Sent via electronic mail: No hard copy to follow

February 18, 2016
CIWQS Place ID No. 810706
Regulatory Measure ID 398842
Corps File No. 2014-00418S

San Mateo County Resource Conservation District
625 Miramontes Street, Suite 103
Half Moon Bay, CA 94109

Attention: Kellyx Nelson, Executive Director (Kellyx@Sanmateorcd.org)

Subject: Conditional 401 Water Quality Certification for the Coastside County Water District Property Rural Roads Improvement Project, City of Half Moon Bay, San Mateo County

Dear Ms. Nelson:

San Francisco Bay Regional Water Quality Control Board (Water Board) staff has reviewed the application submitted by Lux Environmental Consulting, LLC (Agent), on behalf of the San Mateo County Resource Conservation District (Applicant) for the Coastside County Water District Property Rural Roads Improvement Project (Project) along Pilarcitos Creek in the vicinity of Half Moon Bay, San Mateo County. The Project has been authorized by the U.S. Army Corps of Engineers (Corps) pursuant to a Clean Water Act (CWA) Section 404 Nationwide Permit (NWP) No. 14 (*Linear Transportation*) (Corps File No. 2015-00275S). You have applied to the Water Board for CWA Section 401 Water Quality Certification (certification) that the Project will not violate State water quality standards.

Project Description: The following Project description is derived from the application materials received by the Water Board on November 13, 2014 (Application). The application was deemed complete on September 1, 2015.

The Applicant, in collaboration with the Coastside County Water District (CCWD) and L3 Communications-Randtron Antennae Systems (Randtron), is proposing erosion control and erosion prevention treatments (e.g., ditch relief culverts, stream crossings, bank stabilization, etc.) along three roads in the Pilarcitos Creek watershed to reduce road-related sediment runoff. The three roads, which are maintained by the CCWD and

Randtron, encompass a total of 2.91 miles and 32 sediment delivery sites: (1) Pilarcitos Creek Road is approximately 1.34 miles long with 17 sediment delivery sites; (2) Cell Tower Road is approximately 0.94 miles long with 6 sediment delivery sites; and (3) Transformer Road is approximately 0.63 miles long with 9 sediment delivery sites (see Figure 1 in the Attachment to this Certification). The types of treatments to be implemented at the sites include landslide and bank stabilization along Pilarcitos Creek, removal of failing ditch relief culverts and replacement with new, reconfigured relief culverts, improvement of road drainage through construction of rolling dips, critical dips and other measures, and replacement of several failing culverts on streams tributary to Pilarcitos Creek.

The Project will be implemented under the Applicant's Rural Roads Program, which addresses human-induced erosion from rural roads that can cause an unhealthy abundance of sediment in local streams. The development of a prioritized list of road improvement opportunities aimed at reducing sedimentation and hydrologic impacts to stream habitats in the Pilarcitos Creek watershed was identified as a priority project in the 2008 Pilarcitos Integrated Watershed Management Plan (Phillip Williams & Associates, October 24, 2008)(IWMP). The Project is an outcome of that inventory, and reflects the high-priority road improvements identified by Pacific Watershed Associates in 2011-2013 during sediment assessments of about 30 miles of rural roads within the greater Pilarcitos Creek watershed. All the proposed treatments associated with the Project were designed by Pacific Watershed Associates in accordance with the guidelines prescribed in Part X of the *California Salmonid Stream Habitat Stream Restoration Manual* (California Department of Fish & Wildlife (CDFW), 2010).

Existing Conditions: The project area, which encompasses all three roads and a 50 foot buffer, is located in Half Moon Bay, within the Pilarcitos Creek watershed and Santa Cruz Mountains (Figure 1). It is situated north of Highway 92, west of the Lower Crystal Springs Reservoir, and south of the San Francisco State Fish and Game Refuge. Surrounding land uses include dirt roads that are maintained for access to Santa's Tree Farm, transmitters and cell towers, and undeveloped lands associated with Crystal Springs Reservoir.

The creek originates on the eastern side of Montara Mountain and flows about 12 miles to the Pacific Ocean near the City of Half Moon Bay. It is the principal watercourse draining a coastal watershed of approximately 17,900 acres. The watershed encompasses seven sub-watersheds containing the following smaller tributaries: Nuff Creek, Corinda Los Trancos Creek, Apanolio Creek, Albert Canyon, Madonna Creek, Mills Creek, and Arroyo Leon. Pilarcitos Creek can be divided up into three broad reaches: Upper Pilarcitos, above the confluence with the seven tributaries just described, Middle Pilarcitos, primarily confined to an agricultural and residential floodplain valley, and Lower Pilarcitos, which flows through the City of Half Moon Bay to the Pacific Coast. The Project location is within the Upper Pilarcitos reach, which originates on land owned by the San Francisco Public Utilities Commission, then passes through CCWD land, then private, residential, and agricultural lands, and then

lands owned by other public entities including the City of Hal Moon Bay and California State Parks.

As described in the *Biological Resources Assessment* (Vinnedge Environmental Consulting, 2014) for the Project, the Project area consists of coastal scrub, mixed riparian and alder scrub, wetland (seep), annual grassland and coast redwood forest habitats (Figure 3). It is located within designated critical habitat for California red-legged frog (*Rana draytonii*) and designated critical habitat for marbled murrelet (*Brachyramphus marmoratus*). Pilarcitos Creek is also identified as critical habitat for Central California coast steelhead (*Oncorhynchus mykiss*). The *Wetlands and Other Waters Report* (Foster Consulting 2014) identified 0.3761 acres of potential waters of the U.S./State within the project area, including 0.049 acre of wetlands and 0.3271 acre of other waters associated with Pilarcitos Creek and several unnamed intermittent drainages and drainage ditches.

The IWMP provides a brief Pilarcitos Creek watershed assessment and identifies priority projects for promoting balanced solutions to effectively manage the watershed and satisfy environmental, public health, domestic water supply, and economic interests. The watershed is a significant area of ecological, cultural and economic diversity. It is a source of clean drinking water for residents of the central coast and San Francisco Bay Area and supports several natural-resource based economies. One of the primary goals of the IWMP is to protect and recover steelhead trout and other native species that depend on aquatic and riparian environments by providing habitat sufficient for sustainable population levels. Another goal is to restore or manage stream channels and their floodplains to resist erosion and sedimentation and to minimize flood risks. The rural roads improvement project is one measure that will help to limit erosion in the watershed, and reduce total sediment delivery to steelhead habitat.

Steelhead access to large portions of the Pilarcitos Creek watershed is blocked or impeded by barriers such as dams or culverts. According to the Watershed Assessment Update included in Appendix A of the IWMP, on the Pilarcitos main stem, the stream habitat quality and fish abundance generally increased upstream. Twelve of 17 spawning habitat reach ratings within the watershed were poor, and only three were rated as fair. Additional investigations of four upstream reaches indicated that spawning on upper Pilarcitos Creek, is rated as fair or better.

Sediment Source Assessments: As mentioned above, between 2011 and 2013 Pacific Watershed Associates conducted sediment source assessments along each of the three roads associated with the proposed Project area (PWA 2013a, 2013b, 2013c). These assessments identified individual erosion sites and recommended treatment for those sites hydrologically connected to the Pilarcitos Creek watershed, as summarized below. The road names used in the Pacific Watershed Associates reports were modified in the Application for consistency and clarity. Table 2 provides a cross-reference to avoid confusion when referencing the supporting Pacific Watershed Associates' technical reports.

Table 1. Project Site - Road Name Cross-Reference

Road Name		Road Length Within Project Area	Sediment Delivery Sites
Permit Application	**Pacific Watershed Associates Report**		
Pilarcitos Creek Road	Unnamed or CCWD Road[1]	1.34 miles	18*
Cell Tower Road	Randtron Road 2[2]	0.94 miles	6
Transformer Road	Cell Tower Road[3]	0.63 miles	9
***One site along Pilarcitos Creek Road, Site 174, was evaluated by Pacific Watershed Associates but is not within the boundary of the Project. Accordingly, only 17 of the 18 sites evaluated in PWA (2013a) are proposed for improvement as part of the Project.			

*Pilarcitos Creek Road***:** Within the Project area, Pilarcitos Creek Road parallels Pilarcitos Creek for 1.34 miles along a canyon bottom (Figure 1). PWA (2013a) identified 18 individual erosion sites and approximately 0.41 mile of road surfaces, roadside ditches, and cutbacks along Pilarcitos Creek Road that are currently eroding and delivering sediment to the stream system, or show a potential to do so in the future (Table 1, Figure 2). Erosion site types include five culvert replacements, one new culvert, approximately three ditch relief culverts, two landslides, three discharge points for road surface drainage, and four bank erosion areas (PWA 2013a; Table A-1).

PWA estimated that implementation of all recommended treatments along Pilarcitos Creek Road could prevent delivery of more than 540 cubic yards (CY) of sediment to the assessment area). Table A-1 in Appendix A, excerpted from PWA (2013a), provides detailed field observations and proposed treatments for Pilarcitos Creek Road.

Cell Tower Road: Cell Tower Road travels east from Pilarcitos Creek Road 0.94 mile to Cahill Ridge Road (Figure 1). PWA (2013b) identified 6 individual erosion sites and approximately 0.92 miles of road surfaces, roadside ditches, and cutbacks along Cell Tower Road that are currently eroding and delivering sediment to the stream system, or show a potential to do so in the future (Table 1, Figure 2). Erosion site types include one culvert removal and construction of an armored fill crossing, one culvert replacement, one ditch relief culvert removal and redirection of flows away from gully, one culvert cleaning, one ditch relief culvert replacement, and one discharge point for road surface drainage (PWA 2013b).

PWA estimated that implementation of all recommended treatments along Cell Tower Road could prevent delivery of more than 1,200 CY of sediment to the assessment area. Table A-2 in Appendix A, excerpted from PWA (2013b), provides detailed field observations and proposed treatments for Cell Tower Road.

[1] PWA (2013a)

[2] PWA (2013b)

[3] PWA (2013c)

Transformer Road: Transformer Road is a spur road that travels west from Pilarcitos Creek Road (Figure 1). This steep and windy dirt road is approximately 0.63 mile long and 10 feet wide and provides access to an existing transformer site operated and maintained by Randtron. PWA (2013c) identified 9 individual erosion sites and approximately 0.53 miles of road surfaces, roadside ditches, and cutbacks along Transformer Road that are currently eroding and delivering sediment to the stream system, or show a potential to do so in the future (Table 1, Figure 2). Erosion site types include one stream crossing culvert replacement, two road ditch fill sites where road surface drainage will be improved, one removal of ditch relief culvert and improvement of road surface drainage, and three landslides. These landslide repair sites on Transformer Road will not involve any impacts to waters of the State.

Pacific Watershed Associates estimated that implementation of all recommended treatments along Transformer Road could prevent delivery of more than 740 CY of sediment to the assessment area. Table A-3 in Appendix A, excerpted from PWA (2013c), provides detailed field observations and proposed treatments for Transformer Road.

Proposed Improvements: A total of 32 sediment delivery sites would be treated along the three roads. The specific treatments at each site are itemized in Tables A-1 (Pilarcitos Creek Road), Table A-2 (Transformer Road), and Table A-3 (Cell Tower Road), which are included in the Attachment to this Certification. Typical schematic diagrams of these improvements are also provided in the Attachment to this Certification.

Pacific Watershed Associates identified seven general erosion site types within the project area, each of which generally falls into three categories:

- Stream crossings
- Bank erosion/landslide areas (including springs)
- Road drainage points (including ditch relief culverts, discharge points for road surface drainage, and ditch sites)

The following summarizes the general approach to implementing improvements within each of these categories. Additional site-specific detail on individual treatments (e.g., area of disturbance, treatment components, work sequence) is summarized in the tables.

Stream Crossings & Road Ditch Relief: Stream crossing improvements would include culvert repair or replacement at specific treatments sites along each road. In general, stream crossing treatments would require removal of the damaged culvert, replacement with a new appropriately sized pipe, and reconstruction of the fill slopes at a sustainable grade.

The disturbance area at stream crossings would generally occur within an area 10 to 15 feet upstream of the culvert inlet and 25 feet downstream of the culvert outlet. This

disturbance area would be limited to the minimal size necessary and would be largely influenced both by the amount of aggraded sediment in the channel and the proximity of the drainage to the main-stem of Pilarcitos Creek.

The primary purpose of the Project is to reduce sediment loading into Pilarcitos Creek, and the scope does not include providing fish passage at the Pilarcitos Creek tributary culvert replacement sites. Assessment of the fish spawning and rearing habitat in these small tributary streams in the Upper Pilarcitos reach was not included in the IWMP or in the Application. If future studies indicate the presence of historic and/or future viable spawning and/or rearing habitat in these small tributaries, then measures to provide fish passage could be implemented at a later time. The Application provided representative schematic drawings for the culvert replacement areas, *Typical Problems and Applied Treatments for Non-fish Bearing Upgraded Stream Crossin*g, *Typical Drawings No. 1, 2, and 4* (Pacific Watershed Associates, Inc.). The use of the term non-fish bearing is not intended to characterize the tributary streams as non-fish bearing. Rather, the intent is to clarify that the culvert replacement designs do not include baffles or other culvert design features that could enhance fish passage through the reach. This was not considered to be a priority considering the limited size and flows within the tributary streams, and resources available for Project implementation.

The Project will include replacement of tributary stream channel culverts at three locations. All other culvert replacement and removal locations described in the Application generally refer to ditch relief culverts. In some locations, ditch relief culverts have caused severe erosion and creation of gullies on the downstream end of the culverts. These culverts will be removed and replaced with new ditch relief culverts designed to more effectively convey flows from the roadside ditches without causing erosion. In some cases, the ditch relief culverts will not be replaced. Rather, the road drainage conditions at these locations will be modified through minor grading to create rolling dips, critical dips, etc., and/or establishment of an armored fill crossing. Several culverts with accumulated sediment will be cleaned.

Bank Erosion / Landslide Areas: In areas subject to bank erosion or landslides, loose material would be excavated and the site armored with imported rock riprap. These treatments would generally extend to the limit of downslope disturbance, or the edge of a main-stem channel, but would not extend upslope of the road. The specific dimensions and approach for these treatments are site-specific and summarized below and in Appendix A of the Application. There are a total of seven sites where the stream bank needs structural support to prevent erosion of the road bed and the buried water pipeline: Sites 143, 147, 148, 167, 169, 171, and 172. All of these sites are located along Pilarcitos Creek where the road is directly adjacent to the creek. Sites 147 and 172 are associated with landslides. Re-location of the road and buried pipeline would not be feasible at these locations due to the steep slopes on the upslope side of the road. The goal at all of these sites is to ensure that the road and buried pipeline remain stable. However, at several locations, including Sites 167 and 169, the situation is complex and potentially problematic because future erosion is expected despite treatment, so other longer term measures may be necessary in the future.

