab/Shipment Method:_____

***XXXX-YY-Z** (e.g. Corona1-09/25/12-EVENT)= **XXX**: Location (creek name and reach #), **YY**: Date, **Z**: Monitoring Sample Type ("PRE", "EVENT" or "POST A", "POST B")

SAMPLE #3B: POST-EVENT MONITORING @ Immediately Downstream or Adjacent to Treatment Site

Collect immediately downstream of treatment area in flowing water or adjacent to the trement area in non-flowing waters within one week after the application

Date:_____ **Time:**_____ **Collected By:**_____

Site Details (include water flow, appearance, weed and treament area description):_____

_____

Sample ID (XXX-YY-Z)*:_____**-POST_B**____ **Sample Depth (meters):**_____

Sample Collected From (circle):____at application site____upstream____downstream____ **Blank Collected (✓):**_____

Physical and Chemical Parameters (field or laboratory testing)								
Air Temp	Water Depth	pH	Dissolved Oxygen	Water Temp	Conductivity	Salinity	Meter Used	Lab or Field?
° C	Meters		mg/L	° C	mS	ppt		

Date and Time Sample Sent to Lab/Shipment Method:_____

***XXXX-YY-Z** (e.g. Corona1-09/25/12-EVENT)= **XXX**: Location (creek name and reach #), **YY**: Date, **Z**: Monitoring Sample Type ("PRE", "EVENT" or "POST A", "POST B")

Date Field Duplicate Collected:_____ **Field Duplicate ID:**_____**-DUP**

By signing I hereby certify that all monitoring conditions of the SCWA Aquatic Pesticide Application Plan were followed

(Signature):_____ (Date):_____

SEE FRONT SIDE OF FORM

Appendix F

Glyphosate Quick Reference

Glyphosate Quick Reference [1]

Trade Name	Aqaumaster ® (Monsanto Company)	**Specific gravity**	0.5
Resistration No.	1071-83-6	**Minimum drying time**	6 hours
Formulation	Aqueous solution of isopropylamine salt of glyphosate; technical formulation contains 2,4-nitrosoglyphosate ("NNG") impurity; active ingredient: 53.8% glyphosate isopropylamine salt; equivalent to 48.0% glyphosate	**Highest proposed application rate**	—1.2 percent solution (handheld equipment) —3 quarts per acre (broadcast spray)
Chemical Name	IUPAC: N-(phosphonomethyl)glycine CAS: N-(phosphonomethyl)glycine	**Rate of kill**	Relatively slow
Formula	C3H8NO5P	**Volatility**	Extremely low vapor pressure, thus, negligible risk of movement through volatility
Herbicide Family	Organophosphorus	**Solubility**	Water: ~12,000 mg/L
Mode of Action	Systemic, broad-spectrum (non-selective); amino acid synthesis inhibitor; inhibits 5 enolpyruvylshikimate-3-phosphate synthase, needed by plants to synthesize chorismate, an intermediate metabolic product in the synthesis of aromatic amino acids	**Soil organic carbon absorption coefficent**	Koc = 24,000 Very high Koc indicates tight sorption to most soils, suspended solids, and sediments in the environment.
Molecular Weight	169.08 g/mole glyphosate 228.22 g/mole glyphosate isopropylamine salt	**Degradation pathways**	Primarily degraded by microbes and fungi in soil or water, under both aerobic and anaerobic conditions. Photodegradation in water and soil are not expected to contribute significantly to glyphosate degradation.
Half life in soil	Average t½ = 32 days, based on 47 agricultural and forestry studies. In most cases, >90% degraded within six months after application.	**Degradation products**	Aminomethylphosphonic acid ("AMPA"); further degraded to carbon dioxide and phosphate.
Half life in benthic sediment	t½ = >3 to 12 months	**Advantages for aquatic use**	Low leaching potential due to strong sorption to soil/sediment particles
Half life in water	t½ = 7–14 days	**Disadvantages for aquatic use**	— Efficacy hindered by minimum drying time — Inactivated by adsorption to sediment particles — Requires use of non-ionic surfactants

[1] ExToxNet. Pesticide Information Profile for Glyphosate; http://extoxnet.orst.edu/, accessed November 20, 2012.