Alternative Watershed Plan for Russian River Subwatersheds Affected by 2020 Glass and Walbridge Fires

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1 INTRODUCTION AND WATERSHED BACKGROUND

1.1 PURPOSE OF ALTERNATIVE WATERSHED MANAGEMENT PLAN

The purpose of this plan is to identify water quality problems, or potential problems, and create a criteria to use as a tool to prioritize restoration sites and management practices that:

a) control and minimize nonpoint source pollution from entering the streams of the Lower and Middle Russian watersheds through the planning and implementation of post-fire best management practices (BMPs) on lands burned by the LNU and Glass wildfires in 2020, and

b) support the attainment of the Laguna de Santa Rosa Watershed Dissolved Oxygen TMDL; the Russian River Pathogen and Indicator Bacteria TMDLs currently being developed; the Laguna de Santa Rosa Watershed Nutrients (nitrogen and phosphorous), Temperature, and Sediment TMDLs under development; and reduce sediment and temperature impairments in the Russian River watershed and some of the major tributaries. An Alternative Watershed Plan is intended to provide a framework to pursue near-term restoration actions that will contribute to meeting water quality objectives for the region. This Plan addresses the following descriptions of the USEPA's five elements of an Alternative Watershed Plan (U.S. Environmental Protection Agency 2020).

KEY	Description of Minimum Element for Alternative Watershed Plan
A	*Identification of the causes or sources of nonpoint source pollution impairment, water quality problem, or threat to water quality*
B	*Watershed project goal(s) and explanation of how the proposed project(s) will achieve or make advancements towards achieving water quality goals*
C	*Schedule and milestones to guide project implementation*
D	*Proposed management measures (including a description of operation and maintenance requirements) and explanation of how these measures will effectively address the nonpoint source pollution impairment identified above*
E	*Water quality results monitoring component, including description of process and measures (e.g., water quality parameters, stream flow metrics, biological indicators) to gauge project success*

1.1.1 Watersheds addressed

The LNU Lightning Complex fires include the Walbridge, Meyers, and Hennessey Fires. The Hennessey Fire was in Napa County. The Meyers Fire was in the Russian Gulch Watershed, which flows directly to the coast instead of into the Russian River. Therefore, of the three LNU Lightning Complex fires, only the Walbridge Fire, which burned within Sonoma County and within tributaries of the Russian River, has been included in this plan.

The Glass fire burned within Sonoma and Napa Counties; this plan covers watersheds affected within Sonoma County.

The watersheds addressed in this plan include the following watersheds within the Sonoma Resource Conservation District boundary in Sonoma County:

Fire footprint	HUC12	Subwatershed name
Glass	180101100702	Upper Santa Rosa Creek
Glass	180101100706	Porter Creek - Mark West Creek
Walbridge	180101100503	Warm Springs Creek
Walbridge	180101100505	Pena Creek
Walbridge	180101100506	Mill Creek
Walbridge	180101100507	West Slough - Dry Creek
Walbridge	180101100801	East Austin Creek
Walbridge	180101100902	Porter Creek - Russian River
Walbridge	180101100903	Guerneville North Watershed subbasins

See Map 1. Russian River Subwatersheds impacted by the 2020 Sonoma-Lake-Napa Unit and Glass wildfires.

1.1.2 Stakeholder groups

Stakeholders include:

Landowners and community members in the proposed project watersheds
California Department of Fish and Wildlife (CDFW)
California Sea Grant
California State Water Resources Control Board
Friends of the Mark West Watershed
Laguna de Santa Rosa Foundation
LandPaths
National Marine Fisheries Service (NMFS)
National Oceanic Atmospheric Administration (NOAA)
Natural Resources Conservation Service (NRCS)
North Coast Regional Water Quality Control Board (NCRWQCB)
Pepperwood Foundation
Russian Riverkeeper
Sonoma County Agricultural Preservation and Open Space District (SCAPOSD)
Sonoma County Department of Agriculture/Weights and Measures
Sonoma County Department of Transportation and Public Works
Sonoma County Permit and Resource Management Department
Sonoma County Public Health Division

Sonoma County Regional Parks
Sonoma County Water Agency (SCWA)
Sonoma Land Trust
Sonoma State University
Trout Unlimited
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (EPA)
U.S. Fish and Wildlife Service
University of California Cooperative Extension

1.2 Watershed Background

1.2.1 Regional setting

The Russian River watershed includes many diverse watersheds. From its headwaters in the Mayacama Mountains, the river flows 110 miles to meet the ocean near Jenner ("About the Russian River" n.d.). Its tributaries begin in the ridges of the nearby mountains, flow past vineyards and homes, and through floodplains that are now used for cattle ranching and other agriculture. It is a source of water for three counties and has provided resources for the people who lived in this area since before written history. Within the Russian River watershed, two reservoirs are currently managed for flood control, water supply, habitat, and recreation (Sonoma Water 2022).

The Russian River steelhead fishery was once one of the largest on the west coast (Sotoyome Resource Conservation District 1995). Several species of anadromous fish still spend a portion of their lives here, including an endangered ecologically distinct population of coho salmon (National Marine Fisheries Service 2012). Much of the river restoration in the area has been focused on recovery of coho, steelhead, and chinook salmon populations, but all of these different types of land use can benefit from some of the best management practices included in this alternative watershed plan.

1.2.2 History of land use and ownership

The earliest human relationships with these watersheds were those of many different indigenous tribes (Bay Area Equity Atlas 2022). Their management practices to maintain quality harvesting, fishing, plant material, and hunting helped to create the landscape that we are familiar with today (Goode et al. 2018; Romero-Briones et al. 2020; Long, Lake, and Goode 2021, and many others). Members of these communities are currently living and striving to thrive on, and with, this land. It is important to acknowledge that these original indigenous people's land was stolen by settlers, and that this alternative watershed plan encompasses the stolen land.

Once Europeans began to use the land for their own purposes, it changed drastically in a short span of time. Cattle were introduced around the beginning of the 1800's for the export of hides and tallow, and grazing led to the replacement of native bunchgrass prairies with introduced annual European grasses (Sonoma Resource Conservation District 2015a). The California Gold Rush in the 1850's brought many more people of various cultures and ethnicities to the area. Riparian habitat was converted to cropland. Around the 1900's and after WWII, redwood forests were heavily logged as a main industry of the area. Oak and madrone were also logged for charcoal. Forestland was often converted to agricultural or grazing use.

Wine grapes, which are now the highest-grossing crop in the region, have been grown in the areas since the early 1800s. Prohibition dealt a blow to the economy, but the California wine industry recovered and began to boom in the 1970's. Apples, prunes, and hops were once the primary crops of this area, but increased demand for wine in the 1970s expanded vineyards throughout the state (Alston, Lapsley, and Sambucci 2018).

The development of this area has had huge impacts on water quality. "A History of Salmonid Decline in the Russian River" (Steiner Environmental Consulting 1996) gives a thorough overview of the effects of western development on the Russian River and its tributaries, including a useful References list.

A more thorough narrative of this social history can be found in (Laurel Marcus and Associates 2005) and of the ecological history, in (Steiner Environmental Consulting 1996).

The history of land use has drastically changed this landscape depending upon the culture of those in power. Many different cultural and ethnic groups have been involved in these changes, but some have been forced out of the area due to racial exclusion laws. The current land ownership is a result of the displacement of indigenous peoples and the exclusion of others.

It is beyond the scope of this report to detail the long-standing economic and quality of life disparities in the region, many of which have been directly caused by racially unjust laws. However, there are several valuable resources which detail the history of land use in this region. These are available online and listed below, as well as referenced at the end of this document.

Document title	Accessible online
Bay Area Equity Atlas: Indigenous Populations in the Bay Area	https://bayareaequityatlas.org/about/indigenous-populations-in-the-bay-area
Roots, Race, and Place: A History of Racially Exclusionary Housing in the San Francisco Bay Area	https://belonging.berkeley.edu/rootsraceplace
Portrait of Sonoma County 2021 Update	https://upstreaminvestments.org/Microsites/Upstream%20Investments/Documents/Archive/Portrait-of-Sonoma-County-2021-Report.pdf
Racist deeds in Sonoma County and elsewhere are still on the books. A new law seeks to get rid of them	https://www.pressdemocrat.com/article/news/racist-deeds-in-sonoma-county-and-elsewhere-are-still-on-the-books-a-new-s/
Chapter 2: A History of California Agriculture	https://s.giannini.ucop.edu/uploads/pub/2021/01/21/chapter_2_history_of_california_2020.pdf

The California Department of Water Resources (DWR) has mapped parts of the Mark West Creek, Laguna de Santa Rosa, Mill Creek, and lower Russian River Watersheds as severely disadvantaged communities (SDACs) and disadvantaged communities (DACs), as well as a significant portion of the Lower Russian River area and its communities, into which all the impacted watersheds drain ("Disadvantaged Communities – Bay Area Integrated Regional Water Management Plan" n.d.).

One of the goals of the Sonoma Resource Conservation District (SRCD) is to become a more equitable, just, and inclusive organization. In considering site prioritization criteria, it is important to understand the history of racially-based exclusion in the area, which has directly influenced the land ownership and use that we see today, including economic disparities which affect community health.

1.2.3 Current agricultural setting

Agriculture continues to be an important industry in Sonoma County. Ongoing drought conditions present challenges to farmers and ranchers, and an ability to adapt to new practices and water use needs may determine the most successful of these in the future.

2021 Summary of gross production values by crop ("2021 Sonoma County Crop Report" 2021):

Wine grapes	Over $540 million
Milk	Over $124 million
Ornamental plants; Other nursery plants; Livestock and poultry products; Cattle	Over $20 million each
Vegetables; Cut flowers; Bedding plants; Sheep; Other livestock and poultry	Over $4 million each
Rye and oat hay crops; Apples; Gravenstein apples; Silage crops	Over $1 million each

Present land ownership and use within the areas affected by the 2020 fires ("Watershed Emergency Response Team Evaluation: LNU Lightning Complex Walbridge and Meyers Fires" 2020; "Watershed Emergency Response Team Evaluation: Glass Fire" 2020; Sonoma Resource Conservation District 2020):

Land ownership by %	Glass Fire area	Walbridge Fire area
Private	74%	89%
Public	19%	10.5%
Non-Profit conservancies and trusts	7%	0.5%

Land use by %	Glass and Walbridge Fire areas combined
Timber, hardwoods, and chaparral	36%
Pasture	33%
Rural residential	20%
Urban	11%
Vineyard	1%

1.2.4 Geology

The area of both fires is within the southern part of the northern California Coast Ranges geomorphic province, a series of steep mountains and valleys which run subparallel to the San Andreas Fault.

