Date: August 11, 2015

To: Don Harris, Treasurer
Nash Ranch Road Association,
Board Members
Nash Ranch Road Association

From: Colin Hughes, PG# 8549
Pacific Watershed Associates
PO Box 4433
Arcata, CA 95518

Design Basis and Plan Description Memorandum for the Martinez Crossing Design, Mendocino County, California.

This memorandum presents the design basis and plan description for a proposed upgrade to the crossing of Wallace Creek on Nash Mill Road (hereinafter referred to as "Martinez Crossing") on Mendocino County Assessor's parcel numbers 026-280-49 (owner: Martinez) and 026-280-33 (owner: Lineck), as shown on Figure 1: Location Map and Plan View. Parcel number 026-280-50 (owner: Hunter Ruffler Trust) will also be affected by implementation of this design plan in the vicinity of the gated access road (see Figure 1). The design parameters are based on the relevant portions of the California Department of Fish and Wildlife (CDFW) Salmonid Stream Habitat Restoration Manual and the Handbook for Forest, Ranch and Rural Roads (Weaver, Weppner and Hagans, 2015), funded by California State Water Resources Control Board (SWRCB) and CalFire and published by the Mendocino County Resource Conservation District (MCRCD).

Site Location

The site lies about 4.65 miles northwest of Philo, California. The site can be accessed from Boonville by driving west on California Highway 128 (Oat Valley Road) about 10.25 miles, turning north onto Nash Mill Road and proceeding about 0.2 miles to the site location at the first major stream crossing on Nash Mill Road (Figure 1). It is located in Township 15 North, Range 15 West, Section 34, Mount Diablo Meridian.

Site Characterization

Pacific Watershed Associates, Inc. (PWA) staff inspected the non-fish bearing stream crossing and affected channel reaches with Nash Ranch Road Association (NRRA) board members to identify fluvial and geomorphic features and characteristics of the existing native and affected channel reaches and evaluate the stream crossing fill. A longitudinal profile and multiple cross sections along the interpreted natural channel alignment was taken with tape measure, laser range finder, and clinometer. This survey was used to create the design plan and utilized to create the design excavation plan figures and estimate volumes of material for all design plan elements. Additionally, 1952 historical aerial photographs located at the California Geological Survey office in Santa Rosa, California, were inspected in stereo to characterize the historical effects of stream crossing emplacement on the upstream channel reach of Wallace Creek.

The stream crossing at the site was first installed in the 1950s or earlier, and was observed to be in-place on historical aerial photographs taken in 1952. The crossing flow conveyance structure has likely been replaced at least once since its original installation. The existing culvert has been installed with both the inlet and outlet set high in the fill and with the inlet skewed to the east of the historic channel alignment to allow for a shorter length of culvert to be installed perpendicular to the roadway

(Figure 1, Photo 1). Woody debris can be seen to be emplaced within the earthen crossing fill from the downstream side where the outboard fillslope has been partly washed away from splash zone erosion at the culvert outlet. The culvert is observed to be deformed from vertical pressures and is partially squashed, reducing the hydraulic capacity of the culvert (Figure 1, Photo 2). The culvert inlet was measured to be 66 inches in width and 50 inches in height. Based on observable deformation in the middle of the culvert from the interior, it is interpreted that the outboard half of the culverted fill likely slumped in the past during a period of saturation or leakage and partially sheared the culvert, separating some of the culvert plating. This sheared section of culvert was later repaired by local landowners by patching with cast-in-place concrete. Repairs by addition of cast-in-place concrete around the culvert inlet at the inboard fill face were also observed and were likely required due to surface water infiltrating the stream crossing fill via soil piping, preferential stream flowpaths developed through erosion of the crossing fill and/or decomposition of organic materials.

Because the existing culvert has been installed in the stream crossing with an inlet elevation higher than the natural stream base level, thousands of cubic yards of transported sediment has aggraded in the channel over a length of approximately 750 linear ft upstream of the culvert inlet (Figure 2a). Due to the aggradation of such a large quantity of sediment, surface flow is generally not present during low flow periods, and is absorbed into the wedge of channel stored sediments. A meandering and moderately dissected channel is present across the affected channel reach and is occupied by surface flows during periods where stream flow is greater than the capacity for infiltration. Within the vicinity of the culvert inlet, several soil pipes have developed in the stream channel where surface flow is preferentially flowing into the visible voids and into the crossing fill. Sheet plastic has been installed in the streambed by local landowners in an attempt to prevent surface flows from entering these soil pipes and further destabilizing the stream crossing fill. Water stored in the aggraded sediment wedge above the culvert inlet certainly drains to and through these subsurface flowpaths as well.

Utilizing the methodology stated in Chapter X of the CDFW Salmonid Stream Habitat Restoration Manual, we have estimated from our survey data that approximately 8,890 yd^3 of sediment could be delivered to Mill Creek, a valuable coho salmon and steelhead stream located 200 ft from Nash Mill Road, if a complete failure and washout of the crossing was to occur. Additionally, long lengths of Nash Mill Road are hydrologically connected to Wallace Creek at the site. We estimate that approximately 630 yd^3 of chronic fine sediment produced from the erosion of road cutbank, ditch, and driving surfaces will be delivered to the stream system over the next decade (Reid and Dunne, 1984).

