

DEMONSTRATING ROAD IMPROVEMENTS IN THE NAPA RIVER WATERSHED



Before and after road decommissioning, Carneros Creek watershed



December, 2010

FINAL REPORT

Prepared by
Napa County Resource Conservation District

For
State Water Resources Control Boards
319h Contract Agreement #06-245-552-0

DEMONSTRATING ROAD IMPROVEMENTS IN THE NAPA RIVER BASIN



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This project was funded with a grant awarded to the Napa County RCD through the Clean Water Act 319(h) – Nonpoint Source Implementation program administered by the California State Water Resources Control Board (Contract # 06-245-552-0). Funding for this project also came from Napa County Measure A, Scannell Properties, Inc., Natural Resource Conservation Service, and participating landowners.

ACKNOWLEDGEMENTS

The RCD would like to thank all the landowners that made this work possible by granting access to their properties and agreeing to maintain the sediment reduction practices.

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1. Project Summary

At the request of the Napa County Resource Conservation District (NCRCD), Pacific Watershed Associates Inc. (PWA) completed the project design and layout, and supervised heavy equipment operations, to implement road related erosion control and erosion prevention treatments along approximately 5.17 mi of road in two subwatersheds of the Napa River basin: Sulphur Creek and Carneros Creek. The work plan addressed treatment sites previously assessed as having high or high-moderate treatment immediacies, as well as all lengths of hydrologically connected road. The completed work in the Carneros and Sulphur Creek subwatersheds represents the first two phases of a three-phase sediment reduction and watershed restoration project being undertaken by the NCRCD for the Napa River basin.

In the Sulphur Creek subwatershed, PWA supervised upgrading treatments along approximately 3.85 mi of road on 4 private landownerships (Cain, Learned-Perry, Marston, and Hoffman properties). The work was completed between August and October 2010. A total of 32 sites were treated, including 29 stream crossings, 2 ditch relief culverts, and 1 landslide.

In the Carneros Creek subwatershed, sediment reduction treatments were completed between August and November 2009 along approximately 1.32 mi of road on 3 different landownerships (Saintsbury, Artesa, and Hudsonia properties). A total of 14 sites were treated to reduce erosion and sediment delivery: 12 sites were upgraded (11 stream crossings and 1 ditch relief culvert), and 2 stream crossings on the Saintsbury property were decommissioned.

PWA estimates that treating the 46 sites and 5.17 mi of road reaches in the two subwatersheds will substantially diminish the delivery of coarse and fine sediment to the stream system, including approximately 3,465 yd³ of sediment projected to originate from episodic erosion at individual sites, and approximately 4,045 yd³ of fine sediment estimated to originate from the chronic erosion of road, ditch, and cutbank surfaces during the next decade alone.

The successful completion of this project represents important progress in reducing road related erosion and sediment delivery to Carneros and Sulphur Creeks, and establishing long-term improvements in water quality in local streams as well as in the Napa River. If employed with responsible future land use practices, the erosion control and erosion prevention treatments completed for this project can be expected to contribute to the recovery of salmonid habitat in the Napa River basin over the next several decades.

2. Certification and Limitations

Sections 1 through 6 of this report was prepared by or under the direction of a licensed professional geologist at Pacific Watershed Associates Inc. (PWA), and all information herein is based on data and information collected by PWA staff. Erosion control treatment prescriptions, on-the-ground pre-implementation layout, and technical oversight of heavy equipment for the project were similarly conducted by or under the responsible charge of a California licensed professional geologist at PWA.

Analyses, data, and results presented in this report are only intended to meet the reporting requirements as specified in California Department of Fish and Game Agreement #1600-2008-0413. Data used to generate the original proposal and work plan were based on road erosion inventories originally conducted in 2002. Site conditions can change rapidly under certain conditions; therefore, prior to implementation many sites were reevaluated in 2009-2010. The data expressed within this draft report are PWA's best approximations based on all the available information. Final data for heavy equipment hours and excavation volumes were provided to PWA by heavy equipment subcontractors, and PWA is not responsible for any errors in their records or reporting.

Initial recommendations prescribed for restoration and erosion control at specific sites are based on observations of surficial conditions at the time of the original assessment. Once implementation is underway, subsurface conditions revealed by heavy equipment may not reflect the original surficial observations. Where necessary, original treatment prescriptions may be modified based on the updated site-specific subsurface conditions. This practice of "adaptive management" is undertaken as necessary in order to maximize the success of the project and to minimize the risk of future erosion and sediment delivery.

The interpretations and conclusions presented in this report are based on a study of inherently limited scope, and findings are valid as of the report submittal date. Observations are semi-quantitative, confined to surface expressions of limited extent and artificial exposures of subsurface materials. Interpretations of problematic geologic and geomorphic features (such as unstable hillslopes) and erosion processes are based on the information available at the time of the study, and on the nature and distribution of existing features. PWA is not responsible for changes in the conditions of the property with the passage of time, whether due to natural processes or to the works of man, or changing conditions on adjacent properties.

Certified by:

Tara Zuroweste
California Professional Geologist #8418
Pacific Watershed Associates Inc.