Pursuant to a request by the Water Board, the Applicant considered alternative biotechnical methods for stabilization of stream banks to reduce the amount of rock and increase vegetation along the bank. However, with the exception of one location, Site 143, the bank erosion treatment designs have not changed due to the anticipated difficulty of implementing substantial biotechnical stabilization methods immediately adjacent to a water supply line that is located beneath the road, costs, and the need for strong structural support to deter movement of the toe of the landslides. Designs utilizing live crib walls and/or large woody debris instead of the rock were considered and may be feasible at several of the locations. However, the cost was anticipated to be substantially more than required for rock and the current Project budget does not include funds that would allow for installation of these biotechnical stabilization measures.

At most locations, the bank stabilization work will involve the placement of rock, keyed in at the toe of the bank. Where feasible, in accordance with the conditions of this Certification, the Applicant will plan to include native vegetation appropriate for the watershed within and around the rock placement to offset the use of hardscape along the edge of the stream channel. For those locations that are in the moderate to moderate-low category of risk for treatment immediacy as shown on the maps included in the Pacific Watershed Associates assessments (see Attachment to this Certification), if alternative funding becomes available prior to implementation of the work, then the Applicant may be able to revise the Project plans to incorporate the alternative methods at certain locations. The overall benefit of this approach would be to improve fish habitat along the channel while at the same time provide the structural stability for the road and water pipeline.

Site 143: The bed of the creek is approximately 10 feet below the road at this location. Some large rock has been placed around the base of the bank slope in the past, and moderate vegetation is growing on the slope. The recommended treatment originally would have involved the excavation of a 20-foot-wide by 10-foot-long keyway at the toe of the slope along the edge of the stream, and placement of approximately 25 CY of 2½-foot rock riprap within the keyway and up the bank slope. To avoid and minimize impacts to the stream channel, the Applicant has modified the design to eliminate the rock riprap. Instead, two live willow fascines will be keyed into the upper slope, using willow sprigs as staking, and local dogwood material. As needed, road drainage at this location will be modified to direct stormwater runoff away from the vulnerable bank area.

Site 147: At this location there is a small landslide/slope failure that is vulnerable to stream flows at its base. Some armor has already been placed in the channel. This site may continue to erode despite treatment due to its location relative to the stream and the unstable nature of the local soils. However, to maintain the current stability of the road and pipeline, approximately 20 CY of perched road fill along a 30-foot-long by 10-foot-wide by 1.5-foot-deep area will be excavated along the channel, and 30 CY of 2- to 3-foot rock riprap will be installed in the excavated area to stabilize the toe of the landslide.

Site 148: At this location approximately 45 linear feet of the 10-foot high stream bank is eroding below the road. The road is very narrow through this reach, and loss of driving surface will occur if the bank is not protected from further erosion. A 35-foot long by 10-foot wide keyway will be excavated and backfilled with 25 CY of 1- to 4-foot rock riprap.

Site 167: Problems at this location appear to be the result of poor drainage and the location of the road along the stream. Erosion at this location may continue post treatment, but the goal is to reduce the overall amount of sediment discharged from the site. A 30-foot long by 6-foot wide by 3-foot deep trench will be excavated at the toe of the stream bank and backfilled with approximately 20 CY of rock riprap. A 25-foot long ditch relief culvert will also be replaced at this site.

Site 169: At this location the road can be moved about three feet back to accommodate lay back of the upper bank along approximately 50 linear feet of stream channel. The lower half of the bank will be armored with approximately 35 CY of 2- to 3-foot rock riprap. If feasible, a willow mattress or similar bioremediation measure will be installed on the upper half of the slope during construction.

Site 171: A 75-foot long, 1.5-foot deep trench will be excavated at the toe of the stream bank and backfilled with approximately 25 CY of 3-foot rock riprap. A rolling dip will be constructed on the road on the right approach. The use of a willow mattress will be considered at this site to add post-construction stability to the upper bank.

Site 172: Approximately 41 CY of soil from the outboard fill slope of the road will be removed. The lowest 1/3 of the slope will be armored with approximately 10 CY of 3-foot diameter rock riprap. A willow mattress will be considered to stabilize the upper 2/3 of the excavated slope.

If a willow mattress is not used at any of the three locations described above, then the disturbed upper bank area will be covered with a native seed mix and mulch.

Road Drainage Improvements: Road drainage improvements (e.g., road out-sloping, rolling dips, ditch relief culvert installation, ditch clearing, etc.) would generally involve reshaping existing roads to improve drainage and decrease sedimentation. With the exception of rolling dip outlets and ditch relief culverts, impacts would be limited to the existing road footprint and up to three or four feet beyond the outboard edge of the road. Rolling dip and ditch relief culvert outlets could disturb up to 15 feet beyond the outside edge of the road.

Maintenance and Monitoring: Long-term maintenance of roads within the Project area would remain the responsibility of CCWD (Pilarcitos Creek Road) and Randtron (Cell Tower Road and Transformer Road). Roads would be inspected annually and all locations indicating that runoff is not being directed off the roadbed (e.g., ruts, rills, surface erosion/degradation) would be identified and mapped. Stream crossings, ditches and culverts would be inspected for erosion, infrastructure damage, blockages,

or changes in vertical or horizontal alignment. Maintenance activities could include repair of eroding or degraded infrastructure, grading the road surface, and/or shovel work to clear aggraded debris and sediment. Maintenance work would generally follow the guidelines provided in the *Handbook for Forest, Ranch & Rural Roads* (Weaver et. al. 2014).

Annual road inspections and maintenance activities would occur prior to the rainy season. Roads may also be inspected following large or prolonged storm events to ensure the implemented treatments are functioning properly.

Construction Methodology: Proposed improvements would generally be implemented using heavy equipment, although some hand labor would be used at sites needing new culverts or culvert repairs, or in areas where streams or drainages would need to be dewatered to allow for construction. Specific construction methods that would be employed at each treatment site are provided in Appendix A of the Application.

Dewatering may be required at some treatments sites if flowing water is present at the time of construction. In these instances, water would be isolated upstream of the work area using cofferdams and transported downstream/around the work site through a gravity fed diversion pipe (although a pump may be used if necessary) to keep the stream “live” below the work area. An additional dam would be installed downstream of the work area to capture any subsurface flow that might travel through the construction area. Water would be collected at the upstream and downstream locations and pumped away from the site to infiltrate into the ground without the potential for delivery to the stream.

At treatment sites for bank erosion on the main-stem of Pilarcitos Creek (Sites 143, 148, 169, and 171), the treatment site would be isolated from flowing water by installing plywood fencing. The fencing would limit soil from entering the waterway and minimize the need for dewatering.

Work Sequence: The following construction sequence is proposed:

- Establish staging areas
- Mobilize equipment
- Conduct required pre-construction biological surveys
- Install temporary erosion control measures
- Remove low hanging tree vegetation/ branches along roads, as necessary
- Temporarily dewater areas with flowing water (as needed) OR install plywood fencing along bank erosion treatment sites at Pilarcitos Creek (Sites 143, 148, 169, and 171)
- Implement improvements at treatment sites
- Seed and mulch temporarily disturbed soils with native vegetation

Construction Equipment: Heavy equipment, including excavators, dozers, backhoes, graders, rollers, dump trucks, and/or water trucks may be used to implement the proposed improvements.

Construction Staging and Access: Access to the project area would be provided from Pilarcitos Creek Road, Cell Tower Road and Transformer Road. All equipment would be staged either on adjacent properties (e.g., Santa's Tree Farm) or in wide or open spots along the roads, away from and outside sensitive habitat areas. Where feasible, materials (rock, culverts, etc.) would be stockpiled temporarily at the site or delivered directly to the site as required.

Construction Schedule: Construction would occur in the late fall, after September 15 to avoid the marbled murrelet nesting season and prior to October 15 to accommodate in-water work windows for fish. All work would be completed in a dry or dewatered condition. Construction would generally be completed during a 4-week period in 2016; however, due to funding constraints, improvements to some of the lower immediacy treatment sites may occur over a longer 5-year period (2016-2020).

Proposed Discharge of Fill Material Waters of the State: A delineation of wetlands and other waters of the State within the Project area was completed by Foster Consulting in August 2014. The delineation assessed 33 treatment sites, a 50 foot buffer around each site, and staging and equipment storage areas. As summarized in that report, there are 0.3761 acre of potential jurisdictional waters within the Project area, including 0.049 acre of wetlands and 0.3271 acre of other waters.

Impacts: Table 2 below summarizes direct temporary and permanent impacts to waters of the State under the proposed project. Tables 4 through 6 included in the Application and in the Attachment to this Certification summarize approximate direct and indirect impacts to waters of the State for each treatment site along each road. In total, about 0.16 acre of Other Waters (referred to as relatively permanent waters (RPW), non-RPW, and culverts) would be permanently impacted by implementation of the proposed project (Table 2 below). Permanent impacts would be associated with installation of new and replacement culverts, rock for bank and landslide stabilization along stream channels, and fill of roadside ditches during construction of road surface improvements to facilitate drainage on and adjacent to the subject roads. All improvements would occur along approximately 2,084 linear feet of other waters (Tables 4, 5, and 6), which includes approximately 300 linear feet of rock riprap for bank and landslide stabilization along Pilarcitos Creek, approximately 843 linear feet for culvert replacements, approximately 176 linear feet for new culverts, and approximately 809 linear feet for replacement and rehabilitation of ditch relief culverts. These values are worst case estimates of the potential impacts. About 542 CY of soil, rock, and/or culverts would be used as fill material for the proposed project.

An additional 0.02 acre of other waters would be temporarily impacted during construction. Temporary impacts would be associated with dewatering and limited ground disturbance to facilitate access to the treatment sites. All areas temporarily

disturbed would be restored to preconstruction conditions and seeded with native vegetation.

No wetland areas would be directly impacted by the proposed project. About 0.16 acre of wetlands that occur within a 25-foot buffer of the proposed treatment sites may be temporarily *indirectly* impacted by construction activities (see Tables 4 and 6 in the Attachment to this Certification).

Table 2

Road	Temporary Impacts		Permanent Impacts	
	Other Waters		Other Waters	
	Acres	Linear Feet	Acres	Linear Feet
Pilarcitos Creek Road	0.0158		0.1108	690
Cell Tower Road	0.0016		0.0175	645
Transformer Road	0.0043		0.0256	749
Total	**0.0217**		**0.1539**	**2,084**

Special Status Species Consultation: The Corps consulted with the United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to address Project related impacts to listed species pursuant to Section 7(a) of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq*.). By email dated March 20, 2015, NMFS concurred that the Project's impacts are not likely to jeopardize the continued existence of the Central California Coast steelhead and may be covered by the incidental take statement of a programmatic Biological Opinion for fisheries restoration projects (#151422SWR2006R00190:JMA), cited in enclosure 6 of the Corps authorization letter. By letter dated November 18, 2015, USFWS issued a Biological Opinion (08ESMF00-2015-F-0981), cited in enclosure 7 of the Corps authorization, with an incidental take statement for the California red-legged frog. In the same letter, USFWS also concurred with the determination that the Project is not likely to adversely affect the San Francisco garter snake and the marbled murrelet.

Mitigation: The purpose of the proposed Project is to reduce road-related sediment runoff in the Pilarcitos Creek watershed by implementing erosion control and erosion prevention treatments on three existing dirt roads. Permanent direct impacts to about 0.16 acre of other waters under the proposed Project would contribute to a loss of waters of the State in the Pilarcitos Creek watershed. However, most impacts associated with the Project would be associated with features intended to improve drainage along subject roads, primarily through culvert repair and replacement or road surface drainage modifications, where the function of the water would not be "lost", but rather modified). Once complete, the proposed Project would prevent the delivery of

approximately 2,480 CY of sediment to the Pilarcitos Creek watershed (PWA 2013a, 2013b, 2013c), which would improve hydrologic function and habitat value at the treatment sites, within the impacted waters, and throughout the larger watershed. As a result, the proposed Project would result in a beneficial impact on waters of the State.

To reduce the overall impact of the rock riprap installation along the bank of Pilarcitos Creek at the bank and landslide stabilization locations, the Applicant shall maximize opportunities to (1) modify road drainage to prevent further bank erosion; (2) install willow and/or dogwood stakes (rooted stock is preferable for dogwood plantings) within the rock and/or adjacent to the rock structure to provide root structure that may increase the overall stability of the bank reinforcement, and to provide riparian habitat along the reach. Willow mattresses shall be installed at Sites 169, 171, and 172 as described in the Application, unless the Applicant submits a demonstration, satisfactory to the Executive Officer prior to construction, that the use of a willow mattress at the subject sites in infeasible.

Temporary and localized impacts to waters of the State, including wetlands, and water quality would be minimized by implementing the construction-related BMPs provided in Table 7, which is included in the Application and in the Attachment to this Certification. All areas temporarily disturbed would also be returned to pre-construction conditions and reseeded with native vegetation. Limited permanent impacts to waters of the State (0.16 acre) would be offset by improved habitat function both onsite and downstream after the proposed project is implemented.

California EcoAtlas: The Water Board is now tracking riparian repair and maintenance projects in an effort to detect potential systemic instabilities and document project performance in Bay Area creeks. To streamline the reporting requirement, the Applicant is required to submit a Riparian Repair and Maintenance Wetland Tracker short form describing Project size, type, and performance measures. An electronic copy of the short form and instructions can be downloaded at: http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml. Project information will be made available at the web link: http://ecoatlas.org.

CEQA Compliance: The Applicant determined that the Project is categorically exempt from the requirements of the California Environmental Quality Act (CEQA), pursuant to section 15301 of the CEQA Guidelines, which covers the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The Project will implement various erosion control and erosion prevention treatments along three roads in the Pilarcitos Creek watershed to reduce road-related sediment runoff. Project activities will not result in significant impacts on endangered, rare or threatened species or their habitat. The CDFW filed a Notice of Exemption for the Project with the San Mateo County Clerk on December 15, 2014. The Water Board, as a responsible agency under CEQA, has considered the Notice of Exemption and concurs with the categorical exemption determination.