The bedrock in the Glass Fire area is Franciscan Complex, Great Valley Sequence, Sonoma Volcanics, and fluvial sedimentary deposits. Historic mines may contain potentially harmful concentrations of heavy metals, including mercury. For more detailed resources on this topic, see "Geology and Landslides" from "Watershed Emergency Response Team Evaluation: Glass Fire", 2020.

Bedrock in the Walbridge Fire area is primarily Francisican Complex, as well as some Great Valley Sequence underlying the east side of the fire boundary. This area is prone to landslides both as shallow debris slides or as deep-seated landslides. There are several geologic faults that run through the burned area ("U.S. Geological Survey and New Mexico Bureau of Mines and Mineral

Resources, Quaternary Fault and Fold Database for the United States" n.d.). Landslides in this area can be caused by ground shaking from these faults, combined with rainfall events.

There are several historic mines in the area, which may have tailings with high concentrations of heavy metals susceptible to erosion and runoff into waterways. The tailings from the Jackson mercury mine were especially noted as a potential hazard to water quality. A more thorough summary is contained in the "Geology and Landslides" section of ("Watershed Emergency Response Team Evaluation: LNU Lightning Complex Walbridge and Meyers Fires" 2020).

1.2.5 Soils

Soils within these large fire areas are varied and depend on features such as location, slope, weather, and aspect.

Primary soils within the Walbridge Fire area include several found on steep slopes with rapid runoff and high erosion hazard: Huse stony clay loam, Hugo very gravelly loam, Hugo-Josephine complex soils, Los Gatos loam, and Laughlin loam. Yorkville-Suther complex is found in grass and oak woodland areas, low slopes, and has runoff that is slow to rapid and erosion hazard of slight to high. Other main soils include Hugo, Stonyford gravelly loam, Maymen gravelly sandy loam, Boomer loam, and Yorkville clay loam, all on similar slopes and with similar runoff and erosion characteristics.

Primary soils found in the Glass Fire perimeter are on 30-75% slopes: Goulding cobbly clay loam, Henneke gravelly loam, and Boomer loam, (all of which have rapid runoff and high erosion hazard) and stony, steep slopes and ridges with limited soil material and vegetation. Other main soils include those of shallower slopes, with lower runoff and erosion hazards: Goulding cobbly clay laom, Henneke gravelly loam, Goulding clay loam, Maymen gravelly sandy loam, Boomer loam, Sobrante loam, and Hugo (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. 2003).

1.2.6 Fish and wildlife

This region of the Russian River and its tributaries is home to a diversity of fish, wildlife, and insect species. Those most directly impacted by water quality concerns are those that spend some or all of their life cycles in the water – fish, amphibians, and aquatic insects.

California Department of Fish and Wildlife considers the following aquatic species to be of special concern in the subwatersheds covered by this plan (U.S. Environmental Protection Agency 2010; P. B. Moyle et al. 2015):

Ambystoma californiense	California tiger salamander
Emys marmorata	Western pond turtle
Hesperoleucus symmetricus ssp.	Russian River roach
Hysterocarpus traski pomo	Russian River tule perch
Lampetra ayresi	River lamprey
Mylapharadon conocephalus	Hardhead
*Oncorhynchus gorbusha**	Pink salmon
Oncorhynchus kisutch	Coho salmon, Central California Coast evolutionarily significant unit
Oncorhynchus mykiss	Steelhead trout
Oncorhynchus tshawytscha	Chinook salmon
Rana draytonii	California red-legged frog
Rana muscosa	Yellow-legged frog
Syncaris pacifica	California freshwater shrimp

*historically present, now functionally extinct here

1.2.7 Vegetation and forestry

The plant communities of these subwatersheds include redwood forests, mixed conifer forests, oak woodlands, chapparal, grasslands, and riparian habitat.

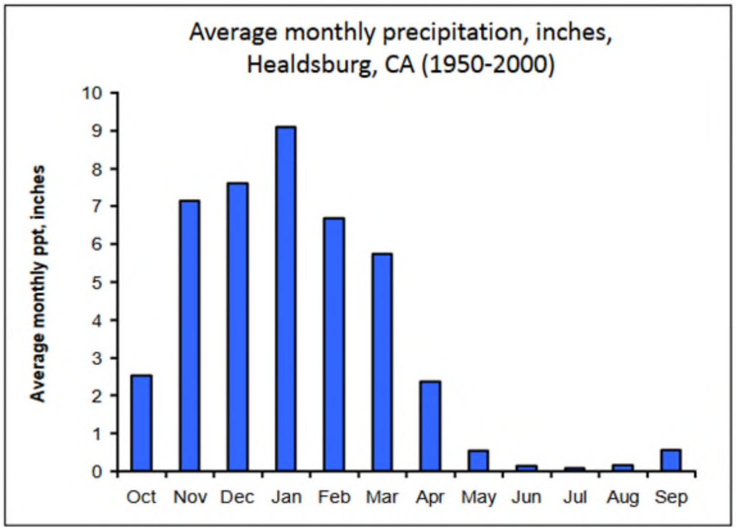
Recent (1880’s) past and current forest management practices, including long-term fire suppression, created vegetative conditions at high risk for high-severity wildfire. The results of that were demonstrated in large fires, which includes the 2020 fires which this project focuses on.

Invasive plant species include annual grasses, giant reed, yellow starthistle, French broom, and water primrose (Mendocino County Resource Conservation District 2012). Sudden Oak Death, a pathogen, is present in these watersheds. It is unknown how Sudden Oak Death may change the dominant vegetation type in oak dominated or co-dominated areas.

Stewarding the return of native, fire-adapted plant species in these areas is expected to protect the long-term fire resiliency of these areas, as well as increasing water quality.

1.2.8 Surface water

Currently, the vast majority of annual precipitation falls in October through April. Rainfall amounts within the region vary with elevation and topography (Sonoma Resource Conservation District 2015a):



Summer water flows are currently regulated by release from two reservoirs: Lake Sonoma and Lake Mendocino. These releases keep water levels artificially high during the summer and low during the winter. The Russian River is also augmented by water from the Eel River, which has been diverted since 1912 (Mendocino County Resource Conservation District 2012).

1.2.9 Climate change and water resources

In two models of climate change, one in which precipitation remains stable and one in which precipitation increases, Micheli et al (2012) predicted "reduced early and late wet-season runoff for the next century, resulting in a potentially extended dry season… Scenarios that estimate increased precipitation project that precipitation to be concentrated in mid-winter months, a trend which could increase the risk of floods… climatic water deficit is projected to increase steadily in both the wetter and drier future scenarios….Summers are projected to be longer and drier in the future than in the past regardless of precipitation trends."

As the climate changes, rainfall is likely to be more variable in terms of both low and high annual extremes (California Climate Commons n.d.).

1.2.10 Fire history

The following summaries are drawn from the Watershed Emergency Response Team Evaluations. There were no Burned Area Emergency Response (BAER) reports found for these fire incidents.

<u>Glass Fire</u>

In October 2020, the Glass Fire began in the Mayacamas Mountains. It burned through 67,000 acres, mostly within the tributaries of the Russian River that include Santa Rosa and Mark West

Creeks, the Sonoma Creek drainage to San Pablo Bay, and tributaries of Putah Creek and Lake Berryessa. Approximately 20% of the area burned as moderate-high soil burn severity, and approximately 80% was categorized as low to no soil burn severity. Approximately 10% of the fire occurred in areas previously burned in the 2017 Nuns fire. 75% of the total burn was on private lands ("Watershed Emergency Response Team Evaluation: Glass Fire" 2020).

Walbridge Fire

In August 2020, the LNU Complex of fires started north of Guerneville. This complex included the Walbridge and Meyers fires in Sonoma County; the Hennessey fire was in other counties. The Meyers fire was near Fort Ross State Historic Park and drains directly to the ocean, and is not part of this grant area since it is not a subwatershed of the Russian River. The Walbridge Fire burned 55,000 acres. 24% of the Walbridge Fire burned at moderate to high soil severity. 76% burned at low to very low soil burn severity. 89% of the total acres burned are on private lands ("Watershed Emergency Response Team Evaluation: LNU Lightning Complex Walbridge and Meyers Fires" 2020).

2 Water Quality Objectives

2.1 Water quality objectives for nonpoint source pollution

The Water Quality Control Plan for the North Coast ("Basin Plan") (North Coast Regional Water Quality Control Board 2018a) is a guiding document that defines beneficial uses of the Russian River basin and water quality objectives which support those uses. This Alternative Watershed Plan aims to provide a framework for meeting those water quality objectives for nonpoint source pollution.

Beneficial uses of the Russian River basin:

	Municipal & domestic supply	Agricultural supply	Industrial service supply	Industrial process supply	Groundwater recharge	Freshwater replenishment	Navigation	Hydropower generation	Water contact recreation	Non-contact water recreation	commercial and sport fishing	Warm freshwater habitat	Cold freshwater habitat	Wildlife habitat	Rare, threatened, or endangered species	Migration of aquatic	Spawning, reproduction, and/or early development	Shellfish harvesting	Estuarine habitat	Aquaculture
Guerneville	E	E	E	P	E	E	E	P	E	E	E	E	E	E	E	E	E	P	E	P
Austin Creek	E	E	E	P	E		E	P	E	E	E	E	E	E	E	E	E			P
Laguna de Santa Rosa	P	E	E	P	E	E	E	E	E	E	E	E	E	E	E	E	E	P		P
Santa Rosa	E	E	E	P	E		E	P	E	E	E	E	E	E	E	E	E	P		P
Mark West	E	E	E	P	E	E	E	P	E	E	E	E	E	E	E	E	E	P		P
Warm Springs	E	E	E	P	E	E	E	E	E	E	E	E	E	E	E	E	E			E

E = existing uses; P = potential uses

Summary of water quality objectives for nonpoint source pollution (North Coast Regional Water Quality Control Board 2018b):

Temperature	-Warm Freshwater Habitat: no more than 5°F above natural receiving water temperature -Cold Freshwater Habitat: no more than 5°F above natural receiving water temperature	
Dissolved Oxygen The Russian River contains the following three designations:	Daily Minimum Objective (mg/L):	7-Day Moving Average Objective (mg/L)
Warm Freshwater Habitat	5.0	6.0
Cold Freshwater Habitat	6.0	8.0
Spawning, Reproduction, and/or Early Development Habitat	9.0	11.0
Sediment Settleable material	Shall not cause nuisance or adversely affect beneficial uses	

Bacteria	Shall not be degraded beyond natural background levels. Median fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed 50/100 ml, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 m. At all areas where shellfish may be harvested for human consumption, the fecal coliform concentration throughout the water column shall not exceed 43/100 ml for a 5-tube decimal dilution test or 49/100 ml when a three-tube decimal dilution test is use.
Biostimulatory substances	Shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.
Turbidity	Shall not be increased more than 20% above natural occurring background levels

*And shall not be in excess of those specified in title 23 of the California Code of Regulations

2.2 Total Maximum Daily Loads

The entire Russian River watershed, as well as each of the subwatersheds addressed in this plan, is 303(d) listed as impaired for sediment and temperature (State Water Resources Control Board 2022).