3. Introduction

In 2007, the NCRCD contracted PWA to undertake the project design and layout to implement the prioritized treatment plans for the Carneros Creek and Sulphur Creek subwatersheds (Map 1) developed as part of an earlier road related sediment source assessment for the area (Pacific Watershed Associates, 2003a, 2003b). The work plan focused on all sediment delivery sites that had been designated with high or high-moderate treatment immediacies, as well as all reaches of hydrologically connected road. The implementation work, reported here, was completed between 2009 and 2010 on a total of 7 private properties: 3 in the Carneros Creek subwatershed, and 4 in the Sulphur Creek subwatershed. The goals of the project were to implement well-established erosion control and prevention techniques in order to minimize the impact of road related sediment to anadromous fish-bearing streams tributaries of the Napa River.

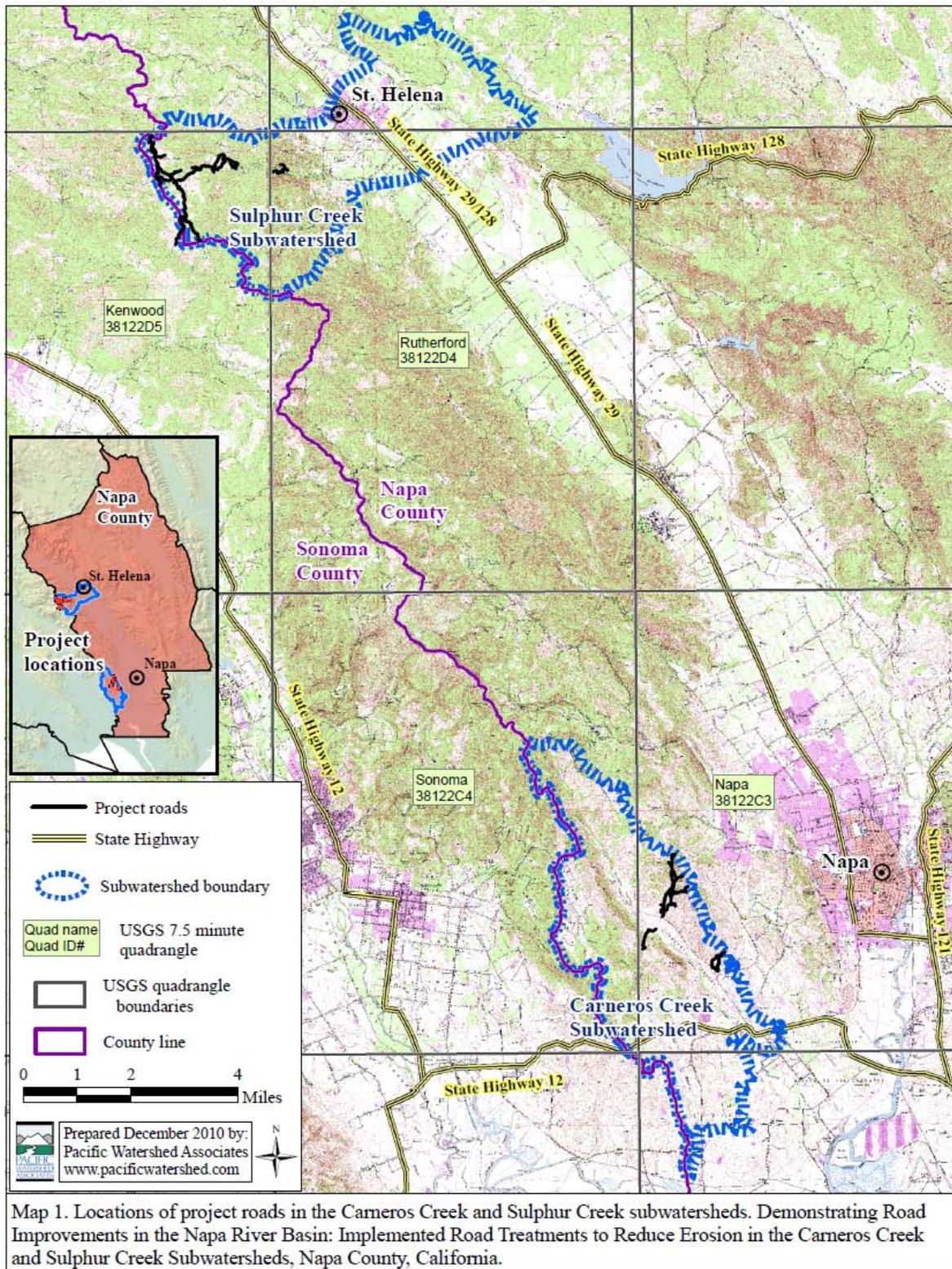
The 2002 assessment for the Carneros Creek subwatershed covered approximately 23.5 mi of county maintained roads and privately owned roads (Pacific Watershed Associates, 2003a). The inventory was conducted on 5 different privately owned parcels as well as the county road that travels along the valley bottom. In 2009, PWA implemented road related erosion control and erosion prevention treatments at individual sites and along road segments on 3 of the properties: the Saintsbury, Artesa, and Hudsonia properties (Maps 2-4, Appendix B). The 2002 assessment for the Sulphur Creek subwatershed covered 23.7 mi of county maintained roads and privately owned roads (Pacific Watershed Associates, 2003b). Road related sediment reduction treatments were completed during 2010 on 4 private landholdings in the Sulphur Creek subwatershed: the Learned-Perry, Cain, Marston, and Hoffman properties (Maps 5-8, Appendix C).