Certification and General Waste Discharge Requirements: I hereby issue an order certifying that any discharge from the referenced Project will comply with the applicable provisions of sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003 - 0017 - DWQ, "General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification," which requires compliance with all conditions of this Water Quality Certification. The following conditions are associated with this certification:

1. No debris, rubbish, creosote-treated wood, soil, silt, sand, cement, concrete, or washings thereof, or other construction related materials or wastes, oil or petroleum products or other organic or earthen material shall be allowed to enter into, or be placed where it may be washed by rainfall or runoff into waters of the State. Any of these materials placed within or where they may enter waters of the State by the Applicant or any party working under contract, or with the permission of the Applicant shall be removed immediately. When construction is completed, any excess material shall be removed from the work area and any areas adjacent to the work area where such material may be washed into waters of the State. During construction, the contractor shall not dump any litter or construction debris within the riparian/stream zone. All such debris and waste shall be picked up daily and properly disposed of at an appropriate site;

2. The Applicant shall adhere to the terms and conditions of Nationwide Permit No. 14 issued by the Army Corps of Engineers (Corps File No. 2015-00275S);

3. The Applicant shall adhere to the terms and conditions of the November 18, 2015, USFWS Biological Opinion (08ESMF00-2015-F-0981) and the March 20, 2015, NMFS concurrence email for the Project;

4. The Applicant shall adhere to the terms and conditions imposed by the CDFW in the Streambed and Lake Alteration Agreement (Notification No. 1600-2014-0408-R3);

5. No equipment shall be operated in areas of flowing or standing water; no fueling, cleaning, or maintenance of vehicles or equipment shall take place within waters of the State, or within any areas where an accidental discharge to waters of the State may occur; construction materials and heavy equipment must be stored outside of the active flow of the creek. When work within waters of the State is necessary, the entire streamflow shall be diverted around the work area;

6. All work performed within waters of the State shall be completed in a manner that minimizes impacts to beneficial uses and habitat; measures shall be employed to minimize disturbances along Pilarcitos Creek and its tributaries that will adversely

impact the water quality of waters of the State. Disturbance or removal of vegetation shall not exceed the minimum necessary to complete Project implementation;

7. Construction in waters of the State is restricted to the April 15 to October 15 dry season, or the end of any extension granted by CDFW;
8. Prior to the start of the rainy season, the Applicant shall ensure that disturbed areas of waters of the State and disturbed areas that drain to waters of the State are protected with correctly installed erosion control measures (e.g., jute, straw, coconut fiber erosion control fabric, coir logs, straw, etc.), and revegetated with propagules (seeds, cuttings, divisions) of locally collected native plants;
9. Within 30 days of the first Project-related disturbance of waters of the State, the Applicant shall provide the Executive Officer of the Water Board with written notification that the Project has disturbed waters of the State;
10. The Project shall be implemented as described in the Application received by the Water Board on November 13, 2014. The Application included the following information that will be used to guide the implementation of the work at the various treatment sites:

    - Table 4, Pilarcitos Creek Road Treatment Sites – Impacts to Waters of the U.S.;
    - Table 5, Cell Tower Road Treatment Sites – Impacts to Waters of the U.S.;
    - Table 6, Transformer Road – Impacts to Waters of the U.S.;
    - Table A-1, Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Pilarcitos Creek Road;
    - Table A-2, Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Cell Tower Road;
    - Table A-3, Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Transformer Road; and,
    - Appendix B, *Typical Drawings (Schematic Diagrams)* (Pacific Watershed Associates, Inc., undated).

    The above described tables and drawings provide summary information about the work that will be completed at the various locations on Pilarcitos Creek Road, Cell Tower Road, and Transformer Road within the Project area. Minor changes to the plans and descriptions of work at each site may be necessary depending on the current conditions of the treatment sites. All changes shall be recorded and reported after completion of the Project in the As-Built required in Condition

17. Any changes to these plans that will result in an increase in impacts to waters of the State must be submitted to the Water Board's Executive Officer for review and approval before they are implemented;

11. The Applicant shall implement all construction best management practices that are included in Table 7 of the Application (see Attachment to this Certification);

12. The Applicant shall establish a minimum of 2 photo-documentation points at each of the stream bank and landslide stabilization locations, and at each culvert replacement and new construction location to track the conditions of the bank prior to construction, and the stability of the stabilized bank after construction including the upstream and downstream transitions to the natural bank. The Applicant shall prepare a site map with photo-documentation points clearly marked. Following construction, the Applicant shall photographically document the immediate post-construction condition of the stream channel and bank. These post-construction photographs and the map shall be submitted to the Water Board within 60 days of constructing the Project;

13. To the extent that stormwater runoff from the road is causing the stream bank erosion at the bank stabilization sites along Pilarcitos Creek, the road drainage will be modified to reduce or eliminate flow over the bank;

14. To reduce the overall impact from the use of rock to stabilize the stream bank along Pilarcitos Creek, the Applicant shall maximize opportunities to install willow and/or dogwood stakes (rooted stock is preferable for dogwood plantings) within the rock and/or adjacent to the rock to provide root structure that may increase the overall stability of the bank reinforcement, and to provide riparian habitat along the reach. The as-built report submitted pursuant to Condition 17 shall include a description of stream bank and vegetation conditions at each stabilization site, and willow mattresses shall be installed at Sites 169, 171, and 172 as described in the Application, unless the Applicant provides documentation, satisfactory to the Executive Officer prior to construction, that the use of willow mattresses at the subject sites in infeasible;

15. For the bank stabilization locations that are in the moderate to moderate-low category of risk for treatment immediacy as shown on the maps included in the Pacific Watershed Associates assessments (see Attachment to this Certification), if additional funding becomes available prior to implementation of the work, and it becomes feasible to install biotechnical bank stabilization structures at some of the locations, then the Applicant shall revise the designs to incorporate the alternative methods prior to implementation;

16. Temporary and localized impacts to waters of the State, including wetlands, and water quality will be minimized by implementing the construction-related BMPs provided in Table 7, which is included in the Application and in the Attachment to

this Certification. All areas temporarily disturbed would also be returned to pre-construction conditions and reseeded with native vegetation;

17. Within 60 days of completing Project construction activities the Applicant shall submit an as-built report to the Water Board. The report shall provide a summary of the work, including characterization of the areas of actual disturbance to waters of the State for each site. The photographs required by Condition 12 shall be submitted with the as-built report;

18. **California EcoAtlas:** The Applicant is required to use the Riparian Repair and Maintenance Wetland Tracker form (short form) to provide Project information within 14 days from the date of this certification. An electronic copy of the short form can be downloaded at: http://www.waterboards.ca.gov/sanfranciscobay/certs.htm. The completed form shall be submitted electronically to habitatdata@waterboards.ca.gov or shall be submitted as a hard copy via mail to both (1) the address on the letterhead (or to the Water Board), to the attention of California EcoAtlas and, (2) to the San Francisco Estuary Institute, 4911 Central Avenue, Richmond, CA 94804, to the attention of EcoAtlas;

19. In accordance with CWC §13260, the Discharger shall file with the Board a report of any material change or proposed change in the ownership, character, location, or quantity of this waste discharge. Any proposed material change in operation shall be reported to the Executive Officer at least 30 days in advance of the proposed implementation of any change. This shall include, but not be limited to, all significant new soil disturbances, all proposed expansions of development, or any change in drainage characteristics at the Project site. For the purpose of this Order, this includes any proposed change in the boundaries of the area of wetland/waters of the State to be filled;

20. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to CWC Section 13330 and 23 CCR Section 3867;

21. Within 30 days of completing all project elements with impacts waters of the State that are authorized by this Certification, the Applicant shall provide the Executive Officer of the Water Board with a Final Project Completion Report that includes: (a) the Project name; (b) the CIWQS Place ID number listed at the top of this Certification; and (c) the date Project impacts to waters of the State at the Project site were completed;

22. This certification action does not apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license, unless the pertinent certification application was filed pursuant to California Code of Regulations (CCR) Title 23, Subsection 3855(b) and that application specifically

identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought; and

23. Certification is conditioned upon full payment of the required fee as set forth in 23 CCR Section 3833. Water Board staff received payment in full of $640.00 on November 13, 2014, for the application fee for the Project. **The fee for the Project is $6,210, which is primarily based on the linear feet of stream channel that will be impacted by placement of rock riprap for bank and landslide stabilization and culvert outlet protection. The Applicant shall submit the remaining fee amount of $5,570 within 10 days of the date of this Certification.** An annual discharge fee shall be paid to the Water Board until all of the impacts to waters of the State at the Project site that are authorized by this Certification have been implemented (See Condition 20) (Note: The Annual Active Discharge Fee may be changed by the State Board; at the time of Certification it was $200 per year).

This certification applies to the Project as proposed in the application materials and designs referenced above in the conditions of certification. Be advised that failure to implement the Project in conformance with this certification is a violation of this water quality certification. Any violation of water quality certification conditions is a violation of State law and subject to administrative civil liability pursuant to California Water Code (CWC) Section 13350. Failure to meet any condition of a certification may subject the Applicant to civil liability imposed by the Water Board to a maximum of $10,000 per day of violation or $10 for each gallon of waste discharged in violation of this action. Any requirement for a report made as a condition to this action is a formal requirement pursuant to CWC Section 13267, and failure or refusal to provide, or falsification of such required report, is subject to civil liability as described in CWC Section 13268. Should new information come to our attention that indicates a water quality problem with this Project, the Water Board may issue Waste Discharge Requirements.

Please contact Katie Hart of my staff at (510) 622-2356 or Kathryn.hart@waterboards.ca.gov if you have any questions. All future correspondence regarding this Project should reference the name of the Project and the CIWQS Place ID No. indicated at the top of this letter.

Sincerely,

Digitally signed by Keith H. Lichten, Chief
Date: 2016.02.18 13:18:03 -08'00'

for Bruce H. Wolfe
Executive Officer

Attachment: Project Location Maps and Treatment Descriptions & Locations

cc: SWRCB, DWQ, stateboard401@waterboards.ca.gov
Regional Water Board, Victor Aelion, victor.aelion@waterboards.ca.gov
CDFW, Suzanne DeLeon, Suzanne.Deleon@wildlife.ca.gov
U.S. EPA, Region IX, WTR-8, R9-WTR8-Mailbox@epa.gov
Corps, SF Regulatory Branch:
Katerina Galacatos, Katerina.galacatos@usace.army.mil
Daniel Breen, Daniel.B.Breen@usace.army.mil
April Zohn, Lux Environmental Consulting, LLC, april@luxenvironmental.com
EcoAtlas, Habitat.data@waterboards.ca.gov

ATTACHMENT

401 Water Quality Certification

San Mateo County Resource Conservation District

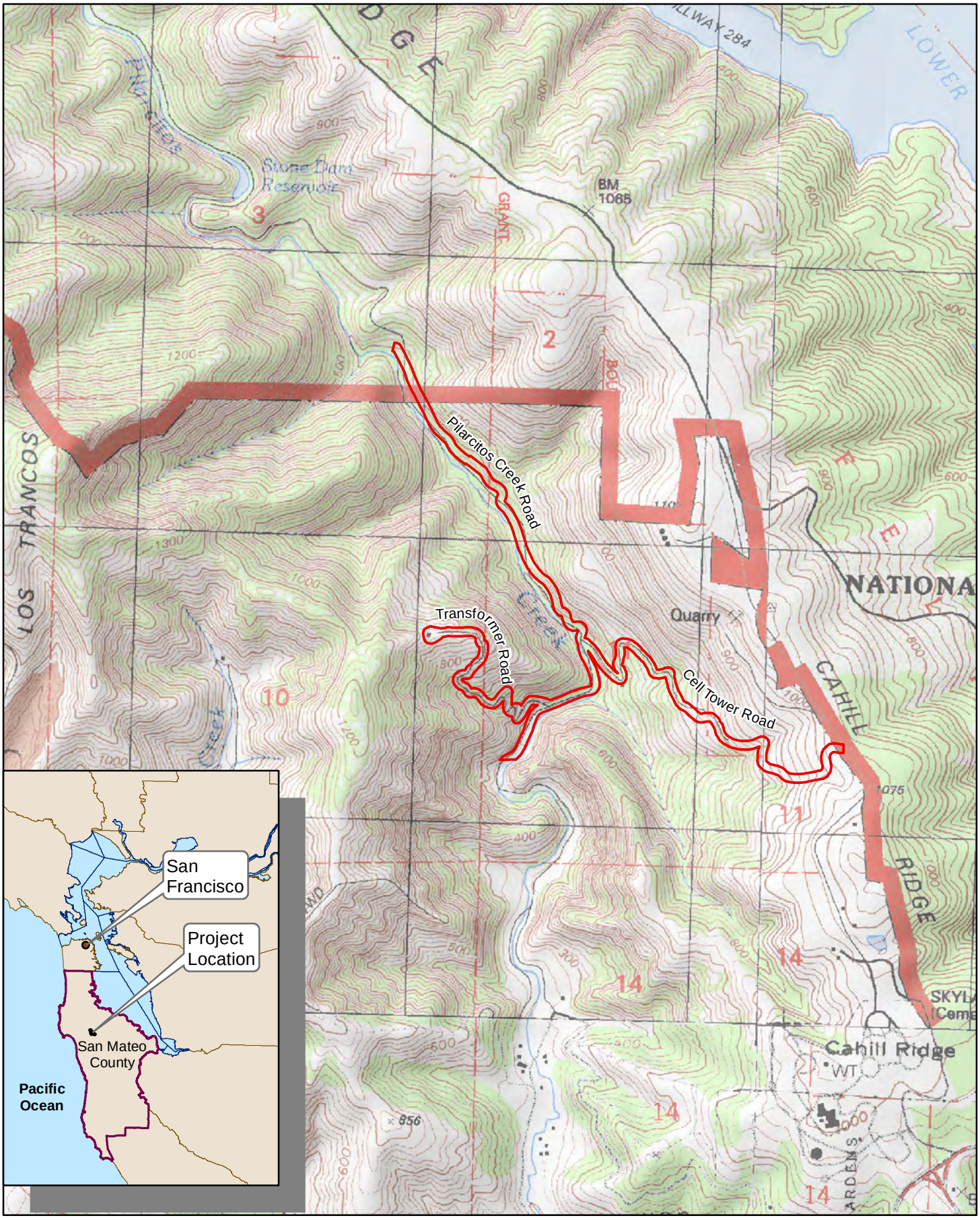
Coastside County Water District Property

Rural Roads Improvement Project

Half Moon Bay

San Mateo County

February 2016



Project Location

Area = 32.65 ac.

