APPENDIX A

Fish Passage Design Flow Calculations

WATERWAYS CONSULTING, INC.

Project:	Permanente Quarry
Project #:	13-016
Date:	8/29/2017
Calculated by:	M.L.B/B.R.S.
Checked by:	B.M.Z.

Exceedence Probability Values for Mean Daily Flows at USGS Gages Near Cupertino

Percent Exceedence	Annual Exceedance Discharge (cfs)									
	Gage #11166575		Gage #11166578		Gage #11169500		Gage #11164500		Gage #11166000	
	Permanente Creek		West Fork Permanente Creek		Saratoga Creek		San Francisquito Creek		Matadero Creek	
	Real Flows (cfs)	Normalized Flows (cfs/sq.mi.)	Real Flows (cfs)	Normalized Flows (cfs/sq.mi.)	Real Flows (cfs)	Normalized Flows (cfs/sq.mi.)	Real Flows (cfs)	Normalized Flows (cfs/sq.mi.)	Real Flows (cfs)	Normalized Flows (cfs/sq.mi.)
95	0.00	0.00	0.00	0.00	0.36	0.04	0.15	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.49	0.05	0.29	0.01	0.00	0.00
10	4.00	1.04	0.82	0.27	18.00	1.95	45.00	1.20	3.50	0.48
5	7.30	1.89	3.49	1.17	38.80	4.21	112.75	3.01	9.90	1.36

	Gage #11166575	Gage #11166578	Gage #11169500	Gage #11164500	Gage #11164500
Drainage Area (sq.mi.)	3.86	2.98	9.22	37.4	7.26

Site Name	Location		Drainage Area (mi^2)	Record Length (yrs)	Normalized Exceedance Flows			
					95% (cfs/mi^2)	90% (cfs/mi^2)	10% (cfs/mi^2)	5% (cfs/mi^2)
PERMANENTE C NR MONTE VISTA CA - 11166575	37°20'00"	122°05'13"	3.86	3	0.00	0.00	1.04	1.89
WF PERMANENTE C NR MONTE VISTA CA - 11166578	37°19'59"	122°05'58"	2.98	3	0.00	0.00	0.27	1.17
SARATOGA C A SARATOGA CA - 11169500 [1]	37°15'16"	122°02'18"	9.22	20	0.04	0.05	1.95	4.21
SAN FRANCISQUITO C A STANFORD UNIVERSITY CA - 11164500 [2]	37°25'24"	122°11'18"	37.4	20	0.00	0.01	1.20	3.01
MATADERO CREEK A PALO ALTO CA 11166000 [3]	37°25'18"	122°08'04"	7.26	65	0.00	0.00	0.48	1.36
				Average =	0.01	0.01	0.99	2.33

[1] Water is diverted 0.7 miles upstream of gage for municipal use by San Jose Water Works

[2] Flow Slightly regulated by Searsville Lake. Diversions upstream from gage to Los Trancos and Lagunita Canal for irrigation on Stanford Universit

[3] No know regulation or diversion upstream of site

Note: Use the Matadero Creek gage to calculate fish passage design flows because it has an extensive period of record (65 years) and is unregulated. The CDFW, California Salmonid Stream Habitat Restoration Manual requires a gage to have at least 5 years of recorded daily average flows, and preferably more than 10 years for use in calulcating fish passage design flows.

Legend - Fish Passage Design Flows	
Juvenile Salmonid Fish Passage - Low	(orange)
Adult Non-Anadromous Salmonid Fish Passage - Low	(yellow)
Juvenile Salmonid Fish Passage - High	(green)
Adult Non-Anadramous Salmonid Fish Passage - High	(blue)

Permanente Quarry Watershed Fish Passage Design Flows				
Drainage Area (mi^2) =		3.50		
Juvenile Low	Adult Non-Anadromous Low	Juvenile High	Adult Non-Adadromous High	
95% (cfs)	90% (cfs)	10% (cfs)	5% (cfs)	
0.00	0.00	1.69	4.77	Using Matadero Creek Gage
0.00	0.00	2.09	5.16	Average of 3 unregulated gages
0.03	0.04	3.46	8.15	Average of all 5 gages

Location: Pond 14 Bypass Channel through the Concrete Channel

Permanente Quarry Watershed Fish Passage Design Flows			
Drainage Area (mi^2) =		3.01	
Juvenile Low	Adult Non-Anadromous Low	Juvenile High	Adult Non-Anadromous High
95% (cfs)	90% (cfs)	10% (cfs)	5% (cfs)
0.00	0.00	1.45	4.10

Location: Culverts #2 - #7

Permanente Quarry Watershed Fish Passage Design Flows			
Drainage Area (mi^2) =		2.70	
Juvenile Low	Adult Non-Anadromous Low	Juvenile High	Adult Non-Anadromous High
95% (cfs)	90% (cfs)	10% (cfs)	5% (cfs)
0.00	0.00	1.30	3.68

Location: Culvert #8 - Pond 13

Permanente Quarry Watershed Fish Passage Design Flows			
Drainage Area (mi^2) =		2.02	
Juvenile Low	Adult Non-Anadromous Low	Juvenile High	Adult Non-Anadromous High
95% (cfs)	90% (cfs)	10% (cfs)	5% (cfs)
0.00	0.00	0.97	2.75

Location: Materials Removal Area

APPENDIX B

Permanente Creek Restoration – Regional Hydraulic Geometry and Analog Channel Assessment Technical Memorandum

TECHNICAL MEMORANDUM - REVISED for 90% DESIGN

Prepared by: Waterways Consulting, Inc.

Date: October 30, 2018

Re: Permanente Creek Restoration – Regional Hydraulic Geometry and Analogue Channel Assessment

Introduction

Waterways Consulting, Inc. (Waterways) is developing engineering drawings to restore portions of Permanente Creek that flow through the Permanente Quarry (Quarry) property and have been impacted by past mining activities. The proposed approach at two locations (the Rock Pile Area and Material Removal Area[1]) focuses on restoring the channel form to an approximation of the pre-mining channel geometry and providing suitable aquatic habitat for local species, including resident rainbow trout. The Quarry is situated on lands owned by Lehigh Hanson Heidelberg Cement Group on the east side of the Santa Cruz Mountains to the west of Cupertino. Quarry operations over the past century have resulted in significant channelization, the installation of numerous culverts and sedimentation basins, and considerable sediment inputs to Permanente Creek. The altered channel form and high sediment loads resulted in the degradation of the instream aquatic habitat.

The proposed restoration will remove overburden sediment and several culverts, rebuild the affected channel reaches, and restore impacted riparian and aquatic habitats. Restoring Permanente Creek at the Rock Pile and Material Removal Areas requires a complete reconstruction of the streambed. Consequently, there is a need to estimate the appropriate channel morphology to support the restoration design, including active channel widths, depths and pool geometries and spacing.

Regional curves, relating channel dimensions to drainage area, exist for the San Francisco Bay region (Dunne and Leopold 1978) (Figure 1). However, these curves are regional in nature, incorporating data from a range of landscape settings and channel morphologies. For example, channel geometries of the low gradient bottomlands of the Santa Clara Valley will vary from bedrock-controlled streams in the Santa Cruz Mountains that are higher gradient and more influenced by hillslope processes. Given that much of the proposed restoration activities are in higher gradient, confined reaches of Permanente Creek, the appropriateness of the regional curves can be improved by focusing the data on sites with a similar geomorphic setting. Focusing the dataset on sites in the Santa Cruz Mountains could greatly improve the use of the hydraulic geometry curves to constrain expected channel morphologies in the impacted reaches of Permanente Creek. Furthermore, field-based measurements of channel geometry within less impacted reaches of Permanente Creek and in adjacent watersheds that exhibit similar characteristics to Permanente Creek could both provide a test for and improve the quality of the developed relationships.

[1] Although the analogue study was developed to support design efforts for the Rockpile and Material Removal Areas of the Permanente Restoration Project, the results are applicable to other locations within the project area including Culverts #7 and #8 within the Channel Widening Area.

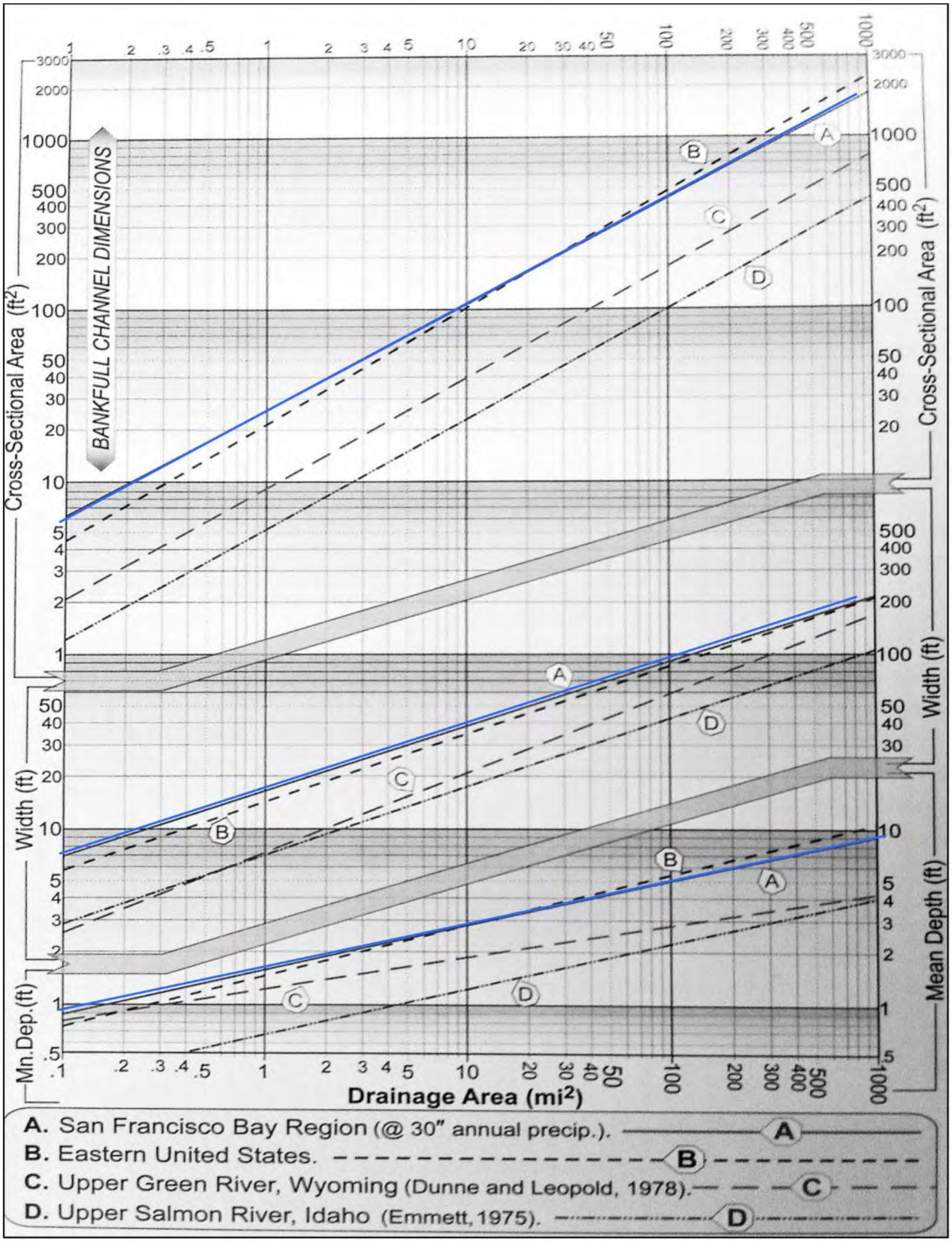


Figure 1. Regional hydraulic geometry curves produced by Dunne and Leopold (1978) relating drainage area to bankfull depth, width and cross-sectional area. The blue lines highlight the regional curves for the San Francisco Bay Area.

To create more site-specific curves, Waterways compiled data for the Santa Cruz Mountain sites that were included in the Dunne and Leopold (1978) curves for the San Francisco Bay region, surveyed two analogue stream channels close to the project area that were previously identified as having similar watershed and geomorphic characteristics as Permanente Creek (URS 2011)[2], and surveyed two segments of Reach 20 on Permanente Creek in what was considered a less impacted reach. These data were used to define reach-specific channel dimensions for the restoration effort. In addition, a longitudinal profile surveyed along portions of Permanente Creek where the channel morphology was determined to be more representative of natural conditions, was used to identify an appropriate size and spacing for pools to support the engineering design. This memorandum summarizes the findings of this work.

Study Area

Santa Cruz Mountains

The Santa Cruz Mountains have a complex geologic history, resulting in areas dominated by sandstone, limestone, igneous rocks (e.g., basalt), or metamorphic rocks (e.g., serpentine). The variable geologies result in different rates of erosion and the presence of different types of channel-forming sediment among streams that can be spatially close to each other. For example, Permanente Creek has abundant limestone that forms calcium carbonate precipitates that can bind rocks along the channel bed and banks. On the other hand, Stevens Creek is approximately one and one-half miles southeast of Permanente Creek and does not have limestone, and thus does not exhibit calcium carbonate precipitates.

Santa Cruz Mountain streams tend to be small headwater channels at the higher elevations and larger, alluvial streams at the lower elevations. The higher and mid-elevation streams generally flow through narrow valleys with steep hillslopes that restrict lateral channel movement. The steep hillslopes are susceptible to landslides and debris flows, especially following wildfire events. Entire reaches can be transformed during a debris flow and associated mudflow event. Debris flows can result in mobilization and deposition of sediment and debris across an entire valley bottom, leaving an aggraded valley consisting of an unsorted mix of materials. Subsequent high flows following a debris flow event reworks the aggraded material, with the active channel incising into the relatively uniform post-debris flow floodplain surface. Large roughness elements, including boulders and logs, become exposed as the channel incises into the debris flow surface, influencing the planform of the channel and providing local grade control for both the channel and floodplain. In higher gradient reaches, pools and riffles form in response to randomly spaced roughness elements. Along Permanente creek, debris flows prior to mining operations likely provided large wood and boulders that were incorporated into steep step-pool reaches and lower gradient riffle-pool reaches.

---

[2] The URS Plan was prepared to comply with the July 27, 1999 Cleanup and Abatement Order – 99-018 issued by the San Francisco Bay Regional Water Quality Control Board by preparation of a report that documented a field reconnaissance of Permanente Creek throughout the quarry facility identifying areas requiring stabilization, prioritizing stabilization activities at candidate sites, and preparing an implementation schedule.

WATERWAYS CONSULTING INC.
509A SWIFT ST.
SANTA CRUZ, CA 95060
PH:(831)421-9291 // FAX:(888)819-6847
WWW.WATWAYS.COM

Map identifying the location of the surveyed reference reaches for Permanente Creek.

FIGURE

2

Field Sites

Waterways reviewed the URS Plan and studied published literature on the Santa Cruz Mountains to determine suitable reference reaches for Permanente Creek. We determined that a reach along Swiss Creek and a reach along Corte Madera Creek were the most appropriate reference reaches for Permanente Creek (Figure 2 and Table 1). The URS Plan described Corte Madera Creek and Swiss Creek as similar in drainage area, slope, and valley shape to Permanente Creek. Both creeks are in the Santa Cruz Mountains, relatively close to Cupertino, with precipitation regimes similar to the Permanente Creek watershed. Corte Madera Creek flows west and Swiss Creek flows east through confined, steep stream valleys, constrained on both sides by steep hillslopes prone to mass wasting and debris flow events. Both reference reaches are bedrock-controlled with a step-pool channel pattern formed by large boulders and other recently delivered colluvial deposits. Swiss Creek exhibited calcium carbonate precipitates within the active channel, similar to the calcium carbonate formations identified in Permanente Creek. In addition to the reference reaches in adjacent watersheds, a less impacted reach (Reach 20) within Permanente Creek was chosen to further support development of regional hydraulic geometries in support of the engineering design effort.

Table 1. Basin Characteristics for the Field Sites and Permanente Creek.

	Swiss Creek	Corte Madera Creek	Permanente Creek
Average annual precipitation (in)	33.8	38.6	34.2
Mean basin elevation (ft)	1,842	1,917	1,957
Dominant geology	limestone, sandstone	sandstone, shale	limestone, sandstone
Dominant hillslope process	landslide/debris flow	landslide/debris flow	landslide/debris flow
Average channel slope (%)	10.72	8.39	3.4 - 13.85
Drainage area (sq. miles)	0.8	1.4	2.7

Analysis Approach

To develop the regional hydraulic geometry relationships, information from the USGS streamflow gage database was compiled for streams in the Santa Cruz Mountains. The focus of this data mining effort was the 1.5-year[3] recurrence discharge because it approximates the channel forming, or bankfull, discharge (Dunne and Leopold, 1978). To evaluate the performance of the curve and provide data for smaller watersheds, which was missing from the USGS dataset, we collected field data from the two adjacent watersheds and within Reach 20 of Permanente Creek with a specific focus on measuring channel geometries at bankfull indicators that were identified in the field.

Hydraulic Geometry using existing USGS gage data

Waterways identified 33 USGS stream gages in the Santa Cruz Mountains, but only 14 of the 33 had sufficient peak flow records to be used in the hydraulic geometry analysis (Table 2). Ideally the gage sites would be limited to the eastern Santa Cruz Mountains near Cupertino and Santa Clara. However, since there are a limited number of gages with sufficient data, the 14 gages Waterways assessed are

[3] Previous iterations of this study focused efforts on the 2-year event. Results of that effort identified disparities between the gage-based analysis and the field-based analysis with the field-based analysis consistently under predicted bankfull widths and depths. This suggested that field-based bankfull indicators occurred at a discharge approximating the 1.5-year event rather than the 2-year event. These results, combined with comments from the reviewers prompted us to redo the analysis with a focus on the 1.5-year event rather than the 2-year event.

Table 2. USGS gage sites used to develop regional hydraulic geometry curves.

Site Name	Location	Period of Record	Drainage Area (sq. miles)	1.5-Year Flood Discharge (Bankfull) (cfs)	Estimated Bankfull Width (feet)	Estimated Bankfull Cross Sectional Area (sq. feet)	Estimated Bankfull Depth (feet)
Llagas Cr above Chesbro Reservoir	37.1483, -121.7672	1971-1982, 2004-2010	9.6	390	25.0	132.5	5.3
Aptos Creek near Aptos	37.0020, -121.9050	1972-1983	10.2	185	29.3	68.7	2.3
San Lorenzo River near Boulder Creek	37.2067, -122.1439	1969-1992, 1997	6.2	105	24.7	32.9	1.3
Bear Creek at Boulder Creek	37.1278, -122.1158	1978-1992, 1997	16.0	540	33.8	122.5	3.6
Boulder Creek at Boulder Creek	37.1267, -122.1217	1977-1992, 1997	11.3	680	47.4	305.2	6.4
Zayante Creek at Zayante	37.0861, -122.0458	1958-1992, 1997	11.1	480	28.0	103.0	3.7
San Lorenzo River at Big Trees	37.0444, -122.0714	1937-2017	106.0	3700	87.5	682.0	7.8
Carbonera Creek at Scotts Valley	37.0506, -122.0125	1985-2007	3.6	505	26.5	117.4	4.4
Scott Creek above Little Creek	37.0642, -122.2283	1937-1941, 1959-1973, 1982	25.1	600	43.5	145.0	3.3
Pescadero Creek near Pescadero	37.2608, -122.3278	1952-2017	45.9	1350	53.0	291.5	5.5
San Gregorio Creek at San Gregorio	37.3258, -122.3856	1955, 1970-2017	50.9	1900	61.5	402.5	6.5
Pilarcitos Creek at Half Moon Bay	37.4666, -122.4331	1967-2017	27.8	450	33.0	139.0	4.2
Redwood Creek at Redwood City	37.4494, -122.2325	1960-1997	1.8	170	13.0	41.5	3.2
San Francisquito Creek at Stanford University	37.4233, -122.1883	1931-1941, 1951-2017	37.4	1000	45.5	198.5	4.4
Saratoga Creek at Saratoga	37.2544, -122.0383	1934-2017	9.2	255	25.6	40.2	1.6

located throughout the eastern and western Santa Cruz Mountains. Despite the slightly wider than ideal geographic range, our gage analysis improves upon the current regional analyses by focusing on a smaller area and limiting gage sites to the Santa Cruz Mountains.

Waterways compiled the existing information available at each of the selected gaging sites, including drainage area, discharge, field measurements of channel width and cross-sectional area, and local channel slope near the gage. We imported the discharge data into HEC-SSP (U.S. Army Corps of Engineers 2010) and developed flood frequency curves (USGS, Bulletin 17b, 1982) for each gage site to estimate the 1.5-year recurrence interval discharge. We then reviewed measurements of channel width and cross-sectional area at each gage site to find measurements that were taken during a high flow event that approximated the 1.5-year recurrence interval discharge. Four of the gaging sites did not have channel width and cross-sectional area data recorded during a 1.5-year event, so we extrapolated based on the available data. We then estimated bankfull depth at each gage site by dividing channel cross-sectional area by channel width. Banfull width, bankfull depth, and the 1.5-year flood discharge were plotted separately against drainage area. One outlier was identified and removed from the study.

Analogue Site Assessment

Waterways surveyed a 200-foot reach of Corte Madera Creek, located downstream of the Alpine Road Trail culvert, a 171-foot reach of Swiss Creek, located approximately 500 feet upstream from the Peacock Court bridge, and two segments within Reach 20 of Permanente Creek totaling over 300 feet of channel. We chose reach locations that were beyond the influence of instream structures (e.g., culverts, bridges) and were representative of conditions within the reach. We used an auto-level to survey four channel cross section profiles at Corte Madera Creek, three channel cross section profiles at Swiss Creek, two sets of three channel cross-section profiles at Permanente Creek and a longitudinal profile at all four sites. Each channel cross section profile included the expanse of the valley floor and the identification of significant geomorphic features using field indicators, such as bankfull. In most cases, the field indicator used to estimate the bankfull width and depth was the base of mature trees.

Using the survey data, Waterways calculated the bankfull channel width and plotted each cross section to calculate their cross-sectional areas. We then divided each cross-sectional area by the surveyed bankfull width to determine average bankfull depth. We estimated drainage area for each field site using StreamStats (USGS 2012) and calculated channel slopes using the surveyed longitudinal profiles. Channel widths and hydraulic depths were determined for each cross-section and then averaged for each reach, or reach segment, to obtain a single channel width and depth for each creek at the estimated bankfull discharge. Two separate segments were surveyed in Reach 20 of Permanente Creek to identify differences in channel geometry based on differences in local channel slope with one segment having a local channel slope of 4.6% and the other a local channel slope of 8.2%.

Hydraulic Geometry Analysis

Waterway combined the USGS gage site data with the field survey data to determine trends in channel geometry as a function of drainage area. We developed relationships between drainage area and bankfull width, bankfull depth, and the 1.5-year recurrence interval discharge. Trend lines were fit to the data to provide a predictive tool to estimate these parameters at specific restoration sites, most specifically the Rock Pile and Material Removal Areas (Figures 3, 4, and 5). Using the equation for each trend line, we solved for the predicted channel width and depth for specific restoration areas within Permanente Creek based on a drainage area of 2.7 square miles (Culverts 7 and 8), 2.54 square miles (Rock Pile), and 2.02 square miles (Material Removal Area). Table 3 summarizes the results of this analysis.

Table 3. Channel Dimensions Calculated Using Hydraulic Geometry Relationships

Project Site	Drainage Area (mi^2)	Predicted Bankfull Width (ft)	Predicted Bankfull Depth (ft)	Cross Sectional Area (ft^2)
Culvert 7	2.70	17.9	2.3	31
Culvert 8	2.70	17.9	2.3	31
Rock Pile	2.54	17.5	2.3	29
Material Removal Area	2.02	16.0	2.1	25

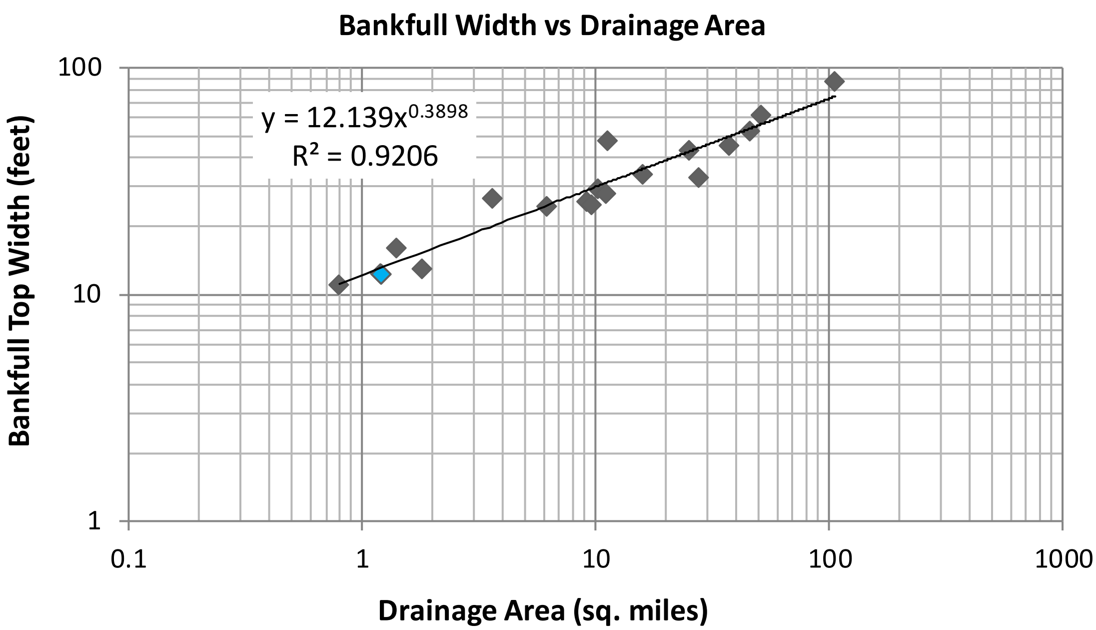


Figure 3. Bankfull Top Width as a Function of Drainage Area for the Santa Cruz Mountains. The blue marker represents the sites on Permanente Creek in Reach 20.

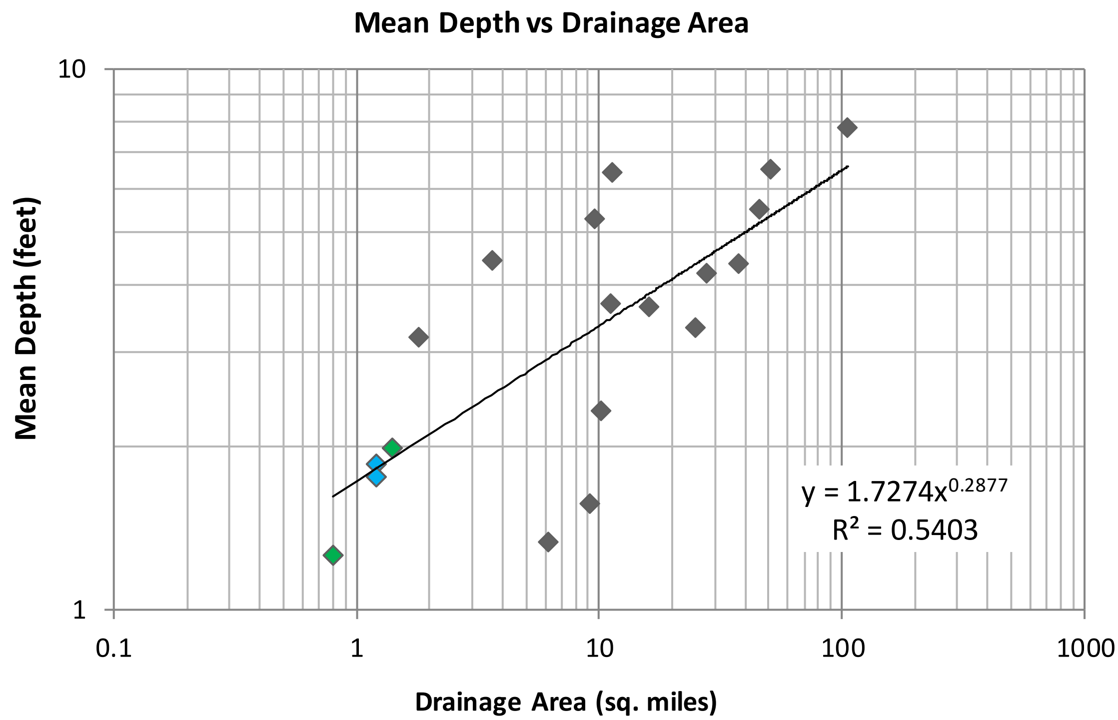


Figure 4. Bankfull Depth as a Function of Drainage Area for the Santa Cruz Mountains. The green data points are Swiss and Corte Madera Creeks. The blue data points are the sites on Permanente Creek.