In this report we provide a summary of the road related sediment reduction treatments completed under the supervision of PWA between 2009 and 2010. All erosion control and erosion prevention treatments implemented for this project followed guidelines described in the *Handbook for Forest and Ranch Roads* (Weaver and Hagans, 1994), as well as CDFG's *Salmonid Stream Habitat Restoration Manual*, Parts IX and X (Taylor and Love, 2003; Weaver et al., 2006). Implementation results are provided on Maps 2-8, Tables 1-4, and Appendixes A-D. Final project costs are detailed in Table 5. An overview of terminology used in road related sediment reduction projects, and typical drawings of treatment procedures, are provided in Appendixes E and F, respectively.

4. Field area / Travel directions

Carneros Creek and Sulphur Creek are subwatersheds of the Napa River watershed in northern California (Map 1). Carneros Creek is third order tributary of the Napa River. The Carneros Creek watershed covers an area of approximately 9 mi², and contains approximately 25 mi of blue-line streams and tributaries (USGS, 1980b, 1980d, 1981). The mainstem of Carneros Creek is approximately 11 mi long; an additional 14 mi of tributary streams drain to it. Elevations in the watershed range from mean sea level at the confluence of Carneros Creek with the Napa River to approximately 1,660 ft above mean sea level at its headwaters.

Map 1



The Carneros Creek project area is accessed by taking California State Highway 29, near the city of Napa, California, to Highway 121, and then traveling west on Highway 121 to Old Sonoma Road. Travel on Old Sonoma road to the intersection with Dealy Lane; turn north on Dealy Lane, and continue to the intersection with Henry Road. Continue north on Henry Road to the start of the project area.

Sulphur Creek is also a major tributary of the Napa River. Its watershed covers approximately 9.5 mi² in Napa County, on the eastern side of the Mayacaama Mountains, and includes approximately 24 mi of blueline streams and tributaries (USGS 1973, 1980a, 1993, 1997). Elevations in the watershed range from approximately 200 ft above sea level at the confluence of Sulphur Creek with the Napa River to approximately 2,730 ft at Bald Mountain.

The Sulphur Creek project area is accessed by 2 different routes from California State Highway 29 near St. Helena, California. The Learned-Perry and Cain properties are reached by taking Spring Mountain Road to Langtry Road. The Marston and Hoffman Institute properties are reached by taking Spring Street to White Sulphur Spring Road.

5. Field Methods and Implementation Techniques

Project Organization, Supervision, and Monitoring

PWA provided technical oversight during on-the-ground implementation (primarily road upgrading) for this project during the summer and fall months of 2009 for the Sulphur Creek area, and 2010 for the Carneros Creek area. The treatment plan employed for the project was based on the detailed field inventory conducted during the original project assessment, which included observations of initial site conditions, estimated risks of future erosion, and a proposed course of action for implementing treatments at each site (Pacific Watershed Associates, 2003a, 2003b).

Pre-implementation layout included compiling road logs for project sites; reevaluating and flagging all work sites in the field; and finalizing lists of needed materials, including culverts, riprap and road rock, seed, and mulch. During the course of the project, PWA supervised the progress of heavy equipment operations, and conferred with operators in the field as needed to review treatment specifications. To monitor remediation efforts while in progress, and evaluate the overall effectiveness and success of the treatment plan, PWA photographed work sites from designated vantage points before, during, and after heavy equipment operations and treatment implementation. Pertinent photosets for site and road drainage treatments for this project are provided in Appendix D.

Heavy Equipment Operations

Napa County RCD contracted Charles Hope Construction and Bud Garman Construction Services Inc., to provide the heavy equipment, operators, and laborers to carry out the work plan. The heavy equipment was used in various combinations as required by the treatment plan, and included an excavator, bulldozer, roller, dump truck, water truck, grader, service truck, and a lowbed for transportation of equipment. The work was undertaken during summer low-flow periods when any potential impacts to water quality could be minimized.

Uses for the excavator were numerous, and included: (1) opening access to each site on abandoned roads (brushing and moving large obstructions); (2) excavating soil and organic debris (including logs and brush) from stream crossings; (3) placing small volumes of excavated spoil on stable slopes near decommissioned stream crossings; (4) insloping and outsloping road beds between sites; (5) “mulching” decommissioned roads with logs, limbs, and brush; (6) constructing cross-road drains on decommissioned roads; (7) excavating material from the outboard edge of the road prism at locations where rolling dips were constructed, to prevent material from becoming sidecast; (8) excavating and replacing fill at stream crossings with upgraded culverts; and (9) installing settling basins to allow fine sediment to settle out before entering the stream.

Uses for bulldozers included: (1) creating access for dump trucks by reconstructing roads and stream crossings, (2) pushing excavated material to nearby disposal sites, (3) grooming off-site spoil disposal sites where excavated material was dumped, (4) ripping (decompacting) old road surfaces, and (5) installing road drainage structures such as rolling dips and critical dips.

Dump trucks were used to haul road rock, riprap, and culverts to upgrade sites specified in the erosion control plan, and endhaul excess spoil material to a stable spoil sites.

Water trucks were used to minimize dust pollution, maintain proper soil moisture during excavation, and ensure good compaction of material during backfill and final road shaping. A grader was used during construction of some road drainage features and served to achieve a final road shape and smooth running surface.