Figure 1. Project Location

Coastside County Water District Property Rural Roads Improvement Project

Montara Mountain and San Mateo USGS 7.5' quads Portion of Sections 3, 10 & 11, T5S, R5W MDBM

1 inch = 1,500 feet

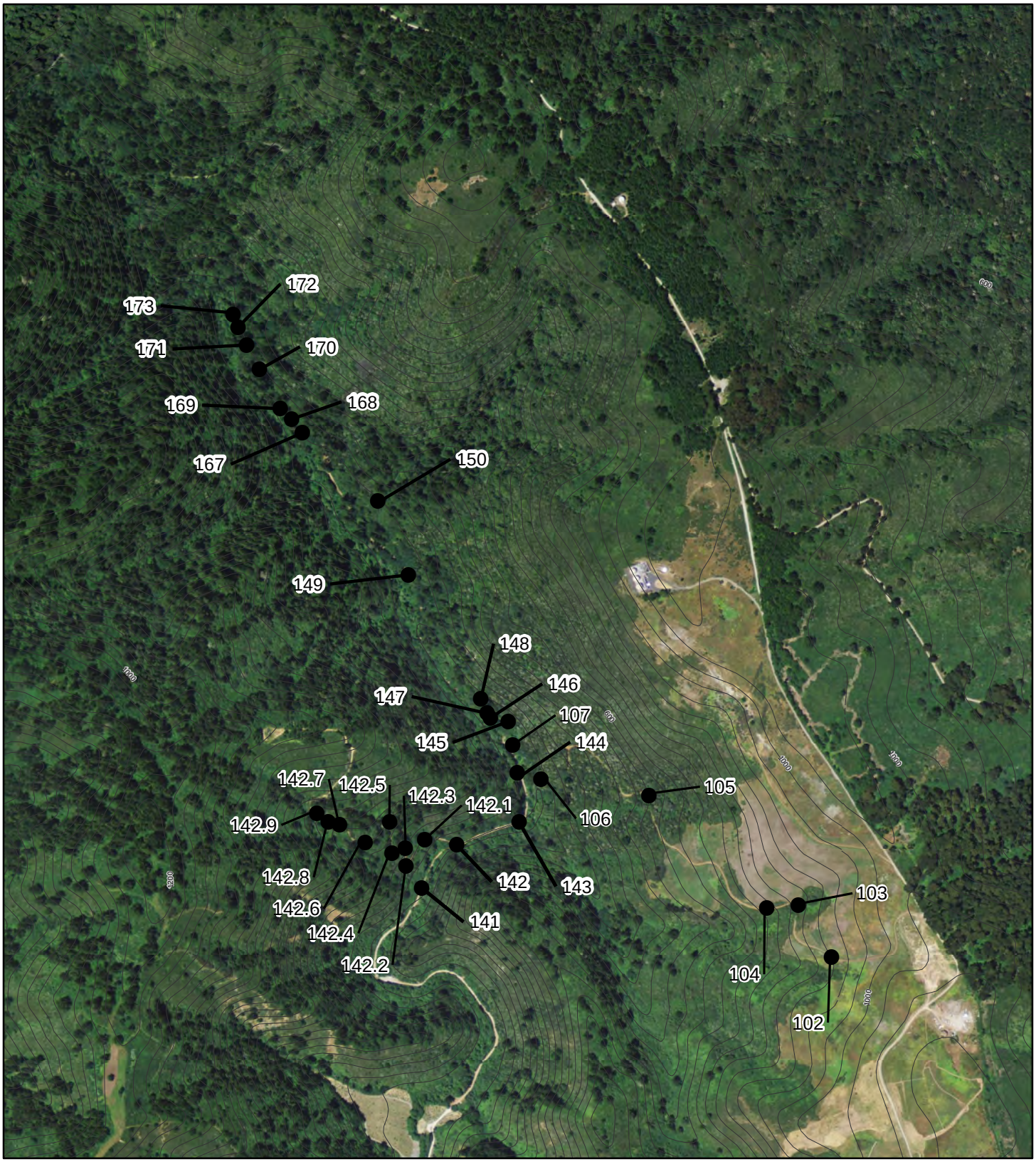


Figure 2. Proposed Treatment Site Locations

Coastside County Water District Property Rural Roads Improvement Project

1 inch = 1,000 feet

● Project Site Numbers

Aerial Phoyography by NAIP
40' Contours by NED

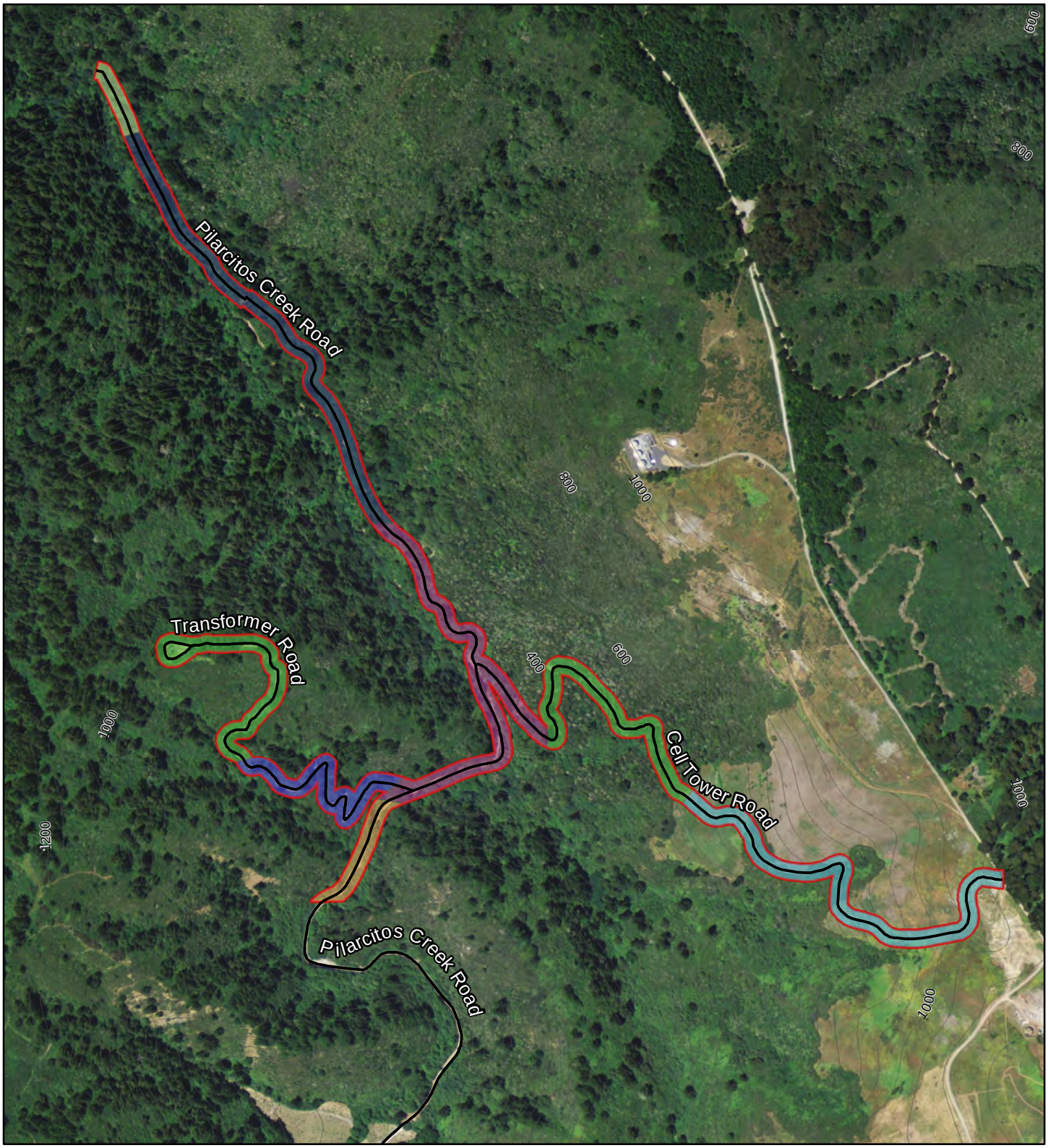


Figure 3. Vegetation Communities and Habitats

Coastside County Water District Property Rural Roads Improvement Project

- Project Area
- Roads
- Coast Redwood Forest
- Arroyo Willow Mixed Riparian Forest
- Sage Brush
- Annual Grassland
- Mixed Riparian/Coastal Scrub
- Coyote Brush
- Red Alder Mixed Riparian and Redwood Forest with Wetland Seep Inclusions

Aerial Photograph NAIP 2012
Contour Interval = 40'

1 inch = 83,333 feet

Table 4. Pilarcitos Creek Road Treatment Sites - Impacts to Waters of the State

Site No.	Feature Number	Proposed Treatment	Fill Type	Vegetation Removal (ft^2)	Fill Volume (CY)	Excavation Volume (CY)	Direct Permanent Impact (acre)	Direct Temporary Impact (acre)	Indirect Temporary Impact[1] (acre)	Impact Length (ft.)
141	Non-RPW-1, C-1	Culvert replacement	24" culvert & soil	10	18	18	0	0.0011	0	50
142	Non-RPW-2, C-2	None	No fill	0	0	0	0	0	0	0
143	RPW-1	Bank stabilization	Rock	5	25	22	0.0154	0.0001	0	56
144	RPW-1, C-3	Road shoulder and slope work	No fill	0	0	0	0	0	0	0
145	W-1	New culvert	No fill	0	0	0	0	0	*0.0022 w*	0
145	Non-RPW-5	New culvert	18" culvert & soil	5	12	12	0.0008	0	0	33
146	RPW-1	Culvert replacement	18" culvert & soil	5	12	12	0.0018	0	0	165
147	RPW-1	Bank stabilization	Rock	5	30	25	0.0186	0.0001	0	30
148	RPW-1	Bank stabilization	Rock	5	25	25	0.0154	0.0001	0	35
149	Non-RPW-3, C-4	Culvert replacement	18" culvert & soil	10	12	12	0	0.0030	0	54
150	Non-RPW-4, C-5	Culvert replacement & armoring	54" culvert & soil	10	80	75	0.0031	0.0103	0	52
167	Non-RPW-6, C-6	Culvert replacement & armoring	18" culvert, soil, rock	10	17	31	0.0062	0.0019	0	80
167	RPW-1	Armoring	Rock	10	10	10	0.0062	0	0	30
168	W-2	Road surface	No fill	0	0	0	0	0	*0.0131 w*	0

Site No.	Feature Number	Proposed Treatment	Fill Type	Vegetation Removal (ft^2)	Fill Volume (CY)	Excavation Volume (CY)	Direct Permanent Impact (acre)	Direct Temporary Impact (acre)	Indirect Temporary Impact[1] (acre)	Impact Length (ft.)
169	RPW-1	Bank stabilization	Rock	10	35	108	0.0217	0.0001	0	50
170	RPW-1	Road surface	No fill	0	0	0	0	0	0	0
171	RPW-1	Bank stabilization	Rock	5	25	72	0.0154	0.0001	0	75
172	RPW-1	Bank stabilization	Rock	5	10	41	0.0062	0.0001	0	30
173	RPW-1	Road surface	No fill	0	0	0	0	0	0	0
			TOTAL	**95**	**311**	**463**	**0.1108**	**0.0158**	**0.153**	**740**

w = wetland impact

[1] Indirect temporary impacts reflect construction work within a 25-foot buffer surrounding the proposed treatment site.

Table 5. Cell Tower Road Treatment Sites - Impacts to Waters of the State

Site No.	Feature Number	Proposed Treatment	Fill Type	Vegetation Removal (ft^2)	Fill Volume (CY)	Excavation Volume (CY)	Direct Permanent Impact (acre)	Direct Temporary Impact (acre)	Indirect Temporary Impact (acre)	Impact Length (ft)
102	Non-RPW-16, C-10	Culvert replacement & ditch relief	18" culvert & soil fill	0	24	12	0.0040	0.0005	0	191
103	Non-RPW-17, C-11	Culvert removal & armoring	Rock	0	15	12	0.0003	0.0011	0	30
104	Non-RPW-18, C-12	Culvert removal	Soil	0	6	6	0.0031	0	0	131
105	Non-RPW-22, C-16	Culvert clean	No fill	0	0	0	0	0	0	0
106	Non-RPW-15	New culvert	18" culvert & soil	10	12	12	0.0049	0	0	143
107	Non-RPW-15	Ditch relief	Soil	10	10	0	0.0052	0	0	150
			TOTAL	**20**	**67**	**42**	**0.0175**	**0.0016**	**0**	**645**

Table 6. Transformer Road Treatment Sites - Impacts to Waters of the State

Site No.	Feature Numbers	Proposed Treatments	Fill Type	Vegetation Removal (ft^2)	Fill Volume (CY)	Excavation Volume (CY)	Direct Permanent Impact (acre)	Direct Temporary Impact (acre)	Indirect Temporary Impact[1] (acre)	Impact Length (ft)
142.1	W-3	None	No fill	0	0	0	0	0	*0.0337 w*	0
142.1	Non-RPW-14, C-13	Culvert replacement & armoring	24" culvert, soil & rock	10	42	22	0.0124	0	0	90
142.2	Non-RPW-13	Ditch relief	Soil	0	18	74	0.0037	0	0	161
142.3	Non-RPW-12, C-14	Road surface	No fill	0	0	0	0	0	0	0
142.4	Non-RPW-11	Ditch relief	Soil	0	18	5	0	0.0043	0	189
142.5	Non-RPW-10	Road surface	No fill	0	0	0	0	0	0	0
142.6	Non-RPW-9, C-9	Road surface	No fill	0	0	0	0	0	0	0
142.7	Non-RPW-8, C-8	Remove culvert & ditch relief	Soil	0	24	6	0.0049	0	0	109
142.8	Non-RPW-8	Road surface	No fill	0	0	0	0	0	0	0
142.9	Non-RPW-7	Ditch relief	Soil	0	62	63	0.0046	0	0	200
			TOTAL	**10**	**164**	**170**	**0.0256**	**0.0043**	**0.0337**	**749**

w = wetland impact

[1] Indirect temporary impacts reflect construction work within a 25-foot buffer surrounding the proposed treatment site.

Table A-1. Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Pilarcitos Creek Road

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
140	Pilarcitos Mainstem	No treat	Stream crossing	4	0	0	Large box culvert (15'h x 12'w) on main Pilarcitos; abundant armor at both inlet and outlet. Approaches drain away from site. Future erosion from bank ravel around armor. Significant infrastructure around in vicinity. Turn around area to left of site.	No treatment.
141	Pilarcitos Mainstem	M	Stream crossing	6	0	45	Small seasonal stream crossing on streamside road adjacent to upper Pilarcitos Creek. Crossing is nearly 50' adjacent to creek and undersized. Culvert may plug frequently due to the dense vegetation around inlet and rock wall built up on inboard road. Possible diversion gully down left road.	1. Excavate current culvert and replace with a 24"x40' long pipe. 2. Rebuild fillslopes to 2:1. 3. Install a critical dip. 4. Cut back vegetation for 10' around new inlet.
142	Pilarcitos Mainstem	HM	Ditch relief culvert	40	200	0	This ditch relief culvert drains the RT 1 Road, a throughcut, very steep and poorly drained road constructed on unstable decomposed granitic rock. Some continued sediment delivery is likely even after any treatments due to local geology and land use patterns.	1. Outslope the road against the downslope cutbank. 2. Excavate a 3'w berm breech every 10' through the outsloped zone. Work spoils into road surface.

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
143	Pilarcitos Mainstem	ML	Bank erosion	26	0	50	Road is on cut side of Pilarcitos Creek about 10' above. Some large riprap has been placed around base of fillslope in the past and moderate vegetation is growing on fillslope plus an Alder. Additional riprap is required to ensure road does not fail into creek. Site may need to be diverted and electro fished before construction-contact CA Department of Fish and Wildlife (hours and cost not included).	1. Excavate a keyway 20'w x 10'l to creek and 3' into road surface. Haul spoils to RT #1 Road with loader and use to enhance outslope. 2. Armor entire bend and keyway with 25 yd^3 of 2'-5' riprap.
144	Pilarcitos Mainstem	ML	Stream crossing	79	290	0	Side by side 72" pipes on mainstem Pilarcitos Creek. Channel makes sharp turn to get into inlet. Crossing is very well armored with very little fill and dipped to reduce diversion potential. Drainage calculations call for bridge to replace the culverts, though bridge installation would prove difficult due to need to import significant amounts of fill to raise approaches. Abundant water supply infrastructure in the area complicates treatments.	1. Enhance critical dip along right hingeline. 2. Install 2 rolling dips up the left road approach. 3. Outslope road/fill ditch for 115' to the RT #2 Road intersection. 4. Outslope road/retain ditch for 150' between RT #2 Road and site 145. 5. Clean/cut ditch for 150' between RT #2 Road and site #145.
145	Pilarcitos Mainstem	M	Spring	26	0	0	Springy swale is saturating road fill causing a weak fillslope along an already wet streamside road. In addition mainstem Pilarcitos Creek makes a tight U-turn at base of fillslope at swale location. Road is ~50' above creek at this location. Spring flow travels down right and left road approaches. The left ditch flow stays contained but right may have caused a significant fillslope failure in the past. Future erosion determined from potential of road prism failure in swale.	1. Clean and cut the ditch for 30' around swale. 2. Install an 18"x40' long ditch relief culvert with outlet near large bay tree.