Need for the Project

The design project goals are to greatly reduce the risk of catastrophic failure of the Martinez Crossing, restore the geomorphic and hydrologic function of Wallace Creek, and prevent significant degradation of Mill Creek water quality and aquatic habitat. Itemized objectives of the project include:

- Greatly reduce the risk of severed vehicular access to and from 100's of properties caused by catastrophic failure of the stream crossing,
- Greatly reduce the risk of substantial degradation of Mill Creek salmonid habitat and water quality from catastrophic failure of the stream crossing,
- Completely remove the existing compromised and unstable stream crossing fill,
- Install a competent stream crossing structure capable of passing estimated 100-year recurrence interval storm flows and debris that will be in transport,
- Restore geomorphic function to the upstream stream channel reach affected by the existing and pre-existing stream crossing structures,

- Provide an effective stream crossing upgrade at the Martinez site that is within agency accepted standards of practice and that could be permitted by all agencies with jurisdiction, and
- Maintain access to properties via Nash Mill Road throughout the period of construction with only minor interruptions and traffic control.

Hydrology

The drainage catchment area contributing to the Martinez crossing has a southwest aspect and is estimated to be 332 acres in area. The drainage area is predominantly comprised of mixed coniferous forestland with a significant portion of grassland and developed vineyard lands ranging from approximately 800 ft at the ridgetop to 200 ft in elevation at the stream crossing. Average annual precipitation within the drainage area is estimated to be 38-40 inches (PRISM, 2010). Stream flows within the small creek are not gaged and no stream flow data for drainages of similar characteristics were identified in the area. 100-year recurrence interval storm flow estimates were computed using published USGS regional regression equations (Gotvald, et. al., 2012) and the Rational Method. The catchment discharge estimate using the Rational Method resulted in an estimated 100-year design flow rate of 296 cubic feet per second (cfs). The method developed by USGS (Gotvald, et. al., 2012) is considered more accurate for catchments of this size and results in an estimated 100-year design flow of 228 cfs.

In order to pass the 100-year recurrence interval discharge of 228 cfs, a 7 ft diameter culvert with a hydraulic cross section of 38.47 ft would be required, but this is just capable of passing design flows at the project site (Bureau of Public Roads, 1965). We are recommending the NRRA install an 8 ft diameter culvert at the site to ensure passage of the design flow, as well as convey the passage of the large amounts of bedload sediment and debris that will be in transport.

Elements of the Design Description

The design presented by this memorandum entails:

1) *Permitting* - This project design has been prepared with the assumption that funding for the construction project will be obtained through a grant process that will utilized either a programmatic permitting or coordinated permitting program to facilitate project permitting with CDFW, United States Fish and Wildlife Service, U.S. Army Corp of Engineers, SWRCB, NCRWQCB, and the County of Mendocino. Direct permit application costs and application development costs represented in this design and the following estimate of construction costs reflect this assumption.

2) *PG&E power pole relocation* - The two power poles identified on Figure 1 should be removed and relocated by PG&E prior to initiation of heavy equipment work.

3) *Equipment mobilization* - All heavy equipment required for project construction will be mobilized to and from the project area. Non-highway legal heavy equipment will be transported by semi and lowboy trailer.

4) *Channel dewatering* - Project construction will occur during the dry season. However, depending on the water year Wallace Creek may still maintain a very small surface base flow during the construction period above the upstream extent of the excavation, and the channel-stored sediments are expected to be wet, particularly at depth. If surface flow in Wallace Creek is present at the time of construction, a clearwater diversion should be maintained via pipe and

pump, if necessary, to route clean water around the worksite and return flow to the channel of Wallace Creek below extent of construction and erosion control measures.

Coffer dams will be utilized within and downstream of the active construction area to contain turbid nuisance water and prevent sediment delivery to Mill Creek. Sediment-laden water will be pumped from within the construction site and discharged onto flat areas away from the construction site allowing the water to infiltrate into the ground without delivery to a watercourse.

5) *Clearing and grubbing* - Brush and trees will be removed from the Martinez Crossing, area of channel to be restored, and materials storage areas. Cleared trees and shrubs will be temporarily stockpiled at the extent of the construction disturbance for later revegetation and redistribution for erosion control and native seeding purposes.

6) *Channel Restoration* - The excavation and removal of channel-stored sediments will be accomplished using a hydraulic excavator and two off-highway dump trucks. A licensed geologist experienced in channel restoration should be present during restoration of the upstream channel to aid in the identification of the historic channel alignment and morphology. The identification of native soil, rock materials, and exhumed channel morphology will guide the finished slope and grade of the excavation to the new proposed design culvert inlet. The area of channel to be restored is detailed on Figure 1. Design channel dimensions are detailed on Figures 2a-c.

7) *Martinez Crossing upgrading* – The existing stream crossing fill, culvert, and all organic debris within the fill will be completely excavated and removed. An 8 ft diameter and 140 ft long culvert will be installed at the base of the crossing fill in the axis of the stream crossing. The stream crossing fill will be rebuilt using clean earthen fill material. Approximately 125 yd^3 of riprap will be used to buttress the inboard and outboard fill faces and prevent scour.