The Laguna de Santa Rosa, of which Porter Creek – Mark West and Upper Santa Rosa Creek are tributaries, is also 303(d) listed for indicator bacteria, dissolved oxygen, mercury, and phosphorous (State Water Resources Control Board 2022).

The Laguna de Santa Rosa is also impaired for ammonia and dissolved oxygen (Morris 1995); however, those pollutants reach threshold levels only downstream of the project area, and it is noted that Santa Rosa Creek appears to dilute nitrate and phosphorus concentrations downstream of its confluence with the mainstem of the Laguna (Tetra Tech, Inc. and Philip Williams & Associates, Ltd. 2007).

Upper Santa Rosa Creek is, however, 303(d) listed for indicator bacteria (State Water Resources Control Board 2022). Low dissolved oxygen has also been observed in Santa Rosa Creek during summer months (Tetra Tech, Inc. and Philip Williams & Associates, Ltd. 2007).

2.3 Existing projects to meet watershed goals

SRCD and other local agencies have recognized the Mark West, Mill, and Austin Creek watersheds, and the Laguna de Santa Rosa as areas of high priority for restoration.

Russian River anadromous fish projects have primarily been spearheaded by the National Marine Fisheries Service, the California Department of Fish and Wildlife, and other agencies and organizations. Other stakeholders include many of the agencies listed in part 1.1.

The North Coast Salmon Project (California Department of Fish and Wildlife 2022) identified Mill Creek as one of four tributaries to the Russian River that are key to Coho salmon recovery. Many recovery projects have been related to instream habitat restoration, but two of the limiting factors to salmon survival in Mill Creek were embeddedness of gravels in fine sediment, and high water temperatures (Sonoma Resource Conservation District 2015b).

Nearby protected lands include California Regional Parks and California State Parks, Austin Creek State Recreation Area, Armstrong Woods State Reserve, and lands held or protected by LandPaths, Sonoma Land Trust, or Ag + Open Space.

The Technical Advisory Committee and other regional experts will be consulted as to the synergy of any potential projects with past / ongoing work. On a case-by-case basis, projects will be investigated to ensure that they will build on, and not interfere with or repeat, previous efforts.

3 Causes and Sources of Nonpoint Source Pollution

3.1 Sedimentation

Any sediment delivered to a small stream will eventually be transported to downstream channels (Pacific Watershed Associates 2001). Sedimentation has been identified as the largest source of nonpoint source pollution for the subwatersheds in the region. Excess sedimentation can have detrimental effects on salmon (North Coast Regional Water Quality Control Board 2006; Flosi et al. 1998; Jensen et al. 2009; Kondolf 2000) and many others.

Nonpoint soil erosion concentration rates tends to increase during high flows corresponding with precipitation-washoff events (Tetra Tech 2020b). Sedimentation can also affect the other two nonpoint source pollutants identified in the area, temperature and dissolved oxygen, in a relationship that tends to increase those pollutants as sedimentation is increased. This is due to increases in the sediment in a watercourse causing shallowing, which leads to increased temperatures and a reduction in dissolved oxygen. Sediment particles suspended in water also increase water temperature by absorbing warmth from the sun.

3.1.1 Roads

A road can contribute sediment to a stream if it is hydrologically connected, meaning that there are direct routes of drainage or overland flow of road runoff to a stream or lake. Roads that are hydrologically connected to streams can alter the natural flow of water and create concentrated runoff events which can lead to sedimentation.

Roads that are hydrologically connected can contribute sediment via some of the following processes:

- Erosion of gravel or unpaved road surfaces
- Erosion of road cut slopes
- Erosion of sediment deposited on roads by soil creep from adjacent hillsides
- Interception of hillslope runoff leading to increased stream flows

Furthermore, road crossings at streams may be improperly designed or constructed for water flow, or in poor repair.

Problems at stream crossings often include:

- undersized culverts
- no culverts, in which cases water may flow either through or beneath the road fill, or across the road surface, or down the inboard ditch
- culverts likely to plug
- improperly placed culverts, including ditch relief culverts, causing gully erosion below outlet or sediment accumulation above the inlet
- stream crossings with diversion potential

Chronic road surface erosion is that which occurs during every surface runoff event. Uncontrolled water flow from sections of roads and ditches discharging directly to the stream system can also contribute to sedimentation in a stream.

Gully erosion may be caused by poorly drained roads, plugged culverts, or insufficient armoring at fill crossing sites or at ditch relief culvert outlets. Gully erosion is a more common cause of sedimentation during high water flow.

There are many local resources regarding sedimentation and roads; this section draws on the following: (Low and Napolitano 2008; Pacific Watershed Associates 2001; Sonoma Resource Conservation District 2015a; Tetra Tech 2020a; Weaver, Weppner, and Hagans 2016).

3.1.2 Other causes of sediment movement

Surface water flow can carry sediment/soil that has been mobilized by rainsplash, sheet erosion, and rill erosion into watercourses. Sediment movement due to slope and gravity, such as landslides and rock falls, is a form of mass wasting. Rainfall events which saturate soils may trigger mass wasting in the form of landslides. Earthquakes may also trigger landslides. Roads can also cause these mass wasting events by weakening the stability of hillsides (Sonoma Resource Conservation District 2015a). Surface water flow that is directed into road-side ditches may also increase its energy and erosive power.

Channel incision lowers the elevation of a stream channel and often simplifies the stream channel geometry. An incised stream channel speeds up streamflow, increasing its energy and erosive power, which can potentially cause erosion on the creek banks and does not allow sediment to deposit naturally.

3.1.3 Turbidity

Turbidity is the measure of relative clarity of water, which is affected by the amount of suspended particulates. Particles can provide attachment for pollutants like bacteria, microbial pathogens, and metals. Sedimentation and erosion contribute to turbidity by washing particles into a water body. High water velocity and water volume (which can be affected by road connectivity) can also increase turbidity.

3.2 Temperature and Dissolved Oxygen

In addition to excess sediment, all the subwatersheds within the Russian River have been identified as being impaired due to excess sediment and lack of dissolved oxygen. Taking measures to control erosion can help to control these other pollutants.

Reducing sedimentation can also lower turbidity, which in turn can help to decrease temperature. When temperature is decreased, dissolved oxygen can increase. Increasing riparian vegetation, which is a BMP for controlling sedimentation, can also help to lower stream temperatures by shading open water.

Bacteria, which thrive in nutrient-rich environments, also decrease levels of dissolved oxygen. Controlling the amount of nutrients washing into a stream via sedimentation will help to minimize the amount of bacteria that can grow. This can be especially important in recently burned areas, where phosphorus and nitrogen may be available via ash and burned plant tissues (U.S. Geological Survey 2018).

3.3 Summary of causes, sources, and general recommendations

Information below is summarized by subwatersheds in the project area. For some subwatersheds, detailed stream inventories have been completed, and for other areas data was incomplete or lacking. The information in this section may be used to help focus outreach efforts and/or prioritize sites selected for projects. More pollutants, causes, and potential BMPs are potentially present in these subwatersheds but were not found in references. A more complete summary of this information is included as Appendix Item 10.4.

3.3.1 Russian River Watershed

The Russian River is polluted with sediment and temperature, and TMDLs are in development for pathogen and indicator bacteria. Causes include soil erosion, stream diversions, impervious surfaces, and harmful invasive plant species (Sotoyome Resource Conservation District unkn.; Kuhlman 2005; Sotoyome Resource Conservation District 2007; State Water Resources Control Board 2022; Fitzgerald 2004).

3.3.2 Project area subwatersheds

		Causes / sources						
Subwatershed	**Identified pollutant/s**	**Sediment inputs related to road system**	**Lack of beneficial riparian vegetation**	**Impervious surfaces**	**Livestock**	**Channel incision**	**Streambank modification**	**Heavy development for housing and agriculture**
Mill Creek	sediment, temperature	X	X	X				
East Austin Creek	sediment, temperature, dissolved oxygen	X	X					
Porter Creek (Russian River)	sediment, temperature	X	X		X	X		
Guerneville North Watersheds	sediment	X	X					
Warm Springs Creek	sediment		X	X			X	
Pena Creek	sediment, temperature	X	X		X			

Laguna de Santa Rosa	sediment, temperature, dissolved oxygen, nutrients (phosphorous, nitrogen, ammonia), indicator bacteria, mercury			X*				X*
Upper Santa Rosa Creek	sediment	X	X					
Porter Creek (Mark West)	sediment, temperature	X	X					

*Pollutant levels in the Laguna are generally associated with development in the lower Laguna (wastewater discharge, septic effluent, stormwater runoff from urban areas, vineyards, and dairies). The Glass Fire burned in the upper Laguna and most potential project sites will be in that area.

3.4 FIRE

3.4.1 Physical effects on bare soil

Fire can significantly increase sedimentation, especially with increased rainfall following a fire within the first five years (Warrick et al. 2012). Larsen et all (Larsen et al. 2009) concluded via field studies and rainfall simulation studies that post-fire sedimentation during this time period was caused primarily from a loss of surface cover during rainfall events, rather than by soil hydrophobicity or soil sealing by ash.

A study in coastal California concluded that sediment yield post-fire is related to precipitation affecting rilling and mass movements in hillslope erosion processes. “Wildfire followed by heavy precipitation was shown to produce annual watershed sediment yields that were an order of magnitude greater than expected without wildfire.” Their review of literature concluded that these effects last 3-8 years, with decreasing effects over that time period. However, they do also note that frequent fire return intervals and/or higher severity fires may also affect this rate of recovery (Warrick et al. 2012).

Another study (Malmon et al. 2007) also concluded that suspended sediments post-fire were dramatically greater than average, but did not study the effects longer than 3 years post-fire. For more information, both of the articles above include many valuable citations.

It appears that the effects of fire on sedimentation can be dramatic, but may decrease after several years.