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
146	Pilarcitos Mainstem	M	Ditch relief culvert	46	125	0	Road drainage to plugged ditch relief culvert on inner gorge road. Gully has been exacerbated by stream flow at base. Suggest moving pipe location to avoid further erosion adjacent to site #147, a road fill landslide. Increased complexity due to electric and water utilities in the area (both underground).	1. Install 18" x 40' ditch relief culvert 30' to the left - place outlet on stable bank area away from the channel. 2. Outslope road and keep ditch for 125' left. 3. Install 1 rolling dip up left road. 4. Clean and cut ditch for 125' left road.
147	Pilarcitos Mainstem	M	Landslide	42	0	0	Small fill failure exacerbated by creek flow at base. Some armor has been placed in channel. This site may continue to erode despite treatment due to its location relative to creek and unstable nature of local soils and geology. No connected approaches.	1. Excavate 20 yd3 perched road fill (30'w x 10'l x 1.5'd) endhaul spoils to the right. 2. Place 30 yd3 2-3' riprap on outboard fill (in addition to existing 10 yd3). Key largest rocks at base.
148	Pilarcitos Mainstem	HM	Bank erosion	21	0	110	Mainstem Pilarcitos Creek makes a sharp turn 10' below road surface and is actively eroding 45' of bank below road. Road is narrow through active bank erosion and will likely continue to migrate into road area and loss of driving surface will occur.	1. Excavate a keyway (35'w x 10'l) and install 25 yd3 of 1'-4' riprap. Spoil with loader near meters to the left.
149	Pilarcitos Mainstem	L	Ditch relief culvert	21	0	370	Flat ditch relief culvert in very springy setting drains to densely vegetated flood plain of Pilarcitos Creek. Increased complexity due to subsurface utilities in the area.	1. Replace pipe at site with 18" x 30' ditch relief culvert. 2. Install 2 type I rolling dips up right road.

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
150	Pilarcitos Mainstem	M	Stream crossing	62	90	35	Stream crossing with water and electrical utilities visible in several places. Pipe replacement would be possible with care. Low gradient channel may potentially be viable fish habitat, though current culvert is clear barrier. Lower partially plugged 24" pipe and squashed/oval 30" pipe towards left hingeline. Crossing is within 100' of mainstem Pilarcitos Creek.	1. Excavate TOP to BOT; exercise extreme caution around utilities. Replace existing pipes with 54" x 40' culvert embedded at least 1' into the channel gravels. 2. Install a trash rack 4.5' above the pipe inlet. 3. Armor the inboard fillface with 5 yd3 .5-1.5' riprap. Note: stream may require dewatering if stream is live at time of construction.
167	Pilarcitos Mainstem	M	Ditch Relief Culvert	27	130	0	A small ditch relief culvert in a very springy swale drains the floodplain road along an unstable section of bank where the channel is scouring the base of the tread. A combination of bad drainage and overall non-ideal road location is in play here. Complexity increased due to CCWD infrastructure subsurface in the area and treatment immediacy lowered due to the likelihood of continued erosional issues in the area even post treatment. The springy swale above appears to have plastic gully repair. Future erosion estimate from bank eroding with contribution from ditch relief culvert pipe.	1. Excavate a 30'w x 3'd x 6'l section of unstable left bank. Labor time added to install temporary plywood silt fencing to protect Pilarcitos creek during excavation. Use excavated spoils for dip construction. 2. Place 20 yd3 3' riprap at top of channel/bottom of road. 3. Replace ditch relief culvert with 18" x 25' pipe. 4. Clean/cut ditch 80' left. 5. Construct one rolling dip up left road approach. 6. Re-rock approach.

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
168	Pilarcitos Mainstem	ML	Road surface	9	115	100	Road drainage from left and right approaches outlets onto flood plain. Only 60% of sediment likely to deliver. Outlet area brushy with large tree trunk 8' to the right outboard fill. 12" PVC utility on cutbank 35' to right and travels under road therefore increased complexity. Gullying on the outboard fill discharge area is insignificant; therefore future erosion is only from chronic delivery. Portions of left and right road approaches are through cut. Discharge point is currently 45' from stream.	1. Install 1 type II rolling dip left and one type II rolling dip right to drain road approaches. *Be careful of large water lines subsurface.
169	Pilarcitos Mainstem	M	Bank erosion	33	0	0	Mainstem Pilarcitos Creek is undermining the road, which is located inner gorge/flood plain and will represent an issue even post treatment due to its location. Increased complexity due to CCWD infrastructure in the vicinity. Decreased immediacy due to overall problematic location. Approaches appear to drain away on both sides.	1. Lay back perched fill along left bank to ~2:1 (or close) for 50'. Labor time added to install plywood silt fencing to protect Pilarcitos Creek during excavation activities. 2. Armor lower 1/2 outboard fill with approximately 35 yd3 2-3' riprap. 3. Consider willow mat or similar bioremediation for upper 1/2; at very least heavy seed/mulch. 4. Road can be moved in ~3' to accommodate bank layback. 5. Haul spoils to no-del location at

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
170	Pilarcitos Mainstem	L	Road surface	14	65	110	Left and right road approaches drain over outboard fill at this discharge point. Sediment delivers straight into a portion of Class I channel that is only active during higher flows and evidence shows it flowed recently. There is deposited road sediment and some standing water below the discharge point at the time of this survey. This sediment is likely a result of the recent work that was done up the right approach. This road reach is extremely close to the stream channel and any rolling dips installed may serve only as new road drainage discharge points to the stream.	1. Install 1 Type II rolling dip to right approach to drain the road into the vegetation above the creek. *Be careful of subsurface water utility likely present at this location.
171	Pilarcitos Mainstem	M	Bank erosion	44	0	155	Road directly next to Class I stream, lies along cutbank of stream causing bank erosion. Right road reach only delivers 50% due to shallow slope and ruts. Bank is oversteepened and hummocky. Some bedrock in channel below banks. 12" PVC waterline runs along the inboard road means increased complexity. Right road is wide and has wattles and silt fence from recent work, wattles also line the outboard road at this bank erosion site.	1. Excavate outboard fill to 1:1 along 75' of affected bank. Labor time added to install temporary plywood silt fence to protect Pilarcitos Creek during excavation activities. Endhaul spoils to tree farm area and be careful of water utility line. 2. Excavate keyway 1.5' deep in stream channel and armor with one layer of 3' armor (25 yd3). 3. Install one rolling dip up right approach; construct a 5'w x 5'l x 2'd sediment basin at the dip outlet. This feature will require ongoing maintenance. 4. Consider willow mats or other structures to add post-excavation stability.

Site #	Sub-watershed	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
172	Pilarcitos Mainstem	M	Landslide	34	0	0	Fill failure along inner gorge road with Pilarcitos mainstem undermining slope. Site is in zone of recent work by CCWD (appears to be above-ground re-route of water supply line) and spoils may have been added at road grade, increasing the weight on top of this potential failure. A recent cutbank slide to right intercepts road drainage (site #173). Overall location of road and unstable setting may lead to problems in the future despite treatment; this is reflected via lowered overall immediacy. Presence of CCWD infrastructure increases complexity.	1. Excavate ~41 yd3 of perched fill from outboard fill (30'w x 3'd x 10'l). 2. Armor the lowest 1/3 of slope (i.e. flow zone) with 10 yd3 3' diameter riprap. 3. Consider biostabilization (i.e. willow mattress) for upper 2/3 of excavated zone (at bare minimum seed and heavy mulch). Use spoils to create dip at left associated with site #171. Site will need to be dewatered during construction.
173	Pilarcitos Mainstem	M	Road Surface	15	0	155	Road drainage hits a recent cutbank slide with past delivery and gullies to Pilarcitos Creek - Mainstem. This site is within a zone of recent work, apparently to re-route a water supply pipeline above ground. It appears crews may have cut into the bank which triggered the slide. Creek below is undermining the base, and even after treatment this read may be problematic. Complex area due to steep terrain exposed utilities and proximity to creek.	1. Outslope road fill ditch 155' right. 2. Construct one rolling dip to the right.

Source: PWA (2013a)

Treatment immediacy ratings are abbreviated as follows: L= low, ML= moderate low, M= moderate, HM=high-moderate, H=high.

Table A-2. Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Cell Tower Road

Site #	Road Name	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
102	Randtron #2	H	Ditch Relief Culvert	15	1020	0	There is an 8' x 6' deep gully from the culvert outlet to a Class II stream below road. Large (1'-3') riprap has recently been placed in the gully to protect outboard fill below road, but the culvert is short and flat causing some undercutting at outlet, and fill directly adjacent to culvert outlet is vertical and bare. With >1,000' of road drainage to this one location, the drainage structure alone is not sufficient. If this much water continues to flow at this site the gully will likely expand and deliver sediment to system.	1. Install 3 rolling dips up the left road approach. 2. Install one 18" x 40' long ditch relief culvert up left road approach. 3. Outslope road and fill ditch for 175' up left road.
103	Randtron #2	L	Stream crossing	12	515	0	Stream crossing with dense shrubs and barbwire prohibiting thorough site investigation. Currently water can be seen going subsurface at evergreen tree and exiting downstream above road. There is no evidence for stream overtopping or diverting in the past, but if it did a gully would develop rapidly and cause much destruction.	1. Install an armored fill crossing: Create a broad dip through the axis of the stream lowering the outboard edge of the road 2' maximum to eliminate diversion potential. At the new outboard edge of the road, excavate a keyway 20' wide, tapering to 4' wide at the base of fill. Place 15 yd3 of 0.5'-1.5' riprap in keyway and the outer 1/3 of the roadbed. 2. Outslope road and fill ditch for 515' up left road. 3. Install 3 rolling dips up left road.

Site #	Road Name	Treatment immediacy	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
104	Randtron #2	HM	Ditch relief culvert	37	365	0	Small shotgunned culvert high in the fill drains insloped road. A 3' x 3' deep gully has formed below culvert outlet, though thick brush prevents accurate estimate of gully length. Due to steep terrain (~80% grade), it is reasonable to assume the gully may extend up to 250' and deliver to stream below. Road is currently being undercut by gully. Future erosion estimate based on continued expansion of gully width/depth.	1. Remove existing culvert. 2. Outslope road and fill ditch for 365' up left road and install 2 rolling dips. 3. Install 1 rolling dip 15' to the left of ditch relief culvert as to not direct flow to the current gully.
105	Randtron #2	L	Stream crossing	25	1165	0	Fairly large culvert in working condition. Brush, leaves, and forest litter have obscured and partially plugged culvert inlet though channel does not exhibit evidence of significant flow. Steep long road approach needs effective drainage, and culvert should be cleaned to decrease plugging and diversion potential.	1. Clean inlet of culvert. 2. Install a critical dip along the right hingeline. 3. Outslope road and fill ditch for 1,165' and install 7 rolling dips along left road.
106	Randtron #2	ML	Ditch relief culvert	0	1630	0	A 50% plugged ditch relief culvert drains an active spring on an inner gorge road. The culvert is currently placed 40' down the road from main hillside spring source. The fill in this area is very saturated and steep. If no treatments are made to site and long road approach, sediment delivery to Class I is likely to occur.	1. Install an 18" x 40' long ditch relief culvert to drain springy area. Leave current culvert and 40' of inboard ditch. 2. Outslope road and fill ditch for 1,630' along left approach and construct 9 rolling dips.
107	Randtron #2	ML	Road surface discharge point	0	150	0	Road drainage from Randtron #2 Road discharges onto main inner gorge road and into Class I stream. Attempts to reduce erosion by filling in gully with road rock have been unsuccessful.	1. Outslope road and fill ditch for 150' up Randtron #2 road and construct 1 rolling dip 75' up from gate.

[a] Field observations and treatment recommendations were taken from 2011 field work and reporting. Field verification was not conducted prior to this memo; conditions might have changed.

[b] Treatment immediacy ratings are abbreviated as follows: L= low, ML= moderate low, M= moderate, HM=high-moderate, H=high.

Table A-3. Field Observations and Proposed Treatments for Road-Related Sediment Delivery Sites on Transformer Road

Site #	Sub-watershed	Treatment immediacy[a]	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
142.1	Pilarcitos Mainstem	HM	Stream crossing	118	0	250	Undersized culvert set flat and high in the fill. Culvert is installed like a ditch relief culvert but a small stream morphology is apparent above. This may be the result of the road drainage discharge higher up the road (being extremely steep and largely throughcut), as well as built on unstable granite soils. This road will likely continue to be problematic even after treatments, especially because the switchback portion will likely drain back on itself.	1. Excavate from TOP to BOT and replace with a 24" x 50' long culvert. 2. Install a critical dip on left hingeline. 3. Armor entire outboard fillslope with 20 yd3 of 0.5'-2' riprap. 4. Outslope right approach for 250'. 5. Construct 2 rolling dips up the right road approach. 6. Remove any outboard berm along right approach for 250'.
142.2	Pilarcitos Mainstem	HM	Ditch	176	0	750	Approximately 180' ditch drains to this discharge point. This site also amounts for the full 1000' of road reach that passed other sites, though treatments are only for 250'. Future erosion from gully development down from discharge point and from perched fill that was pushed out into large outboard berm.	1. Excavate 74 yd3 of perched fill along outboard fillslope of switchback (28' x 12' x 5'). Work spoils into road surface- use to enhance outslope. 2. Outslope and remove ditch for 250' right. 3. Remove berm with 3' x 3' berm breaches every 30' for 250' on right approach.

Site #	Sub-watershed	Treatment immediacy[a]	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
142.3	Pilarcitos Mainstem	HM	Landslide	31	0	80	Perched fill on outer portion of switchback turn on very steep, mostly throughcut section of extremely steep road constructed on unstable granitic soils. Small culvert drains short, grassy ditch and is not really a problem. Perched, unstable fill is the main issue here.	1. Pull 100 yd3 from outboard fillslope and spoil on road surface to enhance outslope.
142.4	Pilarcitos Mainstem	HM	Ditch	12	0	240	Discharge point collects ditch only and diverges from the road. Road surface passes this site and continues to the next site, so only the ditch is accounted for in this site. Treatments for the road still included here. Future erosion is from chronic ditch erosion and gully enlargement. Brush heavily grown over at discharge point, making estimate difficult.	1. Outslope road for 240' right. 2. Install 3' x 3' berm breaches every 30' for 240' along right approach.
142.5	Pilarcitos Mainstem	HM	Road surface	55	0	500	Very steep ditch (road surface drainage bypasses this switchback and delivers below), has resulted in gully down outboard fillslope which is partially lost in the brush but likely connects with stream below. Road is aggressively steep and through cut and located on unstable granitic soil.	1. Outslope road for 500' right. 2. Breach berm 3'w every 30' through outsloped section.