6. Results of Implementation

Summary of Completed Erosion Control and Erosion Prevention Treatments

Between August 2009 and November 2010, PWA supervised the treatment of a total of 46 sites in the project area: 14 sites in the Carneros Creek watershed, and 32 sites in the Sulphur Creek watershed (Maps 2-8; Table 1; Appendixes A-D). Treated sites in the Carneros Creek watershed included 13 stream crossings and 1 ditch relief culvert (DRC). All sites were upgraded with the exception of 2 stream crossings: site #190 and site #200 on the Saintsbury property. All sites in the Sulphur Creek watershed were upgraded, including 29 stream crossings, 1 landslide, and 2 DRCs. Successful erosion control and erosion prevention treatments for some sites also required treating adjacent segments of hydrologically connected road that were eroding and funneling concentrated flow to the sites and into the stream system. Hydrologically connected road reaches treated in the project area totaled approximately 5.17 mi: a total of 3.99 mi leading to stream crossings; 0.44 mi leading to DRCs; and an additional 0.74 mi at locations where there was not an associated site that required treatment (Table 1).

Table 1. Number of sites and lengths of road treated to reduce sediment delivery. Demonstrating Road Improvements in the Napa River Basin: Implemented Road Treatments to Reduce Erosion in the Carneros Creek and Sulphur Creek Subwatersheds, Napa County, California.

Site type	Sites treated (#)	Hydrologically connected ^a road segments treated (mi)
Carneros Creek subwatershed		
Stream crossings	13	1.10
Ditch relief culvert	1	0.07
<i>Subtotal</i>	<i>14</i>	<i>1.32</i>
Locations treated for road drainage only ^b	-	0.15
Sulphur Creek subwatershed		
Stream crossings	29	2.89
Landslide	1	0.0
Ditch relief culvert	2	0.37
<i>Subtotal</i>	<i>32</i>	<i>3.26</i>
Locations treated for road drainage only ^c	-	0.59
Total	46	5.17

^aHydrologically connected road segments refer to lengths of road adjacent to the treatment sites that are funneling sediment to the sites and into the stream system.

^bIncludes 8 stable stream crossings and 1 landslide (site # 199).

^cIncludes 20 stable stream crossings, 1 landslide, 1 DRC, and 4 road drainage discharge points.

Table 2 shows the sediment savings achieved for this project, which is the estimated volume of sediment that will be prevented from eroding into the stream system over time as a result of implementing the site and road drainage treatments. PWA estimates that implementing the site-specific treatments will prevent the future, episodic delivery of approximately 3,648 yd³ of sediment to the stream system in the coming decades. The majority (97%) of site-specific sediment savings (3,545 yd³) is the result of erosion control and erosion prevention treatments at stream crossings. In addition, we estimate that treating landslides and DRC sites in the project area will prevent delivery of about 105 yd³ of sediment. The sediment savings achieved from implementing road drainage treatments on hydrologically connected road reaches, which will reduce chronic erosion and runoff from road surfaces, ditches, and cutbanks in the project area, is calculated for a 10 yr period and is therefore projected to be approximately 4,045 yd³ for the next decade alone.

Table 2. Estimated sediment savings for treated sites and hydrologically connected road reaches. Demonstrating Road Improvements in the Napa River Basin: Implemented Road Treatments to Reduce Erosion in the Carneros Creek and Sulphur Creek Subwatersheds, Napa County, California.

Sediment sources	Estimated sediment savings (yd³)	Percent of total
Carneros Creek subwatershed		
Episodic sediment delivery from road related erosion sites (indeterminate time period)		
Stream crossings	1,290	99%
Ditch relief culvert	5	<1%
<i>Subtotal</i>	1,295	100%
Chronic sediment delivery from road surface erosion (estimated for a 10 yr period) ^a		
<i>Subtotal</i>	1,035	
Sulphur Creek subwatershed		
Episodic sediment delivery from road related erosion sites (indeterminate time period)		
Stream crossings	2,255	95%
Landslides	85	4%
Ditch relief culverts	15	1%
<i>Subtotal</i>	2,353	100%
Chronic sediment delivery from road surface erosion (estimated for a 10 yr period) ^a		
<i>Subtotal</i>	3,010	
Total sediment savings from episodic sources (sediment delivery sites)	3,648	
Total sediment savings from chronic sources (road/ditch/cutbank surfaces)	4,045	

^aSediment delivery for rocked and native surface roads is calculated for a 10 yr period. It assumes a combined width of 20 ft for the road, ditch, and cutbank contributing area, and 0.2 ft lowering of road and retreat of cutbank surfaces per decade based on field analyses by PWA staff.

Table 3 lists the as-built results for each landownership (treated road length, treatment sites, sediment savings); summaries of treatments implemented in each watershed are listed in Tables 4a and 4b. Detailed treatment prescriptions for individual roads are provided in Appendix B and Appendix C. Pre- and post-implementation photos of select project sites are provided in Appendix D.

Table 3. Treated sediment delivery sites and estimated sediment savings per landownership.