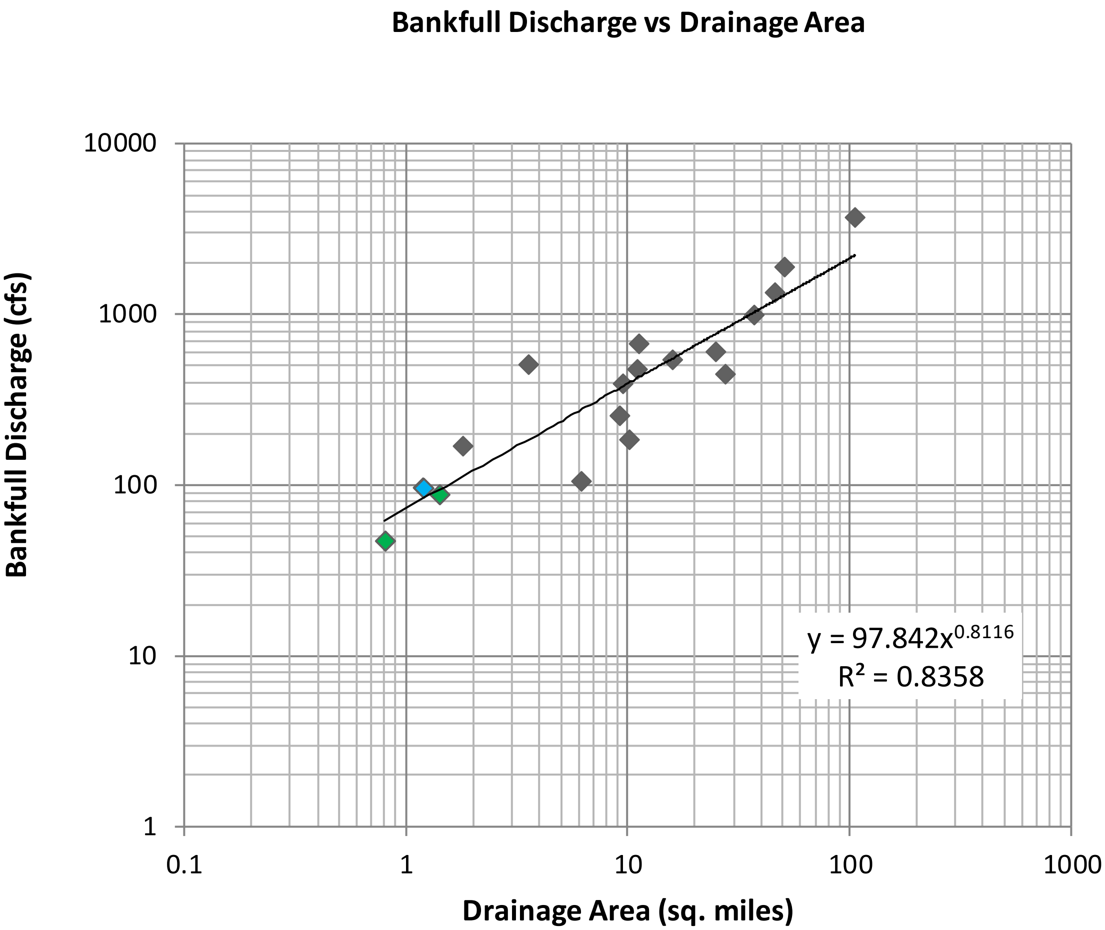


Figure 5. Bankfull Discharge as a Function of Drainage Area for the Santa Cruz Mountains. The green data points are Swiss and Corte Madera Creeks. The blue data points are the sites on Permanente Creek.

Pool Geometry

An important design parameter for reach-scale restoration of Permanente Creek is pool length and pool spacing. Despite the legacy of impacts to Permanente Creek, it was determined that several reaches (R14-R16 and R20-R21) continued to exhibit naturally formed pool and riffle geometries that encompass a range of channel slopes. These conditions provided an opportunity to measure pool and riffle geometries, locally, to support the design effort, rather than measuring those parameters in other adjacent watersheds which may lack specific characteristics found in Permanente Creek such as the prevalence of calcium carbonate precipitates. Given the inherent variability in pool geometries associated with the debris flow morphology of the channel, it was important to collect data along entire reaches and summarize the information to convey averages and ranges of natural conditions. To convey the range of natural variability, longitudinal profile data was collected along the entire length of the identified reaches within Permanente Creek to calculate pool length and spacing in relation to reach-scale channel gradients (Table 4). These data were then used to calculate pool statistics for each site-specific restoration area.

Table 4. Statistics on Pool Length, Depth and Spacing (in feet) By Reach of Permanente Creek.

Reach #	Reach Avg Slope	Avg Pool Length (ft)	Median Pool Length (ft)	St. Dev Pool Length (ft)	Avg Pool Depth (ft)	Median Pool Depth (ft)	St. Dev Pool Depth (ft)	Avg Pool Spacing (ft)	Median Pool Spacing (ft)	St. Dev Pool Spacing (ft)
21	5.1%	13.6	11.6	6.3	0.6	0.6	0.3	211	150	212
20	5.2%	11.4	11.0	4.1	0.9	1.0	0.4	106	92	57
16	7.1%	15.4	14.4	6.1	0.8	0.8	0.4	76	65	69
15	11.6%	10.5	9.4	2.5	0.7	0.7	0.4	58	39	50
14	6.4%	8.8	8.0	3.8	0.6	0.6	0.3	31	19	27
	4-8% Reaches	**12.0**	**10.3**	**5.7**	**0.7**	**0.7**	**0.4**	**94**	**55**	**124**
	8-12% Reaches	**10.5**	**9.4**	**2.5**	**0.7**	**0.7**	**0.4**	**58**	**31**	**50**

Results/Discussion

Dunne and Leopold's (1978) regional curves provide a predictive tool to estimate bankfull channel dimensions for Permanente Creek. Use of the Dunne and Leopold regional curves for the entire Bay Area estimated a bankfull width for the Permanente project area of approximately 17 to 25 feet and a bankfull depth of approximately 1.5 to 2.0 feet. Because these curves are regional and include a significant number of gage locations that are in a geomorphic setting that are different from the project area, regional curves that are more specific to the Permanente Creek project area were developed. Utilizing the more focused data set, which includes the USGS sites within the Santa Cruz Mountains and the field-based assessments sites on Permanente, Corte Madera and Swiss Creek, the curves predicted a bankfull width of 17.9 feet for Culverts 7 and 8, 17.5 feet for the Rock Pile Area, and 16.0 feet for the Material Removal Area and a bankfull depth of approximately 2.3 feet for Culverts 7 and 8, 2.3 feet for the Rock Pile Area and 2.1 feet for the Material Removal Area prior to mining-related impacts (Table 3). As expected, the Dunne and Leopold (1978) curves describe a wider and flatter channel, most likely due to the inclusion of lower gradient, unconfined, alluvial channels in the analysis. Table 5 includes ranges of bankfull channel dimensions for the areas where the channel will be reconstructed to provide for some variability and flexibility during construction since large non-uniform materials will be used in channel construction.

Measured channel slopes for Corte Madera and Swiss Creek, 8.4% and 10.7% respectively, are in the range of the design slopes at the Rock Pile and Material Removal Areas along Permanente Creek. Field observations of a step-pool channel morphology at these channel gradients suggest that Permanente Creek likely had a step-pool channel pattern in the steeper reaches prior to mining. This is supported by the observed conditions in the reaches of Permanente Creek that were identified as having pool and riffle geometry that were representative of natural conditions.

The pool analysis, utilizing the surveyed longitudinal profiles along the more intact reaches of Permanente Creek, suggest that there is an inverse relationship between pool length and spacing relative to channel gradient (Table 4). Furthermore, lower gradient reaches exhibit higher overall pool length and spacing variability than higher gradient reaches. This supports the idea that higher gradient reaches (>8% channel slope) are more characterized by a step-pool morphology, whereas lower gradient reaches (4% to 8% channel slope) exhibit more of a pool-riffle morphology. Pool depth was fairly consistent across all of the evaluated reaches with pools ranging between 0.5 and 2 feet, independent of channel slope. This is likely due to the fact that pool depth may be more a function of the presence of localized roughness elements, and the fact that there are limited opportunities to scour deeper pools due to the composition of the bed material and associated natural armoring.

Table 5. Proposed Channel Dimensions for Constructed Reaches

Project Site	Design Slope (%)	Design Slope Range (%)	Proposed Bankfull Width Min (ft)	Proposed Bankfull Width Max (ft)	Proposed Bankfull Depth Min (ft)	Proposed Bankfull Depth Max (ft)	Cross Sectional Area Min (ft^2)	Cross Sectional Area Max (ft^2)
Culvert 7	4.3%	4%-8%	16.5	20.5	2.1	2.5	28.2	34.2
Culvert 8	2.7%	<4%	18.0	22.0	1.9	2.3	28.2	34.2
Rock Pile Area	Varies	<4%	17.5	21.5	1.8	2.2	26.9	32.9
		4%-8%	16.0	20.0	2.0	2.4		
		>8%	15.5	18.5	2.4	2.8		
Material Removal Area	Varies	<4%	16.0	20.0	1.7	2.1	22.5	28.5
		4%-8%	14.5	18.5	1.9	2.3		
		>8%	14.0	17.0	2.3	2.7		

References

Dunne, T. and Leopold, L.B. 1978. Water in Environmental Planning. W.H. Freeman and Company, New York, pp. 615-618.

URS Corporation. 2011. Permanente Creek Long-Term Restoration Plan. *Prepared for Lehigh Southwest Cement Company, March 11, 2011.*

US Army Corps of Engineers. 2010. HEC-SSP Statistical Software Package, Version 2.0. U.S. Army Corps of Engineers Hydrologic Engineering Center, http://www.hec.usace.army.mil/software/hec-ssp/.

U.S. Geological Survey. 2012. The StreamStats program for California, online at http://water.usgs.gov/osw/streamstats/california.html

U.S. Geological Survey. 1982. Bulletin 17B, Guidelines for Determining Flood Flow Frequency. Interagency Advisory Committee on Water Data, Hydrology Subcommittee. Reston, Virginia. http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf

APPENDIX C

Seismic Refraction Survey (Bedrock Analysis)

May 22, 2014

Golder Associates, Inc.
425 Lakeside Drive
Sunnyvale, CA 94085

Subject: Seismic Refraction Survey
Sites 4 and 11
Permanente Quarry
Cupertino, California

NORCAL Job #14-245.15B

Attention: George Wegmann,

This report presents the findings of seismic surveys performed by NORCAL Geophysical Consultants, Inc. for Golder Associates, Inc. at Permanente Quarry in Cupertino, California. The surveys were performed during the period March 4 through 11th, 2014 by NORCAL Professional Geophysicist William J. Henrich, PGp 893. Geologist Jeff Linder and Field Technician Dave Walter of Golder Associates, Inc. provided field assistance throughout the duration of the survey.

1.0 SITE DESCRIPTION AND PURPOSE

The seismic surveys were conducted at two locations referred to as Area 11 and Area 4, as shown on Plates 1A and 1B, respectively. Both areas encompass sections of Permanente Creek which drains in a general west to east direction. The area north of the creek has been subjected to accumulations of overburden materials related to quarrying operations. Particle sizes of the mine wastes ranged from sand and gravel size up to boulders that, on the surface, were several feet across. The local bedrock consisted of greywacke (sandstone), greenstone and limestone belonging to the Franciscan Complex.

The purpose of the seismic survey was to determine the thickness of alluvium and alluvium-rock fills at accessible select areas within the stream channel, along parallel haul roads and areas north of the stream channel. This data will be used by others to assess volumes of unconsolidated materials needed to be removed for restoration to the original stream channel grade and configuration as part of a reclamation plan for the quarry.

2.0 METHODOLOGY

We collected seismic data using two methods known as seismic refraction (SR) and multi-channel analysis of surface waves (MASW). The SR method was used to determine the compressional (P-) wave velocity of subsurface materials. The P-wave velocity (Vp) of fill, sediments, and rock are dependent on physical properties such as compaction, density, hardness, and induration. However, other factors such as bedding, fracturing, and saturation also affect Vp.

Typically, low Vp is indicative of loose, dry soils, poorly compacted fill material, poorly to semi-consolidated sediments, or alternatively, deeply weathered and/or highly fractured rock. Moderate Vp usually indicates dense and highly compacted or saturated sedimentary deposits or fill, and/or moderately weathered and fractured sedimentary rock. High Vp typically represent un-weathered sedimentary (i.e., sandstone, conglomerate, meta-sandstone or basalt) bedrock. A more detailed description of the SR methodology is provided in Appendix A.

The MASW method was used to determine both the P-wave and the shear (S-) wave velocity of subsurface materials in areas where limited access precluded the use of the SR method. S-waves typically propagate through earth materials at roughly one-half the velocity of P-waves. However, S-wave velocities are more directly related to the strength of fill, sediments, and rock than P-waves. Furthermore, unlike Vp, S-wave velocity (Vs) is not affected by saturation. Typically, low Vs is indicative of loose, dry soils, poorly compacted fill material, poorly to semi-consolidated sediments, or alternatively, deeply weathered and/or highly fractured rock. Moderate Vs usually indicates dense and highly compacted sedimentary deposits or fill, and/or moderately weathered and fractured sedimentary rock. High Vs typically represent un-weathered sedimentary (i.e., sandstone, conglomerate, meta-sandstone or basalt) bedrock. A more detailed description of the MASW method is provided in Appendix B.

3.0 DATA ACQUISITION

SR surveys were conducted in two locations referred to as the Rock Pile Area (Area 11) and the Material Removal Area (Area 4). The SR surveys were conducted according to the procedures described in Appendix A. MASW soundings were conducted in Area 11 according to the procedures described in Appendix B. The salient features of the data acquisition procedures used in each area are described in the following sections.

3.1 AREA 11

In Area 11 we collected SR data from 8-lines ranging in length from 75- to 250-ft. The locations of these lines, labeled Line 1 through Line 8, are shown on Plate 1A. We also conducted two MASW soundings. The locations of the soundings, labeled MASW-9 and MASW-10 are also shown on Plate 1A. Where possible, the SR lines and MASW soundings were located within the stream channel. However, there were some areas where the lines had to be placed on adjacent compacted gravel roads because of the presence of dense vegetation, concrete linings or steel culverts within the channel.

3.2 AREA 4

In Area 4, we acquired SR data from 13-lines ranging in length from 125- to 250-ft. The locations and orientations of the SR lines are shown on Plate 1B. The SR lines were positioned within the stream channel and on the northern portions (hill slopes, access roads and parking area) of the site.

4.0 DATA PROCESSING

4.1 SEISMIC REFRACTION (SR)

The refraction data were processed as described in Appendix A. Elevation data were provided by Waterways Consultants, Inc. at each shot point location within every seismic line. These elevation data were incorporated into the final processed seismic models. Further information regarding specific data input and sample compilations can be found in Appendix A.

4.2 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

The MASW data were processed according to the procedures described in Appendix B.

5.0 RESULTS

The results of the seismic refraction survey are illustrated by the seismic velocity cross-sections (profiles) shown on Plates 2 through 8. On each profile the vertical axis represents elevation above mean sea level (MSL) and the horizontal axis represents draped survey distance (Station) along each line. Color shaded areas represent the lateral and vertical extent of the seismic layers comprising each profile. Modelled layer depths (thicknesses) as described in the Appendix A were determined beneath each geophone. These data were interpolated/extrapolated beneath each shot point. The relationship between color and seismic velocity is indicated by the color scales plotted to the right of each seismic refraction profile. In order to indicate how velocity varies from line to line within each survey area, the same scale was used for every profile. The results obtained in each area are described in the following sections. Specific results are presented for areas where two or more seismic refraction profiles either cross each other or are in a local proximity. It was useful to group seismic lines in this manner because of common characteristics involving of topography, location or surface conditions.

5 .1 AREA 11

5.1.1 Lines 1 and 2 (Plate 2)

Lines 1 and 2 were located within the stream channel, just west of a retention pond, as shown on Plate 1A. During the survey, water from remote pumping was actively being discharged to the stream channel above the seismic lines. The profile for Line 1 indicates velocities (Vp) ranging from 1200- to 7200-ft/sec. Our interpretation of the data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1as representing unconsolidated stream deposits and V2 as representing bedrock. The depth to rock ranged from 18- to 25-ft. The Profile for Line 2 indicates velocities (Vp) ranging from 1150- to 2550-ft/sec. Our interpretation of the data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. Given the low velocities of these layers, we interpret both as representing unconsolidated stream deposits. The difference in velocity between the two layers is related to their relative degree of compaction. V2 has a higher velocity than V1 because it is more highly compacted, probably because of the overbearing weight of V1. Line 2 did not detect bedrock because it was a relatively short line length which limited the depth of exploration.

5.1.2 Line 3 – 6, MASW Soundings 9 and 10 (Plate 3)

Lines 3 through 5 were located on access roads that parallel the stream channel, as shown on Plate 1A. Line 6 was situated in open, gravel packed area that ranged from 40 to 60-ft north of a subsurface diversion channel. The profiles for Lines 3-6 indicate velocities (Vp) ranging from 2300- to 7800-ft/sec. Our interpretation of the data resolves this range into two seismic layers designated as V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing unconsolidated materials, e.g. road fill and/or alluvium. Given the high velocity range of V2 (6850- to7800-ft/sec) we interpret it as representing bedrock. The depths to bedrock ranged from 8- to 35-ft bgs.

MASW Soundings 9 and 10 were located north of Seismic Refraction Line 3, as shown on Plate 1A. The MASW soundings were acquired for the purpose of assessing possible near surface high velocity layers and providing depth to bedrock information further north of the stream channel. The 1D MASW Velocity Models (9 and 10) shown at the top of Plate 3 indicate a near surface high velocity layer (Vs=1500- to 2000-ft/sec) that is 8- to 16-ft thick. We interpret this high velocity layer as representing compacted (by very heavy vehicle loads) road fill. The materials underlying the compacted fill have lower velocities (Vs=500- to1000-fps) and thus constitute a velocity inversion. This velocity inversion, which is typically about 8- to 9-ft thick, is characteristic of alluvium. It is underlain, at depths of 17- to 26-ft bgs by velocities (Vs) of about 1800-ft/sec. We interpret these velocities as being indicative of consolidated bedrock. The bedrock depth indicated by the MASW-9 model (about 17-ft) is more shallow than the depth indicated by the Line 3 profile (23-ft) at its point of closest approach. Conversely, the bedrock depth indicated by the MASW-10 model (26-ft) is significantly greater than the 5- to 10-ft depth indicated by the Line 3 and Line 4 profiles at their points of closest approach to MASW-10. These factors highlight the erratic nature of the bedrock surface and can be, in part, attributed to the fact that MASW-9 and MASW-10 are 25-ft north of Lines 3 and 4.

Additionally, the MASW soundings were undertaken to provide a constraint on the seismic refraction results in the general area (Seismic Refraction Lines 3 and 4) as the MASW techniques can accommodate shallow velocity inversions in processing. The MASW bedrock depths (17- to 26-ft bgs) derived from MASW analysis thus formed an approximate magnitude range of values. Our seismic refraction results indicated that bedrock depths ranged from 5- to 35-ft bgs which is in the same order of magnitude as the MASW estimate of depths to bedrock in the general area.

5.1.3 Lines 7, 8 and 11(Plate 4)

Lines 7, 8 and 11 trend northward, away from the stream channel, as shown on Plate 1A. Lines 7 and 8 cross an uphill section of accumulated mine waste and packed surficial gravel. The local topography was highly variable and steep. Line 11 crosses a gently sloping, open, gravel packed area from the edge of a metal culvert up to point 50-ft distant from the rock discharge pile (Rock Pile). The profiles for Lines 7, 8 and 11indicate velocities ranging from 1850- to 5700-ft/sec. Our interpretation of the data resolves this range into two seismic layers designated as V1 and V2, in order of increasing depth and velocity. Because of its relatively low velocity and highly variable thickness, we interpret V1 as representing mine wastes and/or alluvium. We interpret V2 as representing bedrock. Beneath Lines 7 and 8, the depth to rock ranges from less than 10- to over 50-ft. The Time-Distance plot for Line 11 indicated a relatively high velocity V1 layer associated with the road bed. No characteristic higher V2 bedrock velocity layer was detected. Therefore, no modeling results are presented for this line.

5.2 AREA 4

5.2.1 Lines 12, 13, 14 and 15 (Plate 5)

Lines 12, 13 and 14 were situated within a relative wide section of the stream channel, as shown on Plate 1B. Line 15 was located along a man-made bench that parallels the stream channel, about 20-ft upslope from the channel. The profiles for the four lines indicate velocities (Vp) ranging from about 900- to 3550-ft/sec. Our interpretation of the refraction data resolves this velocity range into three layers labeled V1 through V3 in order of increasing depth and velocity. We interpret the V1 and V2 layers as representing unconsolidated stream deposits and V3 as representing weathered bedrock. The depth to rock (V2/V3 interface) ranges from 7- to 23-ft bgs.

The relatively low velocity of V3 (2800- to 3450-ft/sec) suggests that it comprises a very weak rock like a meta-shale. The profile for Line 15 indicates that bedrock deepens to the east (downstream), reaching a maximum depth of 36-ft-bgs at the east end of the line. This puts it at an elevation of 1190-1192-ft MSL, which corresponds to the bedrock elevations at the west end of Line 12 and the east end of Line 13.

5.2.2. Lines 16 and 17 (Plate 6)

Lines 16 and 17 were situated on top of a gravel packed, level parking area, as shown on Plate 1B. The profiles for both lines indicate velocities (Vp) ranging from 1150- to 6200-ft/sec. Our interpretation of the Line 16 and Line 17 data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing fill and alluvium and V2 as representing bedrock. The depth to rock ranges from17- to 23-ft bgs.

5.2.3 Lines 18, 19, 20 and 21 (Plate 7)

Lines 18 through 20 were located within the active stream channel, as shown on Plate 1B. However, there was no water in the channel at the time the survey was conducted. Line 21 extended north and upslope from the west end of Line 19. The profiles for these lines indicate velocities (Vp) ranging from 1100- to 4150-ft/sec. Our interpretation of the data resolves this range into three layers labeled V1 through V3 in order of increasing depth and velocity. V2 is absent beneath Line 18 and V3 is absent beneath Line 19. We interpret the combined V1 and V2 layers, with velocities ranging from 1050- to 2650-ft/sec, as representing unconsolidated stream and slope deposits. However, below Lines 19 and 20, the V2 layer could represent decomposed bedrock or dense gravel deposits. In addition, our field observations indicate that, beneath Line 21, V2 could represent mining waste that contains a high percentage of boulder size fill. We interpret theV3 layer as representing bedrock with velocities, where defined, ranging from 3400- to 4150-ft/sec. The depth to rock ranges from about 8- to 32-ft.

5.2.4 Lines 22, 23 and 24 (Plate 8)

Line 22 and Line 23 were located on an access road, as shown on Plate 1B. This road leads to Pond 4 (not shown). Line 24 extended southeast and down slope, from the access road towards the stream channel. The profiles for the three lines indicate velocities (Vp) ranging from 1200- to 6700-ft/sec. Our interpretation of the data resolves the velocity range into two layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing unconsolidated stream deposits. We interpret V2 as representing bedrock. Beneath Lines 22 and 23, the computed depths to bedrock ranged from 18- to 30-ft bgs. Beneath Line 24, the depths to bedrock decrease in the down slope direction; ranging from 18-ft bgs near the access road to only 8-ft bgs at the southeast edge of the profile.

6.0 STANDARD CARE

The scope of NORCAL's services for this project consisted of using geophysical methods to characterize the subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the standard of care ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having the opportunity to provide you with this information.

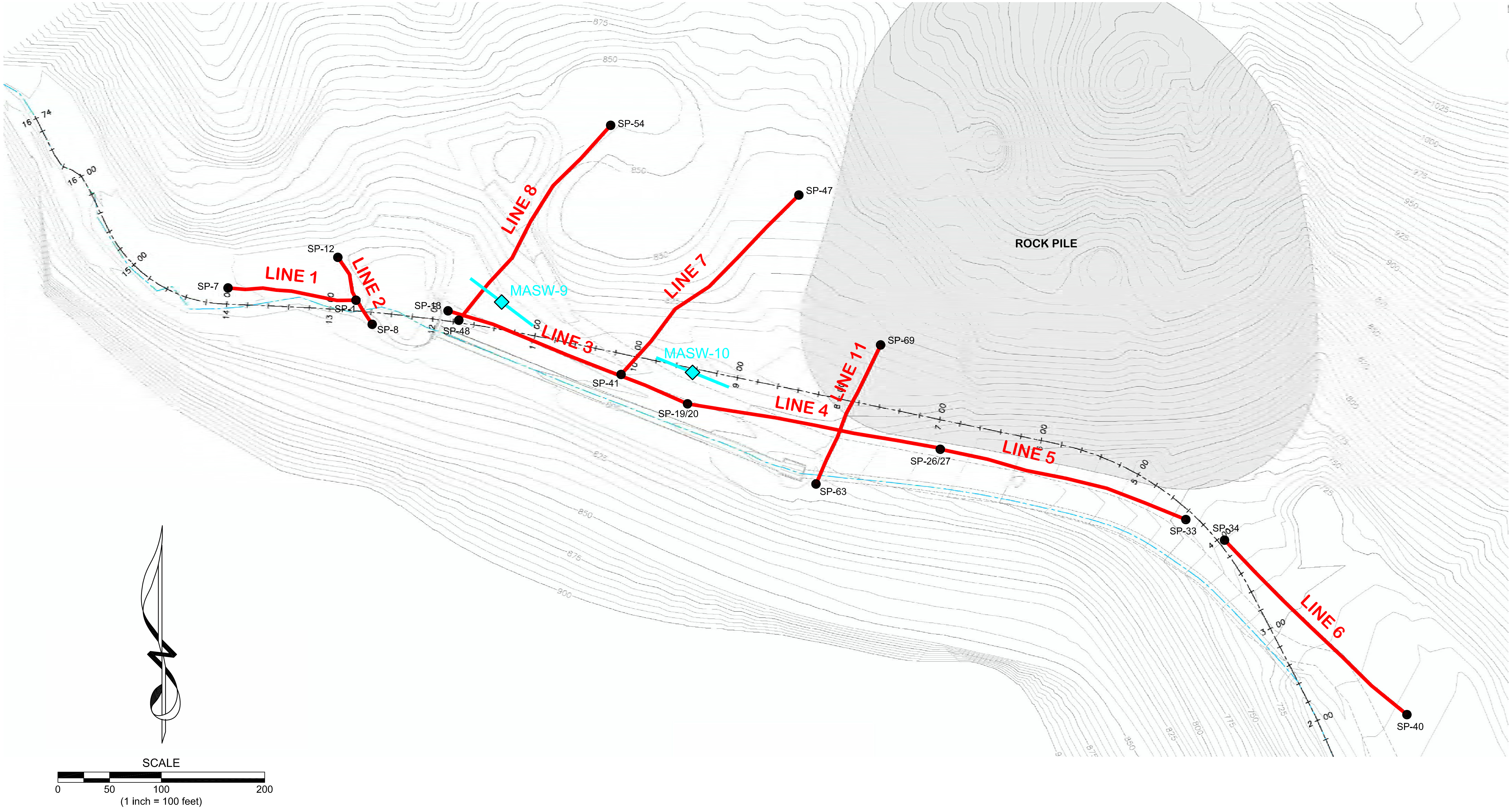
Respectfully,

NORCAL Geophysical Consultants, Inc.

William J Henrich
Professional Geophysicist PGp 893

WEB/tlt

Enclosures: Plates 1A, 1B and 2 through 8
Appendix A - Seismic Refraction (SR)
Appendix B – Multi-channel Analysis of Surface Waves (MASW)



LEGEND

(red line)	SEISMIC REFRACTION LINE
● SP-1	SHOT POINT LOCATION
(cyan line with diamond)	CENTER POINT OF MASW LINE

NOTE: BASE MAP PROVIDED BY WATERWAYS CONSULTING, INC.

NORCAL

SITE LOCATION MAP
PERMANENTE QUARRY AREA 11
SEISMIC REFRACTION SURVEY

LOCATION: CUPERTINO, CALIFORNIA

CLIENT: GOLDER ASSOCIATES, INC.

NORCAL GEOPHYSICAL CONSULTANTS INC.