Site #	Sub-watershed	Treatment immediacy[a]	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
142.6	Pilarcitos Mainstem	HM	Landslide	38	0	0	Perched fill along the outboard edge of very steep, largely throughcut road on unstable decomposed granitic soils. Road requires frequent maintenance and will likely still exhibit some amount of sediment delivery even after treatments. Road approach flows past this failure to delivery point further down.	1. Pull 40' wide x 4.5' deep x 8' long section of perched fill and store spoils on roadbed to enhance outslope.
142.7	Pilarcitos Mainstem	HM	Ditch relief culvert	61	0	250	Ditch relief culvert inlet surrounded and protected by concrete blocks. Waterbar beside culvert gathers flow from road surface. Ditch and road surface gully directed into culvert inlet. Future erosion is based on road lowering plus gully incision on road plus potential gully development at ditch relief culvert outlet.	1. Excavate and remove ditch relief culvert. 2. Outslope and remove ditch for 250' of right approach. 3. Install 3' x 3' berm breaches every 30' right.
142.8	Pilarcitos Mainstem	M	Landslide	57	0	0	Road fill pushed to the outboard road has created a section of oversteepened slope (potential landslide). Some portions have already slumped down, but a larger scale slide remains possible and likely. The fill is mounded up and not compacted.	1. Excavate oversteepened fill 22'wide x 5'deep x 12' long or as long as can be reached with excavator. 2. Spoil against cutbank and along road for outsloping left called for on Site #142.8.

Site #	Sub-watershed	Treatment immediacy[a]	Problem	Estimated future sediment delivery (yd^3)	Hydrologically connected road length (road/ditch/cutbank)		Comment on problem	Recommended treatments
					Left (ft)	Right (ft)		
142.9	Pilarcitos Mainstem	HM	Ditch relief culvert	192	0	750	Very steep tower access road in decomposed granitic material largely throughcut. Ditch relief culvert is barely functional. Inboard ditch up steep approach is above the level of the road surface in places. Ditch creates depositional fan just to the right of the site. Frequent maintenance required on this road with significant sidecasting in places up approach. The treatment will likely not result in full hydrological disconnection, but will help. A small but functional dip helps break flow up by tower. Future erosion from perched fill failing and gully development below ditch relief culvert.	1. Outslope and remove ditch at 6% from site to tower. 2. Construct 3' x 3' berm breach every 30' to drain road. 3. At site pull 40' wide x 3' deep x 11' long section of perched fill and uses to enhance outslope on road surface. 4. Remove ditch relief culvert at site.

[a] Treatment immediacy ratings are abbreviated as follows: L= low, ML= moderate low, M= moderate, HM=high-moderate, H=high.

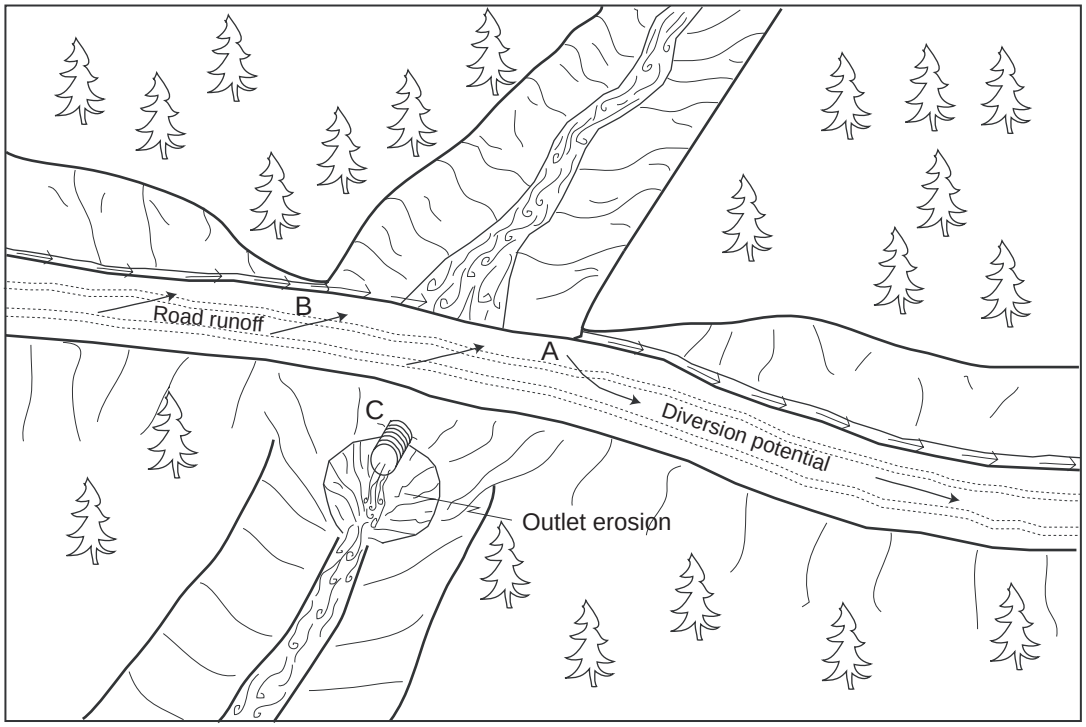
Typical Problems and Applied Treatments for a Non-fish Bearing Upgraded Stream Crossing

Problem condition (before)

A - Diversion potential

B - Road surface and ditch drain to stream

C - Undersized culvert high in fill with outlet erosion

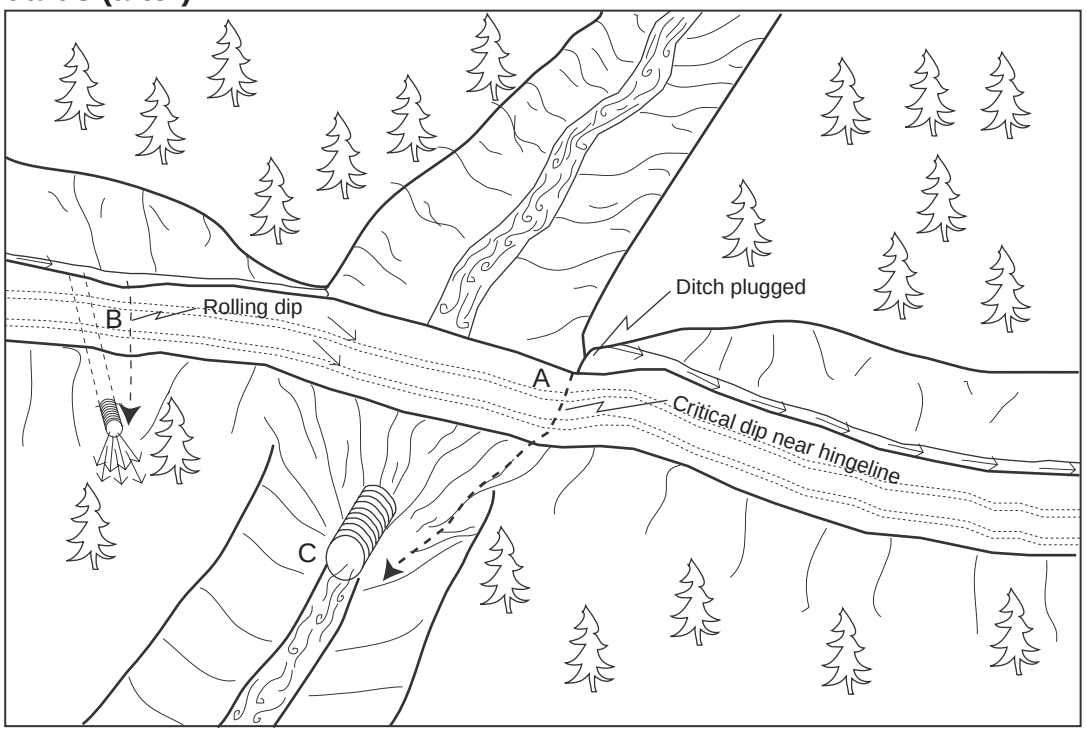


Treatment standards (after)

A - No diversion potential with critical dip installed near hingeline

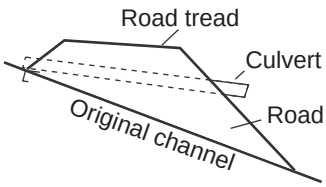
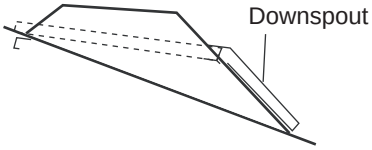
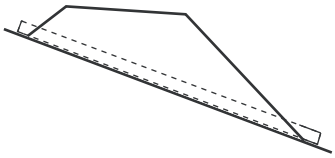
B - Road surface and ditch disconnected from stream by rolling dip and ditch relief culvert

C - 100-year culvert set at base of fill

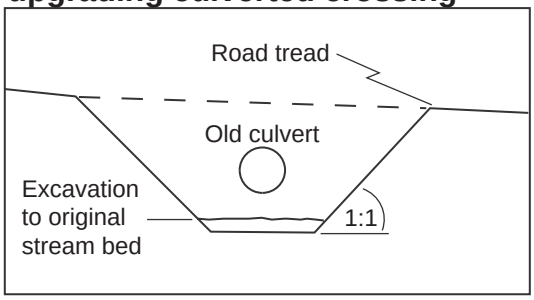


Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

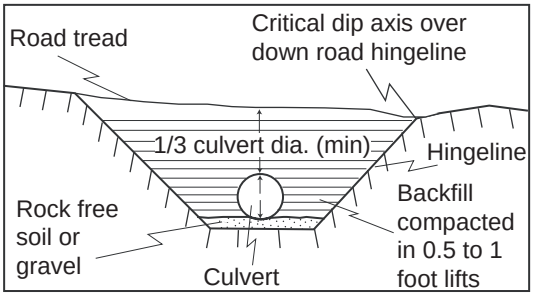
Typical Design of a Non-fish Bearing Culverted Stream Crossing

Existing	Upgraded	Upgraded (preferred)
		
1. Culvert not placed at channel grade. 2. culvert does not extend past base of fill.	1. Culvert not placed at channel grade. 2. Downspout added to extend outlet past road fill.	1. Culvert placed at channel grade. 2. Culvert inlet and outlet rest on, or partially in, the originial streambed.

Excavation in preparation for upgrading culverted crossing



Upgraded stream crossing culvert installation



Note:
Road upgrading tasks typically include upgrading stream crossings by installing larger culverts and inlet protection (trash barriers) to prevent plugging. Culvert sizing for the 100-year peak storm flow should be determined by both field observation and calulations using a procedure such as the Rational Formula.

Stream crossing culvert Installation

1. Culverts shall be aligned with natural stream channels to ensure proper function, and prevent bank erosion and plugging by debris.
2. Culverts shall be placed at the base of the fill and the grade of the original streambed, or downspouted past the base of the fill.
3. Culverts shall be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
5. To allow for sagging after burial, a camber shall be between 1.5 to 3 incher per 10 feet culvert pipe length.
6. Backfill material shall be free of rocks, limbs or other debris that could dent or puncture the pipe or allow water to seep around pipe.
7. First one end then the other end of the culvert shall be covered and secured.;The center is covered last.
8. Backfill material shall be tamped and compacted throughout the entire process:
   - Base and side wall material will be compacted before the pipe is placed in its bed.
   - Backfill compacting will be done in 0.5 - 1 foot lifts until 1/3 of the diameter of the culvert has been covered. A gas powered tamper can be used for this work.
9. Inlets and outlets shall be armored with rock or mulched and seeded with grass as needed.
10. Trash protectors shall be installed just upstream from the culvert where there is a hazard of floating debris plugging the culvert.
11. Layers of fill will be pushed over the crossing until the final designed road grade is achieved, at a minimum of 1/3 to 1/2 the culvert diameter.

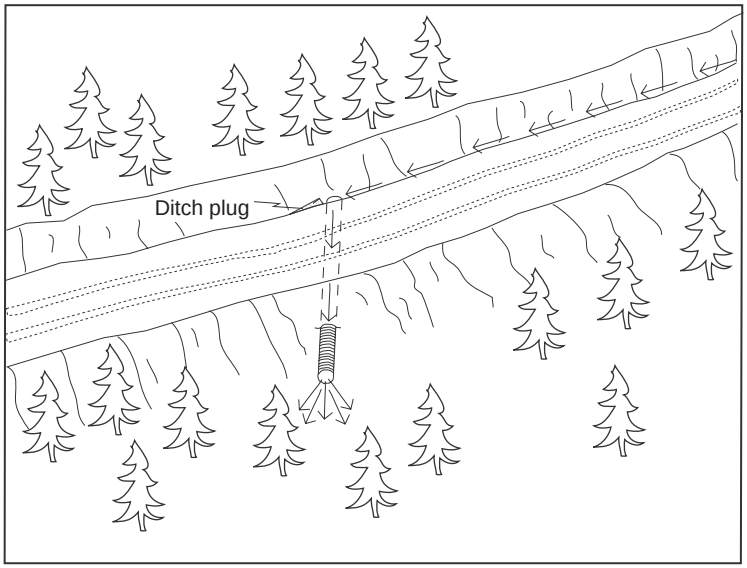
Erosion control measures for culvert replacement

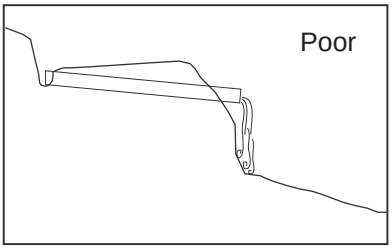
Both mechanical and vegetative measures will be employed to minimize accelerated erosion from stream crossing and ditch relief culvert upgrading. Erosion control measures implemented will be evaluated on a site by site basis. Erosion control measures include but are not limited to:

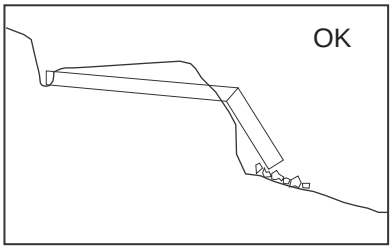
1. Minimizing soil exposure by limiting excavation areas and heavy equipment distrubance.
2. Installing filter windrows of slash at the base of the road fill to minimize the movement of eroded soil to downslope areas and stream channels.
3. Retaining rooted trees and shrubs at the base of the fill as “anchor” for the fill and filter windrows.
4. Bare slopes created by construction operations will be protected until vegetation can stabilize the surface. Surface erosion on exposed cuts and fills will be minimized by mulching, seeding, planting, compacting, armoring, and/or benching prior to the first rains.
5. Excess or unusable soil will be stored in long term spoil disposal locations that are not limited by factors such as excessive moisture, steep slopes greater than 10%, archeology potential, or proximity to a watercourse.
6. On running streams, water will be pumped or diverted past the crossing and into the downstream channel during the construction process.
7. Straw bales and/or silt fencing will be employed where necessary to control runoff within the construction zone.

