White Creek Revegetation Plan

White Creek in Springtime

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Introduction

White Creek is a tributary stream to Wooden Valley Creek in the Suisun Creek watershed in Napa and Solano counties. White Creek has a watershed area of 6.6 square miles and is located along the northwestern edge of the Suisun Creek drainage. White Creek supports spawning and rearing habitat for federally-listed threatened steelhead trout.

Watershed Description

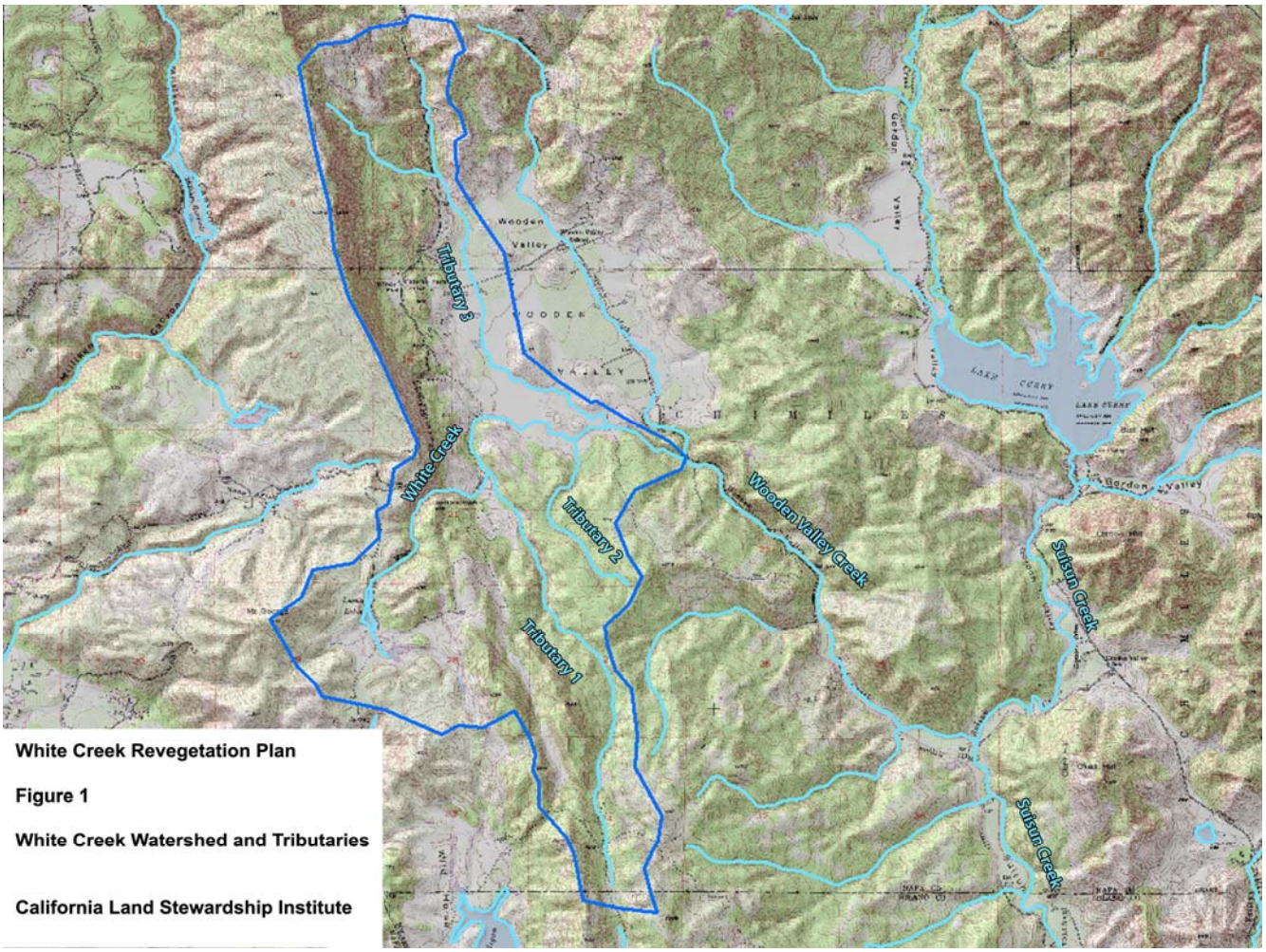
The White Creek watershed consists of four distinct tributary streams which come together 0.56 miles before White Creek meets Wooden Valley Creek (Figure 1). The headwaters of White Creek are on the western edge and the highest point in the drainage. Volcanic rock with chaparral and vineyards covers this area. Leoma Lake is an on-stream reservoir built in the 1940s in the upper reaches of White Creek. As White Creek flows northeast off this high plateau, it descends a canyon and creates a waterfall visible from Monticello Rd.

Tributary 1 runs 0.95 miles from south to north along a steep topographic break on the western side of the watershed. This tributary is located in dense oak woodland with few roads and no development. Tributary 2 also courses south to north through oak woodland and undeveloped lands. Tributary 3 flows north of Wooden Valley along the base of a hillside. Tributary 3 crosses through the vineyards and grasslands of Wooden Valley until it meets White Creek. Tributaries 1, 2, and 3 have seasonal flows only. White Creek has year-round water in the mainstem creek from the confluence with Tributary 2 downstream to the confluence with Wooden Valley Creek. In some years only isolated pools may remain in late summer, rather than continuous flow.