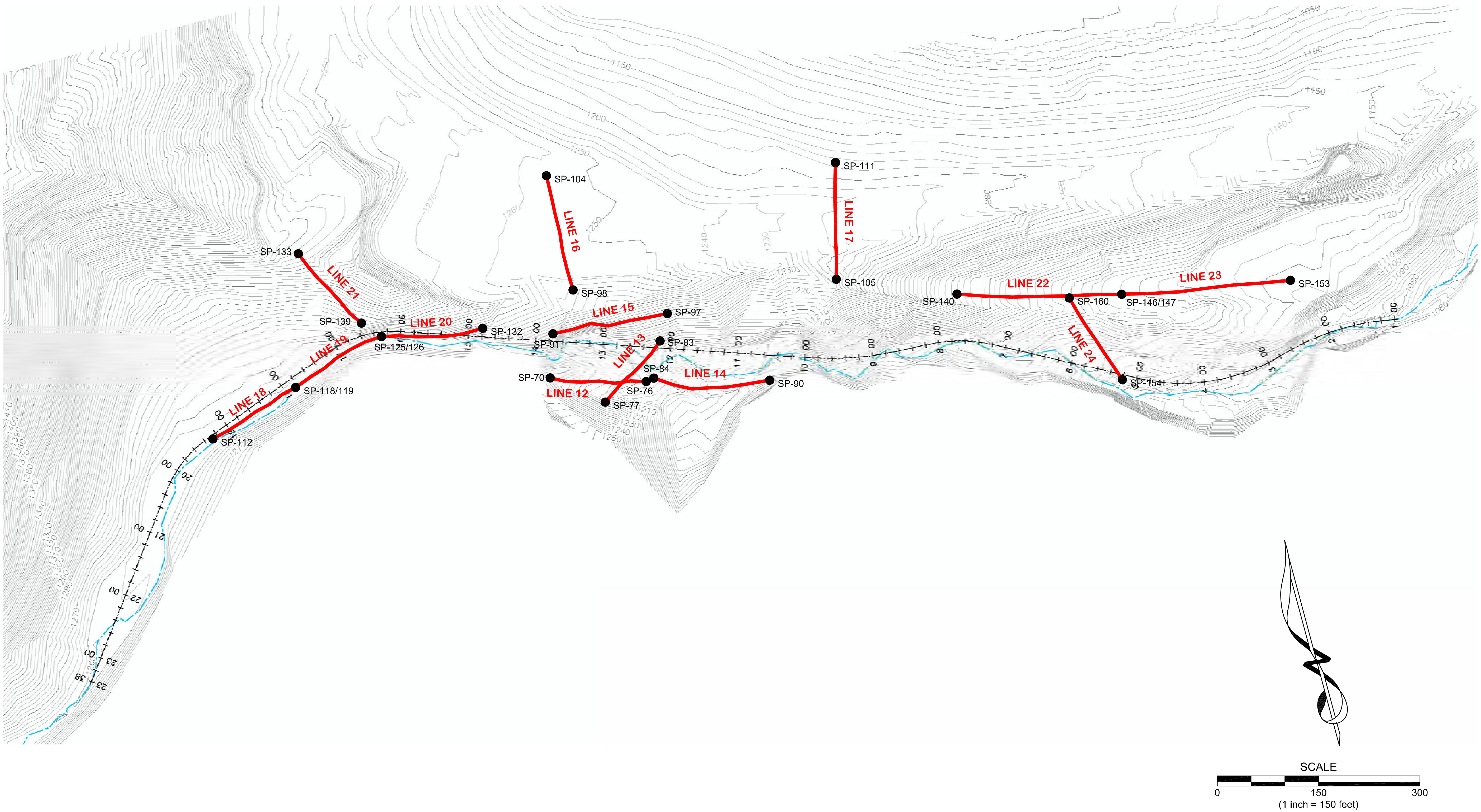
JOB #: 14-245.15B

DATE: MAY 2014

DRAWN BY: G.RANDALL

APPROVED BY: WJH

PLATE 1A



LEGEND	
(red line)	SEISMIC REFRACTION LINE
● SP-1	SHOT POINT LOCATION

NOTE: BASE MAP PROVIDED BY WATERWAYS CONSULTING, INC.

NORCAL

SITE LOCATION MAP
PERMANENTE QUARRY AREA 4
SEISMIC REFRACTION SURVEY

LOCATION: CUPERTINO, CALIFORNIA

CLIENT: GOLDER ASSOCIATES, INC.

PLATE 1B

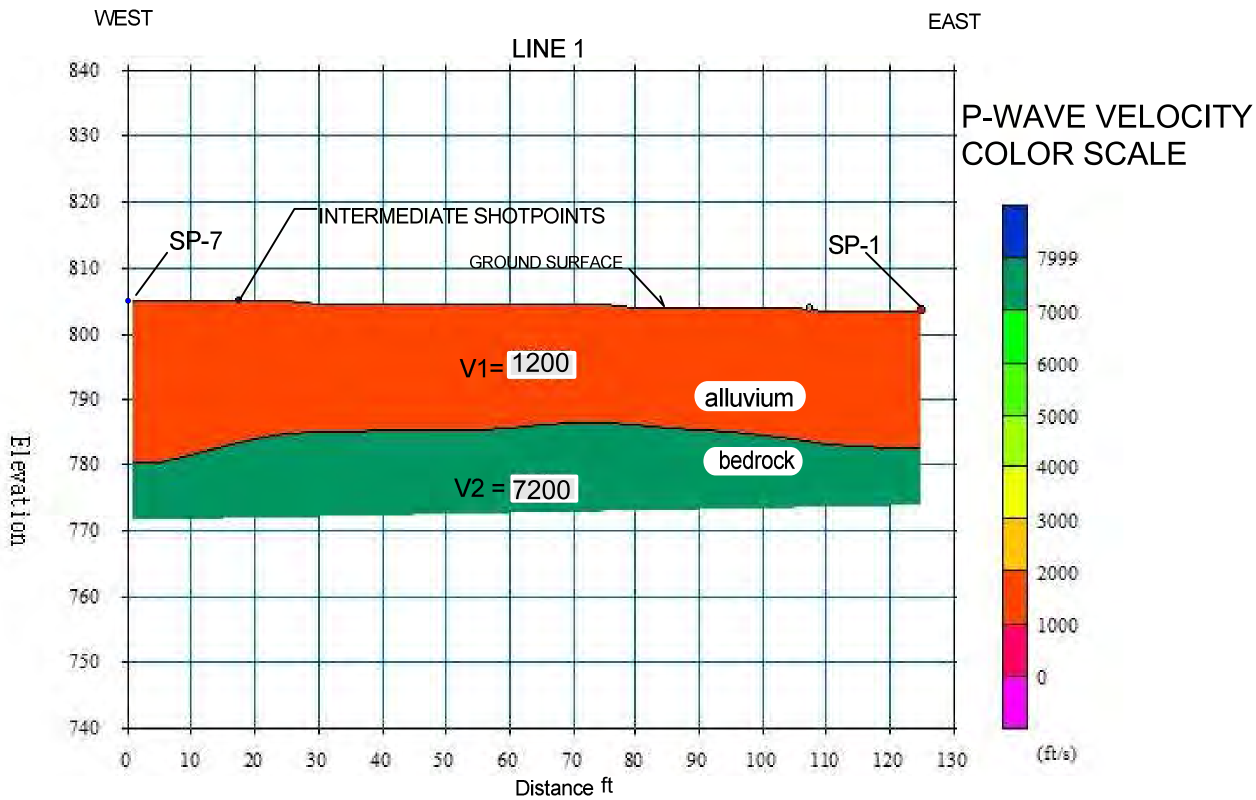
JOB #: 14-245.15B

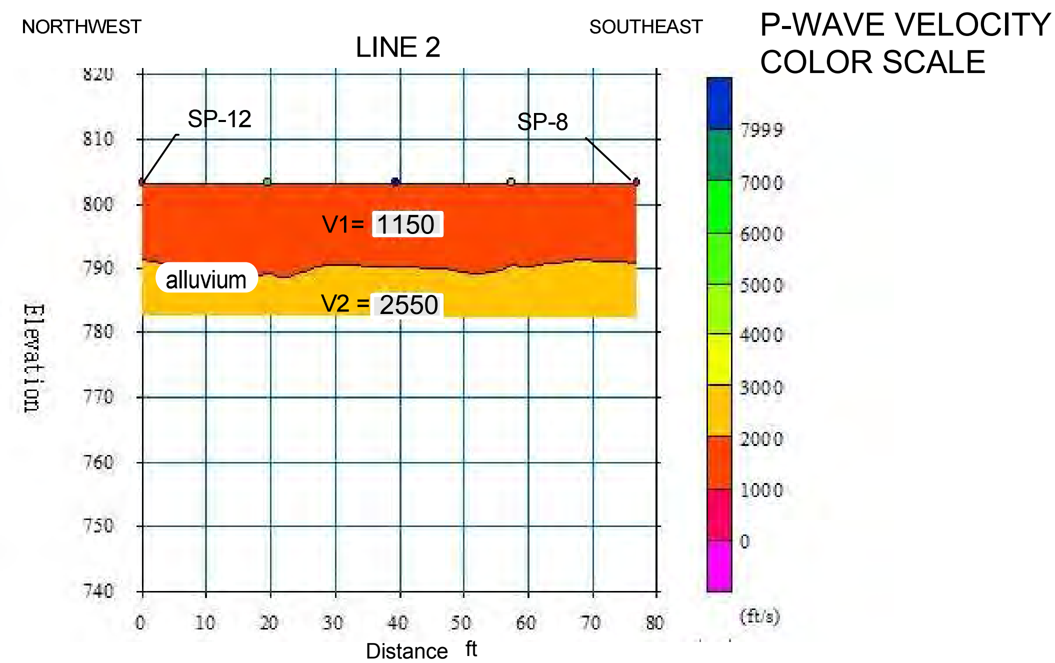
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: MAY 2014

DRAWN BY: G.RANDALL

APPROVED BY: WJH





EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

Horizontal/Vertical Scale 1' = 30 feet

NORCAL

SEISMIC REFRACTION
PROFILES LINES 1 AND 2

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

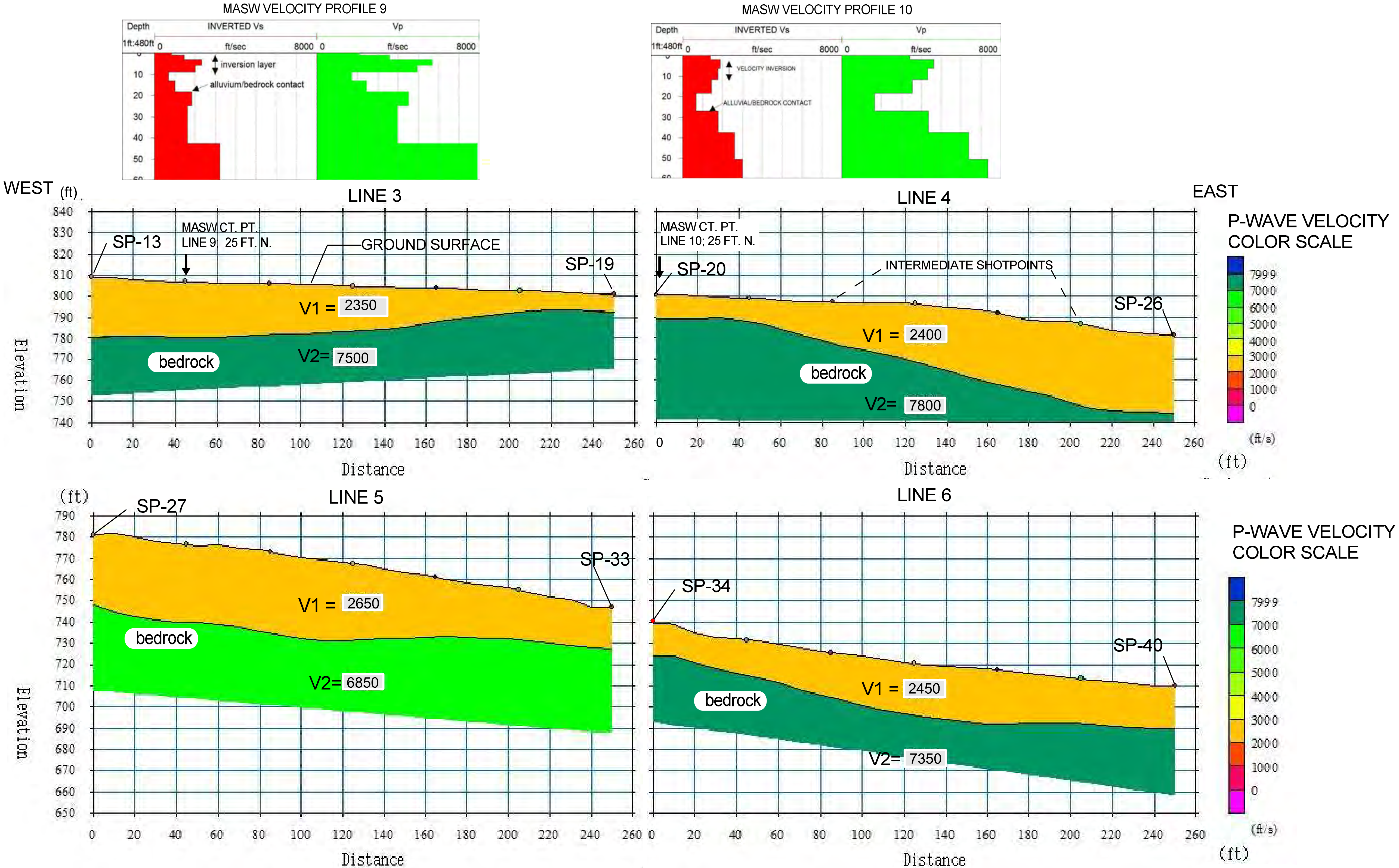
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: APRIL, 2014

DRAWN BY: W HENRICH

APPROVED BY: WJH

PLATE 2



EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: 1" APPROX. EQUALS 50 FEET

NORCAL

SEISIMC REFRACTION PROFILES
LINES 3, 4, 5 AND 6;
MASW PROFILES 9 AND 10

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC

JOB #: 14-245.15B

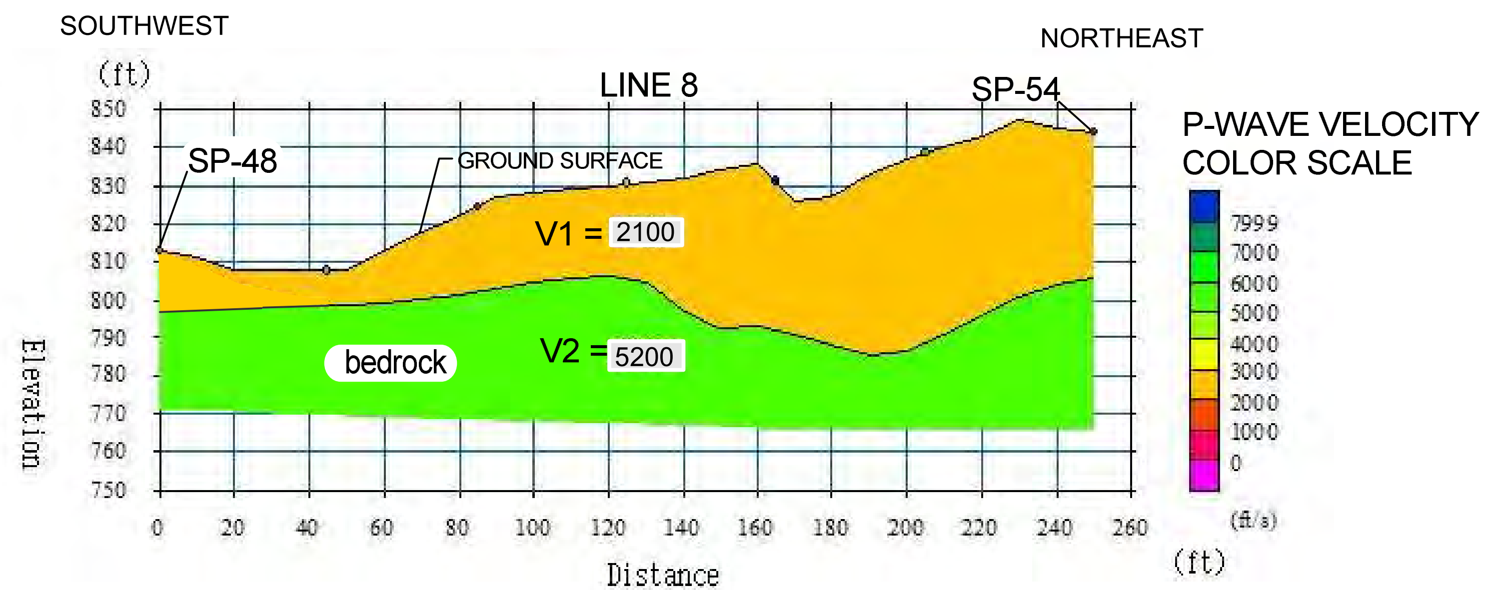
NORCAL GEOPHYSICAL CONSULTANTS INC.

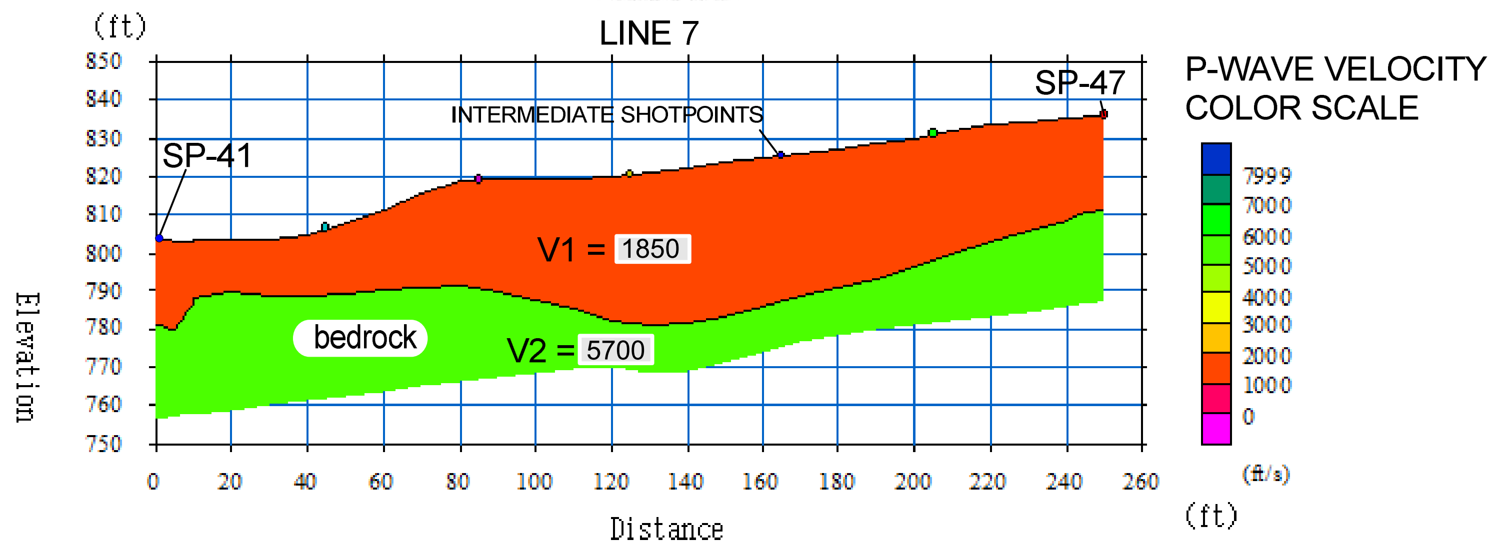
DATE: APRIL, 2014

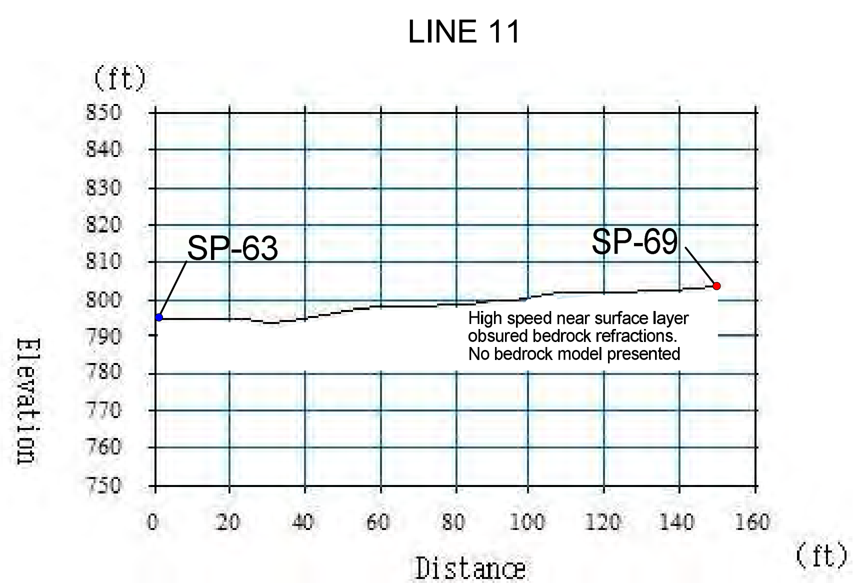
DRAWN BY: W. HENRICH

APPROVED BY: WJH

PLATE 3







EXPLANATION

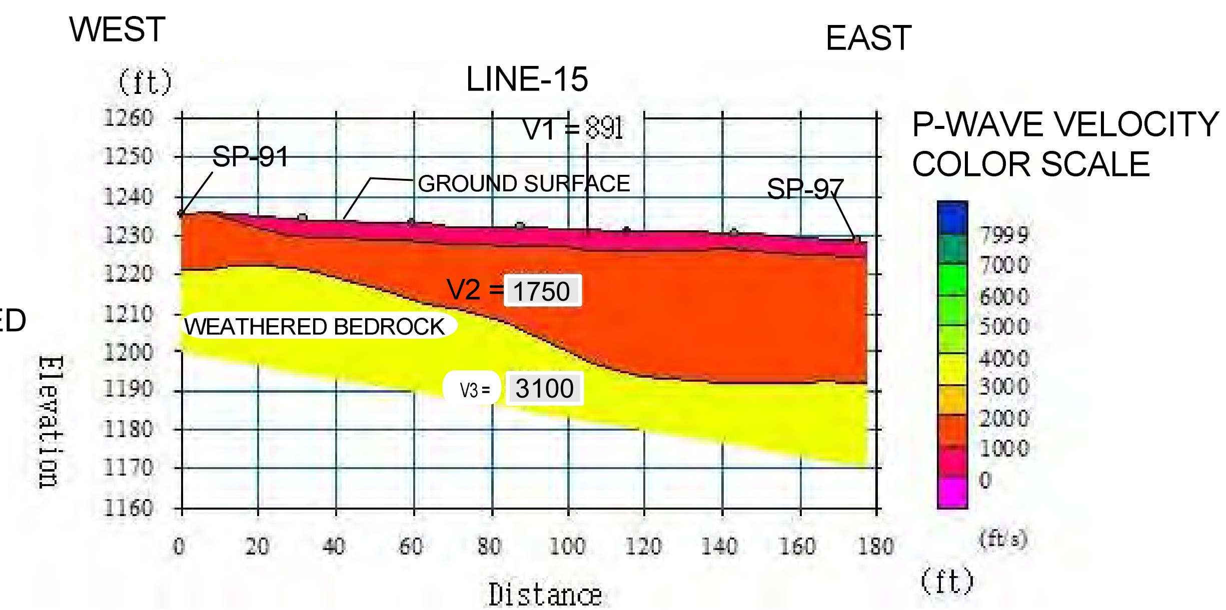
V2 = 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL 50 FEET

NORCAL	SEISIMC REFRACTION PROFILES LINES 7, 8, AND 11
	LOCATION: PERMANENTE QUARRY, CUPERTINO, CA
	CLIENT: GOLDER ASSOCIATES, INC
JOB #: 14-245.15B	NORCAL GEOPHYSICAL CONSULTANTS INC.
DATE: APRIL, 2014	DRAWN BY: W. HENRICH — APPROVED BY: WJH