3.4.2 Short and long-term effects on nutrient loading

Research has focused on sedimentation within the first few years after a fire, but Rhoades et al. (2019) concluded that stream nitrate and total dissolved nitrogen remain elevated for at least 14 years post-fire in the system that they studied.

3.4.3 Damage to roads and stream crossings

Besides the increased amount of bare soil that a significantly burned area may present, other effects of fire damage can include those to unsurfaced roads or culverts. Road and culvert quality may be negatively impacted via creation of fire lines and the transport of heavy machinery, or via emergency timber operations immediately following the fire. Plastic culverts may melt when exposed to high fire temperatures. For more information on these processes and risks, see the following references: (Foltz, Robichaud, and Rhee 2008; California Department of Fish and Game 2002; Taylor et al. 2002).

3.5 Climate Variability

Climate models predict that rain events are likely to become more concentrated during winter months, while summers are likely to be longer and drier (Micheli et al. 2012; Flint and Flint 2012; California Climate Commons n.d.).

In these scenarios of longer dry seasons, wildfire frequency is also predicted to increase (Thorne, Wraithwall, and Guido 2018).

Increased fire and more concentrated rain events can be expected to lead to more sedimentation effects from fire activity, as described above.

4 Best Management Practices for Nonpoint Source Pollution

4.1.1 Upgrade roads

Overview of road improvement characteristics (Pacific Watershed Associates 2001):

Disperse road surface drainage	• Disconnect road surface and ditches from streams and stream crossing culverts • Drain ditches frequently via rolling dips or ditch relief culverts • Ensure ditch relief culverts do not discharge into streams or onto active or potential landslides • Dewater gullies as much as possible

	• For private roads that don't get snow/ice, outsloping is often recommended as a way to help improve road drainage
Improve road and landing fills	• Place excavated spoil where it will not enter a stream • Place excavated spoil where it will not cause a landslide
Improve stream crossings	• Disconnect road surfaces and ditches from streams • Design drainage structures for 100-year flow and associated debris • Place functional critical dips to reduce diversion potential • Incorporate trash barriers and graded drainage to ensure low plug potential • Protect stream closing outlets from erosion • Ensure culverts are open and in good condition • Emergency overflow culverts are placed where undersized culverts cannot be upgraded • Class 1 streams accommodate fish passage

4.1.2 Revegetation

Revegetating streamside habitat can reduce stream temperatures and improve dissolved oxygen levels by providing shade cover. A healthy riparian corridor of various native species provides cover and food resources for fish and wildlife. Plants can act as a buffer for streams by utilizing nutrients to grow before excess nutrients, such as nitrogen, can reach waterways.

Roots assist in infiltrating water into the soil, and stabilizing banks that may otherwise contribute sedimentation to a waterway. Bioengineering techniques, such as willow walls, willow brush mattresses, and willow waddles provide living creek bank protection with root complexity and canopy. Fencing these areas from livestock or other animal browse helps to protect installed plants and preserve existing native vegetation.

4.1.3 Protecting riparian corridors

Livestock grazing is widespread throughout the entire project area. A number of areas have been noted as being impacted by livestock access to riparian corridors. Fencing these areas from livestock can protect water quality by reducing nutrient loading and sedimentation.

4.2 List of Potential Sites and Associated Best Management Practices

See Appendix Item 3, List of Potential Sites and Associated Best Management Practices. Note that BMPs included in the table are rough estimates of the needs of the site and may change during the course of further landowner conversations, site visits, and discussions. A more in-depth discussion will be used to develop project concepts beyond just the notes provided in this table, and will be used by the TAC to select implementation sites.

New sites may become available during the course of the selection and implementation process. Potential new sites will be evaluated based on feasibility, need, and scope of grant work.

5 Site Selection and Prioritization Criteria

5.1 Identifying potential sites

Projects that were identified during the outreach process for other 319(h) grants were considered when compiling the list of potential project sites.

Sites identified during regular Technical Assistance requests to SRCD staff have also been evaluated for suitability for this funding source.

SRCD reviewed a major past project on sediment reduction in the Glass Fire project area, to determine if there was any follow-up work needed for those preexisting projects (Sotoyome Resource Conservation District 2008).

SRCD contacted partners at Ag+Open Space, as well as at Sonoma Land Trust, with a summary of the grant objectives and discussed potential project sites. Ag+Open Space conducted outreach to their contacts on the behalf of SRCD.

The WERT report for each fire identifies potential Values-at-Risk, which are sites where the results of fire may pose a risk to human safety and/or property. Values-at-Risk which match the goal of this grant have been incorporated into the list of potential project sites. ("Watershed Emergency Response Team Evaluation: LNU Lightning Complex Walbridge and Meyers Fires" 2020; "Watershed Emergency Response Team Evaluation: Glass Fire" 2020).

CalFire's database of salvage logging permits due to the Walbridge and Glass Fires was also incorporated into site selection information ("CAL FIRE Emergency Notices All TA83" 2021).

5.2 Prioritization Criteria

5.2.1 Fire footprint

The areas most impacted from the 2020 fires will be those within the burn area or impacted by related activities. Data from CalFire and USGS was used to map soil burn severity for each fire. Soil burn severity was used as a tool to help assess site needs and assist in prioritizing sites when appropriate.

Fire-related activities, such as fire breaks or heavy machinery movement, may be outside of burned areas and were taken into consideration for site prioritization.

5.2.2 Critical Aquatic Wildlife Habitat

Coho, steelhead, and chinook salmon population restoration has been a focus of multiple agencies in the area for many years. Involved agencies, including the Russian River Salmon Habitat Restoration Priorities effort, have also provided information on how best to prioritize salmonid habitat within some of these subwatersheds.

When mapping salmonid habitat, the following resources were consulted:

Salmonid distribution	(Christy 2022; Gavette 2005a; 2005b)
Salmonid critical habitat	(Dunn 2022; National Marine Fisheries Service, West Coast Region 2005a; 2005b; Hampton et al. 2021)
Key riparian corridors	(Penrod et al. 2013)

See Map 2, Salmonid Habitat.

In addition to salmonid species, several other aquatic wildlife species of concern are also present in the area. The ranges of those species were examined using the following resources:

Fish	(P. Moyle and Randall 2012; Santos 2020)
Amphibians and reptiles	(Thomson, Wright, and Shaffer 2016) (Gogol-Prokurat 2018)

Habitats for these other fish, amphibian, and reptile species are found generally throughout the project area watersheds. Although habitat ranges for these other species are important, they were not the main focus for this project and prioritizing sites, and instead it is considered that any water quality improvement will benefit the majority of those species. The effects of nonpoint source pollution from waterways upstream of these areas is also considered.

5.2.3 Nonpoint source pollution

Potential sites are ranked based upon their contribution or potential of contribution of nonpoint source pollution to streams, using technical resources such as the CDFW Salmonid Restoration Manual (Flosi et al. 1998), or models such as the EPA Pollutant Load Estimation Tool, PLET (U.S. Environmental Protection Agency 2022), or STEPL and the Region 5 load reduction model (U.S. Environmental Protection Agency 2018).

5.2.4 Environmental justice and equitable service

At times, projects on larger properties end up being prioritized for public funding because of the perceived cost effectiveness of carrying out a large project without coordination with multiple landowners. While carrying out projects that span multiple properties requires additional coordination, it can have other valuable benefits, such as minimizing the economic resources gap, serving more people, and increasing equity in access to services. Therefore, it may be considered a benefit to select a project that involves multiple properties/ownerships.

Additionally, all of the watersheds in this project area, with the exception of Warm Springs, have been identified by the California DWR as containing disadvantaged or severely disadvantaged communities. The Disadvantaged Communities Mapping Tool ("DAC Mapping Tool" n.d.) is used to identify projects in disadvantaged or severely disadvantaged communities. It will be considered a benefit if a project takes place within, or benefits one of, one of these communities.

The Basin Plan has identified waters with the beneficial uses of Native American Cultural (CUL) use and Subsistence Fishing (FISH) (North Coast Regional Water Quality Control Board 2018b). Prioritizing projects that are within these hydrologic areas is important to acknowledge and respect Native American relationships with this land and water. However, at the time of writing, the Basin Plan has not identified any of the hydrologic areas in the scope of this grant as having those types of beneficial use. That is not to say those uses do not exist in these areas, only that they are not described by that document for this project area at this time.

See Map 3, Economically Disadvantaged Communities.

5.2.5 Other considerations

Projects that enhance existing restoration efforts will be prioritized. Salmonid restoration efforts are widespread and ongoing; any projects that reduce nonpoint source pollution in key riparian corridors, or upstream areas, will be supportive to existing restoration practices.

Land owner/ manager willingness and capability to maintain the project will be taken into consideration, as well as access to get appropriate equipment to the project sites, and cost effectiveness.

5.2.6 Prioritization criteria rubric

See Appendix Item 2, Prioritization Criteria Rubric. The rubric was developed based on other recent 319(h) documents. It will be used as a guide for selecting project sites from the list in Table 10.3 (which, as noted elsewhere, may see additions or deletions over the course of this process due to landowner interest).

6 Technical Advisory Committee Members

6.1 Process

A list of potential TAC members was created and refined with input from various staff at SRCD. The TAC members have expertise in biology, geology, fisheries, forestry, engineering, and other specialties. An initial invitation was sent to potential members, outlining the goals and time commitment of the project.