Landowner	Treated road lengths (mi) ^a		Treated sediment delivery sites ^b					Estimated sediment savings (yd ³)	
	Upgrade	Total	Upgraded sites	Decommissioned sites	Total sites	Site-specific (episodic) ^c	Road surface (chronic) ^d		
	Decom								
Carneros Creek subwatershed									
Saintsbury	0.91	0.95	10 sites	SC: #174, 180, 181, 184, 188, 193, 196, 197, 500 DRC:# 183	2 sites	SC: #190, 200	12	1,195	740
	0.04								
Artesa ^e	0.28	0.28	-	-	-	-	0	0	220
	0								
Hudsonia	0.09	0.09	2 sites	SC:# 202, 203	-	-	2	100	75
	0								
<i>Subtotal</i>	<i>1.28</i>	<i>1.32</i>	<i>12 sites</i>	<i>2 sites</i>	<i>14</i>	<i>1,295</i>	<i>1,035</i>		
	<i>0.04</i>								
Sulphur Creek subwatershed									
Cain	1.17	1.17	10 sites	SC: #53.1, 54.1, 55.1, 56.1, 57.1, 59.1, 98, 99, 159, 1009.	-	-	10	1,355	915
	0								
Learned-Perry	1.37	1.37	10 sites	SC:#64.1, 73, 74, 75, 79, 82, 85, 86, 88, 90	-	-	10	405	1,070
	0								
Marston	1.17	1.17	8 sites	SC: #151, 152, 155, 156, 157, LS: #2001 DRC: #154, 476	-	-	8	475	910
	0								
Hoffman	0.14	0.14	4 sites	SC: #131, 132, 133, 2000	-	-	4	120	115
	0								
<i>Subtotal</i>	<i>3.85</i>	<i>3.85</i>	<i>32 sites</i>	<i>0</i>	<i>32</i>	<i>2,355</i>	<i>3,010</i>		
	<i>0</i>								
Total	5.17		44 sites	2 sites	46	3,648	4,045		

^aIncludes all hydrologically connected road reaches treated to reduce sediment delivery.

^bAbbreviations for sediment delivery sites: SC: stream crossing; LS: Landslide, DRC: ditch relief culvert.

^cEpisodic sediment savings for road related sites (indeterminate time period).

^dChronic sediment savings from hydrologically connected roads, ditches, and cutbanks (estimated for a 10 yr period).

^eUpgrading for Artesa property only included road drainage treatments.

Table 4a. Carneros Creek watershed: proposed versus as-built (completed) treatments. Carneros Creek and Sulphur Creek Watersheds, Demonstrating Road Improvements in the Napa River Basin: Implemented Road Treatments to Reduce Erosion in the Carneros Creek and Sulphur Creek Subwatersheds, Napa County, California.

Treatment type		Proposed treatments	As-built treatments	As-built sites	
Site-specific treatments	Stream crossing treatments	Culvert (replace)	3	3	#180, 184, 188
		Culvert (install)	1	1	#500
		Culvert (remove)	1	1	#200
		Decommissioned crossing (yd ³ excavated)	2 sites 982 yd ³	2 sites 982 yd ³	#190, 200
		Wet crossing (install armored fill or rocked ford)	3	3	#181, 193, 197
		Critical dip	3	7	#174, 180, 181, 188, 196, 202, 203
	Other	Landslide excavation (yd ³ excavated)	(Site# 199) (40 yd ³)	0	
		Rock armor/riprap	55 yd ³	65 yd ³	#180, 181, 193, 197
		Excavate soil	1,469 yd ³	1,469 yd ³	#181, 190, 193, 197, 200, 500
		Mulch area (spread straw/mulch)	29,600 ft ²	29,600 ft ²	#180, 184, 188, 190, 200
Road surface treatments	Road drainage structures	Ditch relief culvert (install)	1	0	-
		Ditch relief culvert (clean inlet)	1	1	-
		Ditch relief culvert (armor outlet)	1	1	-
		Rolling dip (construct)	19	23	-
		Rocked dip	0	1	-
		Cross-road drain	2	2	-
	Road Shaping treatments	Outslope road and remove ditch	240 ft	1,140 ft	-
		Other	Road rock (for road surfaces)	155 yd ³	160 yd ³

Table 4b. Sulphur Creek watershed: proposed versus as-built (completed) treatments. Carneros Creek and Sulphur Creek Watersheds, Demonstrating Road Improvements in the Napa River Basin: Implemented Road Treatments to Reduce Erosion in the Carneros Creek and Sulphur Creek Subwatersheds, Napa County, California.

Treatment type		Proposed treatments	As-built treatments	As-built sites	
Site-specific treatments	Stream crossing treatments	Culvert (replace)	11	10	#54.1, 55.1, 99, 131, 132, 133, 151, 152, 159, 1009
		Culvert (clean/clear)	2	2	#68, 74
		Flared inlet on crossing culvert	1	2	#99, 2000
		Trash rack	9	9	#54.1, 55.1, 64.1, 98, 133, 151, 152, 159, 2000
		Wet crossing (install armored fill)	2	1	#157
		Critical dip	22	20	#53.1, 54.1, 55.1, 57.1, 67, 73, 74, 79, 82, 85, 86, 88, 90, 131, 132, 133, 152, 155, 156, 1009
	Other	Landslide excavation (yd ³ excavated)	170 yd ³	170 yd ³	#2001
		Rock armor/riprap	145 yd ³	125 yd ³	#54.1, 55.1, 157, 159, 1009
		Excavate soil	275 yd ³	275 yd ³	54.1, 154, 157, 159, 1009
		Mulch area (spread straw/mulch)	31,360 ft ²	31,360 ft ²	54.1, 55.1, 99, 131, 132, 133, 151, 152, 154, 159, 1009
Road surface treatments	Road drainage structures	Ditch relief culvert (install or replace)	7	6	-
		Rolling dip (construct)	72	69	-
	Road shaping treatments	Outslope road and remove ditch	2,255 ft	2,245 ft	-
		Crown road	1,145 ft	1,145 ft	-
		Berm (remove)	1,030 ft	1,080 ft	-
		Ditch (clean or cut)	430 ft	350 ft	-
	Other	Road rock (for road surfaces)	1,165 yd ³	1,044 yd ³	-

Implementation Results by Landownership in the Carneros Creek Subwatershed

In the Carneros Creek subwatershed, PWA supervised treatment of 8 roads on 3 different properties for a total of 1.32 mi (Maps 2-4; Tables 3, 4a; Appendixes B, D). Seven of the roads were upgraded, and the Inner George Road on the Saintsbury property was decommissioned. None of the sites or road reaches in the Carneros Creek project area was unusually complex or problematic to treat.