8) *Through traffic ramp construction* – A temporary ramp will be constructed and maintained that will allow traffic to pass around the active construction site upstream of the Martinez crossing during the upgrading of the culvert and fill.

9) *Boondoggle Cr. Crossing upgrading* – The culvert at the stream crossing of Boondoggle Creek on the driveway of APN 026-280-40 is severely undersized and outlets into Wallace Creek within the channel restoration area. This culvert will be replaced with a 48 in diameter and 60 ft long culvert that outlets flow into the restored channel of Wallace Creek upstream of the Martinez Crossing.

10) *Materials storage and road drainage treatments* - Removed channel-stored sediments will be placed along Nash Mill Road at the Material Storage Areas A –D as identified on Figure 1. The stored materials will be compacted in lifts by bulldozer and vibratory compactor to create an outsloped road surface with road drainage structures (rolling dips). Once road shaping has been completed, the disturbed portion of Nash Mill Road will be rocked with 600 tons (400 yd^3) of road rock.

We estimate that the identified Material Storage Areas will not completely accommodate the storage of all removed channel-stored sediments. This design and estimated project cost assumes that 860 yd^3 of excavated channel-stored sediment will be endhauled by off-highway dump trucks and stockpiled on Nash Mill Road much further from the Martinez Crossing or on another property within 2 miles of the construction site.

11) *Surface erosion control measures* – All disturbed soil areas with the potential to deliver sediment to a watercourse via surface erosion processes will be treated by application of erosion control seed, straw mulch, and remaining slash materials produced from the clearing and grubbing activities.

12) *Revegetation* - The restored stream banks of Wallace Creek will be replanted with native riparian plants, trees, and coast redwood. Project laborers will retain willow limbs and rootwads cleared during grubbing activities for replanting along the banks of the restored channel reach.

13) *Replacement of domestic water infrastructure* - A domestic water diversion and storage system will be installed during the construction process. The estimated budget for this design project includes the costs of a spring box type diversion structure, piping, 5,000 gallon HDPE storage tank, and installation.

14) *Technical oversight* - Technical oversight of project construction by a licensed professional experienced in both channel restoration and stream crossing installation will be required for the implementation of this project. The licensed professional and staff under responsible charge of the professional will be responsible for the preparation of required permit applications, field layout of project elements, reviews with agency staff, preparation of additional work descriptions for contractors, identification of geologic conditions, evaluation of surface and subsurface earth materials, interpretation of fluvial and geomorphologic features, project monitoring, day to day decision making regarding project design and adaptive management, and all required project reporting to grant and regulatory agencies.

Estimate of Construction Costs

The following opinion of probable construction costs is based on the above identified conceptual construction plan, the design materials volumes, and on prevailing wage requirements of many agency programs that may provide funding for this project.

Estimated Budget for the Martinez Crossing, Nash Mill Road.	
Item Description	**Total Cost**
Permitting	$5,000
PG&E Power Pole Relocation	$50,000
Equipment Mobilization	$5,100
Channel Dewatering	$13,530
Clearing and Grubbing	$2,820
Channel Restoration	$128,240
Martinez Crossing Upgrading	$82,907
Through Traffic Ramp	$5,250
Boondoggle Cr. Crossing Upgrading	$10,495
Materials Storage and Road Drainage Treatments	$74,405
Surface Erosion Control Measures	$6,780
Revegetation	$2,800
Replacement of Domestic Water Infrastructure	$11,500
Technical Oversight	$37,500
Total Construction Cost	**$436,327**

We appreciate the opportunity to assist you in the development of a design to mitigate the risk of crossing failure. Should you or other interested parties have questions or concerns, feel free to contact me at (707)-839-5130 or via email at colinh@pacificwatershed.com.

Sincerely,

Colin Hughes
Geologist

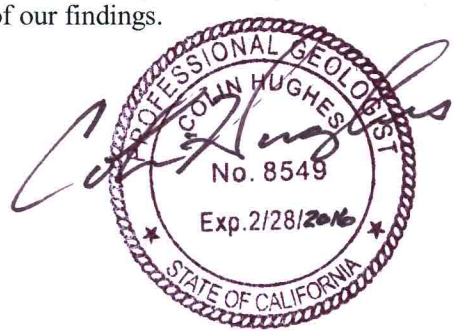
CERTIFICATION AND LIMITATIONS

This memorandum and design, entitled *"Design Basis and Plan Description Memorandum for the Martinez Crossing Design, Mendocino County, California,"* was prepared under the direction of a licensed professional geologist at Pacific Watershed Associates Inc. (PWA), and all information herein is based on data and information collected by PWA staff. Sediment-source inventory, survey, and analysis for the project, as well as storm-proofing and erosion control treatment prescriptions, were similarly conducted by or under the responsible charge of a California licensed professional geologist at PWA.

The interpretations and conclusions presented in this report are based on a study of inherently limited scope. Observations are qualitative, or semi-quantitative, and confined to surface expressions of limited extent and artificial exposures of subsurface materials. Interpretations of problematic geologic and geomorphic features (such as unstable hillslopes) and erosion processes are based on the information available at the time of the study and on the nature and distribution of existing features. No geotechnical or subsurface exploration was conducted.