The commitments of the TAC are as follows:

- Finalize selection criteria for potential projects
- Conduct site visits with SRCD staff to assess 5 properties with proposed projects
- Evaluate and rank properties using approved criteria and determine recommendations for projects to move forward to implementation

6.2 TAC members

As of December 30th, TAC members include:

TAC Participant	Area of Expertise	Organization
Michele Fortner	Grant Manager	NCRWQCB
Maggie Robinson	Geologist	NCRWQCB
Brooke Pippi	Agricultural Engineer	NRCS
Greg Horton	Biologist	Sonoma Water
Tom Hammond	Engineer	SRCD
Gil Falcone	Supervisor, Southern 401 Certification Unit	NCRWQCB
Mike Jones	Forest Advisor	UC Cooperative Extension
Jessica Pollitz	Engineer	SRCD
Andy Casarez	Agriculture and Vineyard Conservation Coordinator / Land Stewardship Division Manager	Sonoma County Department of Agriculture / Weights & Measures

7 MONITORING

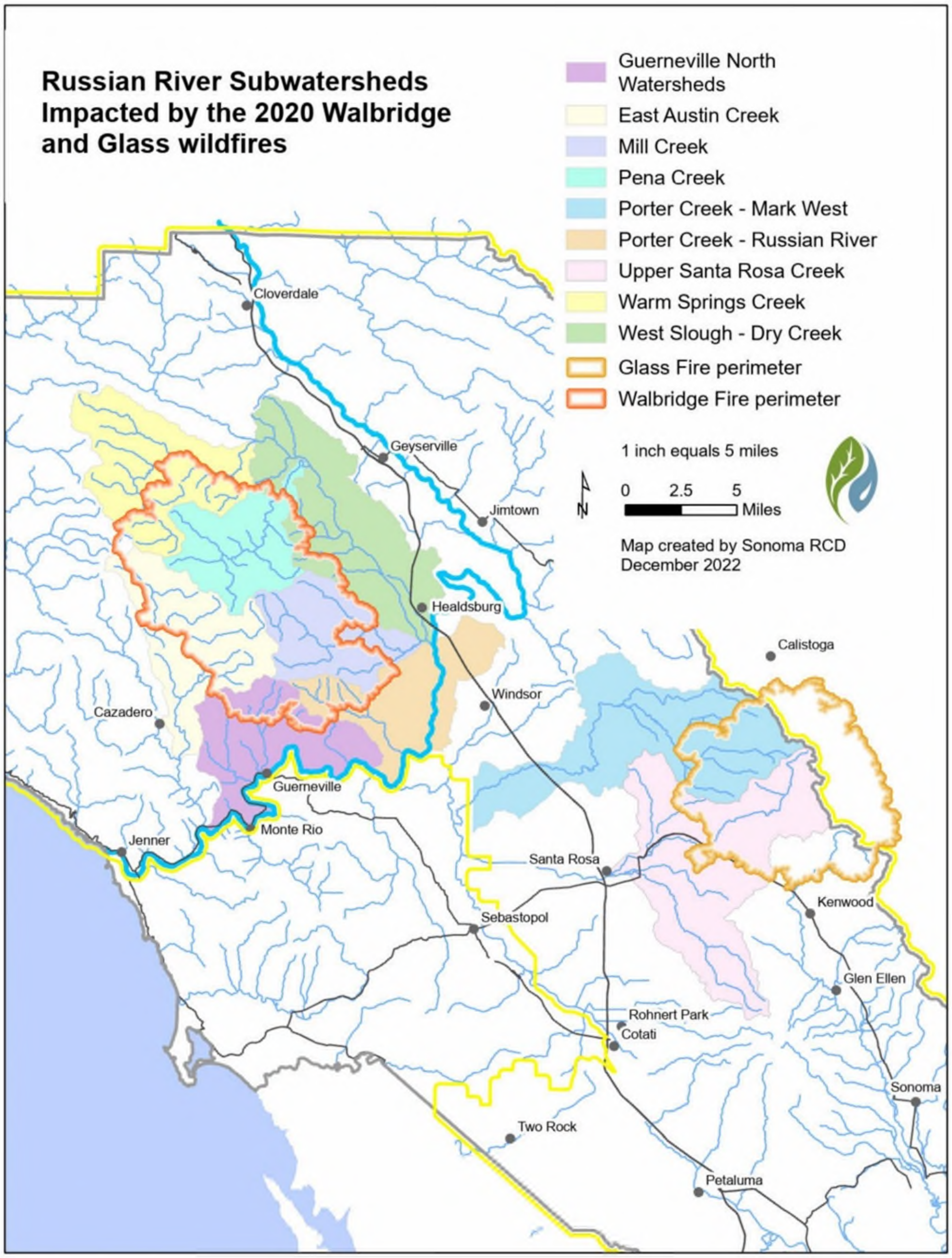
7.1 MEASURING PROJECT SUCCESS

Project success will be measured via "pre-, during, and post-construction photo documentation in accordance with methodology approved by the Project Manager" (Executed Contract Agreement, 2022). See the following two resources for guidance:

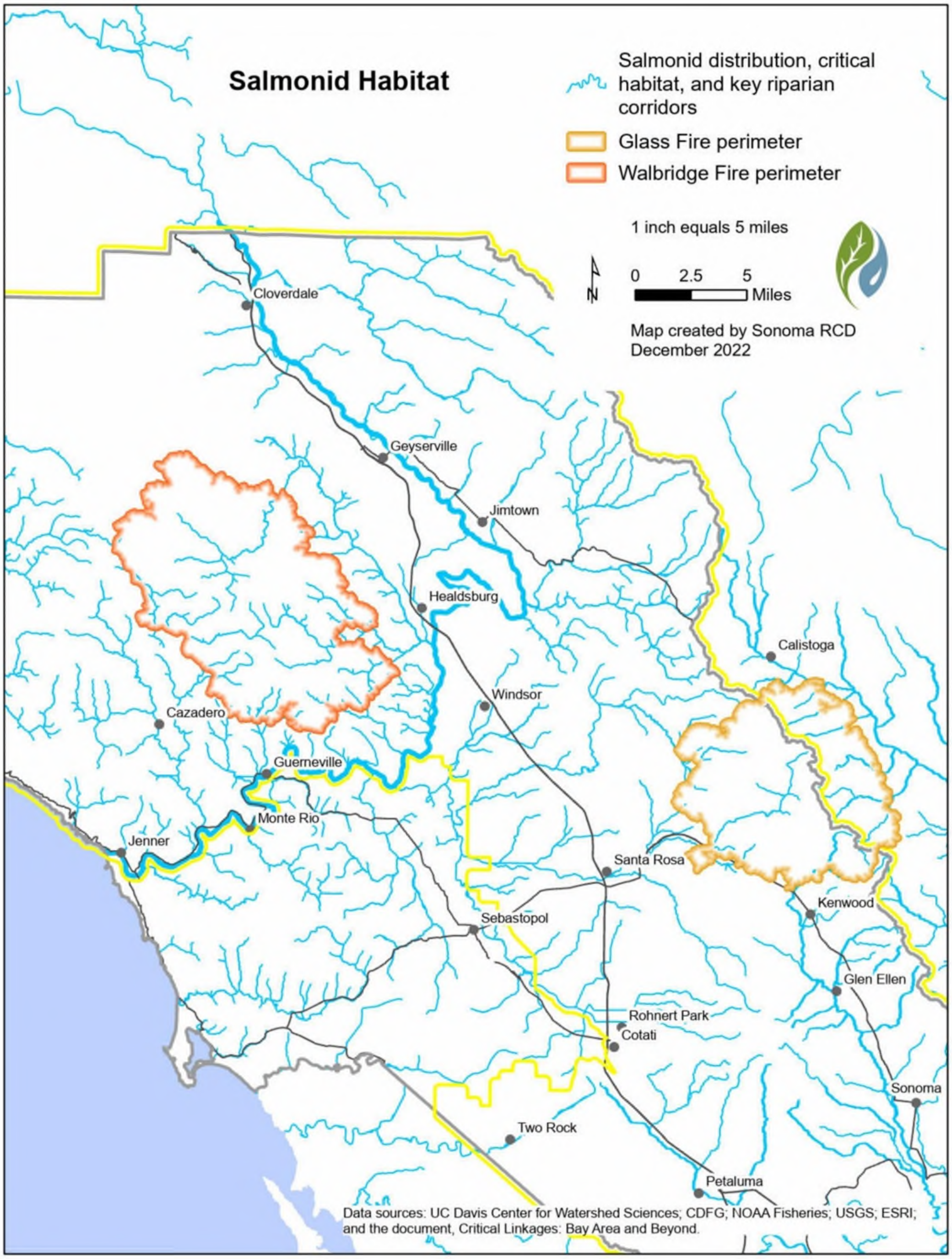
- Dressing, S.A., and D.W. Meals. 2016. "Monitoring and Evaluating Nonpoint Source Watershed Projects. Chapter 5: Photo Point Monitoring." EPA 841-R-16-010. Developed under Contract to U.S. Environmental Protection Agency by Tetra Tech, Inc.
- Hall, Frederick C. 2002. "Photo Point Monitoring Handbook:" General Technical Report PNW-GTR-526. Pacific Northwest Research Station: USDA.

8 MAPS

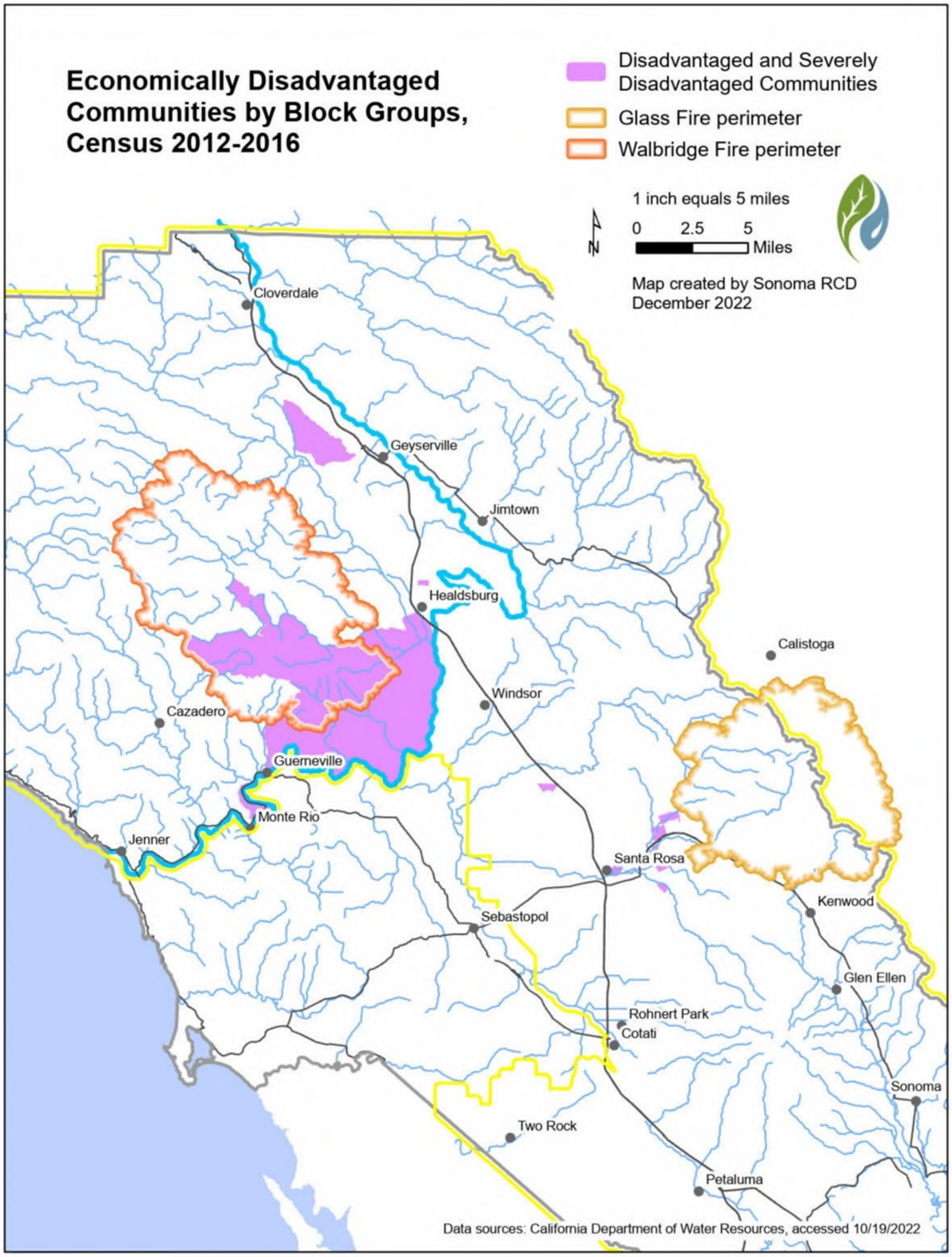
8.1 RUSSIAN RIVER SUBWATERSHEDS IMPACTED BY THE 2020 WALBRIDGE AND GLASS WILDFIRES



8.2 Salmonid Habitat



8.3 Economically Disadvantaged Communities



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10 Appendix

10.1 Existing planning documents

The following references were used when building this Alternative Watershed Plan. These references are also available in the References section of this document.