The geology of the White Creek watershed is complex (Figure 2 and Table 1). The Sonoma Volcanics Formation dominates the western area of the drainage. Several different types of volcanic rock - basalt, andesite, dacite and ash flow tuff all occur in the White Creek watershed. A small area of Great Valley Sequence and serpentinite occur in the northern area of the White Creek drainage. The vegetation in this area consists of serpentine endemic native plants.

A number of faults mark the western side of the White Creek drainage. This area has steep vertical slopes of basalt with large landslide deposits along the base. The course of Tributary 1 follows the northern extension of the Green Valley Fault, a major fault in the San Andreas system. Wooden Valley is an alluvium-filled basin and makes up another area of the White Creek drainage. The mainstem of White Creek meanders along the contact between the alluvium of Wooden Valley and Sonoma Volcanics andesite. The andesite may serve as a dam to subsurface water moving through the alluvium of the valley, the landslide deposits on the western side of the drainage and alluvial fans along the valley edge.

There is a large freshwater wetland just to the north of the mainstem of White Creek which has year-round standing water (Figure 3). White Creek south of this wetland also has pools of water for most of the summer dry season. An additional feature which may affect water movement is a concealed fault which stretches from north to south, passing through the freshwater wetland and the mainstem White Creek. The area of the creek with year-round pools of water is downstream of where the creek crosses this fault.