The recommendations included in this report are professional opinions derived in accordance with current standards of professional practice, and are valid as of the submittal date. No other warranty, expressed or implied, is made. PWA is not responsible for changes in the conditions of the property with the passage of time, whether due to natural processes or to the works of man, or changing conditions on adjacent areas. Furthermore, to ensure proper applicability to existing conditions, the information and recommendations contained in this report shall be reevaluated after a period of no more than 3 years, and it is the responsibility of the Nash Ranch Road Association to ensure that no recommendations are inappropriately applied to conditions on the property that have changed since the recommendations were developed. Finally, PWA is not responsible for changes in applicable or appropriate standards beyond our control, such as those arising from changes in legislation or the broadening of knowledge, which may invalidate any of our findings.

Certified by:



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Pacific Watershed Associates Inc.

References:

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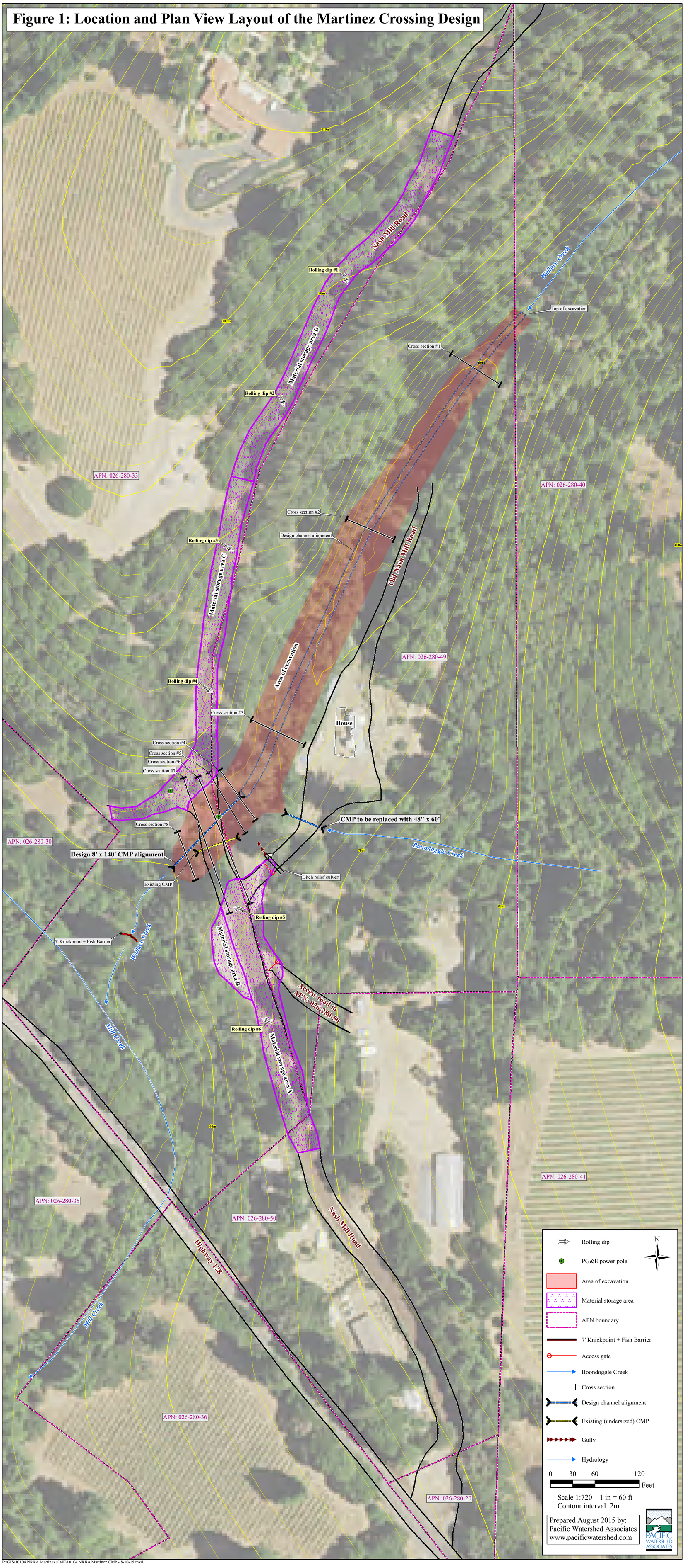
Weaver, W.E., Weppner, E.M. and Hagans, D.K., 2015, Handbook for Forest, Ranch, and Rural Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Upgrading, Maintaining and Closing Wildland Roads (Rev. 1st ed.)**,** Mendocino County Resource Conservation District, Ukiah, California

Figures:
Figure 1: Location Map and Plan View
Figures 2a-c: Design Profile and Cross Sections