Saintsbury property

PWA supervised erosion control and erosion prevention treatments for 5 roads totaling 0.95 mi on the Saintsbury property: 723 Road, Electric Avenue, Hammer Road, Inner George Road, and Reservoir High Road (Map 2; Table 3, 4a; Appendix B; Appendix D, photo sets 1-3). The 723 Road is the main access road for the property. Electric Avenue provides access to PG&E power lines and the adjacent property to the east. Hammer road provides access from the 723 Road to a northern pasture area. The Inner George road parallels the 723 Road and was therefore deemed unnecessary for treatment by the landowner.

Treated sediment delivery sites on the Saintsbury property included 13 stream crossings and 1 ditch relief culvert. All sites were upgraded with the exception of stream crossing sites #190 (723 Road) and #200 (Inner George Road). Upgrading treatments included installing 1 culvert, replacing 3 culverts, and constructing 3 wet crossings. One landslide excavation (site #199) was originally proposed but not implemented because of concerns that earthmoving could lead to greater destabilization and failure at the site. The estimated long-term sediment savings as a result of treating roads on the Saintsbury property is 1,195 yd³ for the 12 treatment sites, plus 740 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Artesa property

PWA supervised the construction of road drainage treatments along 2 roads totaling 0.28 mi on the Artesa property (Map 3; Tables 3, 4a; Appendix B; Appendix D, photo set 4). None of the sediment delivery sites on the property were treated because they did not meet the high/high-moderate treatment immediacy criteria. The estimated sediment savings per decade as a result of treating roads on the Artesa property is 220 yd³.

Hudsonia property

PWA supervised treatment for 2 stream crossings as well as road drainage treatments totaling 0.09 mi along Buckeye Lane on the Hudsonia property (Map 4, Tables 3, 4a; Appendix B). The stream crossings were treated by installing critical dips on their lower hingelines to prevent stream diversion should the culverts become plugged or unable to fully transport flow. The estimated long-term sediment savings as a result of completing on the Hudsonia property is 100 yd³ for the 2 treatment sites, plus 75 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Implementation Results by Landownership in the Sulphur Creek Subwatershed

In the Sulphur Creek subwatershed PWA supervised treatment of 16 different roads on 4 different properties for a total of 3.85 mi (Maps 5-8; Tables 3, 4b; Appendixes C, D). All of the roads were upgraded. None of the sites or road reaches in the Sulphur Creek project area was unusually complex or problematic to treat.

Cain property

PWA supervised erosion control and erosion prevention treatments for 6 roads totaling 1.17 mi on the Cain property: Cabin Road, Cabin Spur 1 Road, Danger Road, P-1 Road, Ridge Top Road, and Vine Road (Map 5; Tables 3, 4b; Appendix C; Appendix D, photo sets 5-7). Cabin Road is the main access road for the property and continues onto the Learned-Perry property. Cabin Spur 1 Road is a short road that connects Cabin Road to a mobile trailer housing area. Danger Road connects Cabin Road to a lower vineyard area and continues onto the Marston property. P-1 Road is a PG&E access road to power line infrastructure. Ridge Top Road begins at Cabin Road, continues along the Napa County/Sonoma County boundary, and onto the Learned -Perry property. Vine Road is a spur road off Cabin Road that provides access to a vineyard area.

An additional road (Diversion Road) on the Cain property was originally proposed for treatment, but the landowner requested that it be excluded from the final project (Appendix C, Table C7). The road reach and 3 culverted crossings drain to an irrigation pond.

The landowner also requested that 2 rolling dips originally planned for Cabin Road not be constructed in favor of constructing additional dips on Danger Road. This was deemed a more prudent plan since surface runoff along Cabin Road flows to a large irrigation pond, and the rolling dips would benefit drainage efficiency and drivability for Danger Road.

Treated sediment delivery sites on the Cain property included 10 stream crossings, all of which were upgraded. Upgrading treatments included replacing 5 culverts, installing 4 trash racks, and constructing 4 critical dips. The estimated long-term sediment savings as a result of treating roads on the Cain property is 1,355 yd³ for the 10 stream crossings, plus 915 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Learned-Perry property

PWA supervised erosion control and erosion prevention treatments for 3 roads totaling 1.37 mi on the Cain property: Cabin Road, Ridge/Cabin Tie Road, and the Ridge Road (Map 6, Tables 3, 4b; Appendix C). Cabin Road is a continuation of the road by the same name on the Cain property, and is the main access road for the Learned-Perry property. Ridge/Cabin Tie Road is a short spur road connecting Cabin Road to Ridge Road. Ridge Road likewise is a continuation of the county boundary road on the Cain property.