White Creek Revegetation Plan

Figure 1

White Creek Watershed and Tributaries

California Land Stewardship Institute

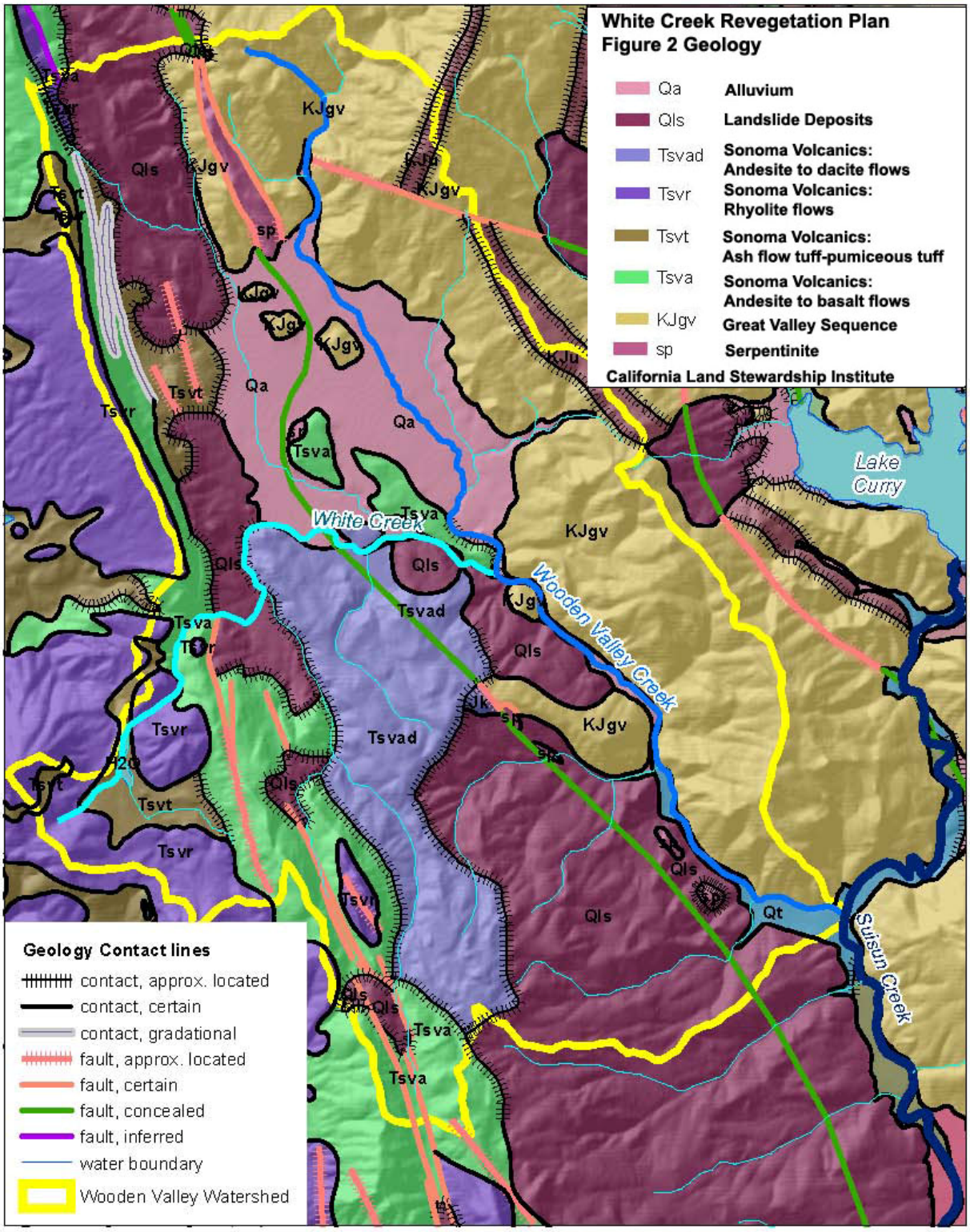
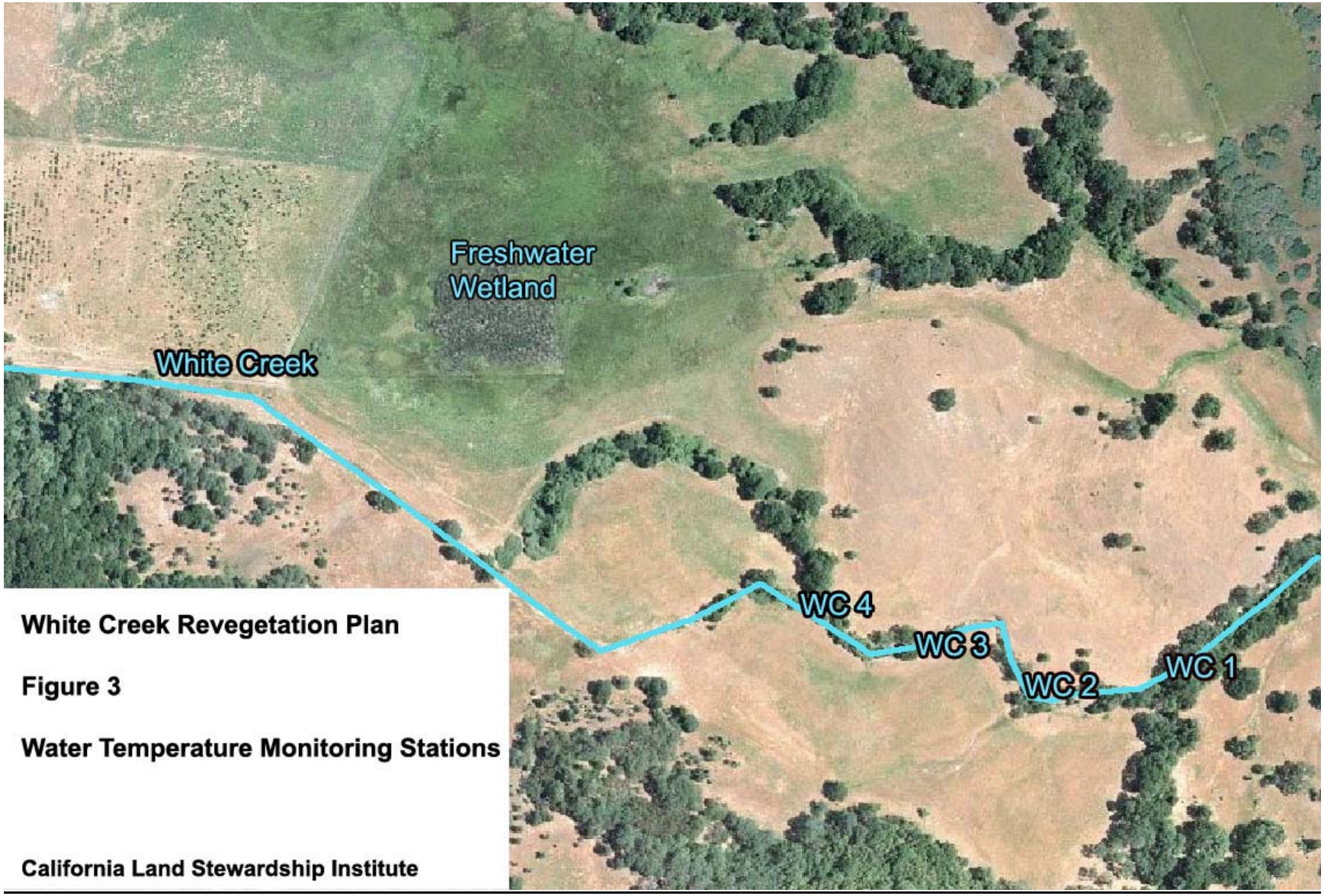

White Creek Revegetation Plan
Figure 2 Geology
Qa Alluvium
Qls Landslide Deposits
Tsvad Sonoma Volcanics: Andesite to dacite flows
Tsvr Sonoma Volcanics: Rhyolite flows
Tsvt Sonoma Volcanics: Ash flow tuff-pumiceous tuff
Tsva Sonoma Volcanics: Andesite to basalt flows
KJgv Great Valley Sequence
sp Serpentinite
California Land Stewardship Institute
Geology Contact lines
contact, approx. located
contact, certain
contact, gradational
fault, approx. located
fault, certain
fault, concealed
fault, inferred
water boundary
Wooden Valley Watershed
White Creek
Wooden Valley Creek
Lake Curry
Suisun Creek