Figure 1: Location and Plan View Layout of the Martinez Crossing Design



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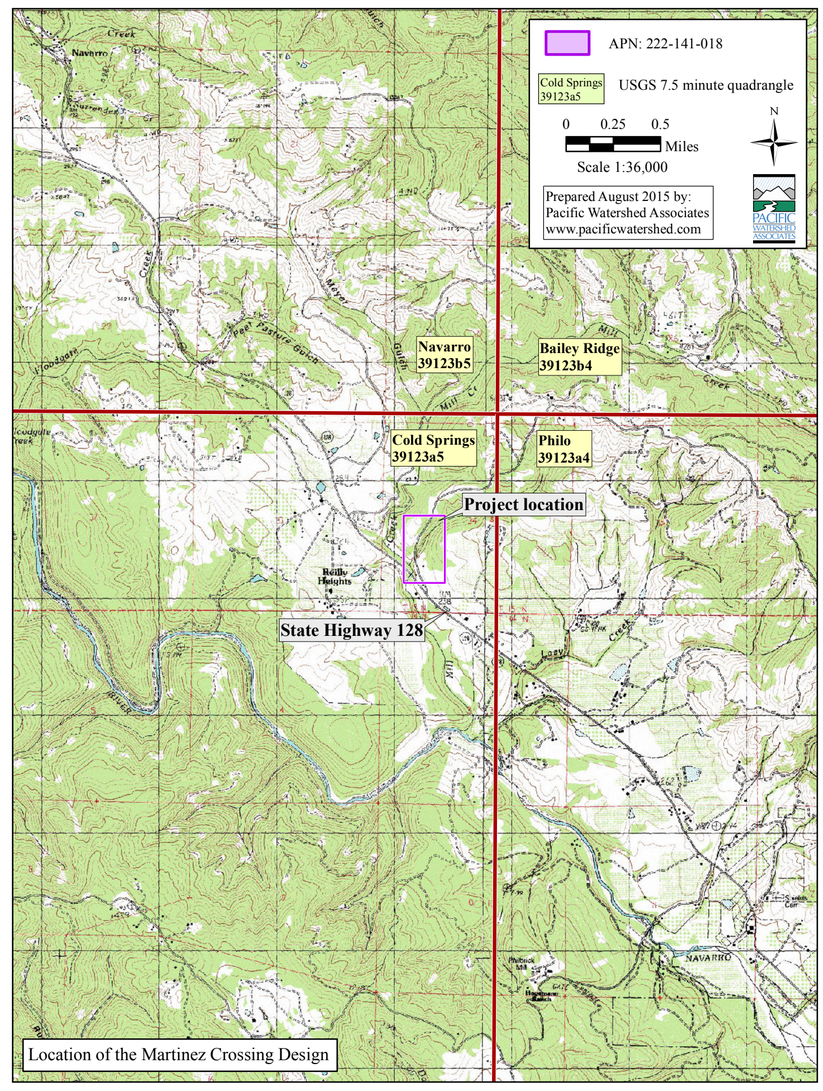

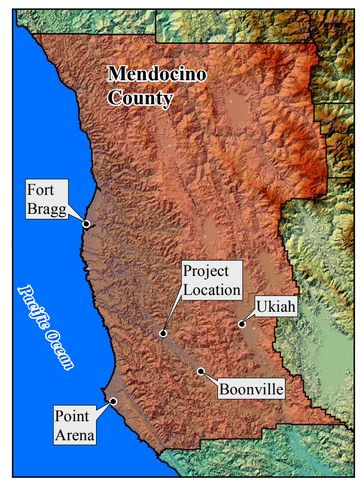

Graded Materials	Volume (yd^3)
Sediment and road fill to be excavated	10,340
Design crossing backfill	3,330
Sediment to be permanently removed from the channel	7,010
Exported sediment to be stored locally on Nash Mill Road	6,150
Exported sediment requiring off-site disposal	860

Materials Storage Area	Area (ft^2)	Average Depth (ft)	Volume (yd^3)
A	14,700	4	2,180
B	5,445	4	805
C	19,180	3	2,130
D	13,960	2	1,035
		TOTAL	**6,150**

Photo 1. View looking upstream at the outboard fillslope and culvert.

Photo 2. View of the culvert inlet. Note the deformation of the culvert and concrete used to repair the inboard fill face.

Figure 2a. Martinez CMP - Long Profile (Estimated Excavation Volume 10,340 cyd)
Nash Ranch Road Association - August 7, 2015
Mendocino County APNs: 026-280-49; 026-280-33