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10.2 Prioritization Criteria Rubric

Post-Fire Recovery in the Russian River Sub-watersheds
319(h) grant through State Water Resources Control Board

Prioritization Criteria Rubric

GOAL: This grant is for the purpose of implementing best management practices (BMPs) to reduce the generation and transport of nonpoint source pollution (sediment, nutrients, pathogens, temperature, and chemicals) to **tributaries of the Russian River within Sonoma County that were impacted by the 2020 Walbridge (Sonoma-Lake-Napa Unit) and Glass wildfires.** The grant will support the attainment of TMDLs for the Russian River and the Laguna de Santa Rosa.

	Qualifying Questions	**Y/N**	
a	Does this project fit with the funding source: 319(h) grant?		If yes, proceed.
b	Is this project technically feasible?		If yes, proceed.
c	Landowner interest is high, landowner is willing and capable of maintaining project		If yes, proceed.
d	Can this project be covered 100% and allow for 4 other projects to be funded?		If yes, proceed.
e	Can project be accomplished within acceptable timeframe? (by June 2025)		If yes, proceed.

	Selection Criteria	**Yes = 1 No = 0**	**Notes**
Plants/Animals			
1	Project benefits high-priority areas* with respect to listed species		
2	Project is contiguous with key riparian corridors		
3	Project protects/restores/enhances an ecological function or ecosystem		
Soil/Water			
4	Project directly address water quality by reducing nonpoint source pollutant loads		
5	Potential to reduce sediment discharge to water systems is high relative to other projects and/or relative to priority reaches		
6	Project incorporates protection of, or planting of, native plants or natural regeneration within a riparian area or perennial wetland habitat		
Design/Funding/Feasibility			
7	Technically sound, effective and appropriate design solution (addresses causes rather than symptoms)		
Synergistic Effects, Landowner Interest			
8	Project may promote other projects in the area		
9	Multiple landowners will benefit from the project and/or project involves multiple ownerships		
10	Benefits a land use not historically served (e.g. urban landscape, equine facility, community garden, emerging agricultural crop)		
11	Site is located within a DWR mapped DAC community, or directly benefits a DAC		
	TOTAL SCORE per site (max score = 11)	**0**	
	Subjective RANKING (High, Medium or Low Priority? Gut reaction?)		

	Bonus Points (use only to break ties in project scoring)	**Yes = 1 No = 0**
i	Project address multiple benefits, beyond reducing nonpoint source pollution	
	TOTAL BONUS POINTS per site (max bonus points = 1)	**0**

*high priority areas are defined by Russian River Basin Fisheries Restoration Plan (California Department of Fish & Wildlife, 2002) and by the Salmonid Habitat Restoration Prioritites (of which Mill Creek is a priority in this area)

10.3 List of Potential Sites and Associated Best Management Practices

Site ID	Fire	Watershed	Project Concept
1	Glass	Mark West and Santa Rosa Creek	Privately owned with a conservation easement from LandPaths. Property contains a portion of Alpine Creek (rainbow trout bearing stream) which runs through a pond with a fish ladder. Haven't had major ground disturbance following fire, but lost some blue oaks and Oregon white oaks. Dozer crossed through during fire, but natural revegetation quickly happened. Owners are conservation-minded and might like to be proactive.
2	Glass	Mark West and Santa Rosa Creek	Significantly burned, lost structures. Between Saddle Mountain and Hood Mountain.
3	Glass	Mark West and Santa Rosa Creek	Significantly burned, lost structures. Between Saddle Mountain and Hood Mountain.
4	Glass	Mark West and Santa Rosa Creek	Privately owned conservation easement which may be selling to Ag+Open Space or Regional Parks soon. Lots of Doug fir loss - Weeks North had a salvage harvest that caused a lot of soil disturbance postfire. They replaced some culverts as part of road improvements associated with that salvage harvest. May have taken care of roads by now, but may also have revegetation needs.
5	Glass	Mark West Creek	Explore need for nonpoint source pollutant reduction projects.
6	Glass	Mark West Creek	Site is on a private road off of Sharp Road. The road had extensive traffic from large PGE trucks, which caused damage. Road grading, replacement of DRCs, and potentially replacement of a large 72" rusted out metal pipe stream crossing. Owner is currently working with neighbors on putting a pipe sleeve in the large 72" culvert, but if we can help her out with replacement of the whole thing (including permits) that would be great.
7	Glass	Mark West Creek	A privately owned dam in the upper Mark West Watershed has released a significant mount of sediment due to land disturbance, and could release significant quantities in the evenf of a failure. Shoring of the dam would reduce sediment loads and risk of dam failure.
8	Glass	Mark West Creek	Part of previous SRCD road improvement project, but may need more work done here.
9	Glass	Mark West Creek	LandPaths is acquiring 266 acre property spring 2023 and is interested in erosion control as a first priority, including a ranch and logging road erosion inventory and treatments.

10	Glass	Mark West Creek	Area off Calistoga Road at outlet of canyon (Rattlesnake Bend) where culvert is plugged and creating ponding/water flow over Calistoga Rd.
11	Glass	Mark West Creek	At very edge of fire perimeter, likely need roads work and may also be interested in a shaded fuel break (which dovetails well with our Forestry program).
12	Glass	Mark West Creek	Part of previous SRCD road improvement project, but may need more work done here.
13	Glass	Mark West Creek	Invested landowners have worked with SRCD in the past and may need more assistance with roads improvement after fire activity.
14	Glass	Mark West Creek	Landowner interest and project identified during Upper Mark West Sediment Reduction Project. Road inventory completed by PWA. SCCD staff submitted request to DFG Adaptive Management program but there were insufficient funds available. Upper Mark West Sediment Reduction Project Final Report notes that the SRCD continues to seek funding to implement sediment reduction measures on this road.
15	Glass	Mark West Creek	Sloped property directly above Mark West Creek severely affected by fire. Owned by LandPaths as a "life estate". Owners live on site and are proactive about management.
16	Glass	Mark West Creek	Landowners are interested in road improvements and have other erosion concerns.
17	Glass	Mark West Creek	SRCD did work here for Mark West Vegetation Management project, including 3 miles of fuel breaks. Manager identified here may be able to identify potential areas for road work.
18	Glass	Santa Rosa Creek	Explore need for nonpoint source pollutant reduction projects.
19	Glass	Santa Rosa Creek	Structure burned in the fire, owner is rebuilding. Site seems pretty stable but landowner may have need of further assistance. North and eastern part of property goes into hill and has a creek.
20	Glass	Santa Rosa Creek	Burned twice (Nuns Fire in 2017). Recently gained a conservation easement for Ag+Open Space. Lost all structures, lots of trees, and possibly some water infrastructure. Lots of damage. Owners are conservation-minded and might like to be proactive.
21	Glass	Santa Rosa Creek	Explore need for nonpoint source pollutant reduction projects.
22	Glass	Santa Rosa Creek	Severely burned during fire; explore need for nonpoint source pollutant reduction projects.
23	Glass	Santa Rosa Creek	Explore need for nonpoint source pollutant reduction projects.
24	Glass	Santa Rosa Creek	Explore need for nonpoint source pollutant reduction projects.

25	Glass	Upper Santa Rosa Creek	Currently constructing a major luxury hotel development directly adjacent to Hood Mountain. This area burned twice (Nuns Fire in 2017). Lost a lot of trees, including mature Doug fir. Lots of grading and construction currently going on at this site.
26	Glass	Upper Santa Rosa Creek	From WERT report, identified as a Value-at-Risk. Private road crossing of Ducker Creek, 60 inch plastic pipe burned completely, potential for scour and fill collapse. Average of 5 feet of fill above pipe. Channel appears active. Within 150 feet of a public road. Action recommended: Clear and maintain culvert; Replace culvert.
27	Walbridge	East Austin Creek	60-acre property adjacent to Austin Creek SRA. Owner contacted SRCD for technical assistance regarding fire recovery.
28	Walbridge	East Austin Creek	Likely has need of road improvements or other sedimentation reduction projects.
29	Walbridge	East Austin Creek	Hulbert Creek area. Heavy machinery traffic during fire turned roads to dust.
30	Walbridge	East Austin Creek	Small homestead on the north side of Austin Creek State Recreation area at the confluence of Gray Creek and East Austin Creek. During fire, bulldozer turned gravel road into firebreak and damaged a culvert. Owner very invested in long-term road maintenance and sedimentation reduction.
31	Walbridge	Guerneville North	Explore need for nonpoint source pollutant reduction projects.
32	Walbridge	Mill Creek	Site is right above confluence of Palmer Creek and Mill Creek confluence. Two big culvert problems, and potential for road closing/abandonment.
33	Walbridge	Mill Creek	Identified as an area with sedimentation concerns via December 2022 Russian River Salmonid Habitat Restoration Priorities meeting. At least 2 culverts need replacing. Landowners are likely to be amendable to restoration efforts.
34	Walbridge	Mill Creek	Likely has need of road improvements or other sedimentation reduction projects.
35	Walbridge	Mill Creek	Includes 1 mile of road. Fire was severe, all trees are dead. Road looks ok, but no armor on outlets of culverts and may lead to erosion.
36	Walbridge	Mill Creek	Potentially a good candidate for some experimental BMPs.
37	Walbridge	Mill Creek	Steep unsurfaced road network in canyon above Mill Creek tributary. Potential for road grading and upgrades of crossings. Some work as done with emergency 319h funds, but needed more done. Owner was interested in addressing the entire road network. May also have contacts for neighboring properties along Cloud Ridge Rd who may need similar help.