Table 1: White Creek Watershed Geology

Rock Type	Tributary Area	Features
	Main- stem White Creek	
Tsvt		Sonoma Volcanics (Pliocene to late Miocene): Ash flow tuff-pumiceous tuff, agglomeratic tuff; also includes minor flow rock
Tsvr		Sonoma Volcanics (Pliocene to late Miocene): Rhyolite flows, includes interbedded rhyolite tuff in places
Tsva		Sonoma Volcanics (Pliocene to late Miocene): Andesite to basalt flows
Qls		Landslide deposits (Holocene and Pleistocene)
Tsvad		Sonoma Volcanics (Pliocene to late Miocene): Andesite to dacite flows
	Tributary 1	
Tsva		Sonoma Volcanics (Pliocene to late Miocene): Andesite to basalt flows
Tsvad		Sonoma Volcanics (Pliocene to late Miocene): Andesite to dacite flows
Qls		Landslide deposits (Holocene and Pleistocene)
	Tributary 2	
Tsvad		Sonoma Volcanics (Pliocene to late Miocene): Andesite to dacite flows
	Tributary 3	
Qa		Alluvium (Holocene and late Pleistocene): Sand, silt, and gravel deposited in fan, valley fill terrace or basin environments. This unit is mapped where deposition may have occurred in either Holocene or late Pleistocene time.
Qls		Landslide deposits (Holocene and Pleistocene)
KJgv		Great Valley Sequence (Early Cretaceous and Late Jurassic)**:** Interbedded sandstone, shale, mudstone, and occasional conglomerate
sp		Serpeninite (Jurassic) Mainly sheared serpentinite, but also includes massive serpentinized harzburgite


Freshwater
Wetland
White Creek
WC 4
WC 3
WC 2
WC 1
White Creek Revegetation Plan
Figure 3
Water Temperature Monitoring Stations
California Land Stewardship Institute

Prior Studies

White Creek was assessed as part of the Suisun Creek Watershed Enhancement Plan completed by Laurel Marcus and Associates (LMA) in 2004. The Enhancement Plan included water temperature monitoring, fish habitat assessment and geomorphic analysis of White Creek. The Plan identified this tributary as an important spawning and rearing stream for listed steelhead trout. High water temperatures over 70 F are lethal to steelhead trout and become steelhead become lethargic at water temperatures over 65 F. High temperature water has less dissolved oxygen and levels of less than 7 mg/l are lethal to steelhead trout.

Following the completion of the Enhancement Plan, additional monitoring was completed on White Creek (Tables 2-9). Water temperature monitoring at four stations (WC1, WC2, WC3, and WC4, see Figure 3) showed cold water (<70°F) temperatures at Stations WC1 and WC4. Stations WC2 and WC3; however, consistently dried up. Stations WC1 and WC4 have white alder and live oak canopy shading the creek and reducing solar inputs and evaporative losses. Stations WC2 and WC3 have far less canopy and typically dry up by July. Additionally, upstream of WC2 there is a long unvegetated area of creek where water warms.

In addition to water temperature monitoring with Hobo data loggers, YSI sondes were deployed in 2005 and 2006 for two-week periods to monitor water temperature, dissolved oxygen, specific conductance, and pH. Tables 2-9 summarize the results of the water temperature and water quality monitoring at the four stations in upper White Creek. Two additional stations (WC0.5, WC0.2) in lower White Creek near the confluence with Wooden Valley Creek.

During the summer of 2006 when the field crew downloaded the data loggers in White Creek and re-deployed them they found numerous dead 1 inch steelhead trout. This die-off coincided with an extreme heat wave where air temperatures reached over 109 F. During these high temperatures water levels also dropped a great deal creating warm, oxygen-deprived conditions lethal to salmonids. The field crew counted over 100 dead juvenile salmonids ranging from 1 to 5 inches in total length. These events demonstrated the importance of the White Creek area as rearing habitat and the need for restoration measures to reduce water temperatures and increase dissolved oxygen.

The YSI sondes demonstrated that while water temperatures at Stations WC1 and WC4 are cold, likely due to groundwater seeps, dissolved oxygen frequently falls below the 0.7 mg/L level needed for steelhead trout rearing. By comparison, monitoring of water temperatures and dissolved oxygen on Wooden Valley Creek and Suisun Creek during the same time period showed that dissolved oxygen levels remained high in these streams even though water temperatures were higher. This difference is likely caused by the water moving and flowing over rocks and being oxygenated in these other two creeks. Both YSI sondes and water temperature data loggers were deployed using Quality Assessment/Quality Control (QA/QC) standards defined in a Quality Assurance Project Plan (QAPP) approved by the State Water Resources Control Board.

Stream flows in White Creek typically drop below connected flow in early summer. The monitoring results and field observations showed that cold groundwater fills White Creek where canopy is present but dissolved oxygen levels are low due to a lack of flow. No stream flow gaging or groundwater monitoring has been completed for White Creek. In alluvial areas such as Wooden Valley, water moves between surface and groundwater frequently. It is important to monitor both surface and