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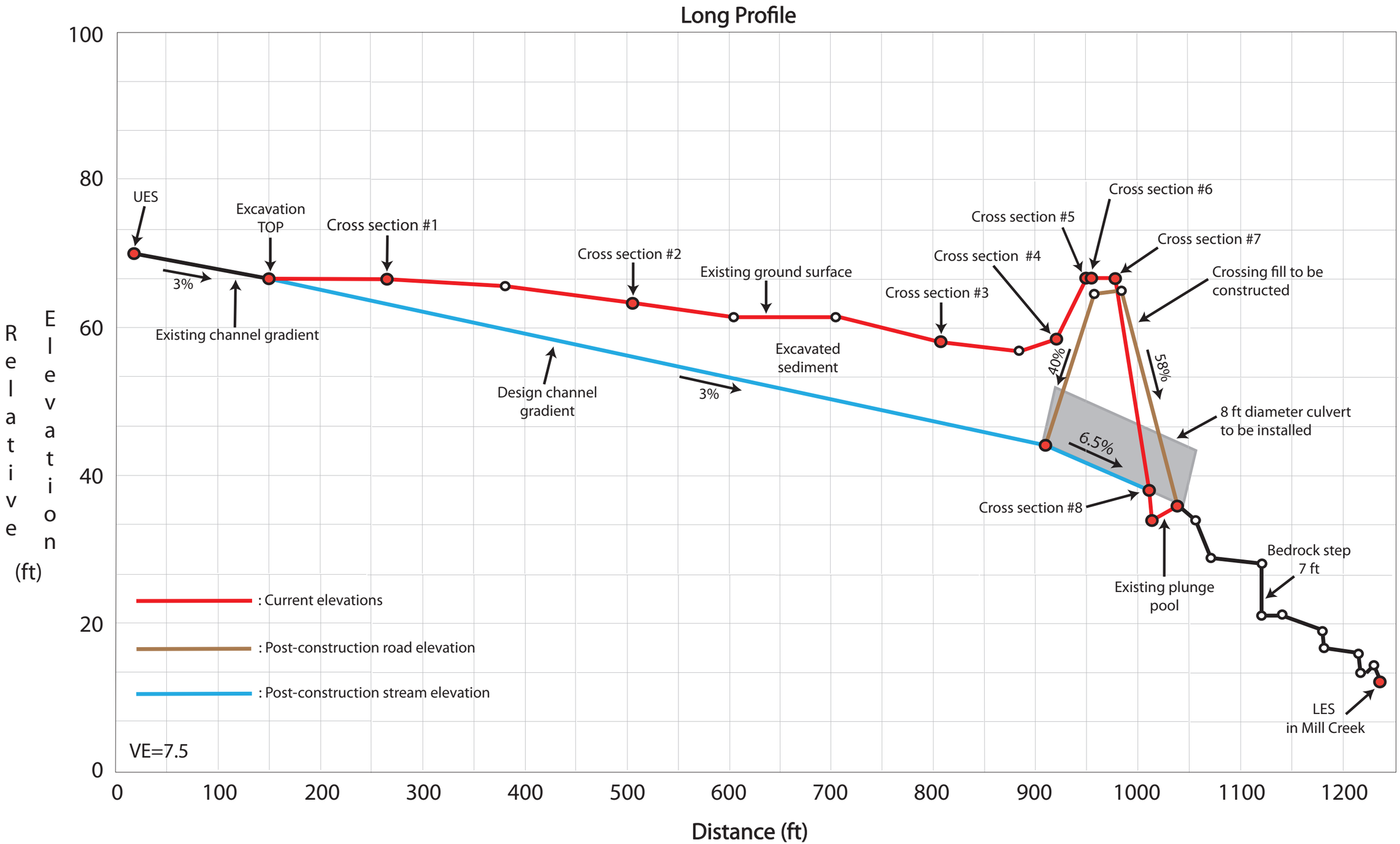

Figure 2b. Martinez CMP - Design Cross Sections (XS# 1 - XS# 4)
Nash Ranch Road Association - August 7, 2015
Mendocino County APNs: 026-280-49; 026-280-33

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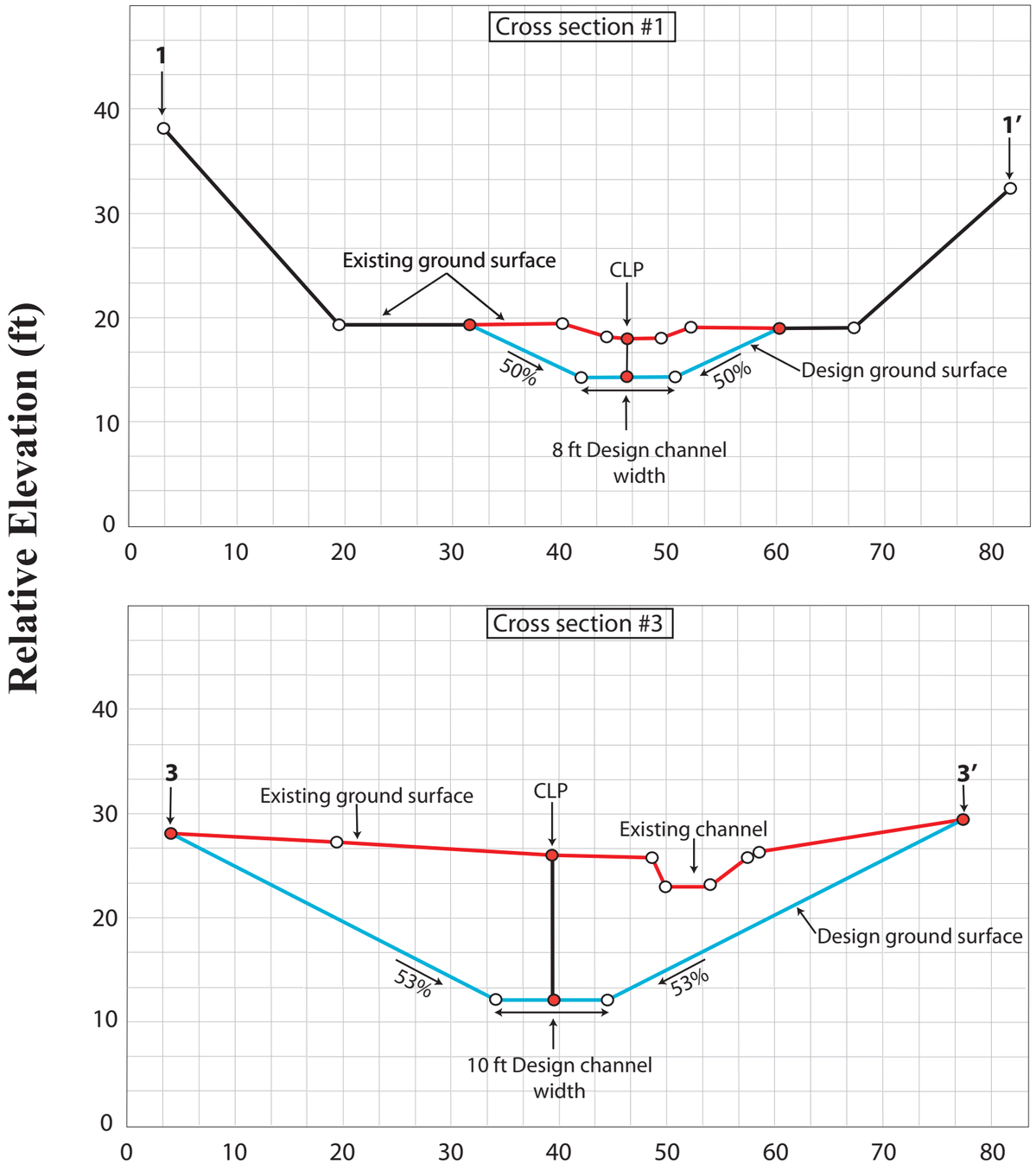