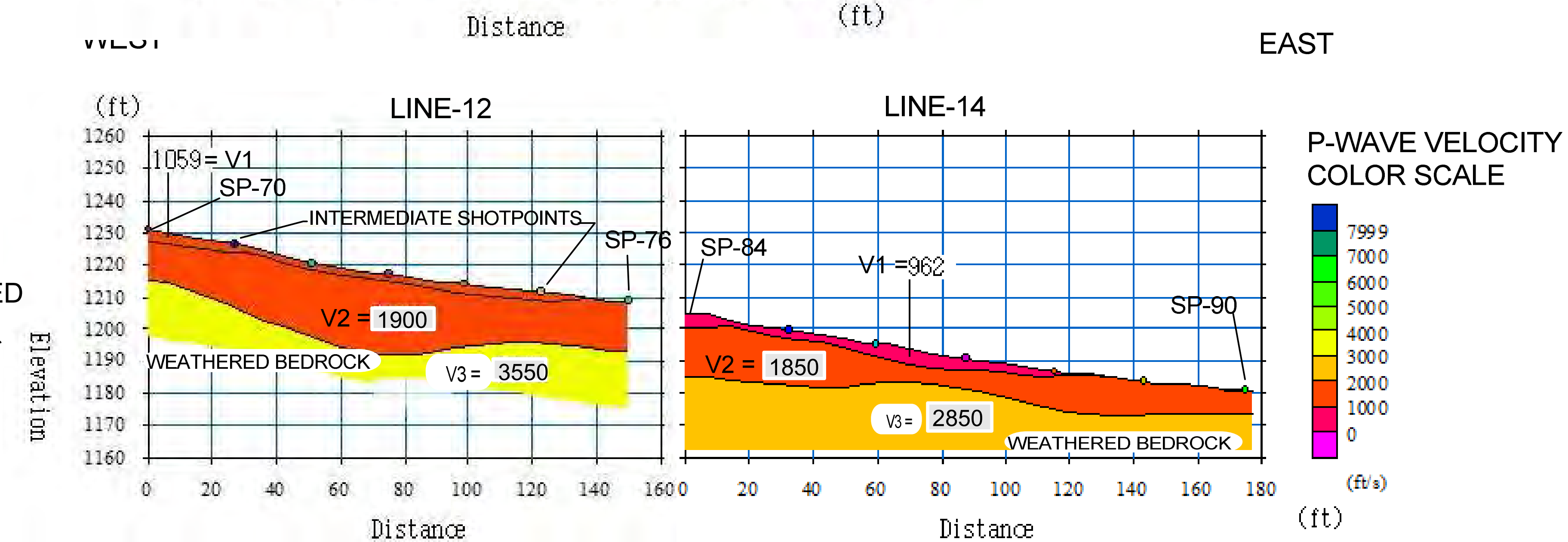
PLATE 4

UPSLOPE OF STREAM BED

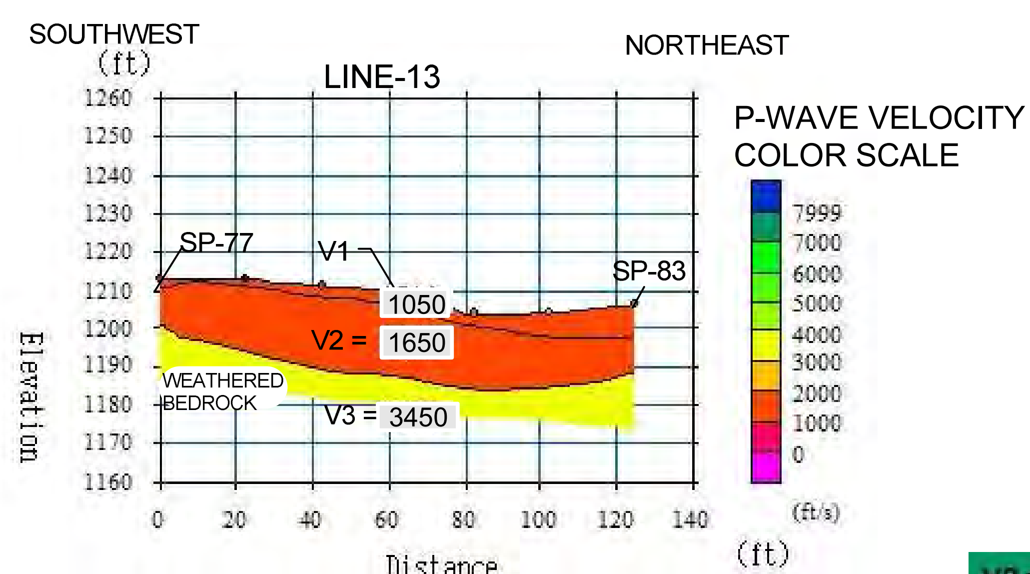


ALONG STREAMBED

DOWN STREAM



CROSS LINE INTERSECTS LINE 12

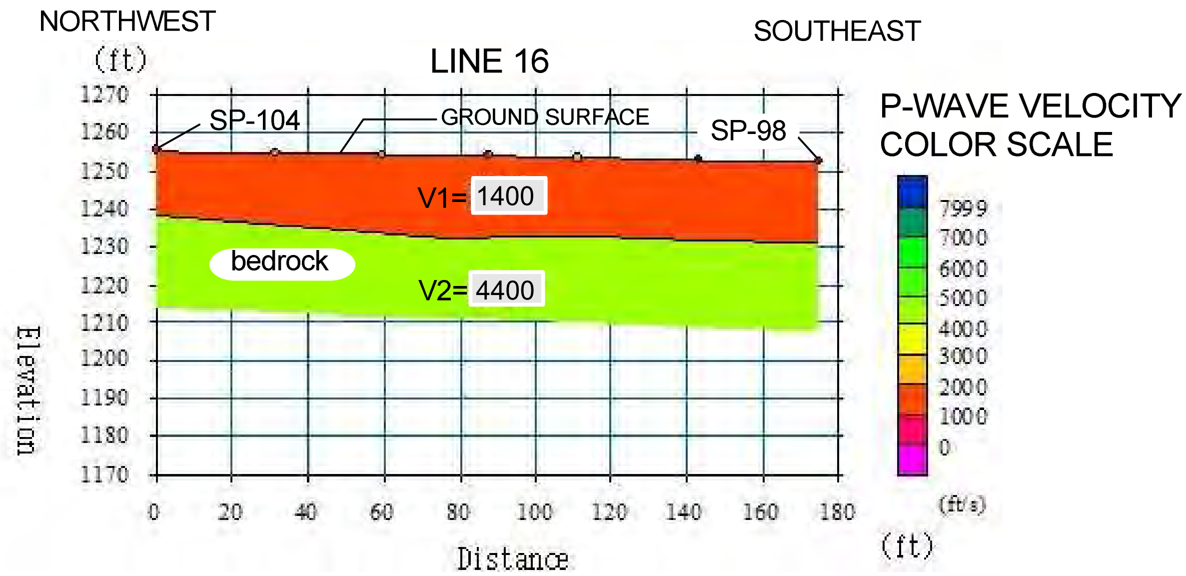


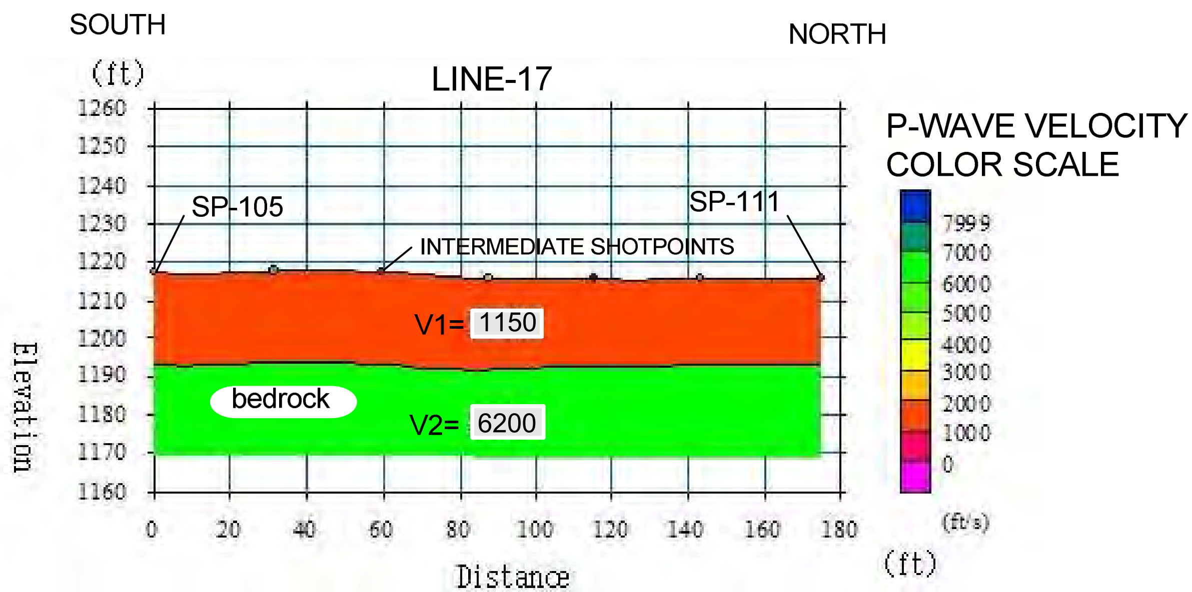
EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL TO 50 FEET

NORCAL	SEISIMC REFRACTION PROFILES LINES 12, 13, 14, AND 15	
	LOCATION: PERMANENTE QUARRY, CUPERTINO, CA	
	CLIENT: GOLDER ASSOCIATES, INC	PLATE 5
JOB #: 14-245.15B	NORCAL GEOPHYSICAL CONSULTANTS INC.	
DATE: APRIL, 2014	DRAWN BY: W. HENRICH / APPROVED BY: WJH	





EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL TO 50 FEET

NORCAL

SEISMIC REFRACTION
PROFILES LINES 16 AND 17

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

NORCAL GEOPHYSICAL CONSULTANTS INC.

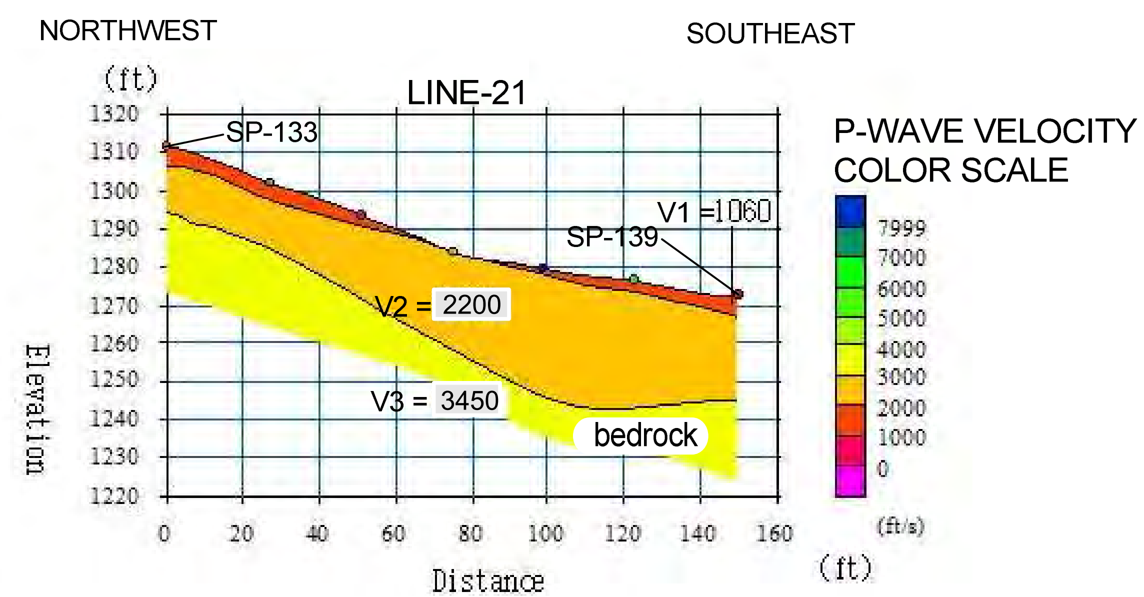
DATE: APRIL, 2014

DRAWN BY: W HENRICH

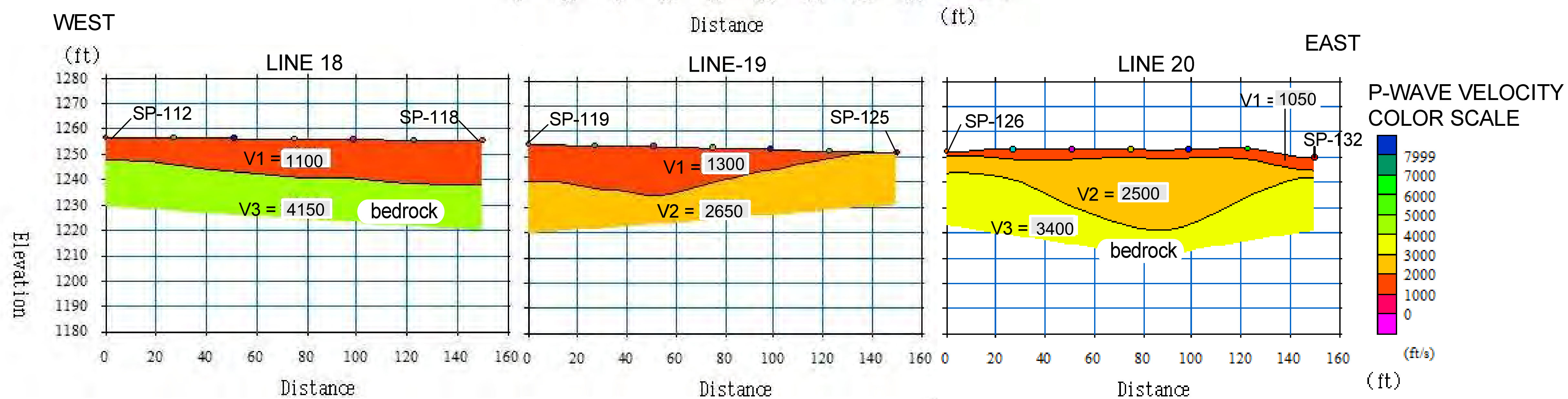
APPROVED BY: WJH

PLATE 6

UPSLOPE OF STREAM BED



SEISMIC LINES ALONG STREAM BED



DOWNSTREAM →

EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL 50 FEET

NORCAL

SEISMC REFRACTION PROFILES LINES 18, 19, 20 AND 21

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC

JOB #: 14-245.15B

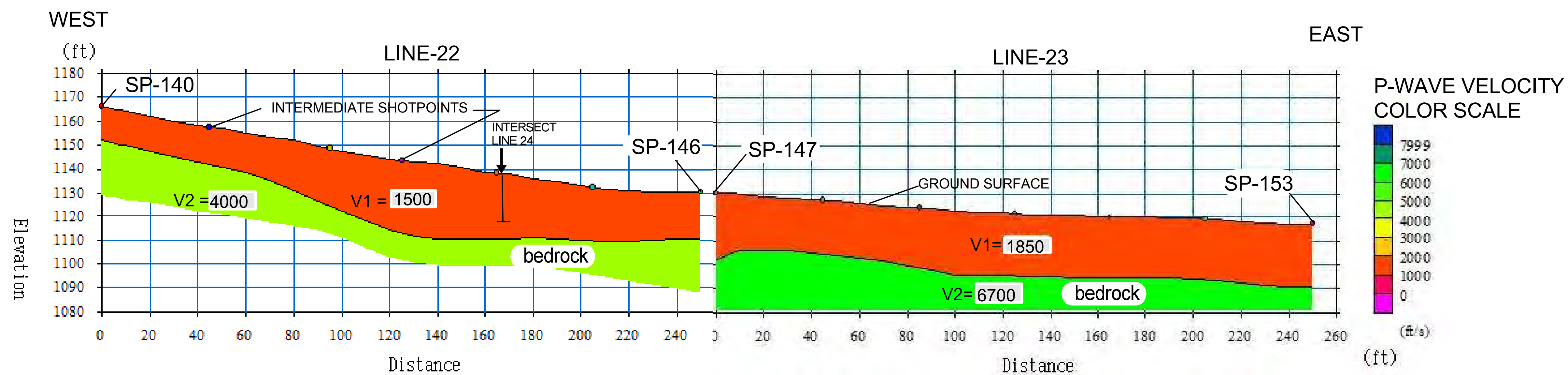
NORCAL GEOPHYSICAL CONSULTANTS INC.

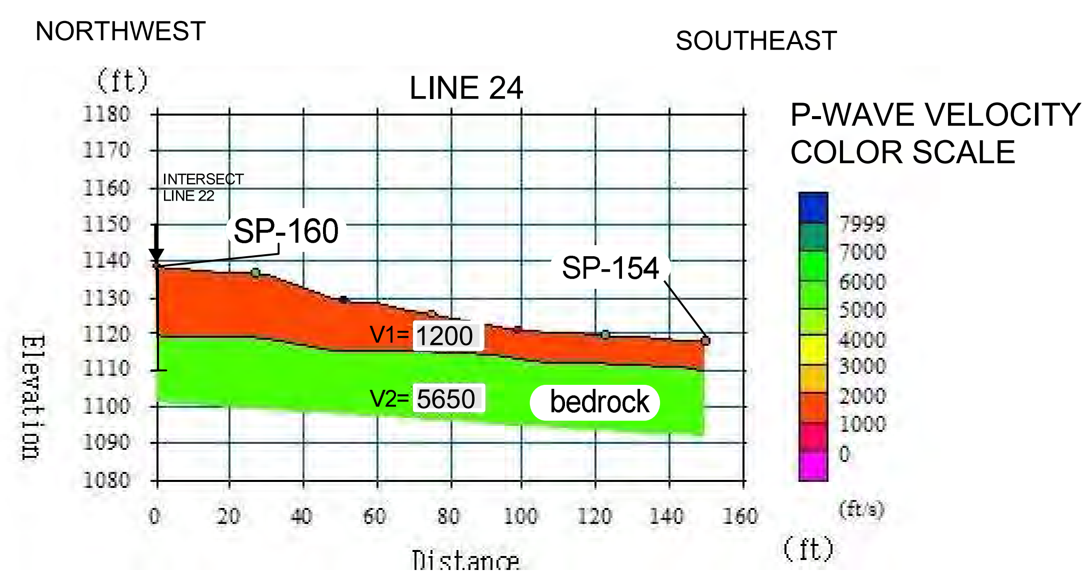
DATE: APRIL, 2014

DRAWN BY: W. HENRICH

APPROVED BY: WJH

PLATE 7





EXPLANATION

V2 = 7200 Velocity Layer in ft/sec

NORCAL

SEISMIC REFRACTION PROFILES LINES-22, -23 and -24

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA		PLATE 8
CLIENT: GOLDER ASSOCIATES, INC		
JOB #: 14-245.15B	NORCAL GEOPHYSICAL CONSULTANTS INC.	
DATE: APRIL, 2014	DRAWN BY: W. HENRICH	APPROVED BY: WJH

Appendix A

SEISMIC REFRACTION (SR)

SEISMIC REFRACTION (SR)

1.0 METHODOLOGY

The seismic refraction method provides information regarding the seismic velocity structure of the subsurface. An impulsive (mechanical or explosive) source is used to produce compressional (P) wave seismic energy. The P-waves propagate into the earth and are refracted along interfaces caused by an increase in velocity. A portion of the P-wave energy is refracted back to the surface where it is detected by sensors (geophones) that are coupled to the ground surface in a collinear array (spread). The detected signals are recorded on a multi-channel seismograph and are analyzed to determine the shot point-to-geophone travel times. These data can be used along with the corresponding shot point-to-geophone distances to determine the depth, thickness, and velocity of subsurface seismic layers.

The seismic refraction technique is based on several assumptions. Paramount among these are that seismic velocity:

1) Increases with depth, and,
2) Is uniform within each layer over the length of the given spread.

In cases where these assumptions do not hold, the accuracy of the technique decreases. For example, if a low velocity layer occurs between two layers of higher velocity, the low velocity layer will not be detected and the depth to the underlying high velocity layer will be erroneously large. Also, if the velocity of a seismic layer varies laterally within a spread, those variations will be interpreted as fluctuations in the elevation of the underlying seismic layer.

2.0 DATA ACQUISITION/INSTRUMENTATION

Each SR line consisted of 24-geophones and 7-shot points distributed in a collinear array (spread). In most areas, the geophones were coupled to the ground surface by metal spike affixed to the bottom of each geophone case. In areas where the ground surface was too hard to penetrate (e.g. the road) the geophones were mounted on weighted pedestals that coupled them to the ground by their weight. The geophone intervals ranged from 3- to 10-ft depending on access. For each spread, the two end shot points were located one-geophone spacing beyond the end geophone at both ends of the spread. The remaining five shot points were evenly spaced along the spread. This distribution of shot points and geophones yielded total draped line lengths (end-geophone to end-geophone) ranging from 77- to 250-ft. The SR survey was designed to target the upper 15 to 50 feet of geologic material beneath each line, generally consisting of native soil, fill (mine waste) alluvium/stream deposits, weathered and un-weathered bedrock.

Data acquisition was initiated along each SR line by producing seismic energy using a mechanical source. Seismic energy was produced by impacting a metal strike plate on the ground surface with a 12-16 pound sledge hammer. The resulting seismic waveforms are recorded using a Geometrics ***Geode*** 24-channel engineering distributed array seismograph and Mark Products geophones with a natural frequency of 8-Hz. The seismic waveforms were digitized, processed and amplified by the Geode and transmitted via a ruggedized Ethernet cable to a field computer. There the data were archived for subsequent processing and displayed on the computers LCD screen in the form of seismograms. These were subsequently used to determine the time required for P-waves to travel from each shot point to each geophone in a given array (spread).

3.0 DATA ANALYSIS

The recorded seismic data were processed using the software package ***SeisImager*** which was written by Oyo Corporation (Japan) and distributed by Geometrics Inc. The first stage of seismic processing included compilation (7 shot points per line) and identification of first arriving P-wave energy. This process was conducted using ***Pickwin, Version 3.2.0.1*** (2004), which is part of the ***SeisImager*** package. A second interactive program ***Plotrefa, Version 2.8.0.1*** (2006) was used to assign geophone travel times, geophone/shot point surface elevations and velocity layer assignments to compute a 2D seismic velocity model based on these inputs. Example Time-Distance graph from a 7 shot point refraction line and inverted seismic layer model are presented in the following figures.

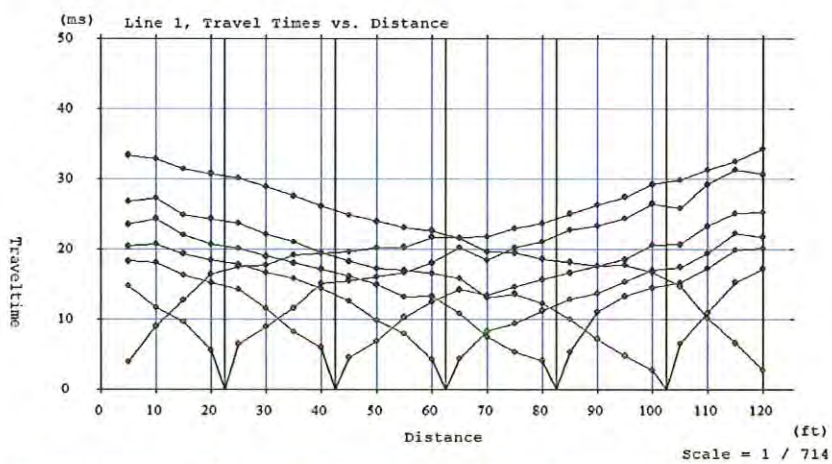


Figure 1 Example SR Time-Distance Graph, 24-geophones; 7 equal spaced shot points

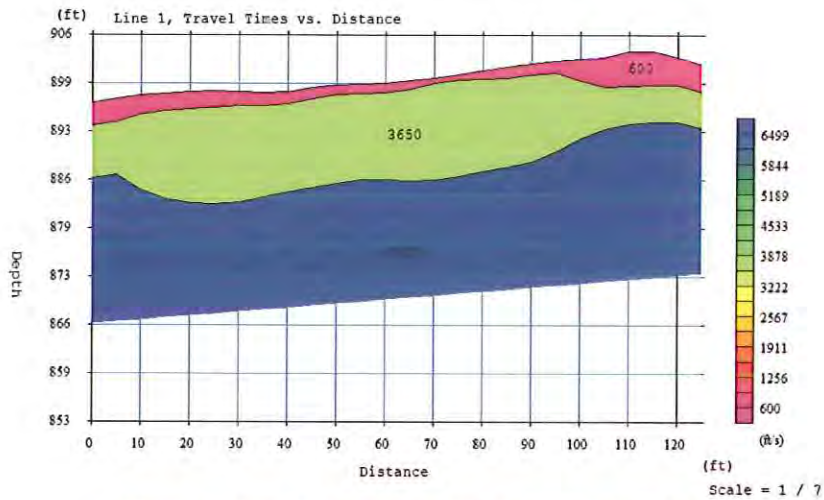


Figure 2 Time-Term Inverted Seismic Velocity Model

For this survey we have chosen an inversion routine that is based on the time-term method. The time-term method employs a combination of linear least squares and delay time analysis to invert the first arrivals into a velocity model. The model can consist of two or three velocity layers depending on the presence of significant line slopes that can be fitted to the first arrival times. Depths to the tops of the velocity layers are calculated below each geophone. For end and interior shot points the depths are extrapolated from the nearest geophone. This inversion as described above produces simplified velocity layers that, though generalized, will provide an adequate, useable characterization of the depth to bedrock.

4.0 LIMITATIONS

In general, there are limitations unique to the SR method. These limitations are primarily based on assumptions that are made by the data analysis routine. First, the data analysis routine assumes that the velocities along the length of each spread are uniform. If there are localized zones within each layer where the velocities are higher or lower than indicated, the analysis routine will interpret these zones as changes in the surface topography of the underlying layer. A zone of higher velocity material would be interpreted as a low in the surface of the underlying layer. Zones of lower velocity material would be interpreted as a high in the underlying layer.

Second, the data analysis routine assumes that the velocity of subsurface materials increase with depth. Therefore, if a layer exhibits velocities that are slower than those of the material above it, the slower layer will not be resolved. Also, a velocity layer may simply be too thin to be detected. Due to these and other limitations inherent to the SR method, the results of the SR survey should be considered only as approximations of the subsurface conditions. The actual conditions may vary locally. Other independent data (e.g., surface and borehole geology) should be integrated with SR data to enhance the subsurface interpretation.

NORCAL

Appendix B

MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

1.0 METHODOLOGY

When seismic energy is generated at or near the ground surface, seismic waves are produced. Those that travel along the ground surface are referred to as ground roll or surface waves. Those that propagate into the earth are referred to as body waves. When a vertical impact seismic energy source is used, the resulting surface waves account for more than two-thirds of the energy that is produced. As a result, surface waves are the most prominent signal on multi-channel seismic records. In addition, surface waves have dispersion properties that body waves lack. That is, different wavelengths have different penetration depths and, therefore, propagate at different velocities. This is referred to as dispersion. Since surface waves travel at 0.9 times the velocity of S-waves, it is possible to determine subsurface Vs by analyzing the dispersion of surface waves. Furthermore, since S-wave velocities are directly proportional to shear modulus, this provides a direct indication in the variation of stiffness (or rigidity) of subsurface materials.

Computer software and processing techniques developed by researchers at the University of Kansas have made it possible to analyze surface waves using a large number of shot points and geophones. This is referred to as multi-channel analysis of surface waves (MASW). Surface wave data are gathered in much the same way as high resolution seismic reflection data. Seismic energy generated by vertical impacts on the ground surface is detected by an array of closely spaced geophones (spread). The energy source and the geophones are sequentially moved along a profile as the survey progresses.

The data gathered from each shot point are analyzed to determine the variation in surface wave velocity versus frequency (dispersion curve). Computer software then inverts the dispersion curve to determine the variation in Vs versus depth. The data gathered from multiple shot points and geophone locations can be collated to produce a two dimensional (2D) cross-section showing the variation in Vs with depth and distance beneath a line.

2.0 DATA ACQUISITION/INSTRUMENTATION

Soundings MASW-9 and -10 each comprised an array of 24-geophones distributed at 3-ft intervals in a collinear array (spread). Seismic energy was produced at four shot points on each spread through multiple impacts with a 12-pound sledge hammer against a metal strike plate placed on the ground surface. The shot points were positioned at distances of 3- and 12-ft beyond the end geophones at both ends of each spread. The resulting seismic waveforms were recorded using a Geometrics ***Geode*** 24-channel distributed array seismograph and Oyo ***Geospace*** geophones with a natural frequency of 8-Hz. The seismograph was networked to a field computer where the data were displayed on a LCD screen for QA/QC review and archived for subsequent processing.

3.0 DATA ANALYSIS

The MASW data were processed using the software package ***SurfSeis 2.05*** which was developed by the Kansas Geological Survey. Using this software, the data acquired from each shot point were processed to develop an overtone display. This is a color contoured plot that depicts phase velocity as a function of frequency and signal amplitude. The overtone display serves as a guide in nominating the dispersion curve that is used by the inversion routine. However, prior to nominating the dispersion curve, the four overtones were merged into one in order to increase the signal to noise ratio and maximize the continuity of the display. The merged and enhanced overtone was then used as a guide in nominating the dispersion curve used in the inversion process. At the onset of the inversion routine the software created a 1D model comprising 10-layers. Starting values of depth, thickness, Vp, Vs and Poisson's ratio (α) were assigned to each layer. The program then proceeded to refine the starting model through an iterative procedure in order to develop a 1D model that provided the best fit to the dispersion curve. In so doing, it was necessary that either Vp or α remain fixed during the inversion process. In this case, we opted to have α remain fixed, at a value of 0.4, so that the final model would provide the best indication of both Vp and Vs as a function of depth. The value of 0.4 was used for α because it is typical of most near surface earth materials.

APPENDIX D

Field Engineering Description for Permanente Creek Restoration Plan

Field Engineering Description for Permanente Creek Restoration Plan.

February 1, 2016

1. General. The Permanente Creek Restoration Plan, Draft 70% Design drawings, ("Drawings") were developed with the goal of creating more natural conditions, while maintaining a relatively uniform profile gradient within the proposed limits of disturbance to improve channel stability and enhance ecological function. The Drawings were prepared without full knowledge of subsurface conditions, including the elevation of underlying bedrock or alluvial materials that would indicate the location of the pre-disturbance channel profile in Reaches 18-17 and 13-11. The design approach will employ field engineering and a field directed construction approach to maximize channel stability, while avoiding excavation into native bedrock. The final constructed geometry will be directed by the engineer in the field, pending subsurface conditions, as described below.

1.1 The Rock Pile Area (Reaches 13-11) is expected to be constructed prior to the Material Removal Area. Experience gained from the field directed construction approach at the Rock Pile Area will be used to refine the design for the Material Removal Area.

2. Profile

2.1 General. The finished grade elevation of the flowline will generally fall between the upper and lower limits shown on the drawings, defined there as the "grading envelope," except where the location of existing bedrock requires deviation. The lower limit of the envelope is the optimum "straight grade" uniform profile within the proposed limits of work. The upper limit of the envelope is a best-fit line between identified points of bedrock control, as estimated from recent subsurface investigations. The construction will attempt to follow the lower limit of the envelope, subject to the constraints set forth below.

2.2 Bedrock.

A. General. The qualification of material as "bedrock" will be initially performed by the project geotechnical engineer. If the project geotechnical engineer determines that excavation to bedrock has occurred prior to reaching the lowest elevation at any location within the grading envelope, an independent professional geologist will assess and make the final determination of the existence and extent of any such bedrock. Where bedrock is encountered above the lower limit of the grading envelope, the profile will not be excavated into the bedrock. An inspection trench will be constructed across the channel, within the potential cross section limits (between the adjacent hill slopes), to ensure that bedrock is continuous. The channel alignment will follow the low point of the bedrock, to the extent that this is feasible while maintaining a geomorphically appropriate planform alignment, and while remaining within the lateral limits described below. Upstream of bedrock control points, the lower limit of the profile will be subject to the minimum design profile gradient, as specified below.

B. Minimum Design Profile Gradient. Upstream of bedrock controls, the minimum design profile grade will be set to 4%, to help maintain sediment transport continuity and channel stability.

C. The constructed profile gradient between bedrock outcrops will not exceed 12.0%.

2.3 Alluvial materials. Where the original "pre-disturbance" streambed is identified by the presence of significant alluvial deposits, the design profile will not be constructed below the elevation of these deposits, provided the specified minimum and maximum profile grade criteria are met. Temporary excavations will not extend below the design profile any more than is necessary to construct the engineered streambed material shown on the design drawings.

3. Cross Section geometry

A. Active Channel. The low flow cross section geometry will be informed by regional analogs and refined based on the local profile gradient within each constructed reach. Cross section details will closely resemble the range of typical sections shown on the Drawings, except where influenced by the presence of bedrock as discussed above.

B. Floodplain. The floodplain widths will be maximized within the constraint of maintaining the stability of the adjacent hillside and the need to accommodate roads shown on the Drawings. The stable design slope of the adjacent hillside will be determined by the geotechnical engineer, and will likely vary between 2H:1V and 1.5H:1V, as shown on the Drawings. Exposed bedrock may allow for steeper slopes, subject to approval of the geotechnical engineer. Where the final design profile approaches the lower limit of the grading envelope, the stability of adjacent hillsides will dictate a narrower floodplain width. Slope benching may be incorporated to reduce slope length, control surface runoff and help protect slopes from surface erosion while vegetation becomes established.