Table 2: White Creek Water Temperature Monitoring 2002-2009, Station WC1

Station	Dates Monitored	7-Day Moving Average of Average Daily Maximum Temperature	Daily Median	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover
WC1	June 25-Oct. 31, 2002	June/July 62-65°F Aug/Sept 58-62°F	June/July 60-63°F Aug/Sept 57-62°F	<1-5°F	0	82%
	May 20-Nov. 5, 2003	May/July 61-70°F Aug/Sept 60-70°F	May/July 59-66°F Aug/Sept 58-65°F	1-10°F	June/July 3-8 hours Aug/Sept 4-7 hours	82%
	July 20-Oct. 27, 2005	July/Sept 58-75°F	July/Sept 52-60°F	1-17°F	1-8 hours	95%
	June 13-Oct. 24, 2006	June/July 65-95°F Aug/Sept.59-66°F	June/July 57-71°F Aug/Sept 55-63°F	1-17°F	0-24 hours	89%
	May 11-Oct. 9, 2007	May/July 56-71°F Aug/Sept 54-75°F	May/July 52-62°F Aug/Sept 46-65°F	1-18°F	0-11 hours	98%
	May 21-Oct. 13, 2009	May/July 58-70.5°F Aug/Sept 66-86°F	May/July 55-63°F Aug/Sept 51-62°F	1-50°F	0-18 hours	96%

Table 3: White Creek Water Temperature Monitoring 2002-2009, Station WC2

Station	Year	7-Day Moving Average of Average Daily Maximum Temperature*	Daily Median*	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover	Comments
WC2	2002	June/July 69-70°F	June/July 66-68°F	<1-1°F	0	92%	Thermal reach just upstream; dried up by July 20
	2003	June/July 68-80°F	June/July 64-69°F	1-6°F	2-9 hours	92%	Dried up by July 15
	2005						Dried by July 20 deployment date
	2006	June/July 69-88°F	June/July 57-66°F	10-18°F	1-15 hours	85%	Dried up by July 15
	2007	May/June 61-64°F	May/June 53-60°F	1-15°F	0	87%	Dried up June 12
	2009	May/June 62-65°F	May/June 56-65°F	1-3°F	0	95%	Dried up by June 27

Prior to drying

Table 4: White Creek Water Temperature Monitoring 2002-2009, Station WC3

Station	Year	7-Day Moving Average of Average Daily Maximum Temperature*	Daily Median*	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover	Comments
WC3	2002	June/July 72-78°F	June/July 64-69°F	1-10°F	20 hours	33%	Dried up by July 20
	2003	June/July 63-74°F	June/July 60-71°F	1-7°F	21 hours		Dried up by July 15
	2005						Dried up by July 20 deployment date
	2006	June/July 75-83°F	June/July 61-70°F	10°F	24 hours	26%	Dried up by July 15
	2007	May/June 66-74°F	May/June 53-74°F	5°F	1-5 hours	65%	Dried up by June 12
	2009	May/June 63-69°F	May/June 55-69°F	6-7°F	5 hours	55%	Dried up by June 27

Prior to drying

Table 5: White Creek Water Temperature Monitoring 2002-2009, Station WC4

Station	Dates Monitored	7-Day Moving Average of Average Daily Maximum Temperature	Daily Median	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover	Comments
WC4	June 25-Oct.31, 2002	June/July 61-69°F Aug/Sept 58-63°F	June/July 61-65°F Aug/Sept 57-62°F	1-12°F	June/July 1-7 hours Aug/Sept 0 hours	93%	
	May 30-Nov. 3, 2003	June/July 65-70°F Aug/Sept 60-65°F	June/July 58-68°F Aug/Sept 59-65°F	<1-7°F	June/July 25 hours Aug/Sept 0 hours	95%	
	July 20-Oct. 30, 2005	July/Sept 58-64°F	July/Sept 55-63°F	<1-3.5°F	0	91%	
	June 13-Oct. 24, 2006	June/July 60-63°F Aug/Sept 61-67°F	June/July 58-63°F Aug/Sept 56-64°F	<1-9°F	0	83%	
	May 11-Oct. 8, 2007	May/Sept 53-77°F	May/Sept. 47-62°F	<1-27°F	1-10 hours	95%	Found floating Aug. 15; redeployed
	May 21-Oct. 13, 2009	May/Sept 57-62.7°F	May/Sept 58-63.1°F	<1-3.8°F	0	94%	

Table 6: White Creek Water Temperature Monitoring 2002-2009, Station WC0.2

Station	Dates Monitored	7-Day Moving Average of Average Daily Maximum Temperature*	Daily Median*	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover	Comments
WC0.2	May 11-Aug. 14, 2007	May/June 57-68°F July/Aug 69-77°F	May/June 48-60°F July/Aug 55-65°F	1-2°F	11 hours	96%	Dried up by Aug. 15
	2009						Not deployed

Prior to drying

Table 7: White Creek Water Temperature Monitoring 2002-2009, Station WC0.5

Station	Dates Monitored	7-Day Moving Average of Average Daily Maximum Temperature*	Daily Median*	Daily Range	Number of Continuous Hours >70°F	Average Canopy Cover	Comments
WC0.5	May 11-Aug. 14, 2007	May 57-59°F June 59-76°F	May 53-58°F June 52-61°F	May 3°F June 11°F	May 0 hours June 12 hours	95%	Dry after June 1
	May 26-Oct. 12, 2009	May/June 58-75°F July/Sept 78-91°F	May/June 54-58°F June/Sept 52-65°F	22°F	1-17 hours	96%	Dried after June 22