Figure 2c. Martinez CMP - Design Cross Sections (XS# 5 - XS# 8)
Nash Ranch Road Association - August 7, 2015
Mendocino County APNs: 026-280-49; 026-280-33

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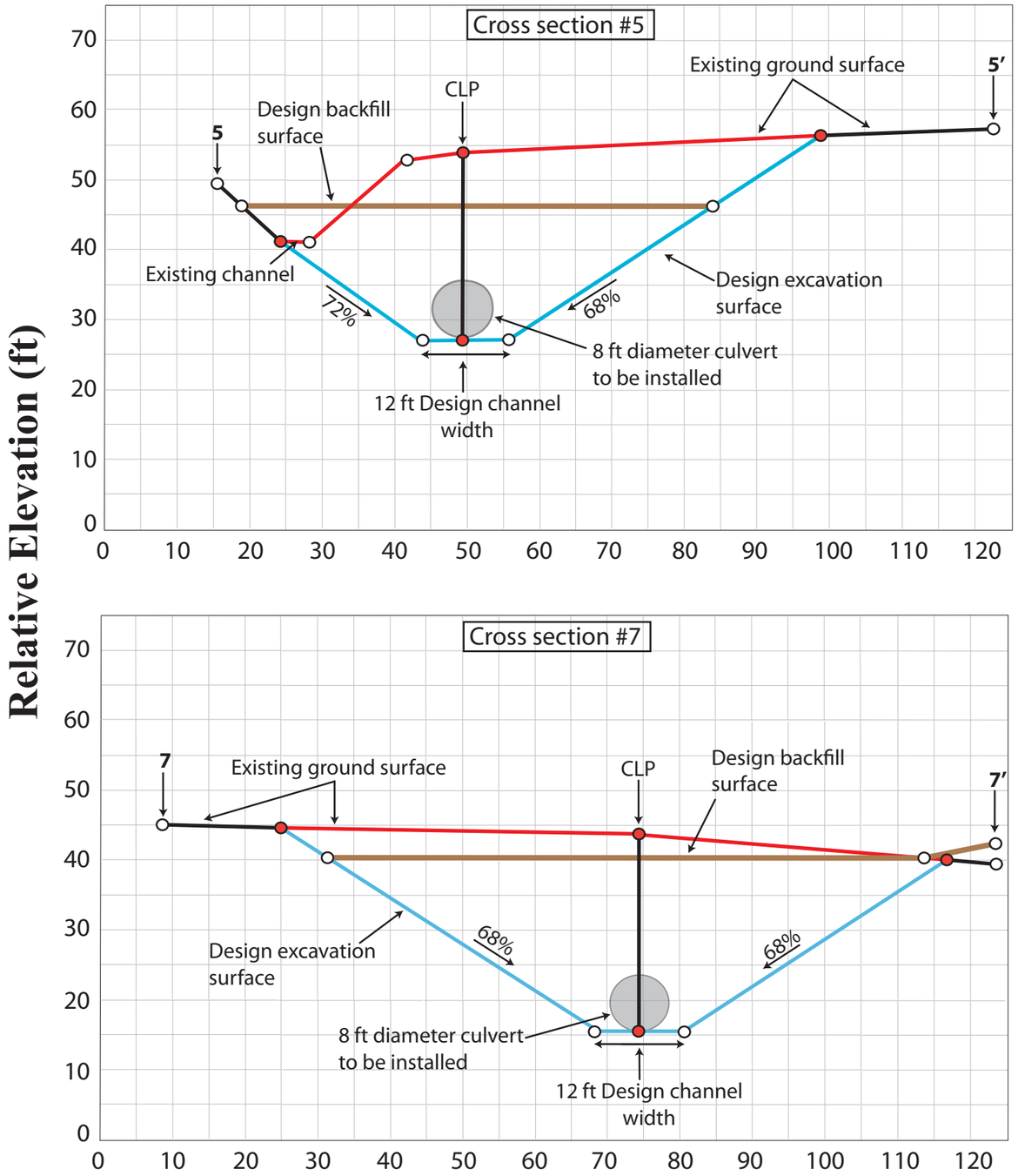