C. Where bedrock outcrops constrain the floodplain width, upstream and downstream floodplains will transition rapidly to conform to those restrictions and then return to the standard floodplain widths as described above.

APPENDIX E

Fish Passage Calculations

Manning's Roughness & Channel Hydraulics using Manning's Equation at a Station

Manning's Roughness Calculations

Project:	Permanente Quarry
Project #:	13-016
Date:	10/30/2018
Calculated by:	B.M.Z.
Checked by:	B.M.S.

Instructions: Enter variables in RED cells only

Design equations to determine roughness coefficient of typical roughened channel section at <u>adult</u> fish passage design flows.

Culvert #7 Replacement Area Slope = 3.9%

Fish Passage Low Flows (Q=2 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.039	
R =	0.32	ft
d =	0.38	ft
D_{84} =	2.3	ft
D_{50} =	1.2	ft
d/D_{84} =	0.17	

n= 0.22

Fish Passage High Flow (Q=4.1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.039	
R =	0.3	ft
d =	0.36	ft
D_{84} =	2.3	ft
D_{50} =	1.2	ft
d/D_{84} =	0.16	

n= 0.22

Culvert #8 Replacement Area Slope = 2.7%

Fish Passage Low Flows (Q=2 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.027	
R =	0.32	ft
d =	0.38	ft
D_{84} =	2	ft
D_{50} =	1	ft
d/D_{84} =	0.19	

n= 0.18

Fish Passage High Flow (Q=4.1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.027	
R =	0.42	ft
d =	0.49	ft
D_{84} =	2	ft
D_{50} =	1	ft
d/D_{84} =	0.25	

n= 0.17

Rock Pile/Material Removal Area Slope = 12%

Fish Passage Low Flows (Q=2 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.12	
R =	0.34	ft
d =	0.41	ft
D_{84} =	3	ft
D_{50} =	1.5	ft
d/D_{84} =	0.14	

n= 0.39

Fish Passage High Flow (Q=2.8 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.12	
R =	0.36	ft
d =	0.43	ft
D_{84} =	3	ft
D_{50} =	1.5	ft
d/D_{84} =	0.14	

n= 0.38

Use roughness of 0.25 (max from literature)

Note:
Julien (2002) reports typical boulder bed stream n-values ranging from 0.25 to 0.04

1.) Bathurst, J.C., 1985, Flow resistance estimation in mountain rivers, Journal of Hydraulic Engineering, ASCE, Vol. 111, No.4

2.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

3.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.

4.) Julien, P.Y. 2002. River Mechanics. Cambridge University Press, Cambridge, United Kingdon

Manning's Roughness Calculations

Project:	Permanente Quarry
Project #:	13-016
Date:	10/30/2018
Calculated by:	B.M.Z.
Checked by:	B.M.S.

Instructions: Enter variables in RED cells only

Design equations to determine roughness coefficient of typical roughened channel section at <u>juvenile</u> fish passage design flows.

Culvert #7 Replacement Area Slope = 3.9%

Fish Passage Low Flows (Q=1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.039	
R =	0.28	ft
d =	0.35	ft
D_{84} =	2.3	ft
D_{50} =	1.2	ft
d/D_{84} =	0.15	

n= 0.22

Fish Passage High Flow (Q=1.5 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.039	
R =	0.32	ft
d =	0.38	ft
D_{84} =	2.3	ft
D_{50} =	1.2	ft
d/D_{84} =	0.17	

n= 0.22

Culvert #8 Replacement Area Slope = 2.7%

Fish Passage Low Flows (Q=1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.027	
R =	0.26	ft
d =	0.32	ft
D_{84} =	2	ft
D_{50} =	1	ft
d/D_{84} =	0.16	

n= 0.19

Fish Passage High Flow (Q=1.5 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.027	
R =	0.29	ft
d =	0.36	ft
D_{84} =	2	ft
D_{50} =	1	ft
d/D_{84} =	0.18	

n= 0.19

Rock Pile/Material Removal Area Slope = 12%

Fish Passage Low Flows (Q=1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.12	
R =	0.28	ft
d =	0.34	ft
D_{84} =	3	ft
D_{50} =	1.5	ft
d/D_{84} =	0.11	

n= 0.41

Fish Passage High Flow (Q=1 cfs)

Mussetter (1989)

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11 (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85} S^{-0.39}$

$n = 0.0926 R^{1/6} f^{1/2}$

Therefore: $\mathbf{n = 0.236 R^{1/6} (d/D_{84})^{-0.46} (D_{84}/D_{50})^{0.85} S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
d/D_{84} range (0.24 to 3.72)
D_{50} range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S =	0.12	
R =	0.28	ft
d =	0.34	ft
D_{84} =	3	ft
D_{50} =	1.5	ft
d/D_{84} =	0.11	

n= 0.41

Use roughness of 0.25 (max from literature)

Note:
Julien (2002) reports typical boulder bed stream n-values ranging from 0.25 to 0.04

1.) Bathurst, J.C., 1985, Flow resistance estimation in mountain rivers, Journal of Hydraulic Engineering, ASCE, Vol. 111, No.4

2.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

3.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.

4.) Julien, P.Y. 2002. River Mechanics. Cambridge University Press, Cambridge, United Kingdon

Channel Report

Adult High Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

User-defined

Invert Elev (ft)	= 0.02
Slope (%)	= 3.90
N-Value	= 0.200

Calculations

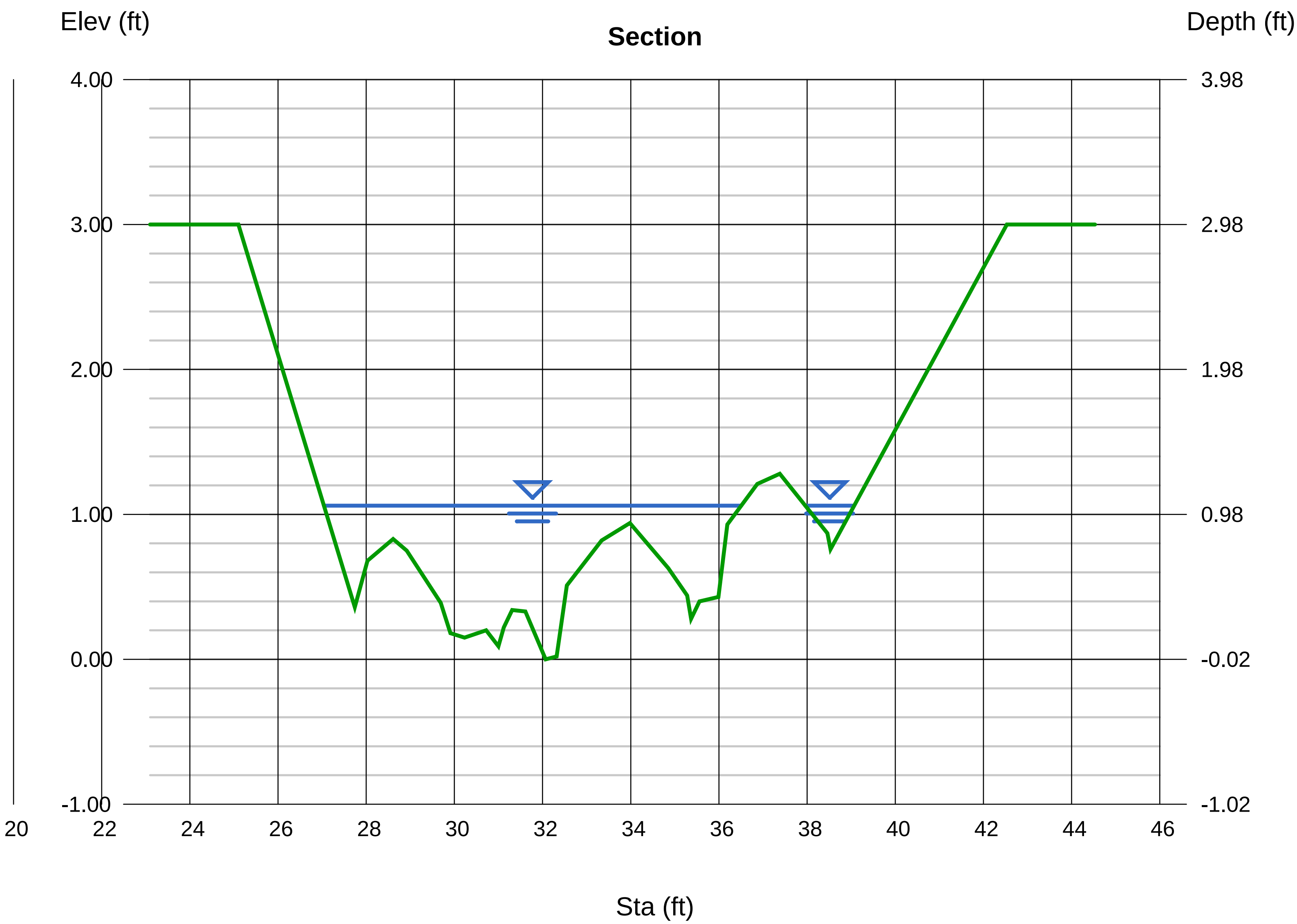
Compute by:	Known Q
Known Q (cfs)	= 4.10

Highlighted

Depth (ft)	= 1.04
Q (cfs)	= 4.100
Area (sqft)	= 5.13
Velocity (ft/s)	= 0.80
Wetted Perim (ft)	= 12.56
Crit Depth, Yc (ft)	= 0.57
Top Width (ft)	= 10.57
EGL (ft)	= 1.05

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(27.74, 0.36, 0.200)-(28.03, 0.68, 0.200)-(28.61, 0.83, 0.200)-(28.92, 0.75, 0.200)-(29.69, 0.39, 0.200)-(29.91, 0.18, 0.200)
-(30.23, 0.15, 0.200)-(30.72, 0.20, 0.200)-(31.00, 0.09, 0.200)-(31.12, 0.22, 0.200)-(31.31, 0.34, 0.200)-(31.61, 0.33, 0.200)-(32.32, 0.02, 0.200)
-(32.55, 0.51, 0.200)-(33.34, 0.82, 0.200)-(33.98, 0.94, 0.200)-(34.85, 0.63, 0.200)-(35.28, 0.44, 0.200)-(35.37, 0.28, 0.200)-(35.56, 0.40, 0.200)
-(35.99, 0.43, 0.200)-(36.19, 0.93, 0.200)-(36.87, 1.21, 0.200)-(37.38, 1.28, 0.200)-(38.46, 0.87, 0.200)-(38.53, 0.76, 0.200)-(42.53, 3.00, 0.200)



Channel Report

Adult Low Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

User-defined

Invert Elev (ft)	= 0.02
Slope (%)	= 3.90
N-Value	= 0.220

Calculations

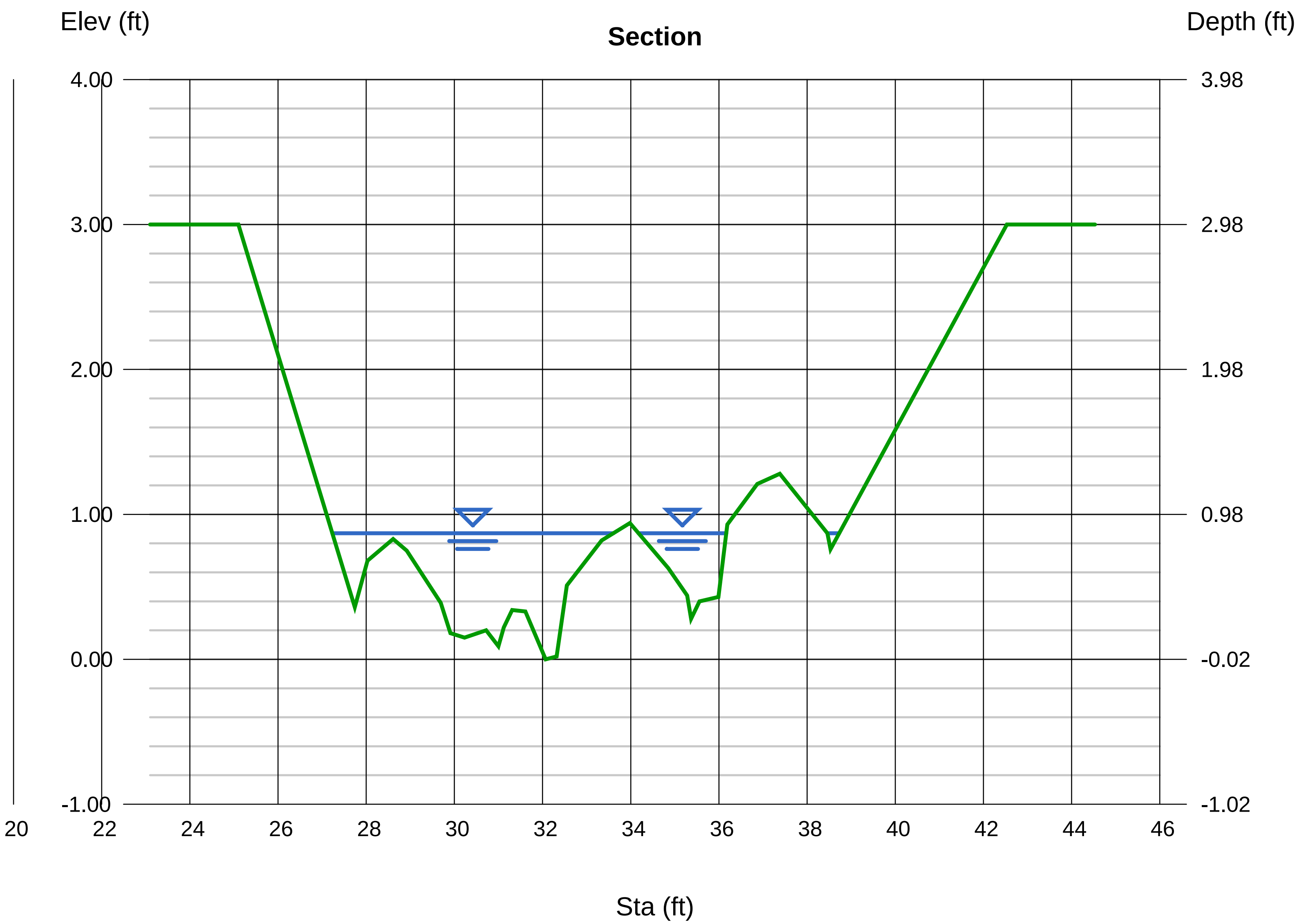
Compute by:	Known Q
Known Q (cfs)	= 2.00

Highlighted

Depth (ft)	= 0.85
Q (cfs)	= 2.000
Area (sqft)	= 3.28
Velocity (ft/s)	= 0.61
Wetted Perim (ft)	= 10.38
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 8.63
EGL (ft)	= 0.86

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(27.74, 0.36, 0.220)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)
-(30.23, 0.15, 0.220)-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)
-(32.55, 0.51, 0.220)-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)
-(35.99, 0.43, 0.220)-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



Channel Report

Juvenile High Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

User-defined

Invert Elev (ft)	= 0.02
Slope (%)	= 3.90
N-Value	= 0.220

Calculations

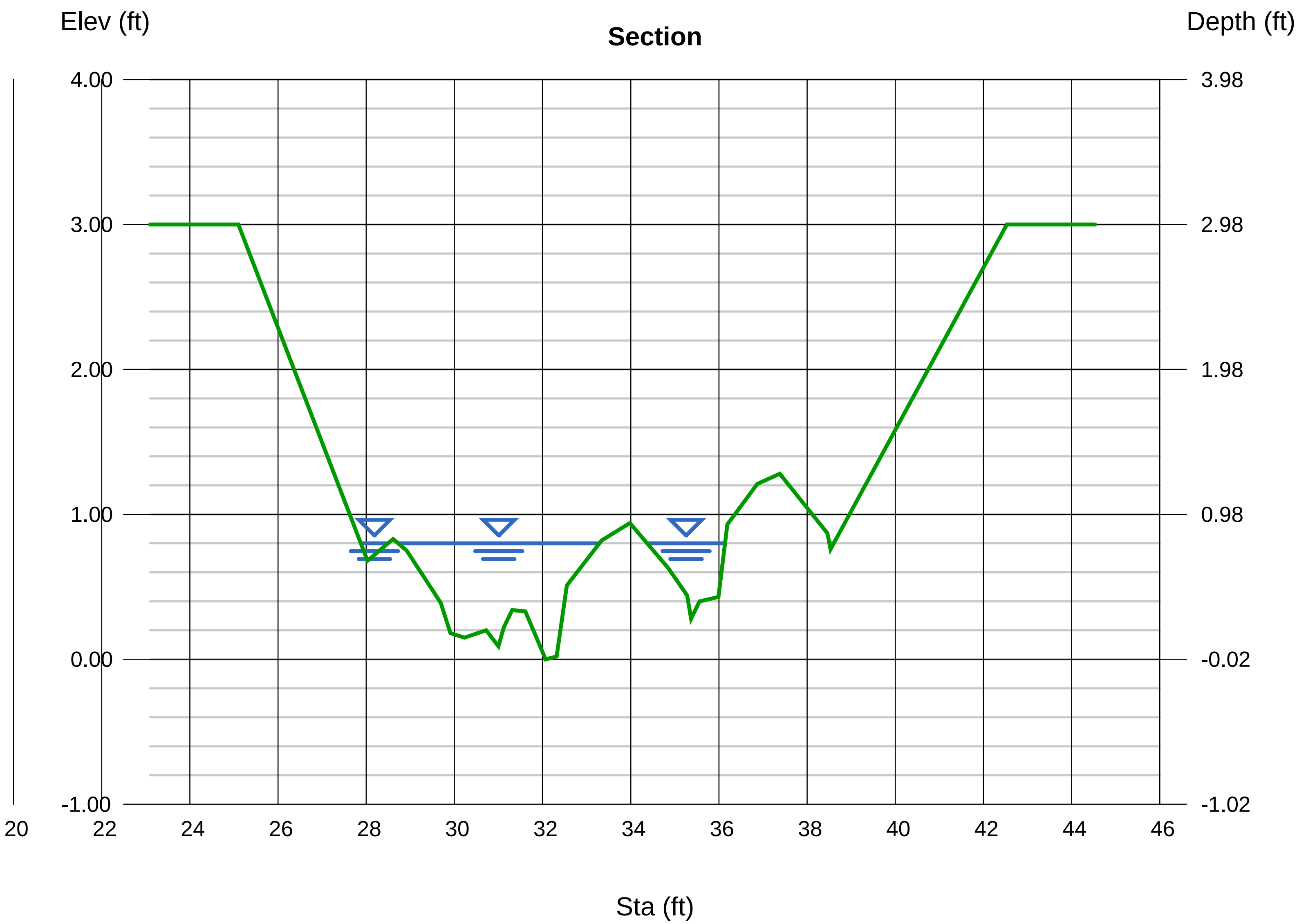
Compute by:	Known Q
Known Q (cfs)	= 1.50

Highlighted

Depth (ft)	= 0.78
Q (cfs)	= 1.500
Area (sqft)	= 2.54
Velocity (ft/s)	= 0.59
Wetted Perim (ft)	= 8.34
Crit Depth, Yc (ft)	= 0.38
Top Width (ft)	= 7.04
EGL (ft)	= 0.79

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)-(30.23, 0.15, 0.220)
-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)-(32.55, 0.51, 0.220)
-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)-(35.99, 0.43, 0.220)
-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



Channel Report

Juvenile Low Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

User-defined

Invert Elev (ft)	= 0.02
Slope (%)	= 3.90
N-Value	= 0.220

Calculations

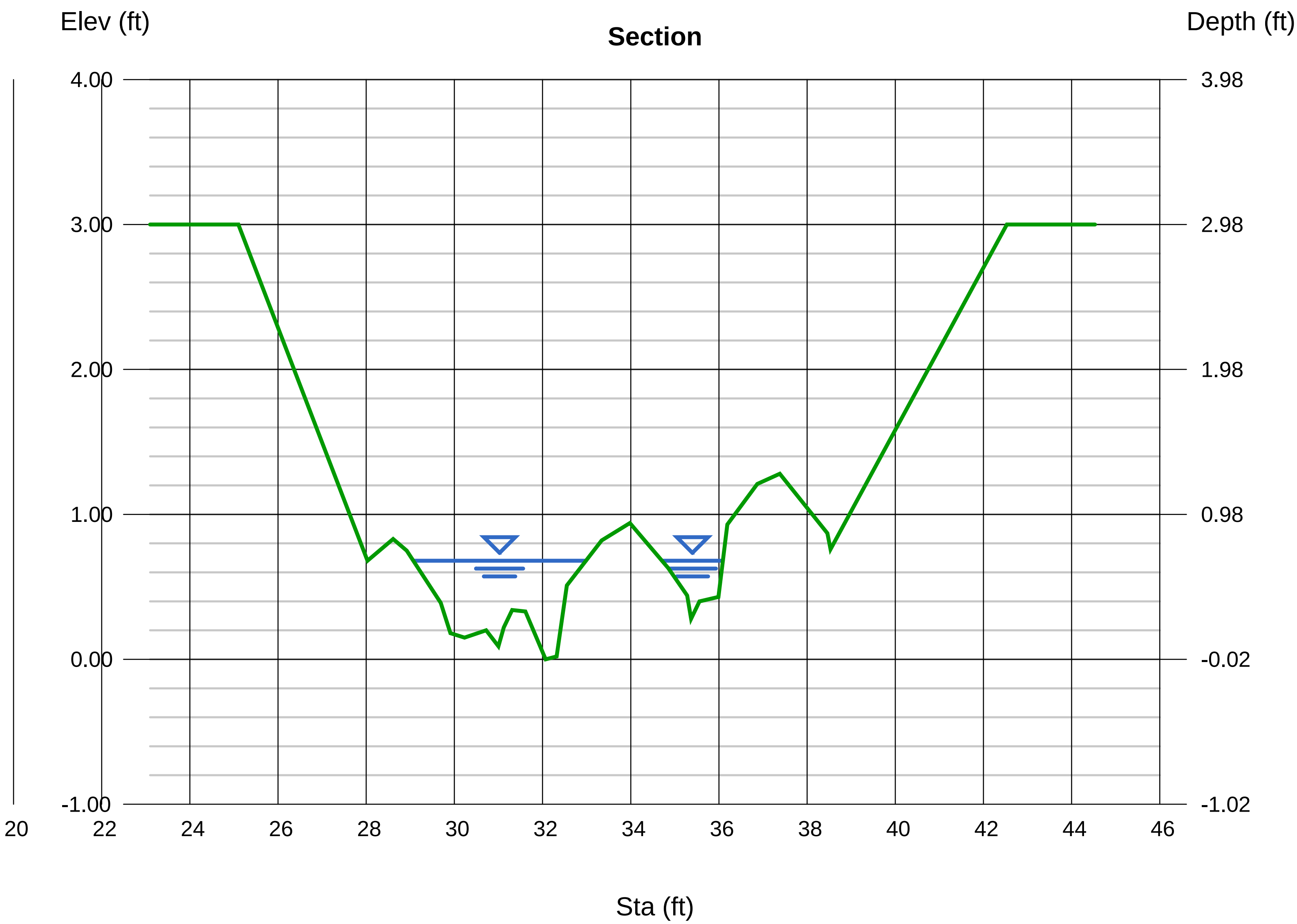
Compute by:	Known Q
Known Q (cfs)	= 1.00

Highlighted

Depth (ft)	= 0.66
Q (cfs)	= 1.000
Area (sqft)	= 1.80
Velocity (ft/s)	= 0.55
Wetted Perim (ft)	= 6.36
Crit Depth, Yc (ft)	= 0.33
Top Width (ft)	= 5.29
EGL (ft)	= 0.66

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)-(30.23, 0.15, 0.220)
-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)-(32.55, 0.51, 0.220)
-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)-(35.99, 0.43, 0.220)
-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



Channel Report

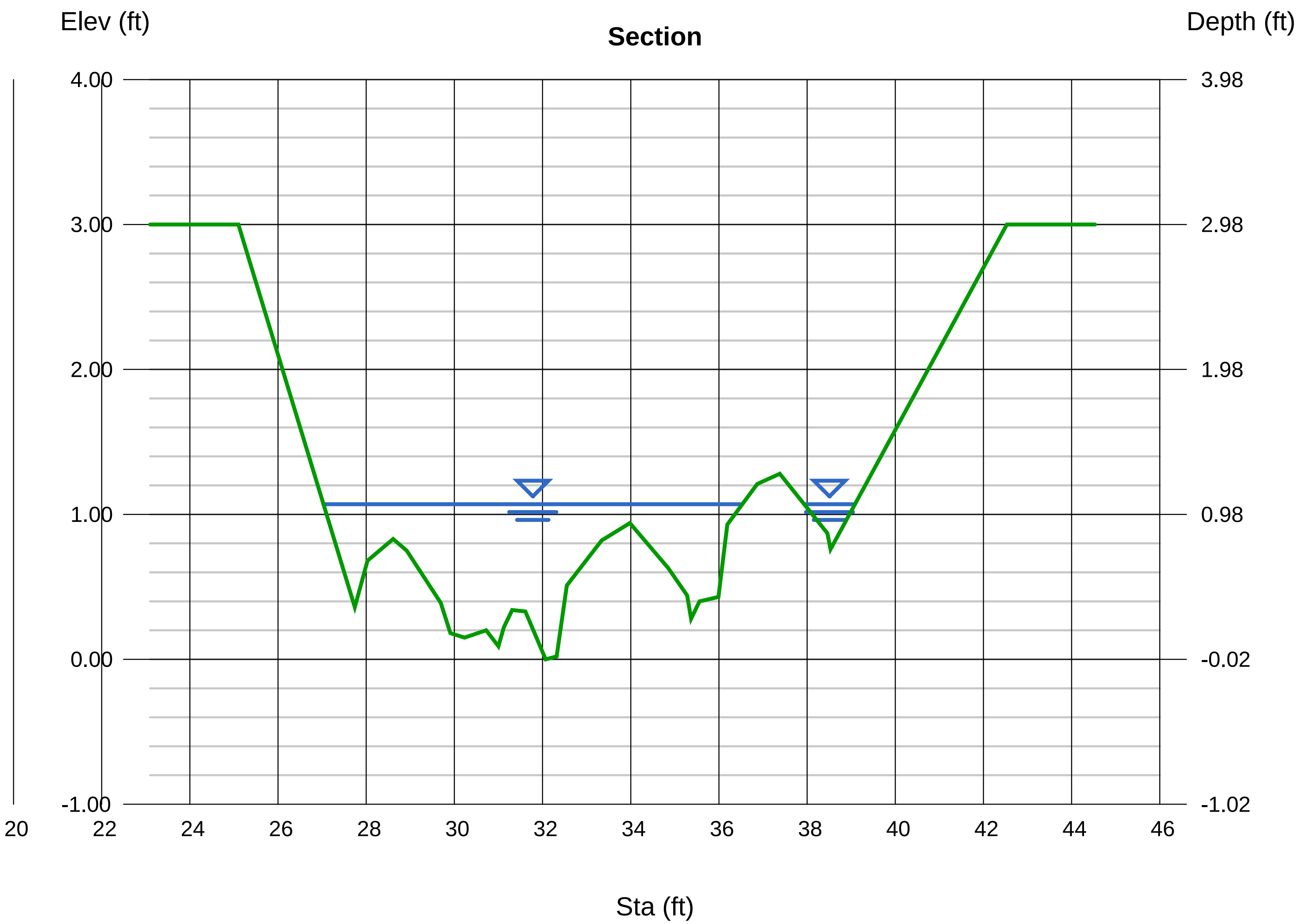
Adult High Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

User-defined
Invert Elev (ft) = 0.02
Slope (%) = 2.70
N-Value = 0.170

Calculations
Compute by: Known Q
Known Q (cfs) = 4.10

Highlighted
Depth (ft) = 1.05
Q (cfs) = 4.100
Area (sqft) = 5.23
Velocity (ft/s) = 0.78
Wetted Perim (ft) = 12.65
Crit Depth, Yc (ft) = 0.57
Top Width (ft) = 10.65
EGL (ft) = 1.06

(Sta, El, n)-(Sta, El, n)...
(25.10, 3.00)-(27.74, 0.36, 0.170)-(28.03, 0.68, 0.170)-(28.61, 0.83, 0.170)-(28.92, 0.75, 0.170)-(29.69, 0.39, 0.170)-(29.91, 0.18, 0.170)
-(30.23, 0.15, 0.170)-(30.72, 0.20, 0.170)-(31.00, 0.09, 0.170)-(31.12, 0.22, 0.170)-(31.31, 0.34, 0.170)-(31.61, 0.33, 0.170)-(32.32, 0.02, 0.170)
-(32.55, 0.51, 0.170)-(33.34, 0.82, 0.170)-(33.98, 0.94, 0.170)-(34.85, 0.63, 0.170)-(35.28, 0.44, 0.170)-(35.37, 0.28, 0.170)-(35.56, 0.40, 0.170)
-(35.99, 0.43, 0.170)-(36.19, 0.93, 0.170)-(36.87, 1.21, 0.170)-(37.38, 1.28, 0.170)-(38.46, 0.87, 0.170)-(38.53, 0.76, 0.170)-(42.53, 3.00, 0.170)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 2 2018