38	Walbridge	Mill Creek	Heavily impacted by the Walbridge Fire in 2020. Most of the non redwood tree species lining the creek were completely burned and/or felled by PG&E shortly after the fire. There is a dirt road that runs along the property that has not been maintained since the fire. This drive has historically had erosion issues, and one year blew out entirely after a large rain ~2018. The repair of that blowout was just a temporary fix and will surely happen again if we experience another atmospheric river-level rainfall in the area. There is also continued concern with sedimentation with the loss of the trees and vegetation along Mill Creek.
39	Walbridge	Mill Creek	Likely has need of road improvements or other sedimentation reduction projects. Good potential for some more experimental BMPs like gully packing. Coho redds recorded at/around this property.
40	Walbridge	Mill Creek	500 acres in Palmer Creek where ditch relief culverts were not installed well.
41	Walbridge	Mill Creek	Landowner called SRCD for technical assistance after the fire.
42	Walbridge	Mill Creek	Likely has need of road improvements or other sedimentation reduction projects. Good potential for some more experimental BMPs like gully packing. Quite a few coho redds between Palmer and Wallace Creeks, where this property is.
43	Walbridge	Mill Creek	PWA has been communicating with the Palmer Creek Road Association which maintains about 2 miles of rural gravel road. PWA upgraded a majority of the road 20+ years ago with grant money and it is ready for some touch-ups, and there are stream crossings that were not upgraded that now need to be. The PCRA has been provided a cost estimate to produce a road improvement plan but their Board said they did not have the funds to cover that service at this time. Assistance with funding or permit assistance for stream crossing repairs would be helpful.
44	Walbridge	Mill Creek	Identified as an area with sedimentation concerns via December 2022 Russian River Salmonid Habitat Restoration Priorities meeting.
45	Walbridge	Pena Creek	Landowner previously identified as being interested in long-term road improvement project. At least two culverts burned in fire. SRCD may have an old road plan for this site.
46	Walbridge	Pena Creek	Likely has need of road improvements or other sedimentation reduction projects.
47	Walbridge	Pena Creek	SRCD staff is in the process of conducting outreach to this area for multiple purposes and expects to receive some interest in sedimentation reduction projects after that outreach is complete.
48	Walbridge	Pena Creek	Landowner may be interested in riparian fencing and planting.

49	Walbridge	Pena Creek	Likely has need of road improvements or other sedimentation reduction projects.
50	Walbridge	Porter Creek - Russian River	Very conservation-minded private landowner with a working forest. There was some limited timber salvage of 44 acres, spread out across property. No major burn effects, but did have dozer lines and lots of engine traffic during the fire, so the road surfaces got torn up. Some culverts need replacing and roads that could definitely use improvement.
51	Walbridge	West Slough	Fire suppression impacts from dozer lines. LandPaths has been in communication with them regarding road repairs/improvements.
52	Walbridge	West Slough	Koch Road was identified by NMFS in 2007 as being generally in bad shape regarding sedimentation.

10.4 Causes, Sources, and Recommendations by Subwatershed

Parts of these summaries are based on information that is over 20 years old. Attempts were made when summarizing to strike a balance between including old information which may still prove useful to current projects, and not including information that is likely now irrelevant. Consult the original sources (cited at the end of each section) to decide how best to use this information for decision-making purposes.

10.4.1 Mill Creek

The Mill Creek Watershed Management Plan was completed by the Sonoma RCD in 2015 and the Mill Creek Streamflow Improvement Plan was also completed in 2015 by the Russian River Coho Water Resources Partnership.

These studies reported that the leading pollution concerns in the Mill Creek watershed are sediment and increasing water temperatures. The main mechanism for these pollutants entering Mill Creek and its tributaries is through nonpoint source inputs. Increasing beneficial riparian vegetation will help reduce water temperatures. Sedimentation related to roads, especially in Reach 8, was noted as a source. Roads are prominent sources of fine sediment. Road improvements were implemented along Palmer Creek Road in 2000, and on roads that would have delivered sediment to Mill Creek, Felta Creek, and Salt Creek in 2010. It was noted that Palmer Creek had cooler average temperatures, whereas temperatures were often highest at specific sites in Mill Creek.

Increased peak discharge due to bare compacted soils and impervious surfaces also contributes to sedimentation.

Tributaries of Mill Creek were surveyed in 1995. In general, Mill Creek has generally good spawning habitat, but elevated water temperatures, inadequate pool density and shelter, insufficient summer baseflow, and a lack of large wood.

In Felta Creek, Reach 1 and 2 spawning and rearing habitat quality diminishes due to the effects of sedimentation from stream bank erosion. In Reach 3, active and potential sediment sources related to the past skid road system need to be mapped and treated. Options to control erosion and increase canopy in Reach 3 should be explored with the landowner.

Sediment transported downstream from stored sediments in Reach 4 during high winter flows impact the spawning habitat in lower gradient reaches below. Also in Reach 4, active and potential sediment sources related to the past skid road system need to be mapped, prioritized, and treated.

Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff. Conifer planting was recommended in Reaches 2 and 3.

Upslope intermittent tributaries should be assessed for all of these above treatments as well.

In Angel Creek, upslope and in-channel erosion sources should be mapped and prioritized for improvements to reduce the amount of fine sediments entering the stream. Several treated landslides exist in the headwater areas, and these sources of erosion should be corrected. Alternatives need to be explored with the landowner.

In Palmer Creek, good riffle habitat exists, but some of it is impacted from sediment, which increases in an upstream direction. Sources of erosion on secondary roads should be mapped, prioritized and treated to reduce the amount of fine sediments entering the stream. A large blowout in Reach 1 was contributing sediment into the stream.

In Wallace Creek, sediment sources related to the road system, upslope, and in-channel erosion need to be mapped and treated. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.

Bond Creek, Mill Creek mainstem, and Coldwater Gulch were not surveyed (Sonoma Resource Conservation District 2015b; Russian River Coho Water Resources Partnership 2015; California Department of Fish and Game 2000d; 2000a; 2000l; 2000s; 2002).

10.4.2 East Austin Creek

The Austin Creek Watershed Assessment concluded that East Austin Creek was one of the areas where restoration practices to reduce sedimentation were likely to be the most effective and beneficial. Projects in Lower East Austin Creek should focus on reducing fine sediment inputs. Projects in Upper East Austin Creek should focus on reducing erosion, mass wasting, and excess sediment.

This subwatershed is impaired by excessive temperatures and low dissolved oxygen concentrations. Known causes of these impairments include flow alteration, regulation, or modification, and removal of riparian vegetation.

East Austin Creek was surveyed in 1996. It was suggested at the time that sites from the road survey should be treated to reduce the amount of fine sediments entering the stream. There were ten sites in East Austin Creek with major bank erosion problems and numerous points where the toe of the fill slope of the road is within the floodplain. = As of 2002, there was a failing riparian road in upper East Austin Creek. These sources of erosion related to the road system have been inventoried and prioritized by NEAP and Pacific Watershed Associates according to present and potential sediment yield. SRCD prioritized and completed a roads-related erosion and sediment project in 2014.

Riparian planting was recommended where shade canopy is not at acceptable levels in Reaches 1 through 9.

Grey Creek, a tributary of the upper East Austin Creek, is a key stream for coho salmon. The stream inventory conducted here in 1996 noted that road management changes held opportunities to decrease considerable amounts of sediment, and should be explored with landowners. Sources of erosion related to the road system should be identified and treated to reduce sediment pollution. High flows in this area have been known to cause road failure and bank erosion.

The survey also noted that structures to decrease channel incision should be installed in the upper reach of Gray Creek. There was at least one major bank erosion problem in Gray Creek, and there were numerous points where the toe of the fill slope of the road was within the floodplain.

As of the survey (1996) the culvert in Reach 5 at Mill Creek Road required maintenance. If not already improved, this culvert should be corrected or replaced.

Thompson Creek was also surveyed in 1996. They survey noted that access for migrating salmonids was possibly limited by a 10 foot cascade barrier, located .6 miles from the mouth. The non-anadromous reach above the survey section and smaller unsurveyed tributaries should be assessed for riparian planting. The unimproved park access road into Thompson Creek has erosive gullies and culverts which need maintenance. These road problems need to be inventoried, prioritized and treated to decrease sedimentation to the stream.

In Gilliam Creek, numerous old stream crossings and untreated haul road failures were generating sediment.

A major road related landslide caused a fish barrier at habitat unit 030 of an unnamed tributary ("Bea Creek")- this landslide was also a source of sediment in the system. To restore this site heavy equipment would be needed to clear the channel, remove the unstable material from the slide, stabilize the hillslope and de-commission the old and failing section of the road on the way out. The log jams downstream at habitat units 023 and 026 could be modified concurrently.

There are six bank erosion problems in Reach 1, four in Reach 3 and two in the unnamed tributary. At these sites, bank stabilization structures followed up with revegetation using native species is recommended.

There are 4 log debris accumulations present on Gilliam Creek and a few on the unnamed tributary that have the potential for causing bank erosion. These were caused by slides, likely during the high water events of 1995/96. The unimproved Austin Creek State Recreation Area access road into Gilliam Creek has erosive gullies and culverts which need maintenance.

Sulphur Creek had a road survey conducted at in 1996, and sites identified from that report should be treated to reduce the amount of fine sediments entering the stream. Opportunities to decrease considerable quantities of sediment to the stream are numerous with changes in road management strategy and should be explored with landowners. There are numerous points where the toe of the fill slope of the road is within the floodplain. High flows erode this fill slope causing bank erosion and road failure. These sources of erosion related to the road system were inventoried and prioritized by NEAP and Pacific Watershed Associates according to present and potential sediment yield.

In Devil Creek, shade canopy was not at acceptable levels in portions of Reaches 1-2 and in "Angels Creek". There were two log debris accumulations with the potential for impeding passage and causing bank erosion (Reach 1, habitat units 95 and 98). There were two massive landslides on very unstable hill slopes with bank erosion problems that should be stabilized to reduce the amount of fine sediment entering the stream; however, they are inaccessible to heavy equipment.