Treated sediment delivery sites on the Learned/Perry property included 10 stream crossings, all of which were upgraded. Upgrading treatments included constructing 9 critical dips at stream crossings and installing 1 trash rack. In addition, 1 stream crossing had been upgraded with an 18 in. culvert by the landowner since the original assessment. The estimated long-term sediment savings as a result of treating roads on the Learned-Perry property is 405 yd³ for the 10 treatment sites, plus 1,070 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Marston property

PWA supervised erosion control and erosion prevention treatments for 4 roads totaling 1.17 mi on the Marston property: Danger Spur 1 Road, Danger Road, Marston Loop Road, N.A. Younger Lane (Map 7; Tables 3, 4b; Appendix C; Appendix D, photo set 8). Danger Spur 1 Road is a PG&E access

road to power line infrastructure. Danger Road is a continuation from the Cain property, leads to a residential section of the property. Marston Loop Road is the main truck access road for the vineyards on the property. N.A. Younger Land is a private driveway off Marston Loop Road.

Treated sediment delivery sites on the Marston property included 5 stream crossings, 1 landslide, and 2 DRCs. All sites were upgraded. Upgrade treatments included replacing 2 culverts at stream crossings, installing 2 trash racks, constructing a wet crossing, and constructing 2 critical dips. The estimated long-term sediment savings as a result of treating roads on the Marston property is 475 yd³ for the 8 treatment sites, plus 910 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Treating landslide site #2001 involved excavating road fill and overburden material from the top of a larger, deep-seated feature. The purpose of treating this site was to enhance stability of the road by diverting surface water away from the slide area and unloading material from the crown of the slide. Material excavated from the top of the slide was spread out along Marston Loop Road and used for road shaping. None of the planned efforts were intended to stabilize the larger feature, or eliminate the need for long-term road maintenance at this locality which will continue to be required because of the topography and dimensions of the natural landslide.

Hoffman property

PWA supervised erosion control and erosion prevention treatments along the 0.14 mi long Sulphur Spring Spur 1 Road on the Hoffman property (Map 8; Tables 3, 4b; Appendix C; Appendix D, photo set 9). This road serves as an access road for water tanks and a septic leach field for the property.

Treated sediment delivery sites on the Hoffman property include 4 stream crossings, all of which were upgraded. Upgrading treatments include replacing 3 culverts, installing 2 trash racks, installing a flared inlet to a culvert, and constructing 3 critical dips. The estimated long-term sediment savings as a result of treating Sulphur Spring Spur 1 Road is 120 yd³ for the 4 treatment sites, plus 115 yd³ per decade for the treated road, ditch, and cutbank surfaces.

Originally an additional road (Sulphur Springs Spur 2 Road) was designated for treatments, but an updated assessment showed that the road is currently unused and overgrown, and that the 2 small crossings on the road were stable enough to not require treatment (Appendix C, Table C16).

7. Outreach and Public Awareness

To ensure successful implementation of road improvements, NCRCD used several strategies to make participating landowners aware of the project's goals, methods, and results. Prior to implementation of road improvements, NCRCD and its technical consultant, PWA, held several on-site one-on-one meetings with landowners to describe the erosion potential of their roads, why certain road lengths or stream crossings had high priority for treatment, and what the treatments would entail. NCRCD and PWA also held meetings with the landowners as a group, to explain the required landowner agreements, funding, and timing of implementation. During implementation, NCRCD sent landowners email updates describing the progress of construction. Several landowners chose to meet with project staff on site during construction. Since implementation, NCRCD and PWA have held additional field meetings with landowners to explain adjustments that landowners should expect and examine the response of road improvements to storms. After the completion of the

2010 implementation work, NCRCD coordinated a workshop and celebration to showcase the completed road improvements. The purpose of the event was to describe the work completed as part of the stewardship efforts in Carneros and Sulphur Creeks, as well as to demonstrate what properly shaped and culverted roads look like on the landscape. This event was attended by landowners in both watersheds in which work was conducted, as well as a landowners who will participate in a road improvement implementation project in 2011. Additionally, this event was attended by staff from funding agencies, NRCS, the Napa County Planning Department, and the offices of local elected officials.

NCRCD presented the project to the general public through articles in the Napa Register, the Farm Bureau newsletter, and the RCD's newsletters, and formal oral presentations at local resource agency board meetings (RCD board meeting, Watershed Information Center & Conservancy board meeting, Flood Control District board meeting). Road improvements and an associated dam removal project on one property in the Carneros Creek watershed has led to a revegetation project in which hundreds of community members have participated. Before working on revegetation tasks, each volunteer receives a brief presentation about road related erosion and strategies for road improvements.

NCRCD incorporated proper road design, erosion control, and erosion prevention treatments into its ongoing watershed education program. NCRCD developed a brochure describing road-related erosion, and distributes it at all events that NCRCD tables (e.g. Napa Earth Day, Napa River Festival, Viticulture Fair). Additionally, NCRCD developed a field guide to road-related erosion that has been used on tours of road treatment sites.

8. Building from Project Successes and Lessons

NCRCD is building from the success of this sediment reduction project by 1) leveraging the funding obtained from SWRCB for this project to obtain additional funding to implement planned road improvements in the Heath Creek watershed and 2) leveraging the experience obtained in the planning and implementation phases of work in the Carneros and Sulphur Creek watersheds to assess, plan, and implement similar road improvements in other watersheds throughout Napa County. Both efforts will support NCRCD's multifaceted approach of assisting Napa County with sediment TMDL compliance. NCRCD is promoting compliance through outreach, erosion assessments, assistance with project planning and permitting, and implementation of erosion reduction measures.