Adult Low Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

User-defined

Invert Elev (ft)	= 0.02
Slope (%)	= 2.70
N-Value	= 0.180

Calculations

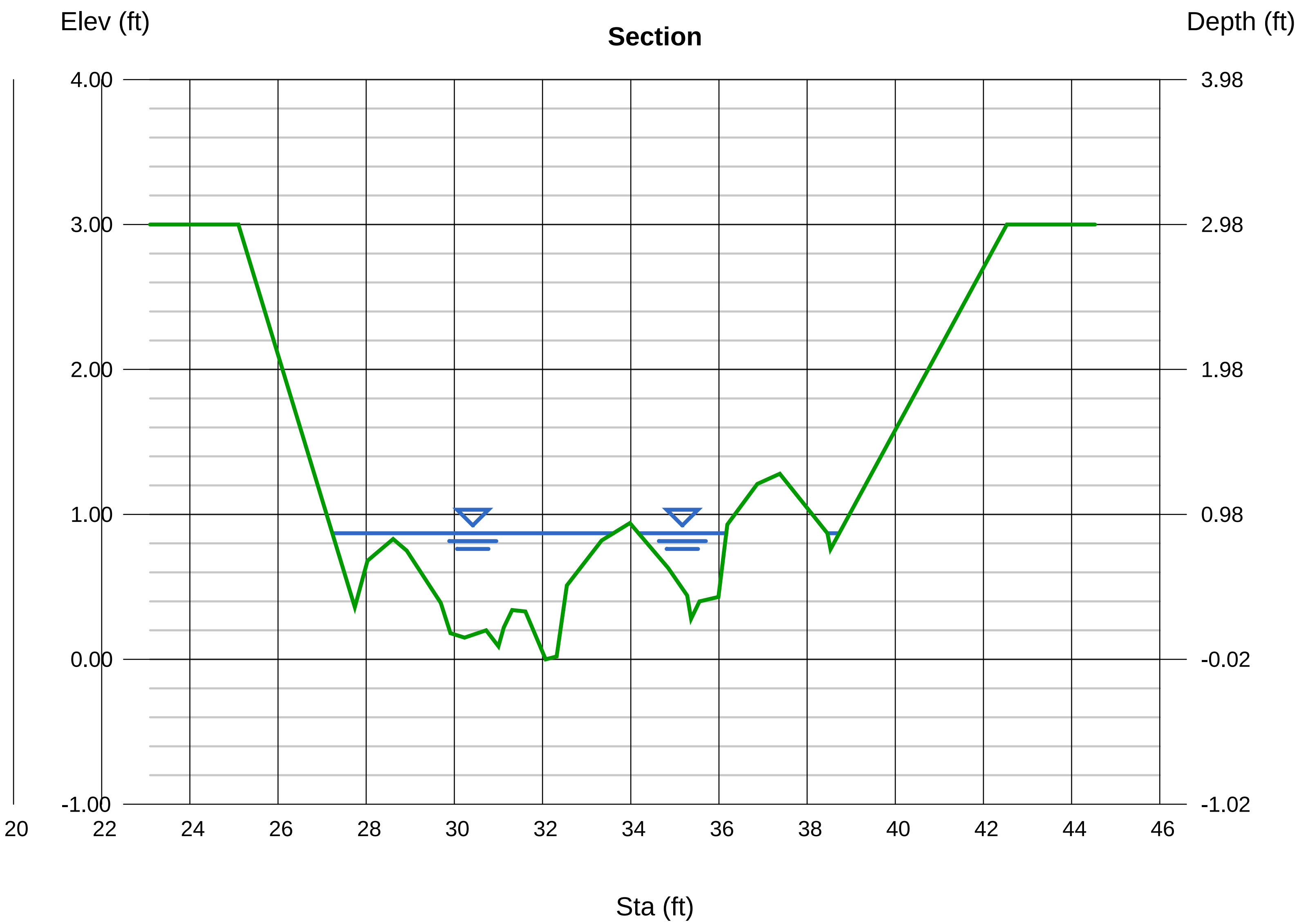
Compute by:	Known Q
Known Q (cfs)	= 2.00

Highlighted

Depth (ft)	= 0.85
Q (cfs)	= 2.000
Area (sqft)	= 3.28
Velocity (ft/s)	= 0.61
Wetted Perim (ft)	= 10.38
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 8.63
EGL (ft)	= 0.86

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(27.74, 0.36, 0.180)-(28.03, 0.68, 0.180)-(28.61, 0.83, 0.180)-(28.92, 0.75, 0.180)-(29.69, 0.39, 0.180)-(29.91, 0.18, 0.180)
-(30.23, 0.15, 0.180)-(30.72, 0.20, 0.180)-(31.00, 0.09, 0.180)-(31.12, 0.22, 0.180)-(31.31, 0.34, 0.180)-(31.61, 0.33, 0.180)-(32.32, 0.02, 0.180)
-(32.55, 0.51, 0.180)-(33.34, 0.82, 0.180)-(33.98, 0.94, 0.180)-(34.85, 0.63, 0.180)-(35.28, 0.44, 0.180)-(35.37, 0.28, 0.180)-(35.56, 0.40, 0.180)
-(35.99, 0.43, 0.180)-(36.19, 0.93, 0.180)-(36.87, 1.21, 0.180)-(37.38, 1.28, 0.180)-(38.46, 0.87, 0.180)-(38.53, 0.76, 0.180)-(42.53, 3.00, 0.180)



Channel Report

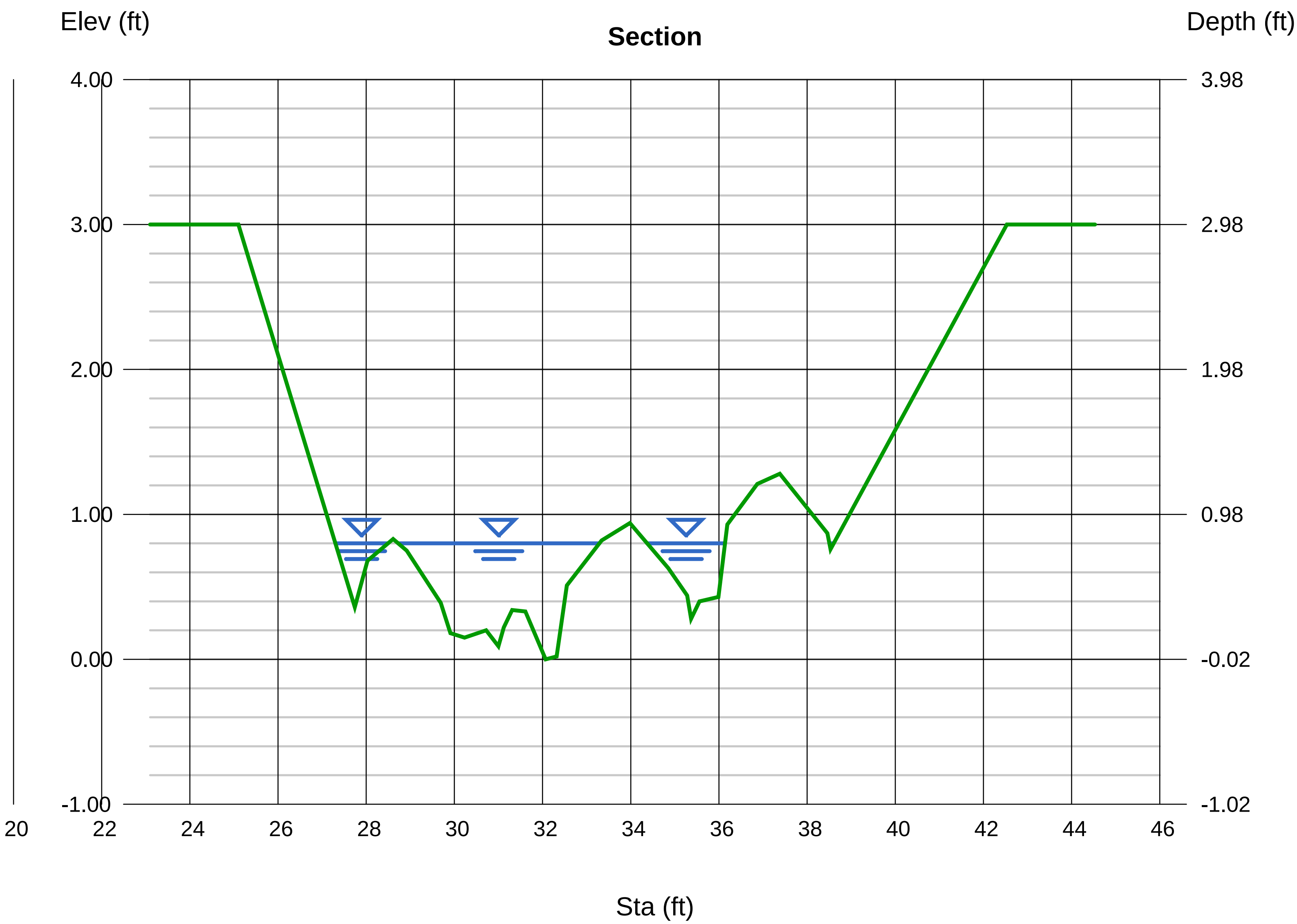
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Friday, Nov 2 2018

Juvenile High Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

User-defined		**Highlighted**	
Invert Elev (ft)	= 0.02	Depth (ft)	= 0.78
Slope (%)	= 2.70	Q (cfs)	= 1.500
N-Value	= 0.190	Area (sqft)	= 2.71
		Velocity (ft/s)	= 0.55
Calculations		Wetted Perim (ft)	= 9.20
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.38
Known Q (cfs)	= 1.50	Top Width (ft)	= 7.62
		EGL (ft)	= 0.78

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(27.74, 0.36, 0.190)-(28.03, 0.68, 0.190)-(28.61, 0.83, 0.190)-(28.92, 0.75, 0.190)-(29.69, 0.39, 0.190)-(29.91, 0.18, 0.190)
-(30.23, 0.15, 0.190)-(30.72, 0.20, 0.190)-(31.00, 0.09, 0.190)-(31.12, 0.22, 0.190)-(31.31, 0.34, 0.190)-(31.61, 0.33, 0.190)-(32.32, 0.02, 0.190)
-(32.55, 0.51, 0.190)-(33.34, 0.82, 0.190)-(33.98, 0.94, 0.190)-(34.85, 0.63, 0.190)-(35.28, 0.44, 0.190)-(35.37, 0.28, 0.190)-(35.56, 0.40, 0.190)
-(35.99, 0.43, 0.190)-(36.19, 0.93, 0.190)-(36.87, 1.21, 0.190)-(37.38, 1.28, 0.190)-(38.46, 0.87, 0.190)-(38.53, 0.76, 0.190)-(42.53, 3.00, 0.190)



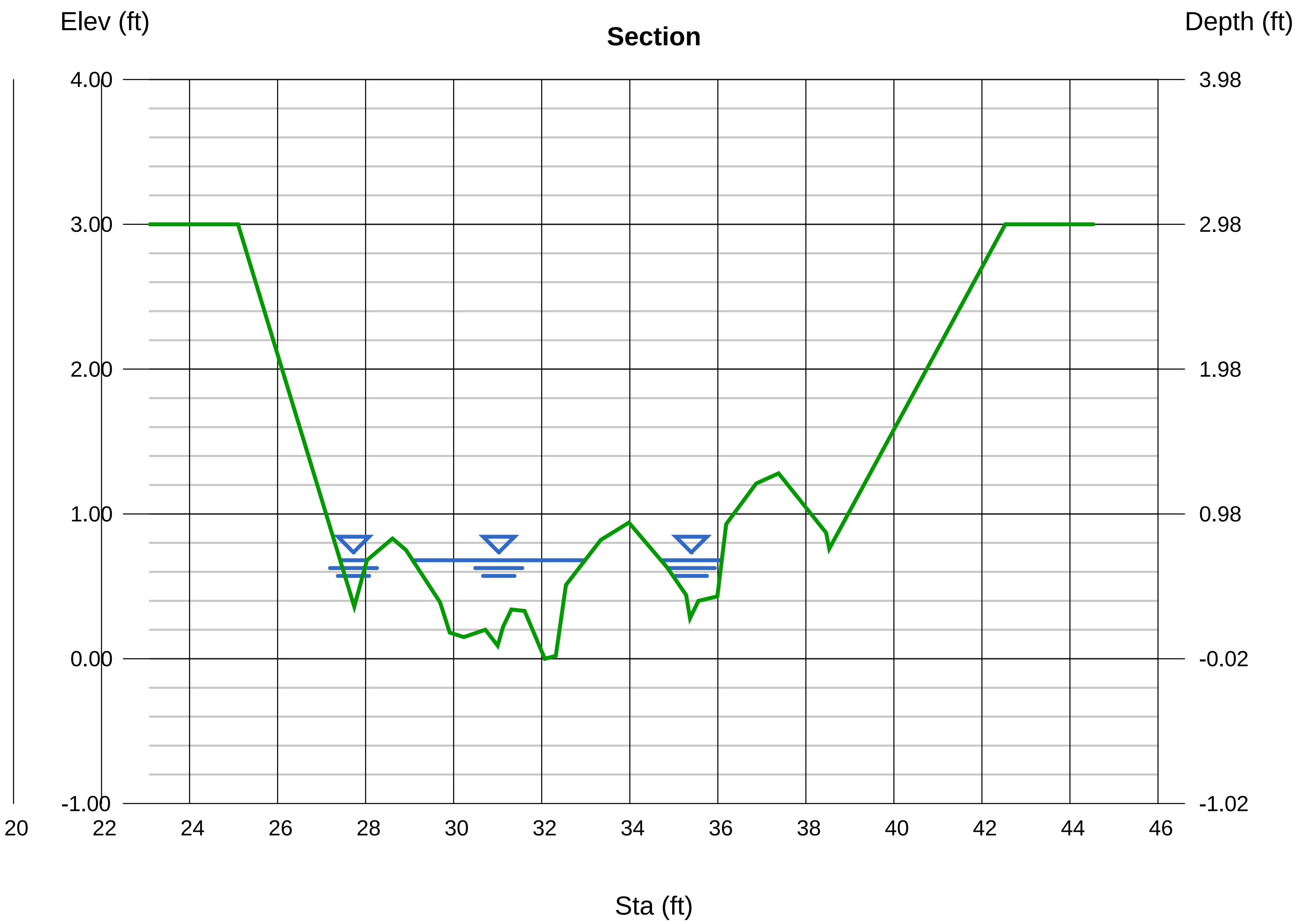
Channel Report

Juvenile Low Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

User-defined		**Highlighted**	
Invert Elev (ft)	= 0.02	Depth (ft)	= 0.66
Slope (%)	= 2.70	Q (cfs)	= 1.000
N-Value	= 0.190	Area (sqft)	= 1.90
		Velocity (ft/s)	= 0.53
Calculations		Wetted Perim (ft)	= 7.24
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.33
Known Q (cfs)	= 1.00	Top Width (ft)	= 5.90
		EGL (ft)	= 0.66

(Sta, El, n)-(Sta, El, n)...

(25.10, 3.00)-(27.74, 0.36, 0.190)-(28.03, 0.68, 0.190)-(28.61, 0.83, 0.190)-(28.92, 0.75, 0.190)-(29.69, 0.39, 0.190)-(29.91, 0.18, 0.190)
-(30.23, 0.15, 0.190)-(30.72, 0.20, 0.190)-(31.00, 0.09, 0.190)-(31.12, 0.22, 0.190)-(31.31, 0.34, 0.190)-(31.61, 0.33, 0.190)-(32.32, 0.02, 0.190)
-(32.55, 0.51, 0.190)-(33.34, 0.82, 0.190)-(33.98, 0.94, 0.190)-(34.85, 0.63, 0.190)-(35.28, 0.44, 0.190)-(35.37, 0.28, 0.190)-(35.56, 0.40, 0.190)
-(35.99, 0.43, 0.190)-(36.19, 0.93, 0.190)-(36.87, 1.21, 0.190)-(37.38, 1.28, 0.190)-(38.46, 0.87, 0.190)-(38.53, 0.76, 0.190)-(42.53, 3.00, 0.190)



Channel Report

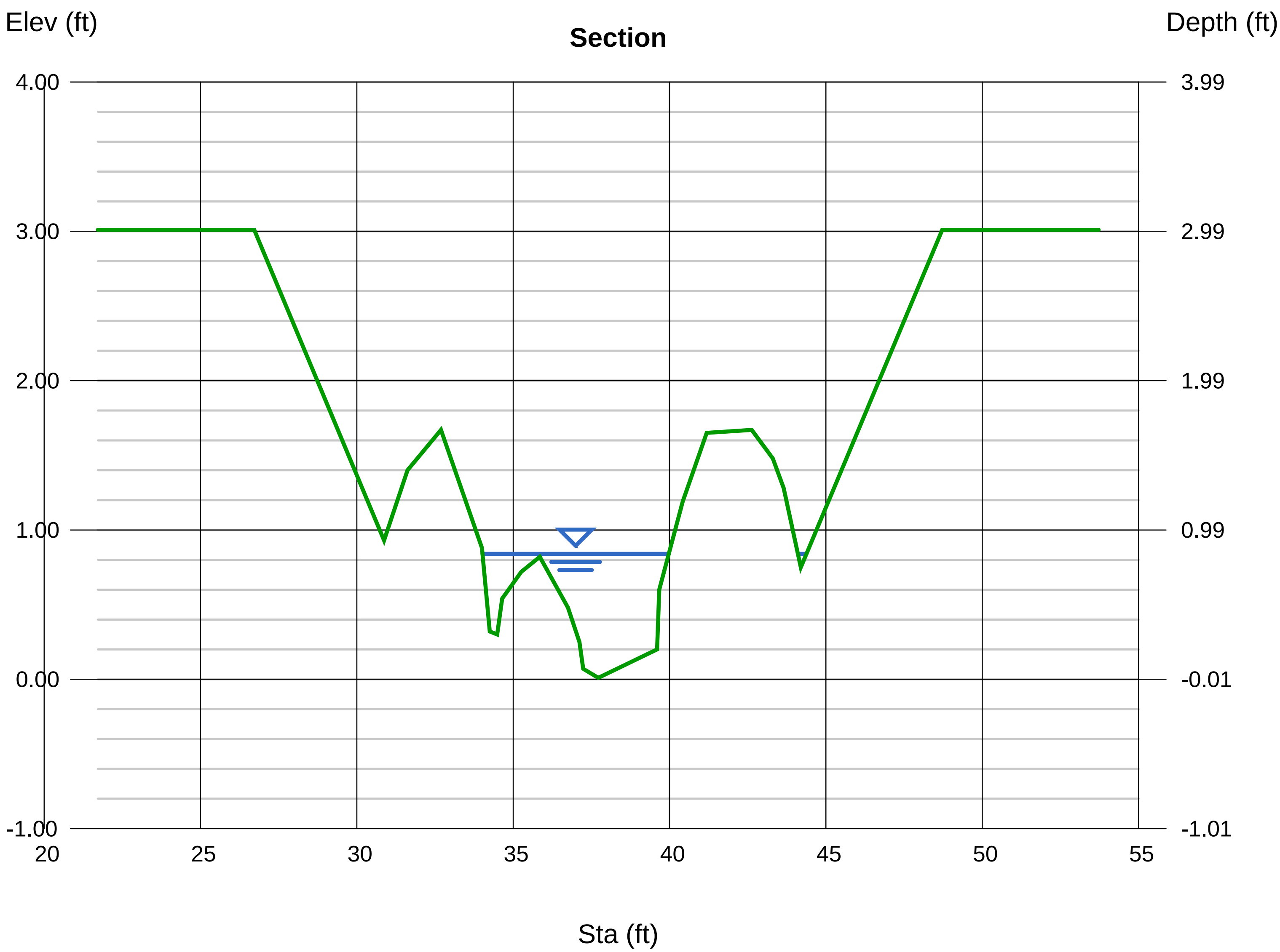
Adult High Flow at Rock Pile/Mat. Rem. Area - Typ. Chnl (9'-10' Base Width, 12% Slope)

User-defined
Invert Elev (ft) = 0.01
Slope (%) = 12.00
N-Value = 0.250

Calculations
Compute by: Known Q
Known Q (cfs) = 2.80

Highlighted
Depth (ft) = 0.83
Q (cfs) = 2.800
Area (sqft) = 2.70
Velocity (ft/s) = 1.04
Wetted Perim (ft) = 7.45
Crit Depth, Yc (ft) = 0.43
Top Width (ft) = 6.23
EGL (ft) = 0.85

(Sta, El, n)-(Sta, El, n)...
(26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



Channel Report

Adult Low Flow at Rock Pile/Mat. Rem. Area - Typ. Chnl (9'-10' Base Width, 12% Slope)

User-defined

Invert Elev (ft)	= 0.01
Slope (%)	= 12.00
N-Value	= 0.250

Calculations

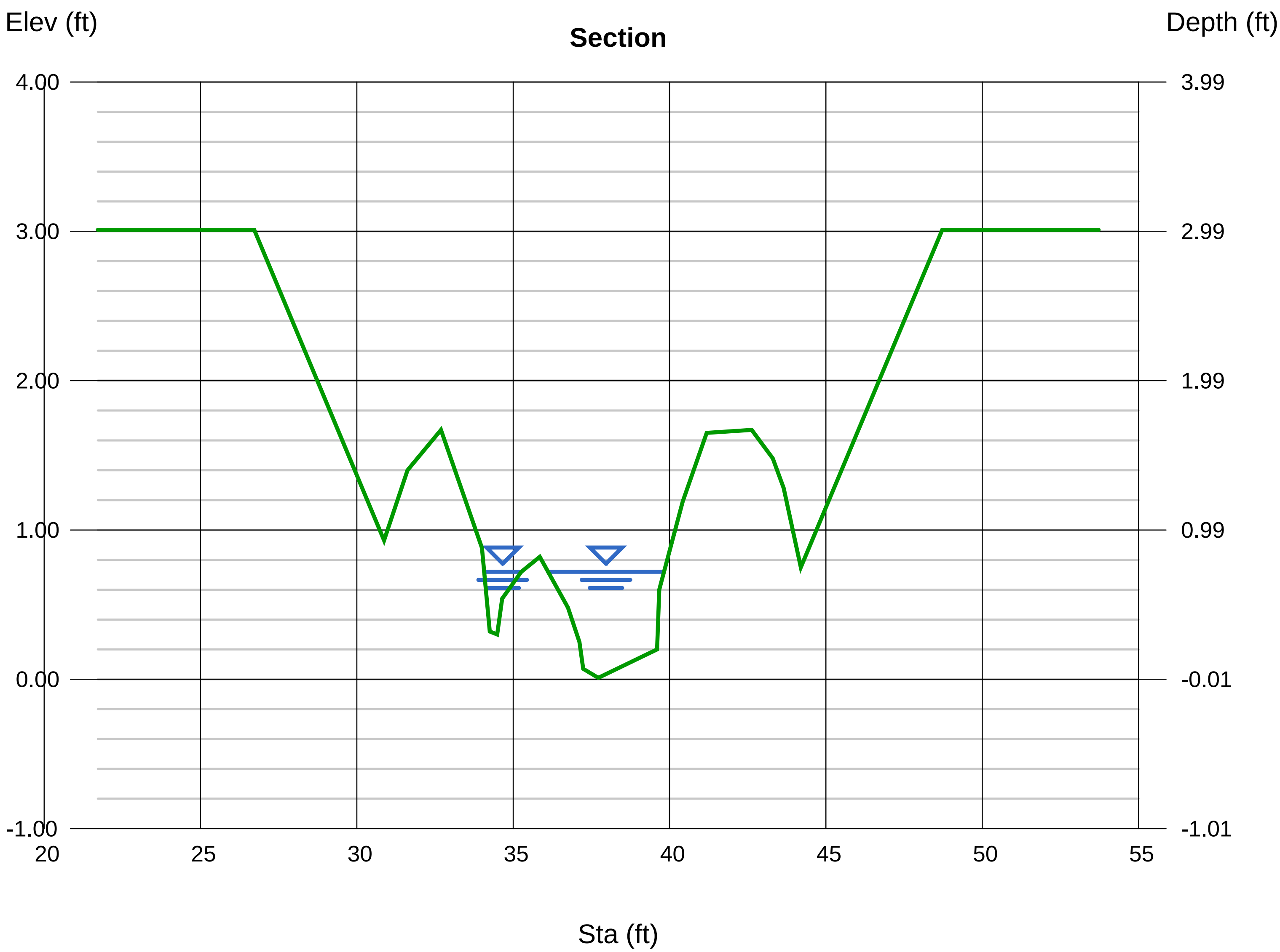
Compute by:	Known Q
Known Q (cfs)	= 2.00

Highlighted

Depth (ft)	= 0.71
Q (cfs)	= 2.000
Area (sqft)	= 2.03
Velocity (ft/s)	= 0.99
Wetted Perim (ft)	= 5.91
Crit Depth, Yc (ft)	= 0.37
Top Width (ft)	= 4.90
EGL (ft)	= 0.73

(Sta, El, n)-(Sta, El, n)...

(26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



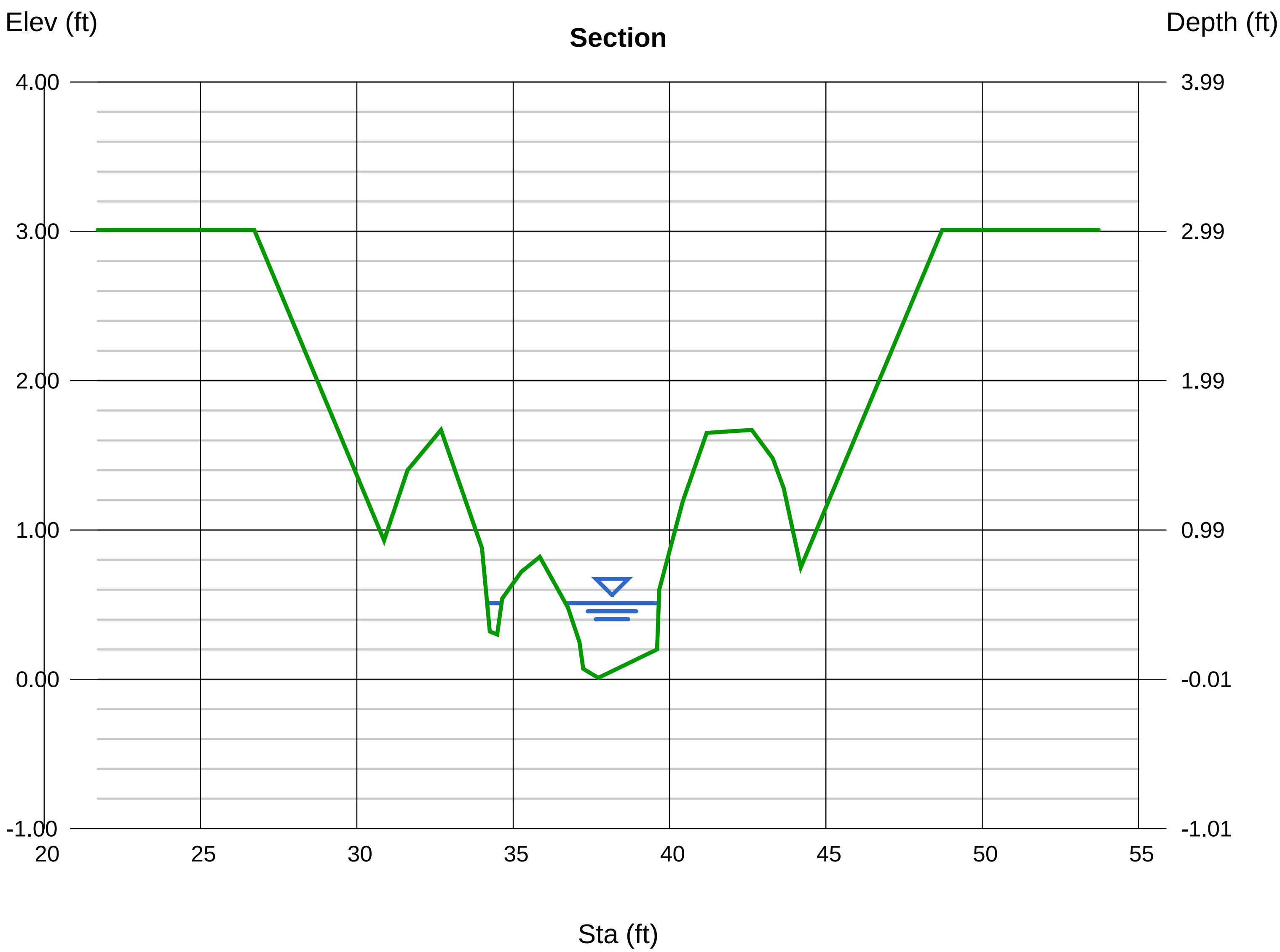
Channel Report

Juvenile High/Low Flow at Rock Pile/Mat. Rem. Area-Typ. Chnl (9'-10' Base Width, 12%

User-defined			**Highlighted**	
Invert Elev (ft)	= 0.01		Depth (ft)	= 0.50
Slope (%)	= 12.00		Q (cfs)	= 1.000
N-Value	= 0.250		Area (sqft)	= 1.16
			Velocity (ft/s)	= 0.86
Calculations			Wetted Perim (ft)	= 4.13
Compute by:	Known Q		Crit Depth, Yc (ft)	= 0.26
Known Q (cfs)	= 1.00		Top Width (ft)	= 3.45
			EGL (ft)	= 0.51

(Sta, El, n)-(Sta, El, n)...