Prior to drying

Table 8: Water Temperature and Dissolved Oxygen Monitoring 2005-2006 Station WC4

Station: WC4													
Date	8/20/05	8/21/05	8/22/05	8/23/05	8/24/05	8/25/05	8/26/05	8/27/05	8/28/05	8/29/05	8/30/05	8/31/05	9/1/05
Water Temperatures (°F)	59.1-59.8	59.5-59.7	59.9-60.0	60.2-60.6	60.6-60.8	60.0-60.6	59.1-60.2	59.3-60.0	60.0-60.4	60.4-60.6	60.6-60.9	59.9060.9	60.0-60.6
Dissolved Oxygen (mg/L)	0.09-2.1	0.09-2.3	0.09-2.2	0.07-0.08	0.07-0.08	0.07-0.72	0.07-0.24	0.05	0.05	0.05	0.05	0.05-0.19	0.05-0.12
Depth: Week 1 dropped 0.45 ft., recovered dropped just. .06 ft.; Week 2 depth up and down 0.26 ft.													
Date*	6/14/06	6/15/06	6/16/06	6/17/06	6/18/06	6/19/06	6/20/06	6/21/06	6/22/06	6/23/06	6/24/06	6/25/06	6/26/06
Water Temperatures (°F)	56.4-57.7	57.3-58.1	58.1-59.1	58.6-59.7	59.1-59.7	59.7-60.0	60.0-60.2	60.2-60.4	60.4-60.6	60.8-61.1	60.9-61.5	61.5-61.8	61.7-62.0
Dissolved Oxygen (mg/L)	0.26-3.57	0.18-0.25	0.16-0.17	0.15	0.14	0.12-0.18	0.11-0.12	0.11	0.11	0.1	0.11	0.1	0.1
Depth: Week 1 dropped 0.32 ft.; Week 2 dropped 1.9 ft.													

* From 6/14/06-6/26/06 extreme heat occurred with air temperatures of over 109°F

Table 9: Water Temperature and Dissolved Oxygen Monitoring 2005-2006 WC1

Station: WC1													
Date	8/20/05	8/21/05	8/22/05	8/23/05	8/24/05	8/25/05	8/26/05	8/27/05	8/28/05	8/29/05	8/30/05	8/31/05	9/1/05
Water Temperatures (°F)	57.7-61.1	58.6-62.28	59.5-64.5	62.4-64.5	62.4-64.5	59.3-62.2	58.1-61.7	56.4-60.9	59.1-62.0	60.6-64.2	59.7-64.2	56.4-64.0	59.7-64.51
Dissolved Oxygen (mg/L)	1.09-4.6	3.04-5.7	0.05-5.8	0.05-4.86	0.05-6.1	1.5-6.0	0.05-4.5	0.04-1.86	0.04-2.5	0.04-4.9	0.04-3.06	0.04-2.1	0.04-4.3
Depth: Week 1 dropped 0.32 ft.; Week 2 dropped 0.64 ft.													
Date*	6/14/06	6/15/06	6/16/06	6/17/06	6/18/06	6/19/06	6/20/06	6/21/06	6/22/06	6/23/06	6/24/06	6/25/06	6/26/06
Water Tem-peratures (°F)	55.7-58.4	58.4-60.2	60.0-63.1	62.7-65.1	62.9-64.5	60.0-64.2	62.2-63.5	63.3-64.7	64.5-65.6	65.3-66.2	64.7-66.9	64.5-66.3	64.9-66.5
Dissolved Oxygen (mg/L)	4.2-7.4	0.96-6.9	0.31-2.9	0.29-3.01	0.3-4.74	0.6-5.8	0.3-4.3	0.28-2.3	0.25-2.05	0.22-1.32	0.2-4.7	1.1-5.5	1.3-5.3
Depth: Week 1 dropped 0.32 ft.; Week 2 dropped 0.29 ft.													

* From 6/14/06-6/26/06 extreme heat occurred with air temperatures of over 109°F

subsurface water levels to characterize stream flow processes in White Creek. There are both agricultural and residential wells and reservoirs in the White Creek watershed and it is not known what effect water use in the area has on flows in White Creek. There is no irrigated agriculture in close proximity to the revegetation area of White Creek.

One other feature of White Creek that may affect the timing and magnitude of stream flow is the entrenchment of the main stem White Creek channel. The channel appears to have entrenched several feet. Several ephemeral creeks have been channelized and Tributary 3 is largely channelized. These alterations in the stream system combined with on-stream reservoirs (Leoma Lakes), road-building, some vegetation removal, and grazing have changed the volume of runoff and sediment supply enough to cause the main stem White Creek to entrench or downcut. The deeper and narrower channel has less area for flood flows to spread out and slow down, and storm water moves faster downstream. As the channel erodes it incises into the floodplain and the change can alter the timing and magnitude of stream flow.

The White Creek drainage has seen alterations to its stream channels, water development for agricultural and residential uses, and loss of canopy cover on the creek. Despite these changes, the White Creek watershed and mainstem White Creek are one of the least developed and least disturbed areas in the San Francisco Bay area. White Creek supports both spawning and rearing steelhead trout and, due to the good condition of its watershed, has a high likelihood for successful salmonid habitat restoration

The monitoring results demonstrate several needed steps for restoration of salmonid habitat on White Creek. The first step is to revegetate the riparian corridor of White Creek to increase the shade canopy and reduce solar inputs and evaporative losses. Simultaneously stream flow and shallow groundwater levels need to be monitored in conjunction with the revegetation. A longitudinal profile of the white creek channel also needs to be surveyed. Finally depending on the results of the stream flow and subsurface monitoring agricultural and residential water use in the White Creek drainage and local Wooden Valley area near White Creek needs to be reviewed for effects on creek flows.