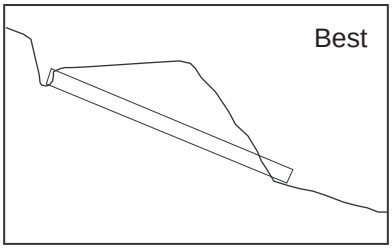
Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Typical Ditch Relief Culvert Installation







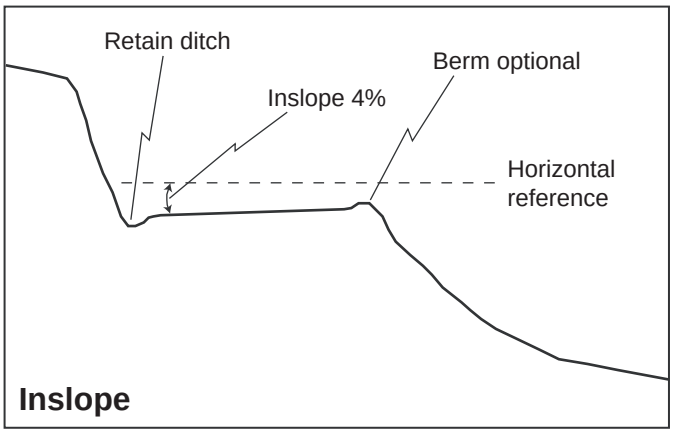


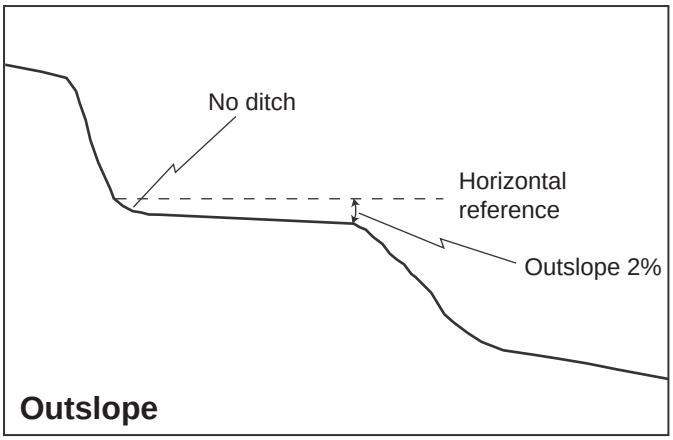
Ditch relief culvert installation

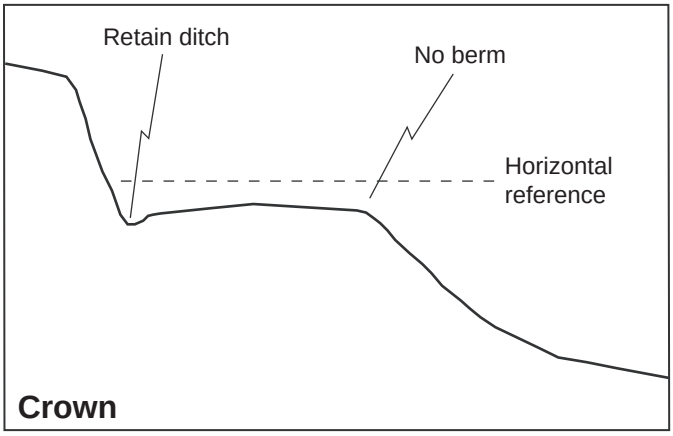
1) The same basic steps followed for stream crossing installation shall be employed.
2) Culverts shall be installed at a 30 degree angle to the ditch to lessen the chance of inlet erosion and plugging.
3) Culverts shall be seated on the natural slope or at a minimum depth of 5 feet at the outside edge of the road, whichever is less.
4) At a minimum, culverts shall be installed at a slope of 2 to 4 percent steeper than the approaching ditch grade, or at least 5 inches every 10 feet.
5) Backfill shall be compacted from the bed to a depth of 1 foot or 1/3 of the culvert diameter, which ever is greater, over the top of the culvert.
6) Culvert outlets shall extend beyond the base of the road fill (or a flume downspout will be used). Culverts will be seated on the natural slope or at a depth of 5 feet at the outside edge of the road, whichever is less.

Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Typical Designs for Using Road Shape to Control Road Runoff





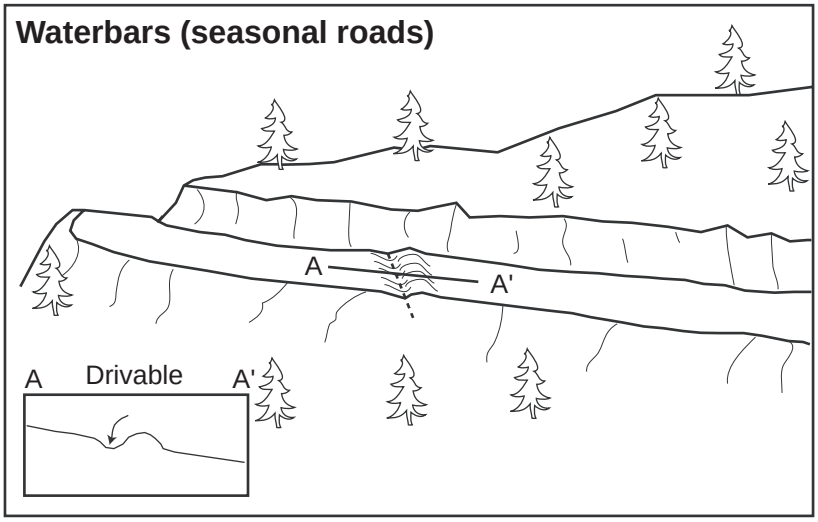


Outsloping Pitch for Roads Up to 8% Grade		
Road grade	**Unsurfaced roads**	**Surfaced roads**
4% or less	3/8" per foot	1/2" per foot
5%	1/2" per foot	5/8" per foot
6%	5/8" per foot	3/4" per foot
7%	3/4" per foot	7/8" per foot
8% or more	1" per foot	1 1/4" per foot

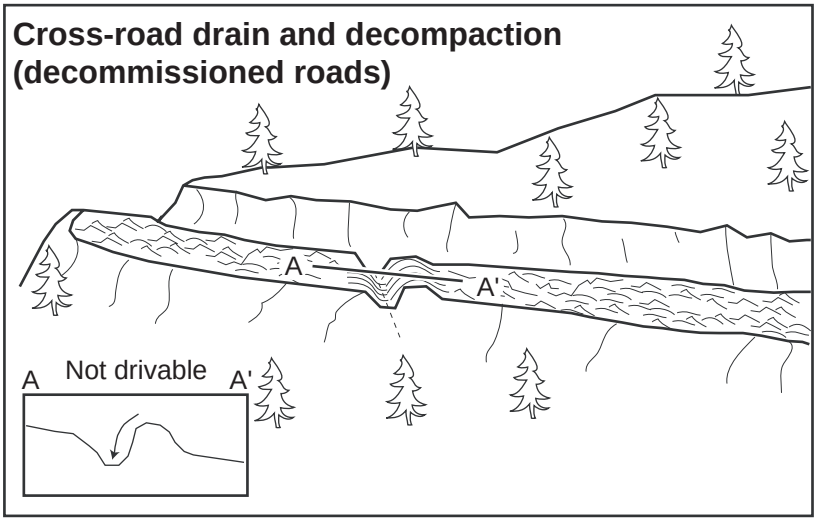
Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Typical Methods for Dispersing Road Surface Runoff with Waterbars, Cross-road Drains, and Rolling Dips

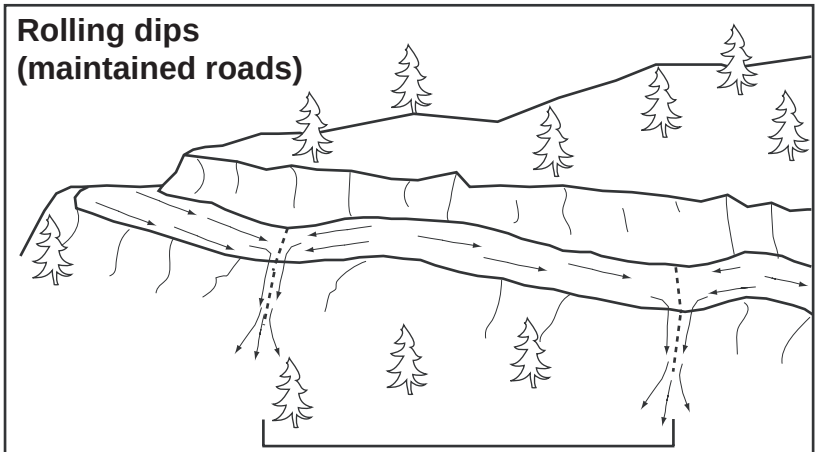
Waterbars (seasonal roads)



Cross-road drain and decompaction (decommissioned roads)

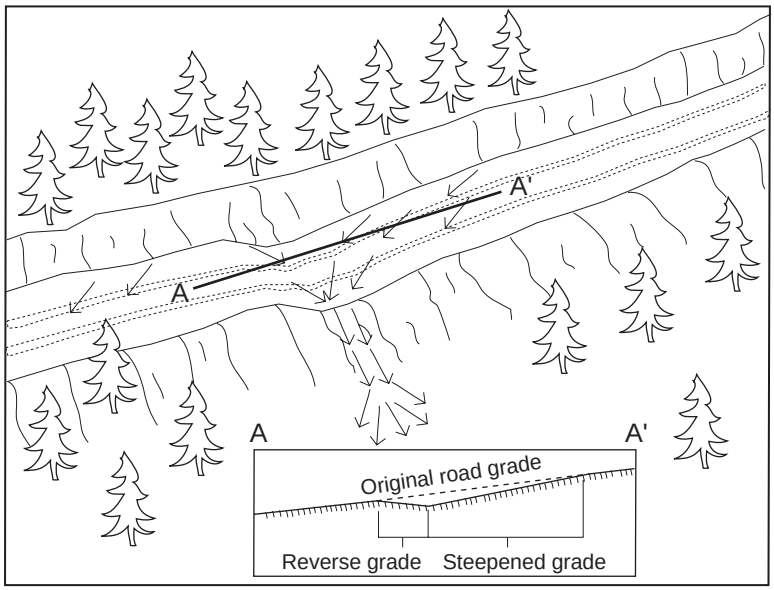


Rolling dips (maintained roads)



Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Typical Road Surface Drainage by Rolling Dips



Rolling dip installation:

1. Rolling dips will be installed in the roadbed as needed to drain the road surface.
2. Rolling dips will be sloped either into the ditch or to the outside of the road edge as required to properly drain the road.
3. Rolling dips are usually built at 30 to 45 degree angles to the road alignment with cross road grade of at least 1% greater than the grade of the road.
4. Excavation for the dips will be done with a medium-size bulldozer or similar equipment.
5. Excavation of the dips will begin 50 to 100 feet up road from where the axis of the dip is planned as per guidelines established in the rolling dip dimensions table.
6. Material will be progressively excavated from the roadbed, steepening the grade unitl the axis is reached.
7. The depth of the dip will be determined by the grade of the road (see table below).
8. On the down road side of the rolling dip axis, a grade change will be installed to prevent the runoff from continuing down the road (see figure above).
9. The rise in the reverse grade will be carried for about 10 to 20 feet and then return to the original slope.
10. The transition from axis to bottom, through rising grade to falling grade, will be in a road distance of at least 15 to 30 feet.

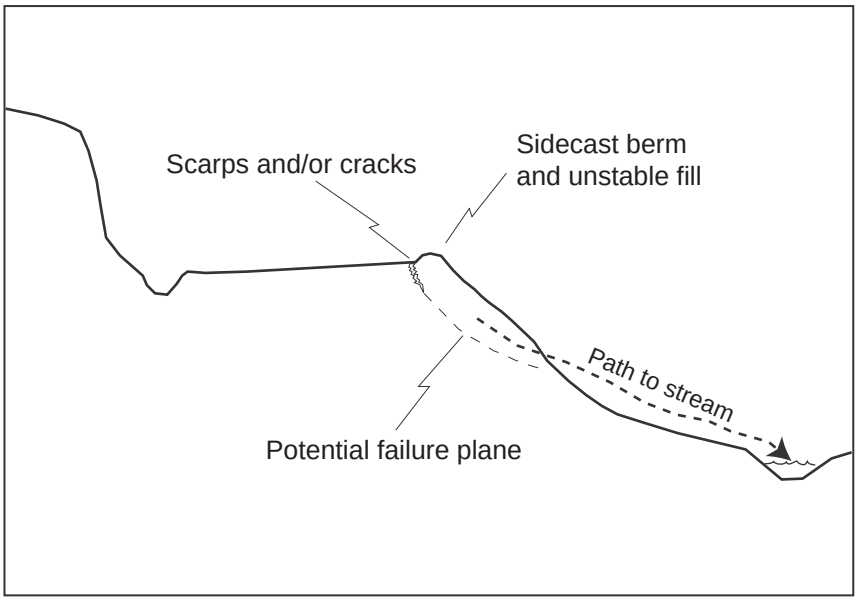
Table of rolling dip dimensions by road grade

Road grade %	**Upslope approach distance** (from up road start to trough) ft	**Reverse grade distance** (from trough to crest) ft	**Depth at trough outlet** (below average road grade) ft	**Depth at trough inlet** (below average road grade) ft
<6	55	15 - 20	0.9	0.3
8	65	15 - 20	1.0	0.2
10	75	15 - 20	1.1	0.01
12	85	20 - 25	1.2	0.01
>12	100	20 - 25	1.3	0.01

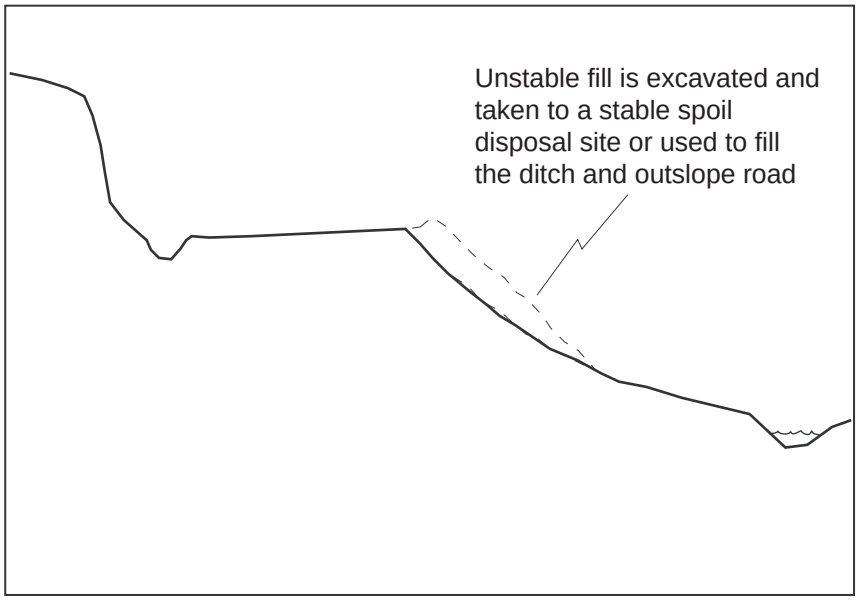
Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Typical Excavation of Unstable Fillslope on an Upgraded Road

Before

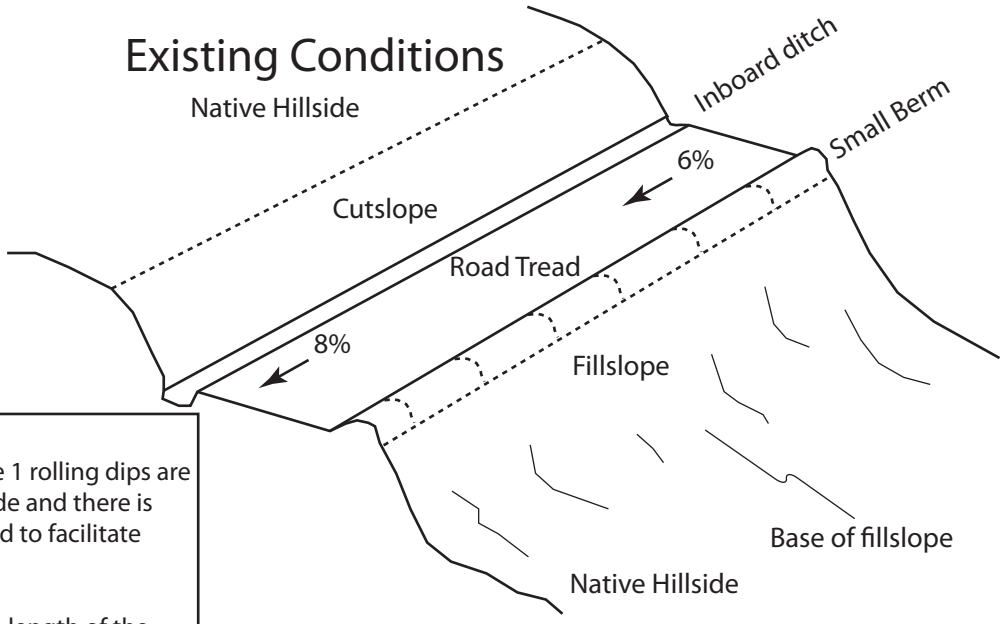


After



Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 2070, Petaluma, CA 94953 / Ph: 707-773-1385 / Fax: 707-773-1451 / www.pacificwatershed.com

Standard (Type 1) Rolling Dip Construction



Notes

Rolling dip type 1 existing conditions: Type 1 rolling dips are utilized when roads are less than 12-14% grade and there is proximal outfall adjacent to the outboard road to facilitate road drainage.