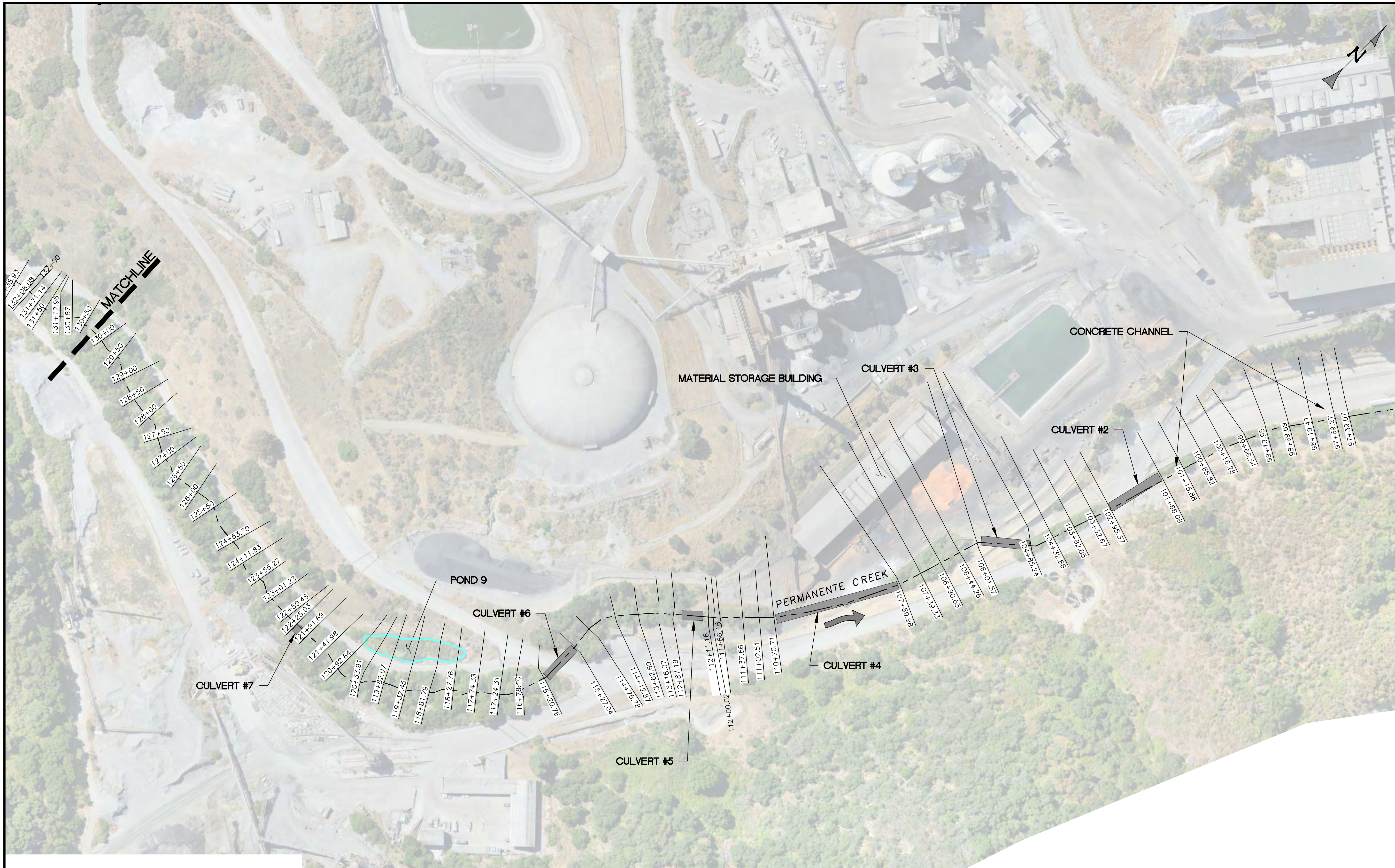
(26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



WATERWAYS CONSULTING, INC.

APPENDIX F

HEC-RAS Overview Figures and Model Results



LEGEND

— — — —	HEC–RAS ALIGNMENT
132+00 ———	HEC–RAS CROSS SECTION LOCATION

HEC-RAS CROSS SECTION OVERVIEW

SCALE: 1"=200'

WATERWAYS CONSULTING INC.

Santa Cruz, CA | watways.com | Portland, OR

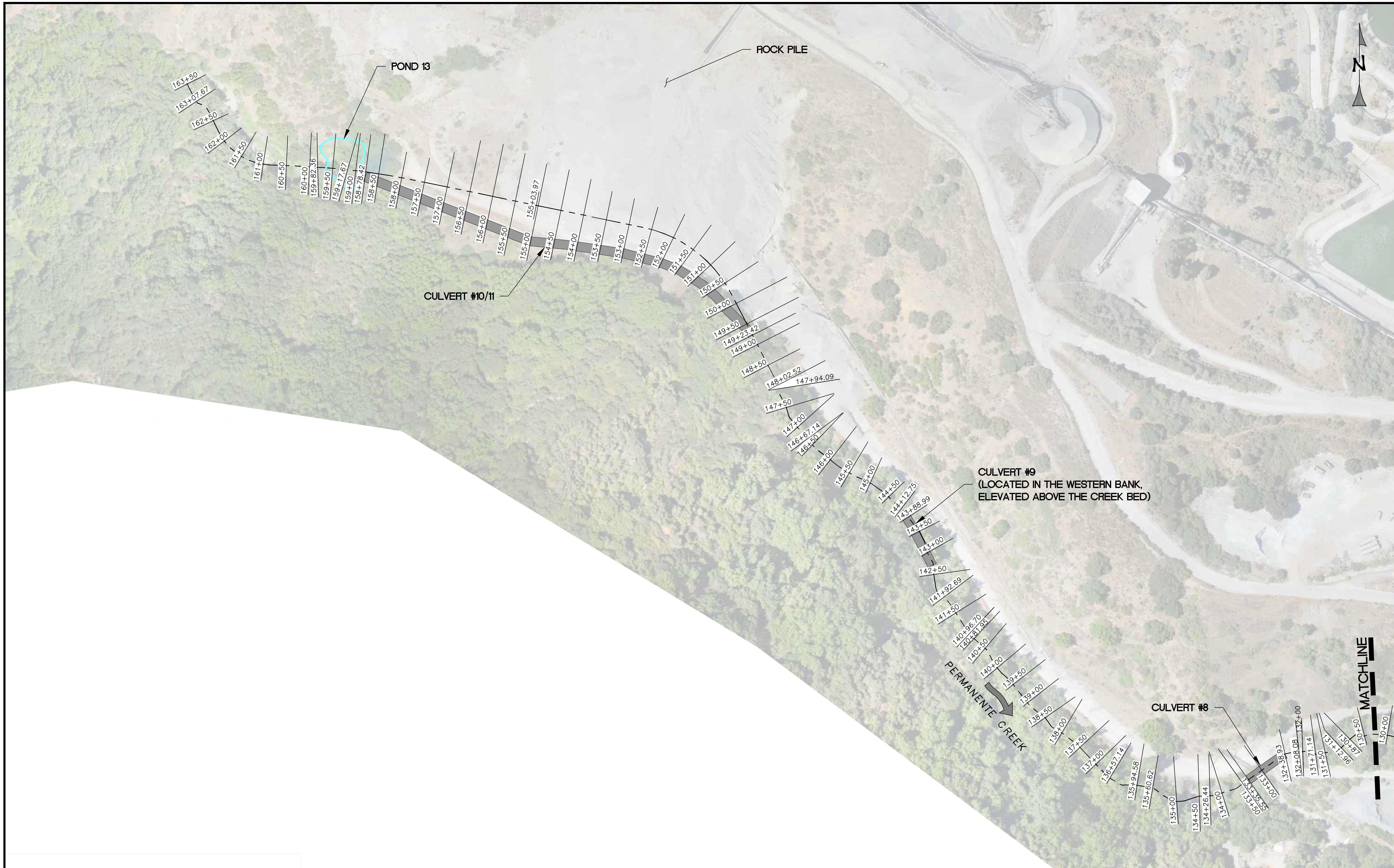
CHANNEL WIDENING TO ROCK PILE AREA
HEC-RAS CROSS SECTION OVERVIEW (1 OF 2)

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

1.0



LEGEND

— — —	HEC–RAS ALIGNMENT
132+00	HEC–RAS CROSS SECTION LOCATION

HEC-RAS CROSS SECTION OVERVIEW

SCALE: 1"=200'

WATERWAYS CONSULTING INC.
Santa Cruz, CA | watways.com | Portland, OR

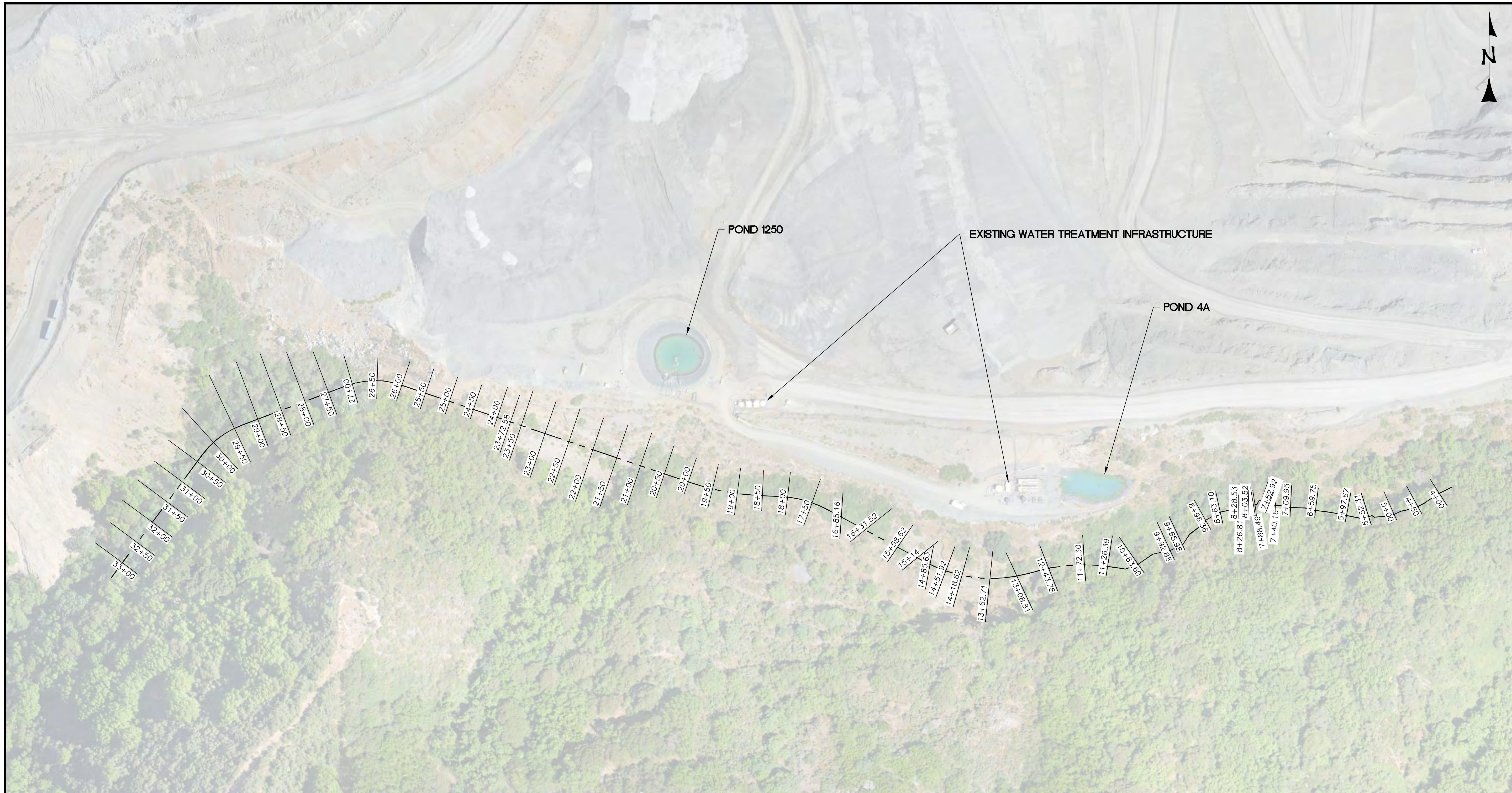
CHANNEL WIDENING TO ROCK PILE AREA
HEC-RAS CROSS SECTION OVERVIEW (2 OF 2)

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

2.0



HEC-RAS CROSS SECTION OVERVIEW

SCALE: 1" = 200'

LEGEND

— — —	HEC-RAS ALIGNMENT
6+40.16	HEC-RAS CROSS SECTION LOCATION

WATERWAYS CONSULTING INC.

Santa Cruz, CA | watways.com | Portland, OR

OVERBURDEN REMOVAL AREA
HEC-RAS CROSS SECTION OVERVIEW

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

3.0

APPENDIX F. HEC-RAS OUTPUT
PERMANENTE CREEK RESTORATION PLAN
LIST OF FIGURES AND TABLES

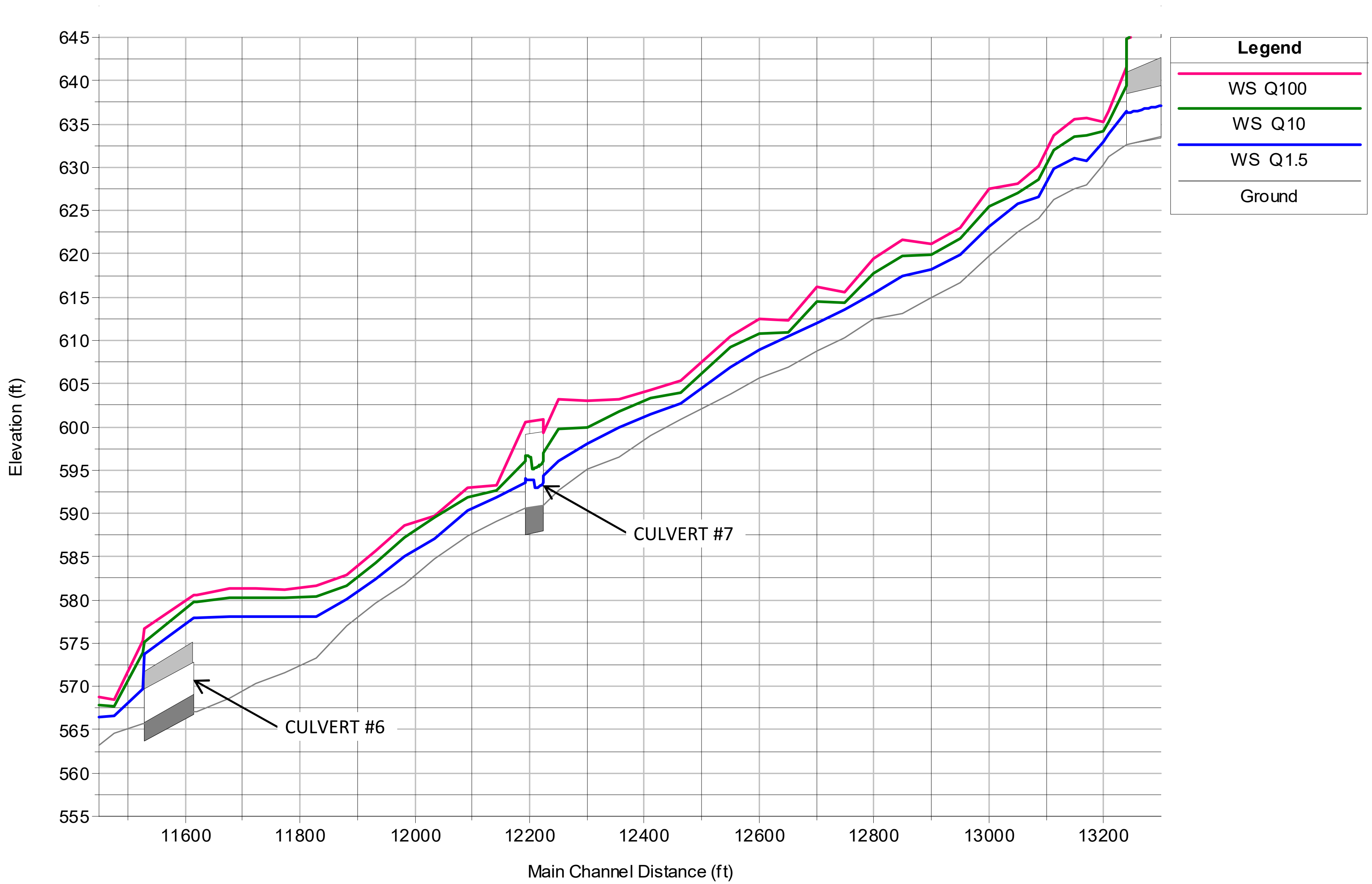
TABLES

HEC-RAS MODEL RESULTS

<u>Existing Conditions</u>

Channel Widening and Rock Pile Areas

Material Removal Area



FIGURE

F1

CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)

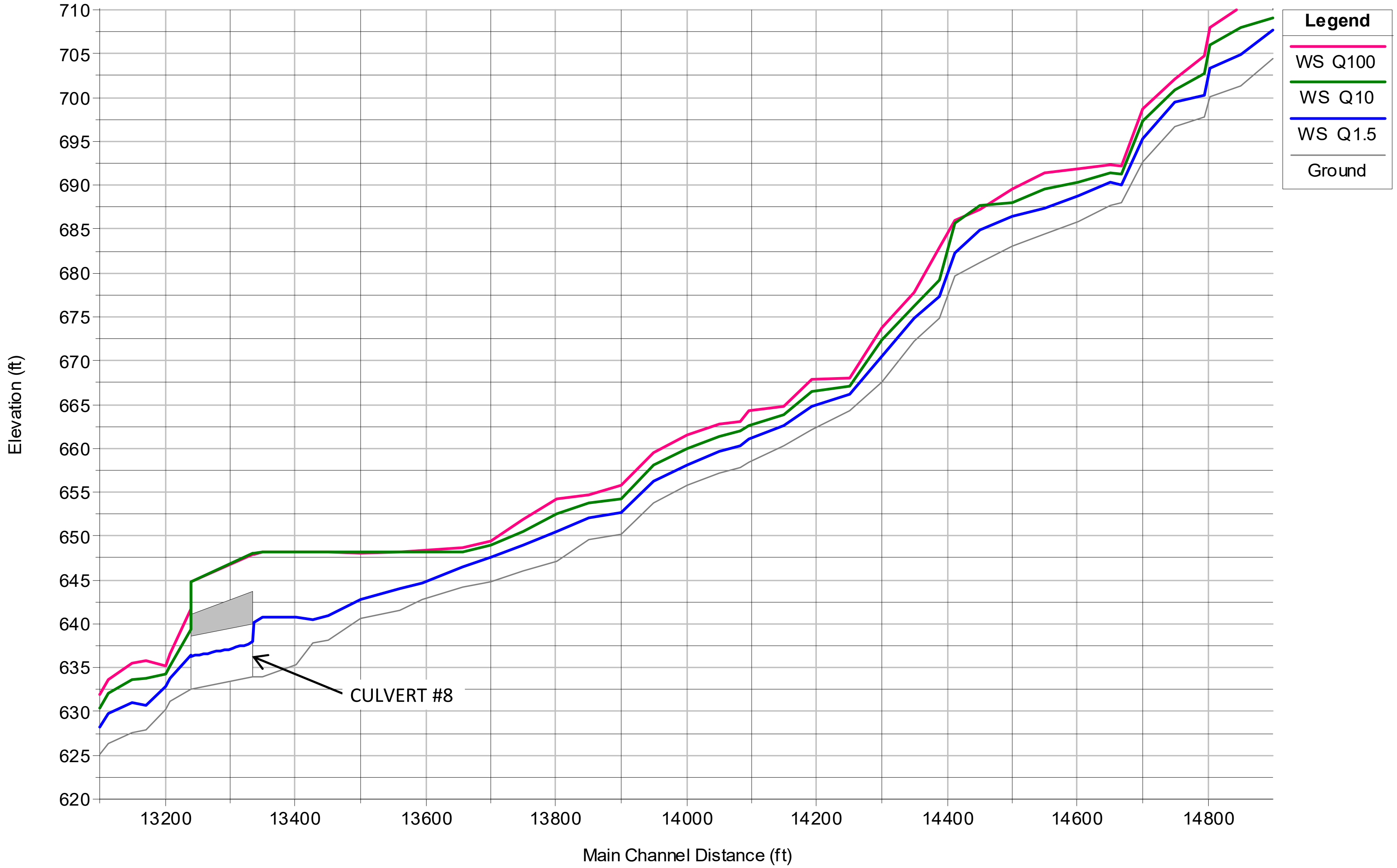
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR



FIGURE

F2

CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)

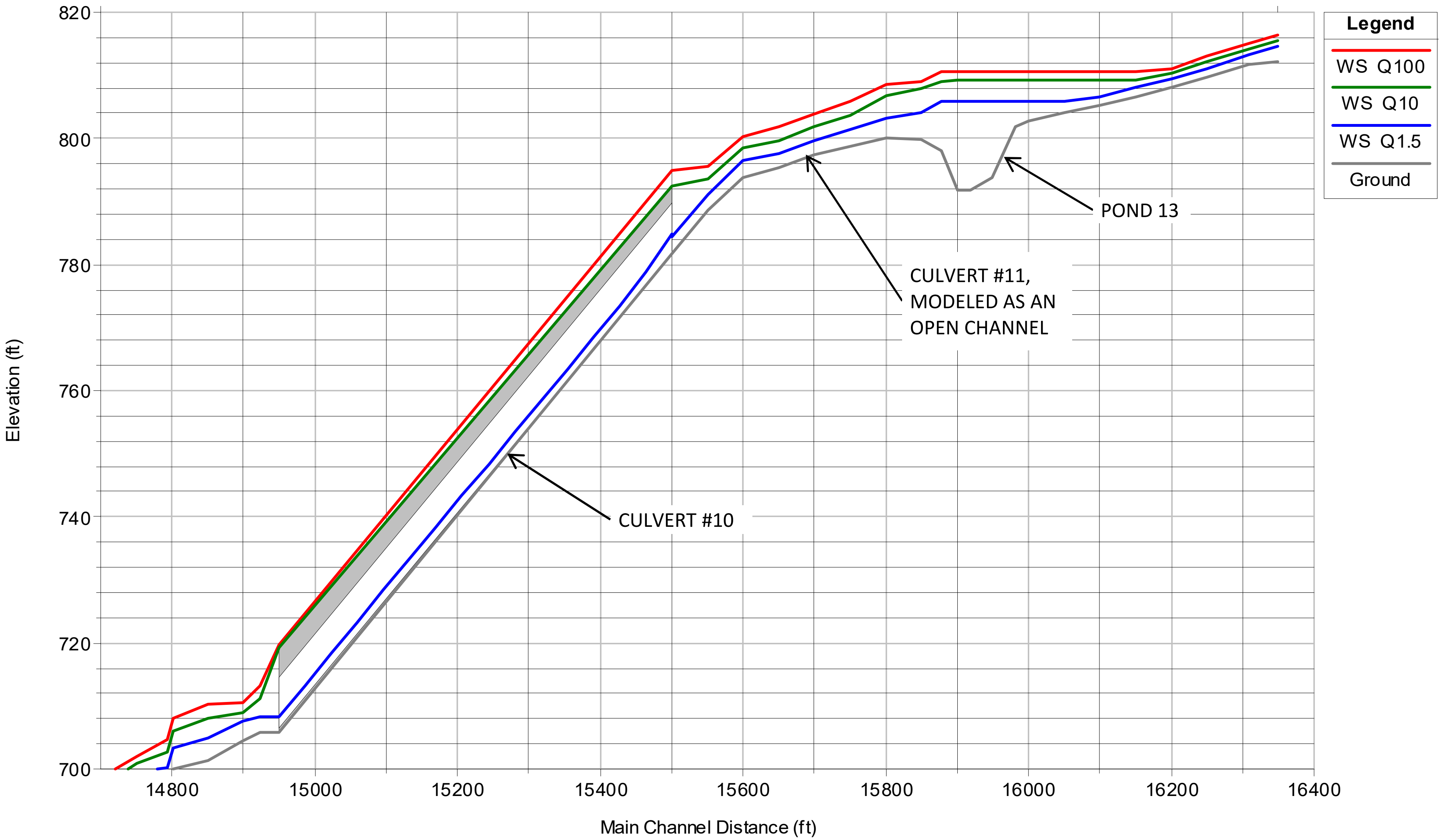
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR



FIGURE

F3

CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)

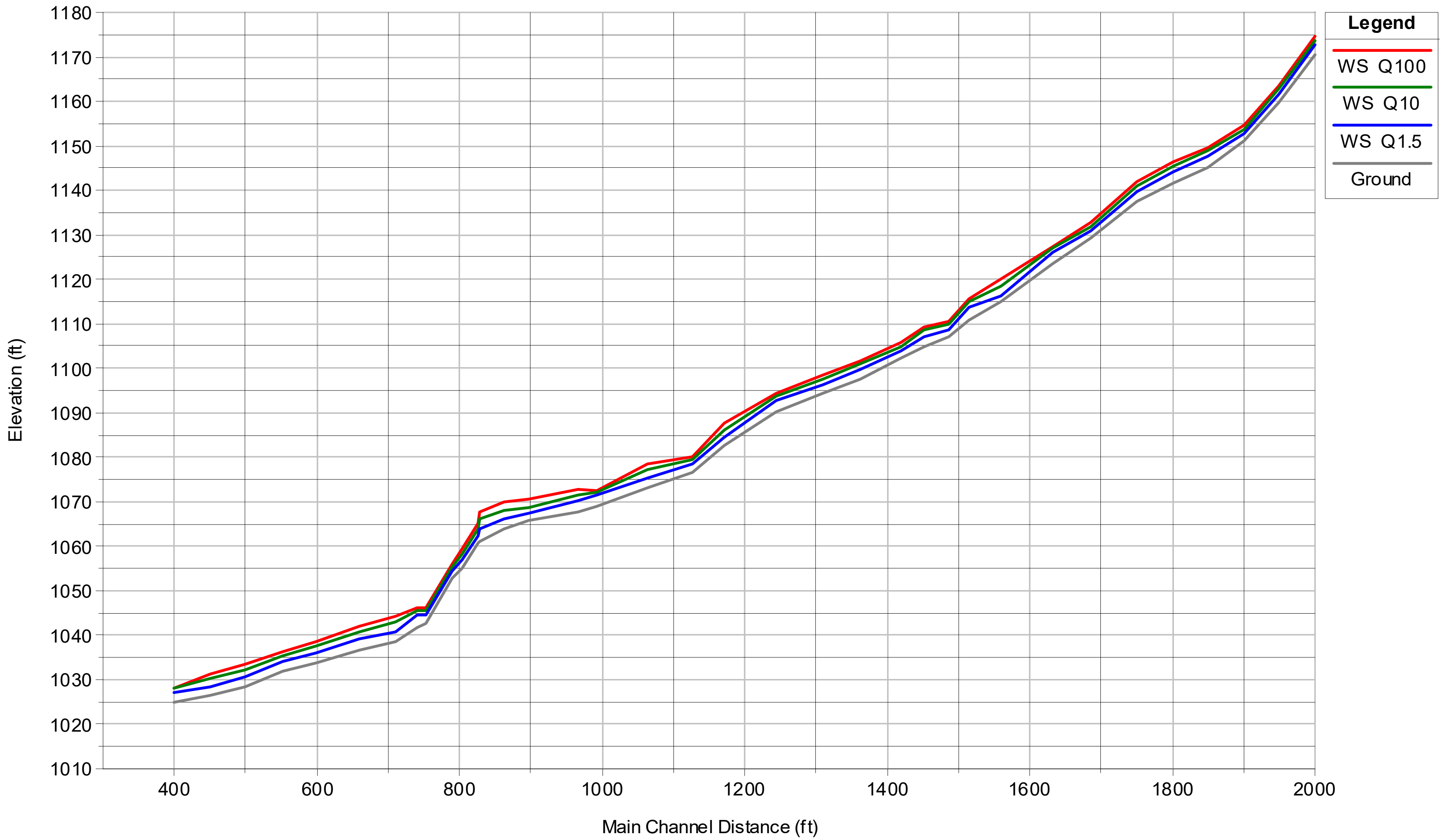
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR