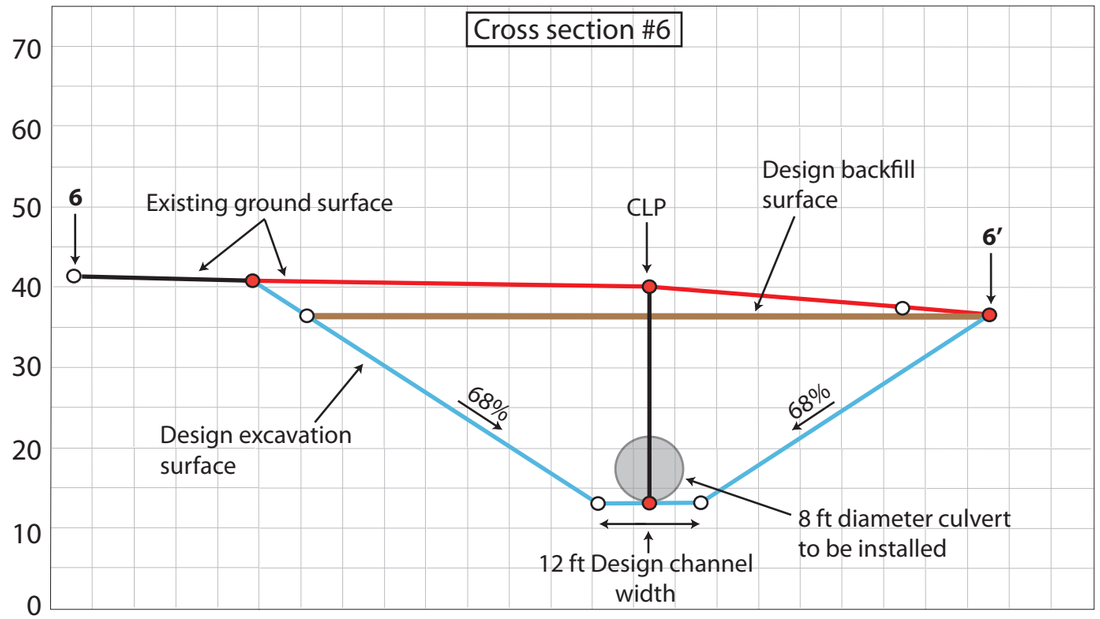

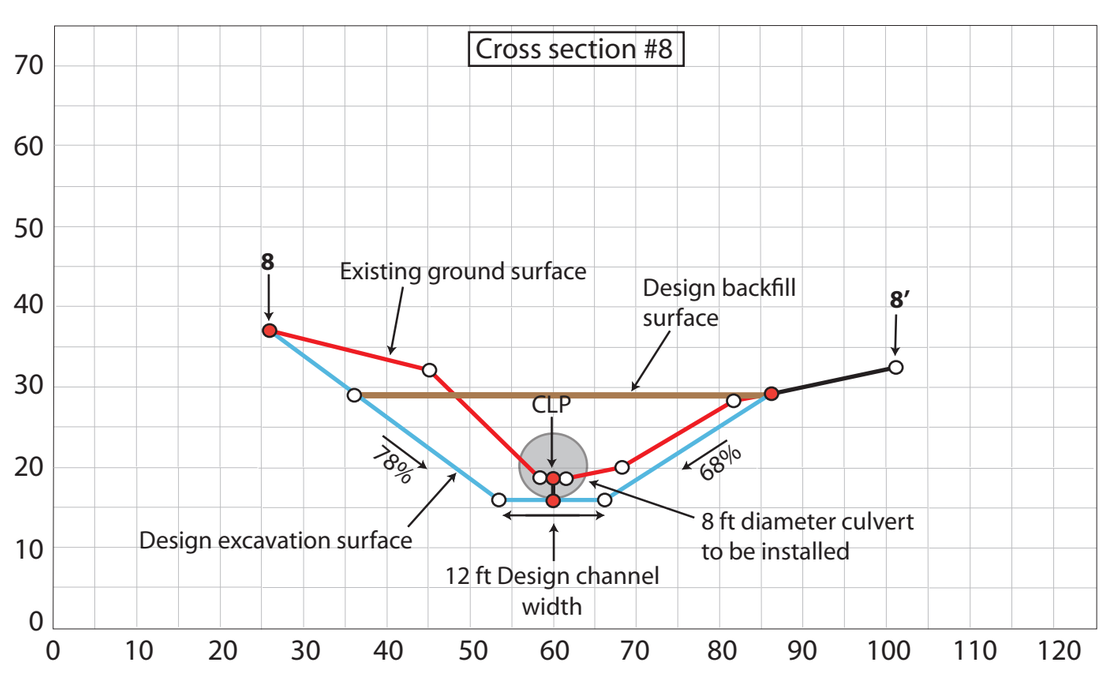

Relative Elevation (ft)

Distance (ft)