Design Notes:

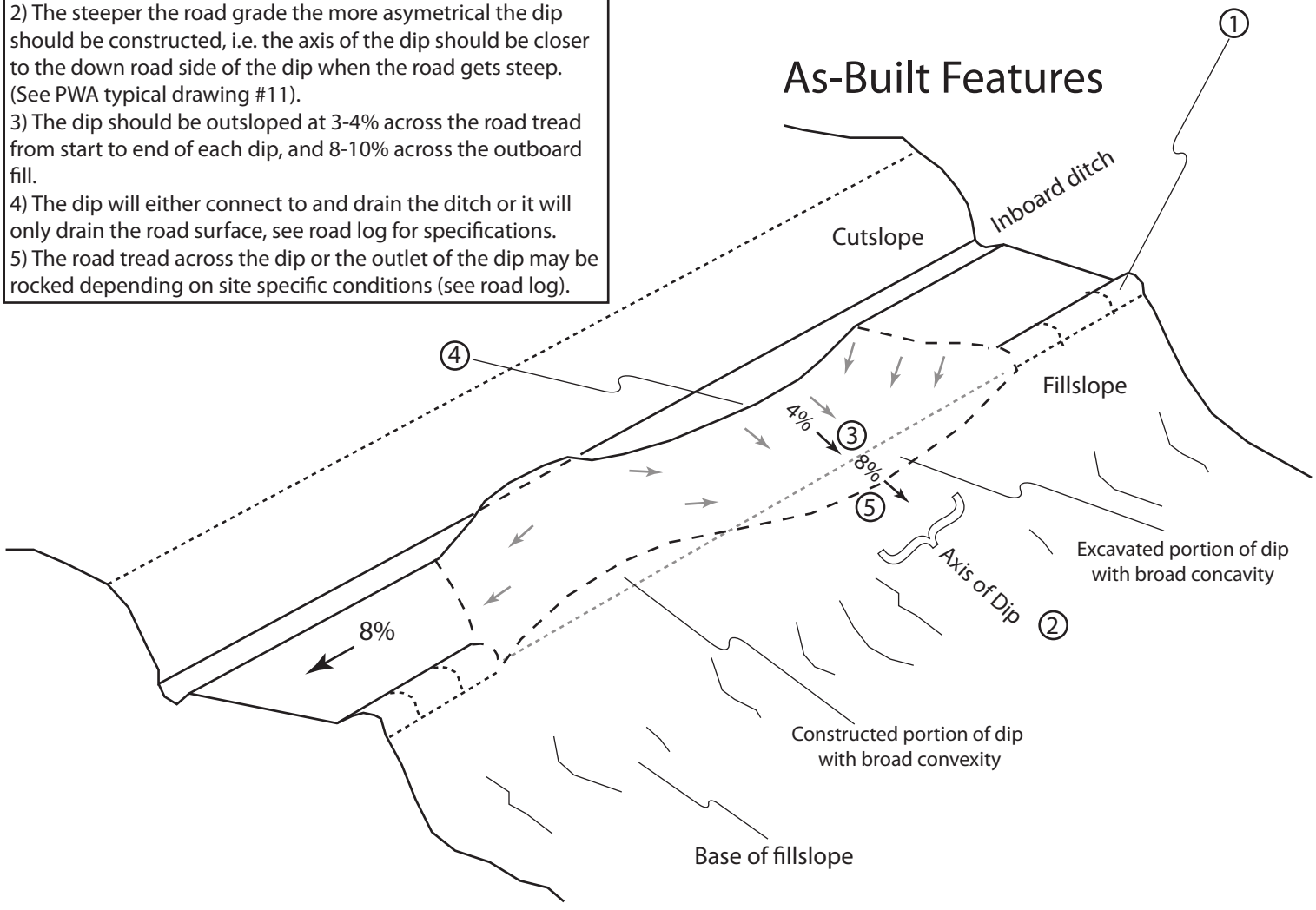
1) The berm should be removed for the entire length of the dip.

2) The steeper the road grade the more asymetrical the dip should be constructed, i.e. the axis of the dip should be closer to the down road side of the dip when the road gets steep. (See PWA typical drawing #11).

3) The dip should be outsloped at 3-4% across the road tread from start to end of each dip, and 8-10% across the outboard fill.

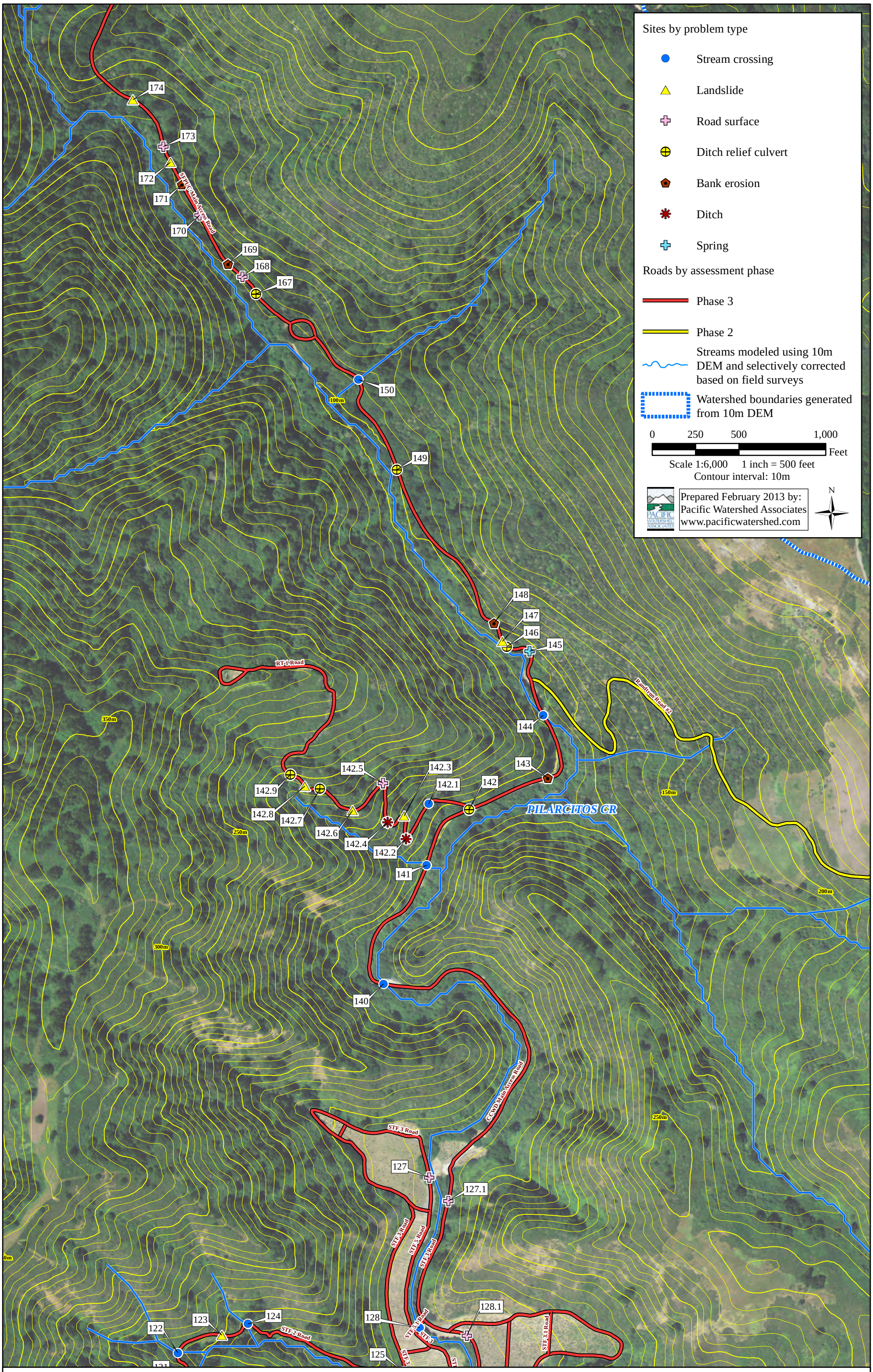
4) The dip will either connect to and drain the ditch or it will only drain the road surface, see road log for specifications.

5) The road tread across the dip or the outlet of the dip may be rocked depending on site specific conditions (see road log).

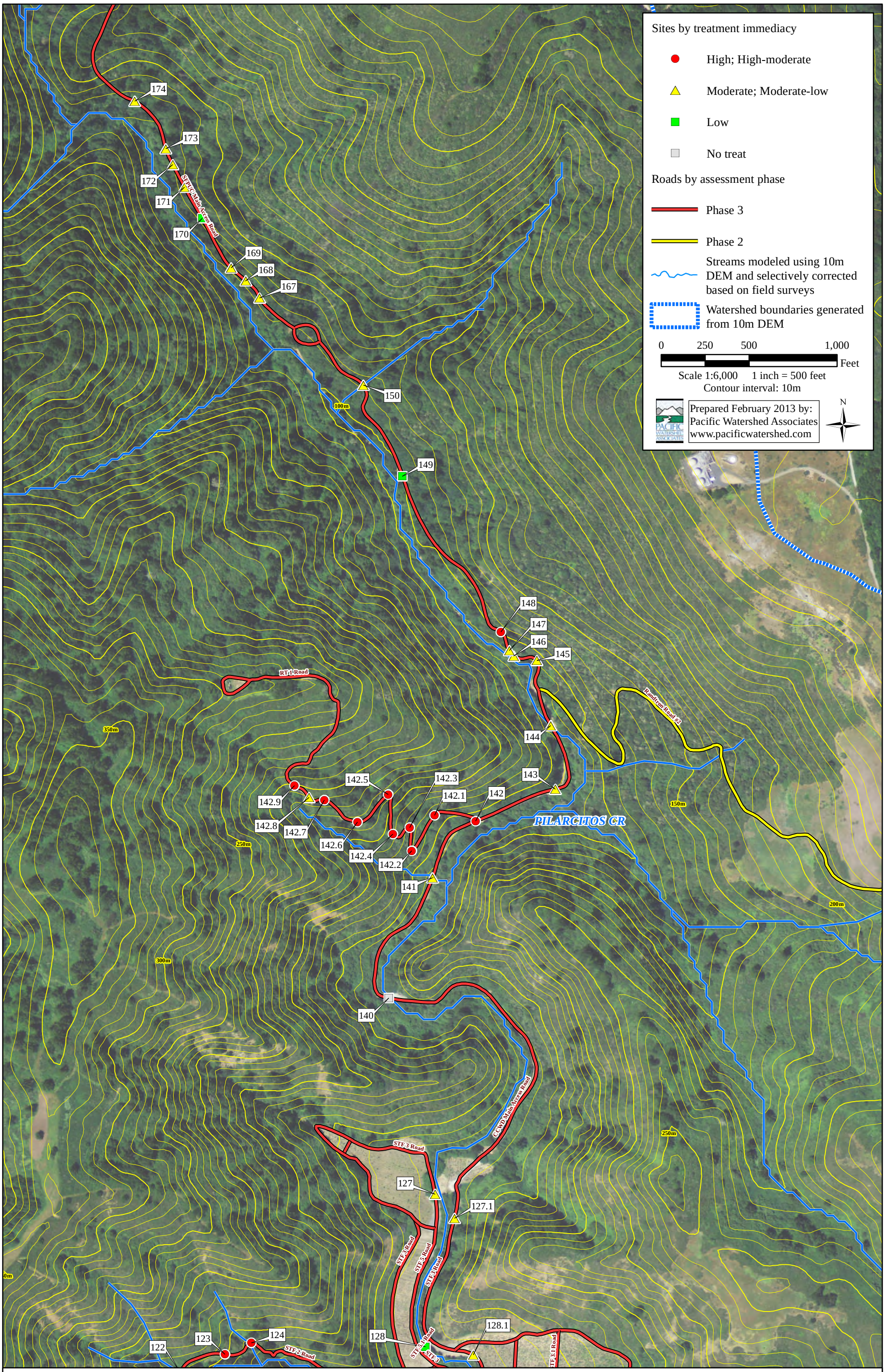


Pacific Watershed Associates Inc.
Geologic and Geomorphic Studies • Watershed Restoration • Wildland Hydrology • Erosion Control • Environmental Services
PO Box 4433, Arcata, CA 95518 / Ph: 707-839-5130 / FAX: 707-839-8168 / www.pacificwatershed.com

PWA Typical Drawing #19a



Map 1. Inventoried sites by problem type, Pilarcitos and Frenchman's Creek Watersheds Phase 3 Road Assessment, San Mateo County, California.



Map 2. Inventoried sites by treatment immediacy, Pilarcitos and Frenchman's Creek Watersheds Phase 3 Road Assessment, San Mateo County, California.

Map 2a. Types of inventoried sediment delivery sites in the northeast project area, Pilarcitos Creek Watershed Road Assessment, Phase 2, San Mateo County, California.

Map 2b. Treatment immediacies for inventoried sites in the northeast project area, Pilarcitos Creek Watershed Road Assessment, Phase 2, San Mateo County, California.