Schoolhouse Creek was not surveyed (California Department of Fish and Game 2000g; O'Connor Environmental, Inc. 2018; California Department of Fish and Game 2000c; 2000r; 2000f; 2000q; 2000b; Laurel Marcus and Associates 2005).

10.4.3 Porter Creek (Russian River)

Porter Creek was surveyed in 1997 and two of its tributaries, Osborne Creek and Press Creek, were surveyed in 2012. Scotts Creek and John Gordon Creek were not surveyed.

The Porter Creek survey recommended that sediment sources related to the road system be mapped and treated. County road maintenance practices along the County maintained portion were a major source of sediment into Porter Creek. Stream bank armor to prevent erosion was recommended in Reaches 1 and 3.

There is at least one section where the stream is being impacted from livestock in the riparian zone. Alternatives to limit cattle access, control erosion and increase canopy should be explored with the landowner.

Along portions of Reaches 1, as well as along the reach above the survey section, the survey recommended increasing canopy to reduce water temperatures.

There was a slide at unit #175 that should be assessed for both fish passage and slide stabilization.

Since the date of the survey, rip-rap was placed on both sides of the channel and large organic debris were removed for approximately 500 feet in Reach 1 just below Westside Road. Alternatives to encourage pool formation, increase shelter values, and increase sediment transport should be explored with the landowner. Single and opposing rock or log wing deflectors, and log cover/scour would be very effective. Construction of a low floodplain bench (utilizing existing rock placed above bankfull) would encourage sediment transport and decrease erosion.

The Osborne Creek survey recommended mapping, prioritizing, and treating sediment sources from the road system and from stream bank erosion to reduce fine sediment yield. The survey noted that fish access should be assessed and improved where possible at road crossings.

The stream is being impacted from livestock in the riparian zone. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible.

There are several log debris accumulations present on Osborne Creek that are retaining large quantities of fine sediment. These should be modified carefully, over time, to avoid excessive sediment loading in downstream reaches.

Press Creek was surveyed in 2012. Channel incision in Press Creek threatens excellent mature riparian canopy and inhibits pool development. Low stage weirs constructed of rock or logs would offset channel incision and erosion and retain gravel for spawning and pool development.

There were several log debris accumulations present on Press Creek that are retaining large quantities of fine sediment. These should be modified carefully, over time, to avoid excessive sediment loading in downstream reaches.

Access for migrating salmonids should be assessed at all road crossings and dams. Sites of particular concern include the Sweetwater Springs Road in-stream culvert and the multiple ford crossings identified throughout the survey.

There are several reaches where the stream is being impacted from livestock in the riparian zone. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible (California Department of Fish and Game 2002; 2000p; 2013c; 2013b; 2012).

10.4.4 Guerneville North Watershed subbasins

Stream inventories were conducted for two Guerneville North Watershed subbasins which are included in the project area.

Hulbert Creek was assessed in 1996. Sediment sources related to the road system, upslope erosion, and in-channel erosion need to be mapped and treated. The survey recommended installing structures to decrease channel incision.

When Fife Creek was surveyed in 1997, road problem assessment has been completed, and data analysis with site improvements and prioritization level were in the process of being funded. Identified sites from that assessment should be treated to reduce the amount of fine sediments entering the stream. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffer against urban runoff (California Department of Fish and Game 2000h; 2000e).

10.4.5 Warm Springs

The segment of Dry Creek from the confluence of Pena Creek (at river mile 11) downstream to the lowest grade control sill (at river mile 3), was reported to have higher levels of sediment which had the potential to negatively impact salmon habitat restoration projects. Historically, Dry Creek has had high sediment contribution to the Russian River. Sediment and temperature have been negatively affected by removal of riparian vegetation, streambank modification, and destabilization (State Water Resources Control Board 2022; Inter-fluve, Inc. 2011).

10.4.6 Pena Creek

Pena Creek watershed has good spawning conditions, but elevated water temperatures, low levels of riparian canopy, and inadequate pool density. Recommended habitat improvement included removal of barriers caused by debris accumulation and reduction of fine sediment inputs.

Surveys of Pena Creek in 1998 included the main stem of Pena Creek, Chapman Branch, Redwood Log, and Sweetwater Creeks.

In Pena Creek watershed, active and potential sediment sources were recommended to be mapped, prioritized, and treated. Sources include the roads system, upslope landslides, and in-channel erosion.

Riparian planting was recommended along any portion of the stream to increase canopy, provide bank stability, and buffer against agricultural, grazing and urban runoff. Planting above the survey section was encouraged as well. Reaches 1 and 3 were suggested for utilizing bio-technical vegetative techniques to reestablish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.

Reach 3 of Pena Creek was also reported to be impacted from livestock in riparian zones.

Road repair was listed as a restoration priority in Redwood Log Creek.

Pechaco Creek, a tributary of Pena Creek, was surveyed in 1998. Recommendations include mapping, prioritizing, and treating sources of upslope and in-channel erosion to reduce sedimentation. The area above Reach 5 was noted to be highly silted, but was not mapped.

Riparian planting was recommended to provide shade canopy (in portions of Reaches 1, 2, and 3) and in general to provide bank stability and a buffering against agricultural, grazing and urban runoff. This also includes the reach above the survey area.

There are at least two sections (Reach 1 and Reach 2) where the stream is being impacted from livestock in the riparian zone.

Woods Creek, another tributary of Pena Creek, was surveyed in 2000. Upslope and in-channel erosion sources were recommended to be mapped, prioritized, and treated to decrease fine sediments entering the stream.

Riparian planting was recommended to provide shade canopy (in portions of Reaches 1, 2, and 3, and likely in the reach above the survey area) and in general to provide bank stability and a buffer against agricultural, grazing and urban runoff. The survey noted that Woods Creek would benefit from utilizing bio-technical vegetative techniques to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.

There were several log debris accumulations present on Woods Creek that the survey noted had the potential for causing bank erosion.

The survey also noted that any attempts to add woody debris cover should be done where the banks are stable or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand (O'Connor Environmental, Inc. 2018; California Department of Fish and Game 2002; National Marine Fisheries Service 2007; California Department of Fish and Game 2000n; 2000m; 2000t).

10.4.7 Laguna de Santa Rosa

The downstream portions of the Laguna de Santa Rosa watershed are heavily developed for housing and agriculture, which strongly affect water quality. Pollutant levels in the Laguna are higher downstream of urban areas and are associated with sources in the lower Laguna: municipal wastewater discharge, septic effluents, and stormwater runoff from urban areas, vineyards and dairies. Pollutant levels are generally lower upstream of urban areas. Pollutants include sediment, temperature, dissolved oxygen, nutrients (phosphorous, nitrogen, ammonia), indicator bacteria, and mercury (Morris 1995; Tetra Tech, Inc. and Philip Williams & Associates, Ltd. 2007; Tetra Tech 2020a; 2020b; State Water Resources Control Board 2022).

10.4.8 Upper Santa Rosa Creek

Sediment load generated by channel and gully enlargement in Santa Rosa Creek is likely a major part of the sediment budget of Laguna de Santa Rosa. Santa Rosa Creek sediment largely comes from upland sources, soil creep, and gullies. The main source of medium (sand size) sediment appears to be bank erosion in the mid portions of most streams on the east side of the watershed. Some of the main sources of fine sediment likely include gully expansion and road runoff associated with housing development, especially in the headwaters of Santa Rosa Creek. Roadside ditches, channel incision and erosion, are likely main sources throughout the entirety of Santa Rosa Creek. Improving roads on smaller tracts of land was also recommended to reduce sedimentation. Dilution from Santa Rosa Creek appears to decrease nutrient concentrations further downstream.

The North Fork of Santa Rosa Creek was surveyed in 1998. Priorities include mapping, prioritizing, and treating sources of upslope, in-channel erosion, and sediment sources related to the road system, to reduce fine sediment contribution to the stream and its tributaries. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff (Tetra Tech, Inc. and Philip Williams & Associates, Ltd. 2007; California Department of Fish and Game 2002; 2000k; Tetra Tech 2020a).

10.4.9 Porter Creek (Mark West Creek)

The leading pollution concerns for the Upper Mark West watershed, which includes Porter Creek, consist of sediment and increasing water temperatures. Upper Mark West creek sediment, like that of Upper Santa Rosa Creek, largely comes from upland sources, soil creep, and gullies. The headwaters of Mark West Creek appear to be one of the main sources of coarse sediment (cobble and gravel), along with channel erosion and debris flows. Some of the main sources of fine sediment are likely to include gully expansion and road runoff associated with housing development, especially in the headwaters of Mark West Creek, and roadside ditches, channel incision and erosion especially in in Porter Creek.The most common erosion problems found in an Upper Mark West watershed roads assessments before 2010 were erosion associated with stream crossings, gully erosion on hillslopes below ditch relief culverts, and road surfaces and ditch erosion. Approximately half of these assessed roads were improved in 2007. In 2015, gullies were estimated to be associated with up to ¼ of road-related sediment sources, and were observed to be caused by long, poorly drained roads, and by poorly sized or plugged culverts and the associated diverted streams. Sediment load generated by channel and gully enlargement is likely a major part of the sediment budget of Laguna de Santa Rosa. In general, projects incorporating forest restoration would reduce runoff and erosion.

There may still be a privately owned, non-engineered and unshored dam in the upper Mark West watershed contributing sediment. This area was heavily impacted by the Glass Fire and warrants outreach.

Recommendations from the Stream Inventory Report may be best implemented within areas of Porter Creek closer to the confluence of Mark West Creek where there is more suitable spawning habitat and where the stream is less confined by Porter Creek Road, but high priority outreach should include all properties in the Porter Creek sub-watershed.

Porter Creek was surveyed in 1996 and again in 2012. In both surveys, temperature was above acceptable range for juvenile salmonids. Recommendations to decrease temperature are to increase canopy, especially through Reaches 1-5. The survey also notes that reaches above that section should also be treated for temperature. The report from 1996 suggests that biotechnical approaches would be beneficial in Reach 5. There were a few reaches where the stream was being impacted from livestock in the riparian area. Dirt roads, improperly sized and/or set culverts, and bare soil contributed to sediment loads.

Other tributaries of Mark West Creek were surveyed in 1998. Recommendations from that survey include increasing canopy in Weeks Creek, and treating sources of erosion related to the road systems (Sonoma Resource Conservation District 2015a; California Department of Fish and Game 2000j; 2013a; 2000i; 2000o; 2013d; Winzler & Kelly-GHD for Sonoma Water Agency 2012; Tetra Tech 2020a; State Water Resources Control Board 2022).