White Creek Revegetation Plan

Figure 4 depicts a series of revegetation zones along Upper White Creek which will be planted with native plants. The proposed fencing and existing fencing is also shown. Fencing is needed to exclude cattle from the revegetation areas. Tables 10 and 11 list the revegetation areas and plant species.

Zone 1

The creek is sparsely vegetated with a number of large blue and live oaks and a few mature willows and big-leaf maple. The creek bed is made up of cobble and boulders and the channel appears to have been straightened at some time in the past.

Planting recommendation: Live oak and blue oak to provide additional shade for seasonal flows. Oaks should be planted 15-25 ft. apart along the top of the bank.

Zone 2

The creek in this zone is largely hard rock with very little vegetation. Invasive, non-native Himalayan blackberry and native coyote brush are sparsely distributed along the rock channel. Isolated summer pools lined with white alder occur at the downstream end of Zone 2. This is the most upstream area where isolated pools occur in the summer. The white alders create areas of good riparian canopy.

Planting recommendation: Additional coyote brush and blue oak will be installed in the upstream hard rock channel area of Zone 2. Live oak, willow, and white alder should be planted along the downstream area of Zone 2. Willow and alder would be installed at the base of the creek bank and oaks installed at the top. There is some entrenchment in the downstream area of this zone.

Zone 3

The creek in this zone has mostly white alder and willow along the base of the bank and good canopy in many areas. Live oak, valley oak, and California buckeye occur on the top of the bank. There are summer pools in this zone and the elevation of the water surface is about six feet below the surrounding land elevation. Station WC4 is in this zone.

Planting recommendation: Additional oaks are needed on the top of the bank and in locations where there is space, additional willow or alder could be installed.

Zone 4

This section of the creek has similar vegetation to Zone 3 in its upstream area. The downstream area has scattered live oaks. The left bank also has rock and borders a hillslope. This area will be difficult to plant. Station WC3 is located in the downstream area of Zone 4 and the creek dries up in this area.

Planting recommendations: Additional live and valley oaks are needed to be installed at the top of the bank on the downstream area. Where possible, alder and willow should be installed at the base of the bank.

Zone 5

There is a long thermal reach in the upstream area of this zone, with little to no canopy where the creek dries up. The downstream area has live oak, valley oak, blue oak on the upper banks, Oregon ash, and willow with California wild rose on the lower bank and tules in the channel. The left bank is largely rock and may be difficult to revegetate.

Planting recommendations: The upstream area needs canopy: live oak, valley oak, and blue oak should be planted at the top of the bank. The base of the bank should be planted with Oregon ash, willow, and white alder.

Zone 6

The creek in this zone has Oregon ash, valley oak, live oak, willow, and white alder in some dense patches along the channel. There are also areas with little vegetation. Station WC4 is located in this zone.

Planting recommendations: Install additional live, blue, and valley oaks at breaks in the canopy at the top of the bank. Alder and willow should be installed at the base of the bank in open areas.