NCRCD has already secured funding (over \$200,000) from CDFG and Napa County Measure A to implement road improvements along over four miles of roads in the Heath Canyon watershed in 2011. These road improvements are expected to prevent approximately 5,000 cubic yards of sediment from entering Heath Creek in the next ten years.

NCRCD also secured funding from EPA (through the San Francisco Estuary Project, in 2010) to continue working with rural landowners on sediment reduction and sediment TMDL compliance. As part of the project, NCRCD will work with the newly formed Napa County Livestock Council and Napa County Horse Council and will engage other rural residential landowners, many of whom also own large parcels with rural roads.

The proposed project will include:

- Workshops and field tours for local road maintenance crews will be held in cooperation with the Napa County Stormwater Management Program with a focus on management measures and maintenance programs to reduce sediment delivery from public roads to local waterways (additional topics related to other limiting factors, such as fish passage, will also be addressed as appropriate)
- Workshops and field tours for local confined animal facilities will be held in cooperation with Napa County Livestock Council with a focus on management measures to reduce pathogen delivery to local waterways and best management practices to promote healthy riparian corridors
- RCD will work with NRCS and other technical professionals to provide site assessment and planning for interested rural property owners to address road erosion and/or pathogen problems (assessment and planning activities will target watersheds where specific problems/priorities have been identified (e.g., Murphy and Browns Valley Creek for pathogen reduction, priority anadromous fish streams for sediment reduction)
- Priority sites for restoration will be selected based upon criteria including, but not limited to pollution prevention calculations, current rates of pollution loading, and feasibility of treatment.
- RCD will collaborate with Napa County Stormwater Management Program, Napa County Public Works Department, other responsible local agencies and affected stakeholders to evaluate effective means of sustaining TMDL implementation.
- RCD will work with project partners to assess permit and environmental compliance needs for priority projects and to the extent possible will implement additional demonstration projects. Likely projects that would result from this task include: road erosion prevention projects, manure management projects, and riparian restoration/revegetation projects.

As a result of *Demonstrating Road Improvements*, NCRCD learned several lessons related to working with landowners to implement sediment reduction practices on private property. NCRCD will use these lesson to improve the experience of the landowners and the technical consultants in future projects. In the future, NCRCD will require that landowners participate in a field tour of road-related erosion sites and treatment sites so that they have a clear expectation of current conditions and how the finished product is intended to perform. In response to questions from landowners after implementation of this project, NCRCD and PWA are planning to collaborate on production of a brochure or website that describes how roads may adjust after treatments are implemented, and how landowners should respond to such adjustments. This publication will also detail best management practices for road maintenance. NCRCD will ensure that all landowners receive the publication and meet individually with technical team members after roads have been improved.

9. List of Items Submitted in Progress Reports

1. PWA Professional Services Agreement and Amendments
2. PAEP
3. Landowner Outreach Cover Letters
4. Right of Entry Agreements
5. Heath Canyon Roads Proposal, submitted to CDFG

6. Heath Canyon Fish Barrier Survey (RCD, 2007)
7. *Demonstrating Road Improvements in the Napa River Basin: Sulphur Creek Watershed* Poster
8. *Demonstrating Road Improvements in the Napa River Basin* Informational Handout
9. SWRCB Grant Summary Form
10. *Forest and Ranch Roads* DVD (Mendocino RCD)
11. *Road Erosion Prevention Plan* for DFG Regional Permit
12. Cost tables for Carneros, Sulphur, and Heath Canyon road improvements
13. Napa County Public Works Department Meeting Summary January 14, 2008
14. Saintsbury ponds aerial photo 2007
15. Saintsbury ponds historical photo 1940
16. DRAFT Archeological Survey Report (Bill Rich, June 2008)
17. CDFG 1602 permit application
18. CDFG 2008 Notice of Determination
19. CDFG 2008 Mitigated Negative Declaration for the Fisheries Restoration Grants Program
20. CDFG Notice to Proceed, 2009 and 2010
21. Landowner agreement with Saintsbury, Hudson Vineyards, Artesa, Learned Perry, Marston, Hoffman Institute, Cain
22. Extended Phase I Interim Report from Archaeological Survey, from HSU-CICD
23. California Red Legged Frog Surveys, Carneros and Sulphur Creek watersheds
24. As Built Road Logs from Pacific Watershed Associates
25. Bid documents for: Road Improvement Implementation in Sulphur Creek Watershed
26. Photomonitoring results from Carneros and Sulphur Creek watershed road improvements, including before and after photos for all treatment sites
27. Saintsbury Channel Restoration video
28. Poster presented at 2010 Salmonid Restoration Federation Conference describing road improvements project on Saintsbury’s property in the Carneros Creek watershed.
29. Professional Service Agreement between PWA and Garman Construction Services, Inc. and PWA and Charles Hope Construction
30. Summary Project Poster for September 30, 2010 workshop/celebration

10. Final Project Costs

The total actual costs for the project were \$529,948 (Table 5). Total projected costs were \$464,647.

Table 5. Total project costs.

Cost category	319(h)	Match¹	Total
NCRCB Personnel Services	\$46,620	\$29,064	\$75,684
Operating Expenses	\$652	\$0	\$652
Professional and Consultant Services (PWA)	\$92,923	\$57,339	\$150,262
Construction	\$204,026	\$99,324	\$303,350
TOTAL	\$344,222	\$185,727	\$529,948

¹Sources of match included: landowners, Napa County Measure A, NRCS California Department of Conservation Watershed Coordinator Grant

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