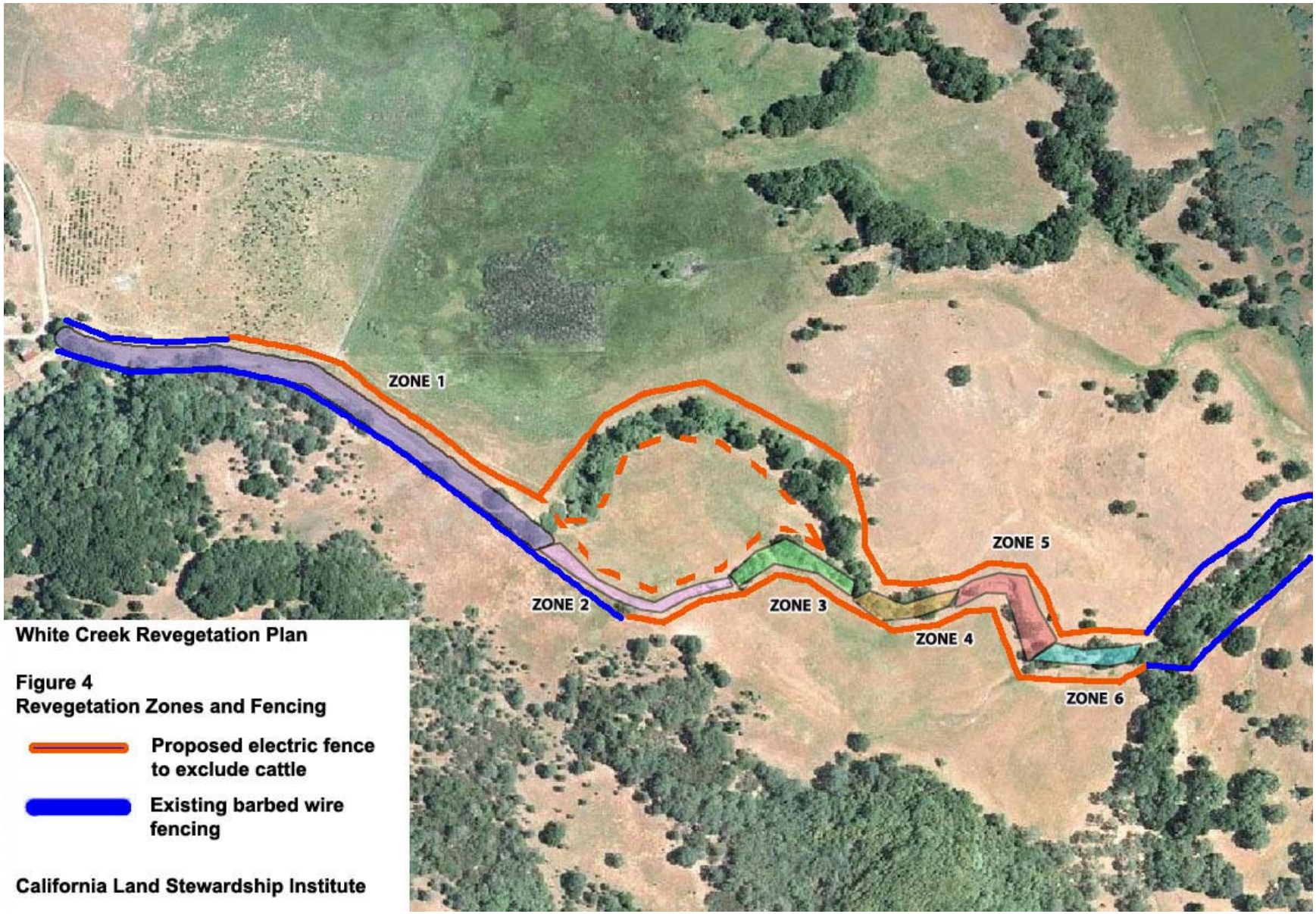

ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ZONE 6
White Creek Revegetation Plan
Figure 4
Revegetation Zones and Fencing
Proposed electric fence to exclude cattle
Existing barbed wire fencing
California Land Stewardship Institute

Table 10: Revegetation Zones on White Creek

White Creek Revegetation								
	Length (ft.)	**Total Area (sq. ft.)**	**Total Area (acres)**	**Area of Existing Veg. Cover (sq. ft.)**	**Existing Vegetation Percent Cover**	**Total Area of Proposed Revegetation (sq. ft.)**	**Estimated number of willow sprigs**	**Estimated number of other trees/shrubs**
Zone 1	1470.00	103,807	2.38	39,194	37.75%	64,613	0	162
Zone 2	600.00	28,204	0.65	2,693	9.54%	25,511	0	55
Zone 3	330.00	17,827	0.41	14,742	82.69%	3,085	0	30
Zone 4	320.00	13,582	0.31	10,420	76.72%	3,162	0	56
Zone 5	350.00	25,149	0.58	7,774	30.91%	17,375	120	24
Zone 6	360.00	19,364	0.44	13,705	70.78%	5,659	40	40
TOTAL	**3,430**	**207,933**	**4.77**	**88,528**		**119,405**	**160**	**367**

Table 11: Planting Specifications for White Creek Revegetation

WHITE CREEK REVEGETATION									
Scientific Name	**Common Name**	**Number of Plants per Area**						**Container Size**	**Spacing**
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**		
Salix sp.	Willow sprigs			15	15	120	40	dormant sprig	5 ft.
Quercus douglasii	Blue oak	25	25			35	10	supercell	10-20 ft.
Quercus lobata	Valley oak		5		20			dee pot	10-20 ft.
Quercus agrifolia	Coast live oak	25		15	20	35	10	D-16	10-20 ft.
Baccharis pilularis	Coyote brush		25					D-16	10-20 ft.
Alnus rhombifolia	White alder		25	10	16		20	dee pot	10-20 ft.
TOTAL		**50**	**80**	**40**	**71**	**190**	**80**		
Plants to be installed with protective hardware and placed on drip or hand irrigation.									

Fencing

The creek area will be excluded from cattle through the installation of electric fence as indicated in Figure 4. Table 12 summarizes the length of fencing needed. The cattle rancher leasing the site will be involved in installing the fencing.

Table 12: Cattle Exclusion Fencing

White Creek Fencing Estimate	
	Length (sq. ft.)
Left bank	3,014
Right bank	1,670
Optional loop	1,780
TOTAL	**6,464**

Photographs

Dead juvenile steelhead trout at Station WC 2 following a heat wave of 109°F temperatures in summer 2006

Dead steelhead trout at Station WC1 during the heat wave in the summer of 2006

Water Temperature Monitoring Stations

Station WC4 in June 2006

Station WC 3 in October 2005

Station WC 2 in June 2006

Station WC 1 in June 2006

Station WC 1 in August 2006 following a 3 week heat wave of 109° F temperatures

Station WC 0.5 in May 2007

Station WC 0.2 in May 2007

Revegetation Zones

Zone 1 looking upstream in October 2005

The downstream end of Zone 2 in February 2008

Zone 2 in August 2010

Zone 3 in February 2008 showing the white alder along the channel but lack of oaks for shade canopy on the top of the bank

Zone 4 showing lack of tree canopy

Zone 5 looking downstream showing scattered trees

Zone 5 looking upstream showing lack of canopy

Zone 6 looking across White Creek from the north