FIGURE

F4

MATERIAL REMOVAL AREA (EXISTING CONDITIONS)

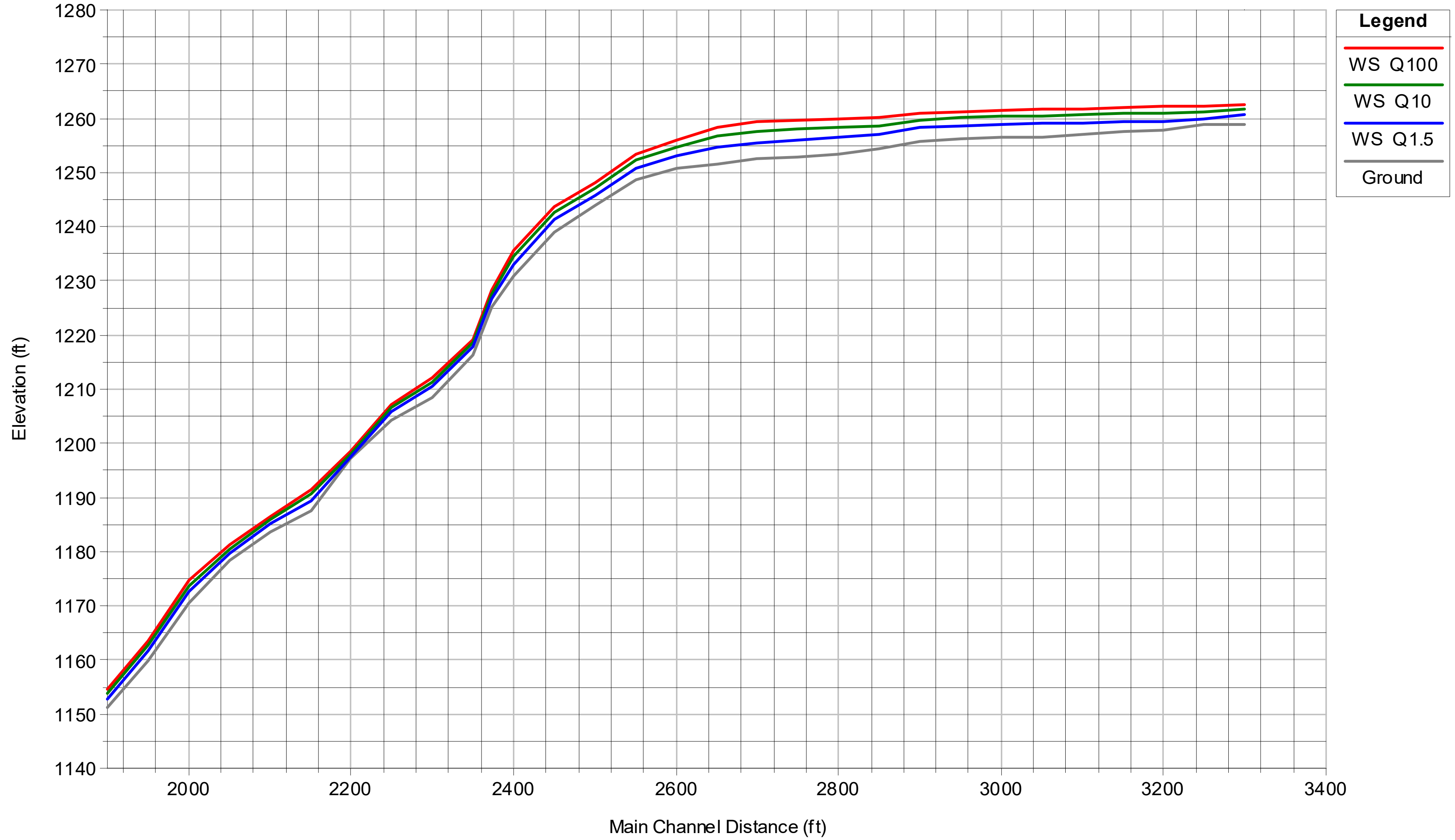
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR



FIGURE

F5

MATERIAL REMOVAL AREA (EXISTING CONDITIONS)

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR

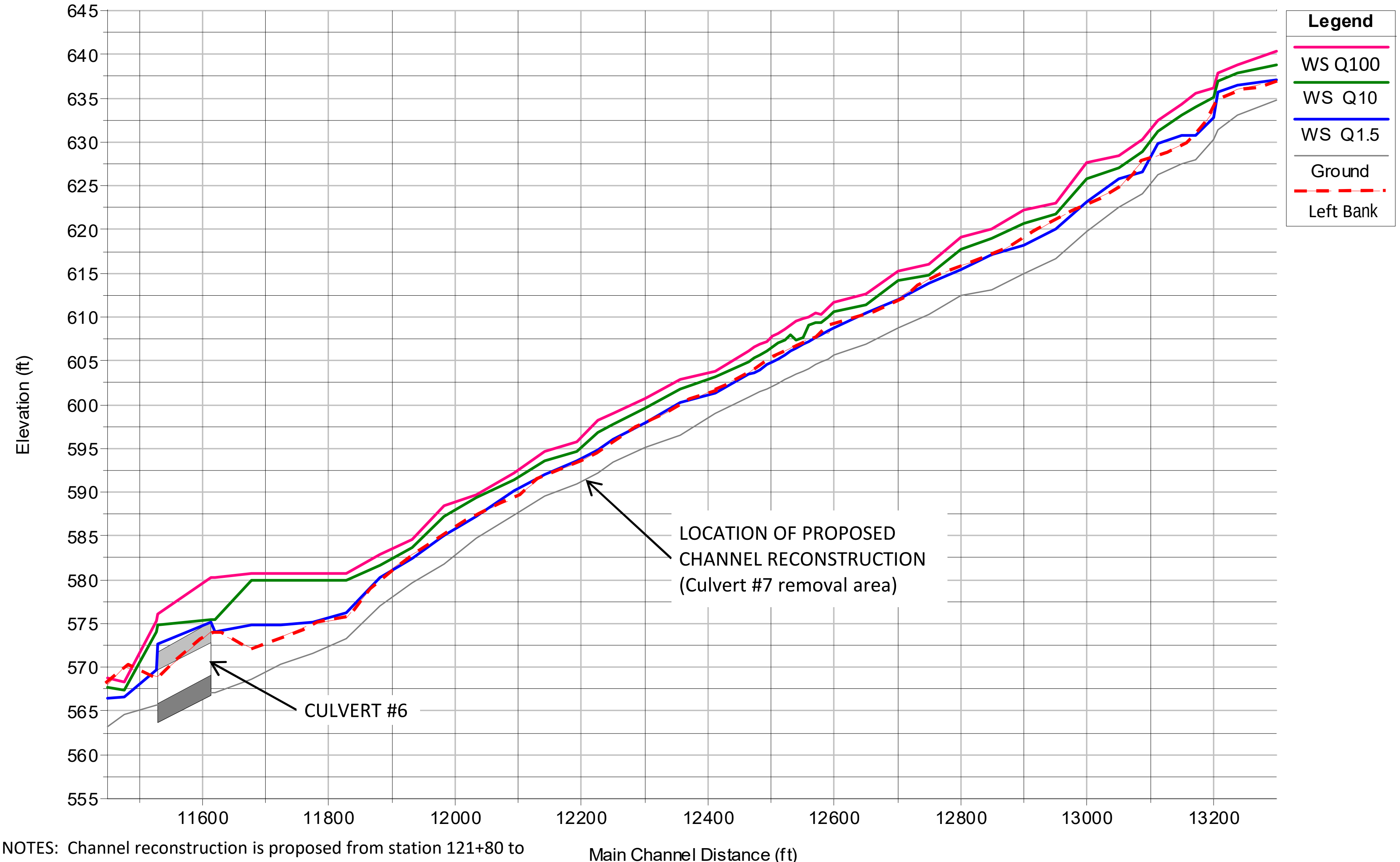
WATERWAYS CONSULTING, INC.

HEC-RAS MODEL RESULTS

Proposed Conditions

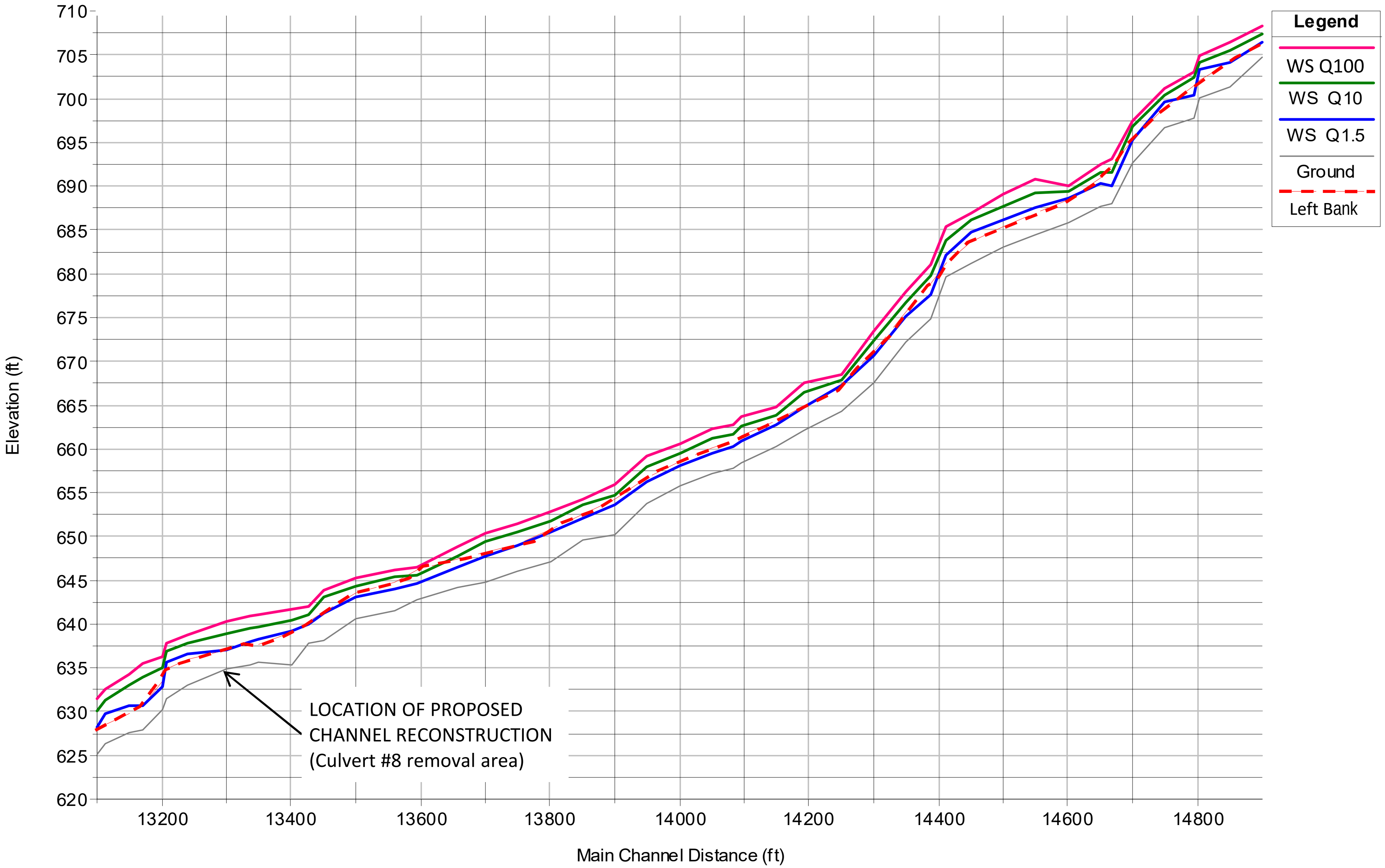
Channel Widening and Rock Pile Areas

Material Removal Area



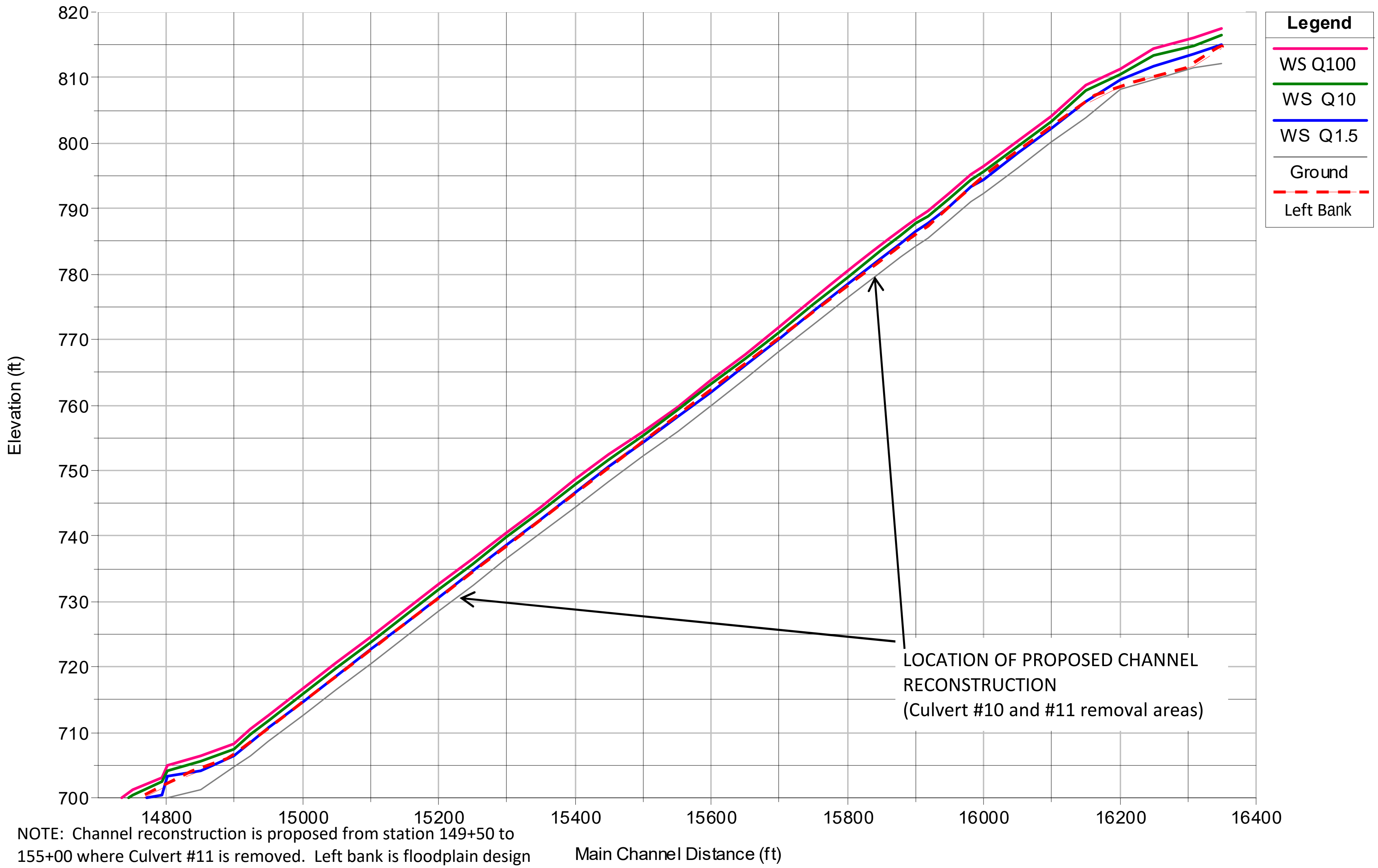
NOTES: Channel reconstruction is proposed from station 121+80 to 123+00 where Culvert #7 is removed. Left bank is floodplain design

FIGURE F6	CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS) 1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA · watways.com · Portland, OR



NOTES: Channel reconstruction is proposed from station 132+00 to 134+00 where Culvert #8 is removed. Left bank is floodplain design elevation.

FIGURE F7	**CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS)** 1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA · watways.com · Portland, OR



NOTE: Channel reconstruction is proposed from station 149+50 to 155+00 where Culvert #11 is removed. Left bank is floodplain design elevation.

FIGURE

F8

CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS)

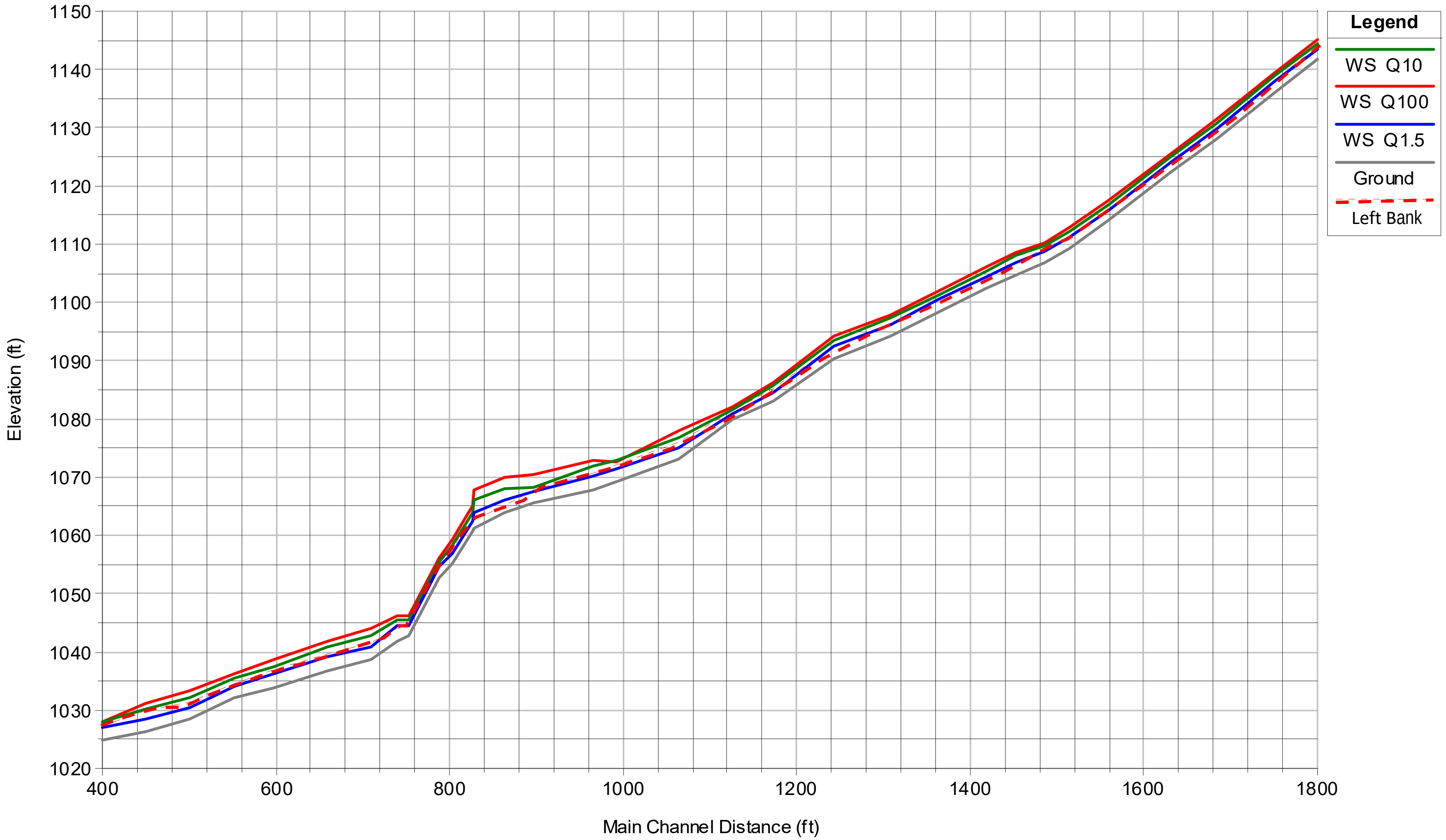
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR



NOTE: Left bank is floodplain design elevation.

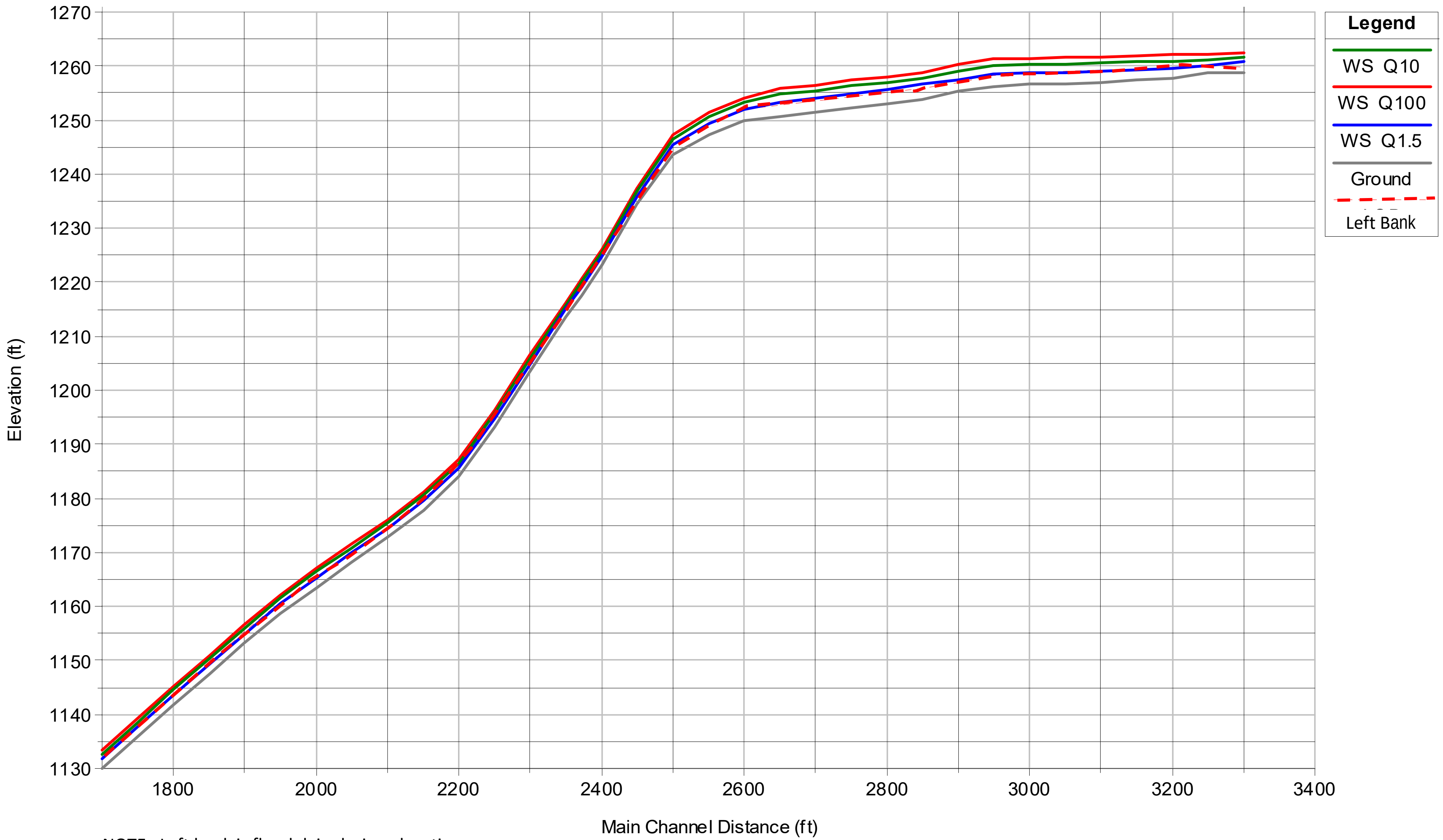
FIGURE
F9

MATERIAL REMOVAL AREA (PROPOSED CONDITIONS)
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.
Santa Cruz, CA | watways.com | Portland, OR



NOTE: Left bank is floodplain design elevation.

FIGURE
F10

MATERIAL REMOVAL AREA (PROPOSED CONDITIONS)
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.
Santa Cruz, CA | watways.com | Portland, OR

WATERWAYS CONSULTING, INC.

HEC-RAS MODEL RESULTS

Fish Passage for Existing and Proposed Conditions

Culvert #7 and Culvert #8

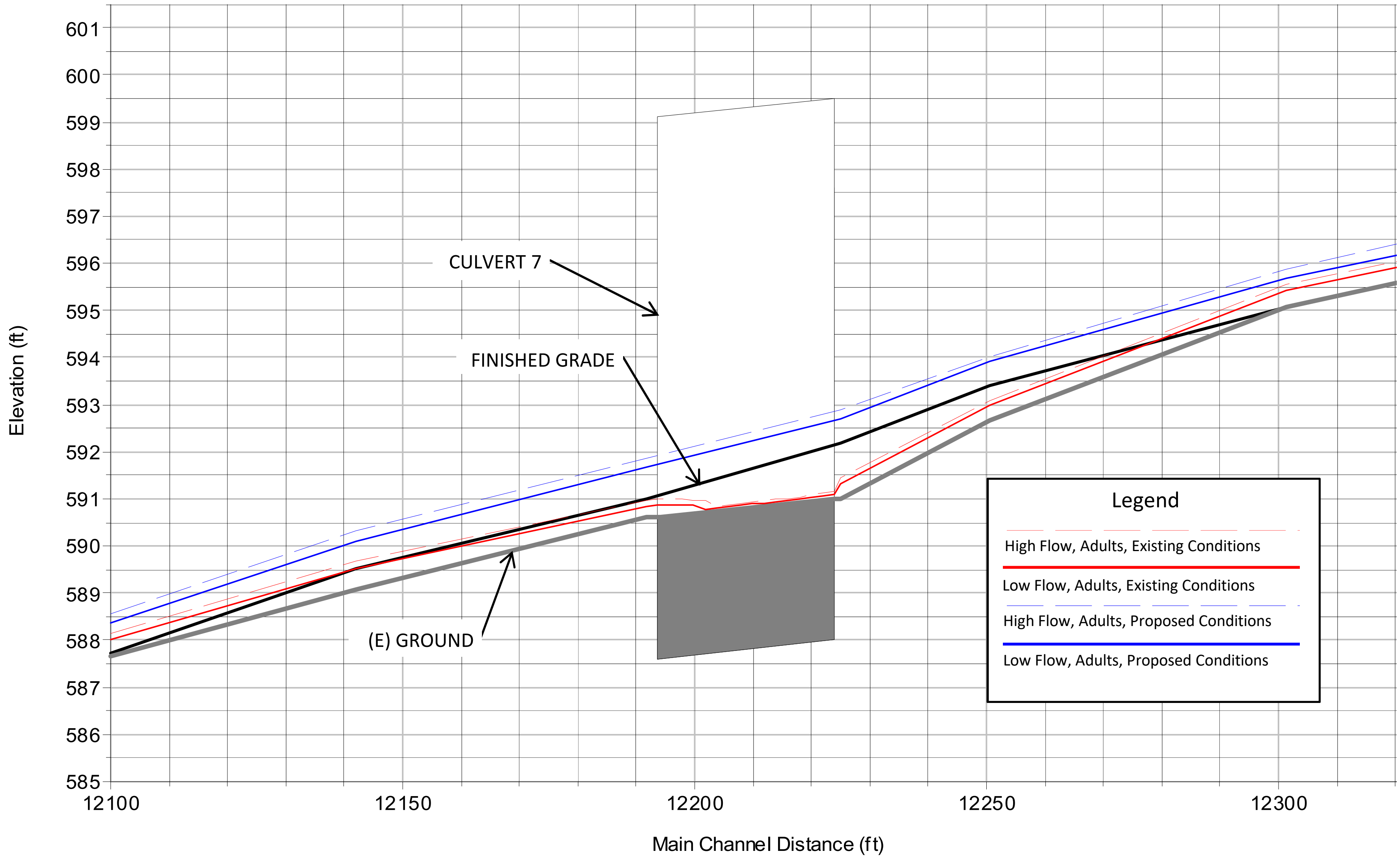
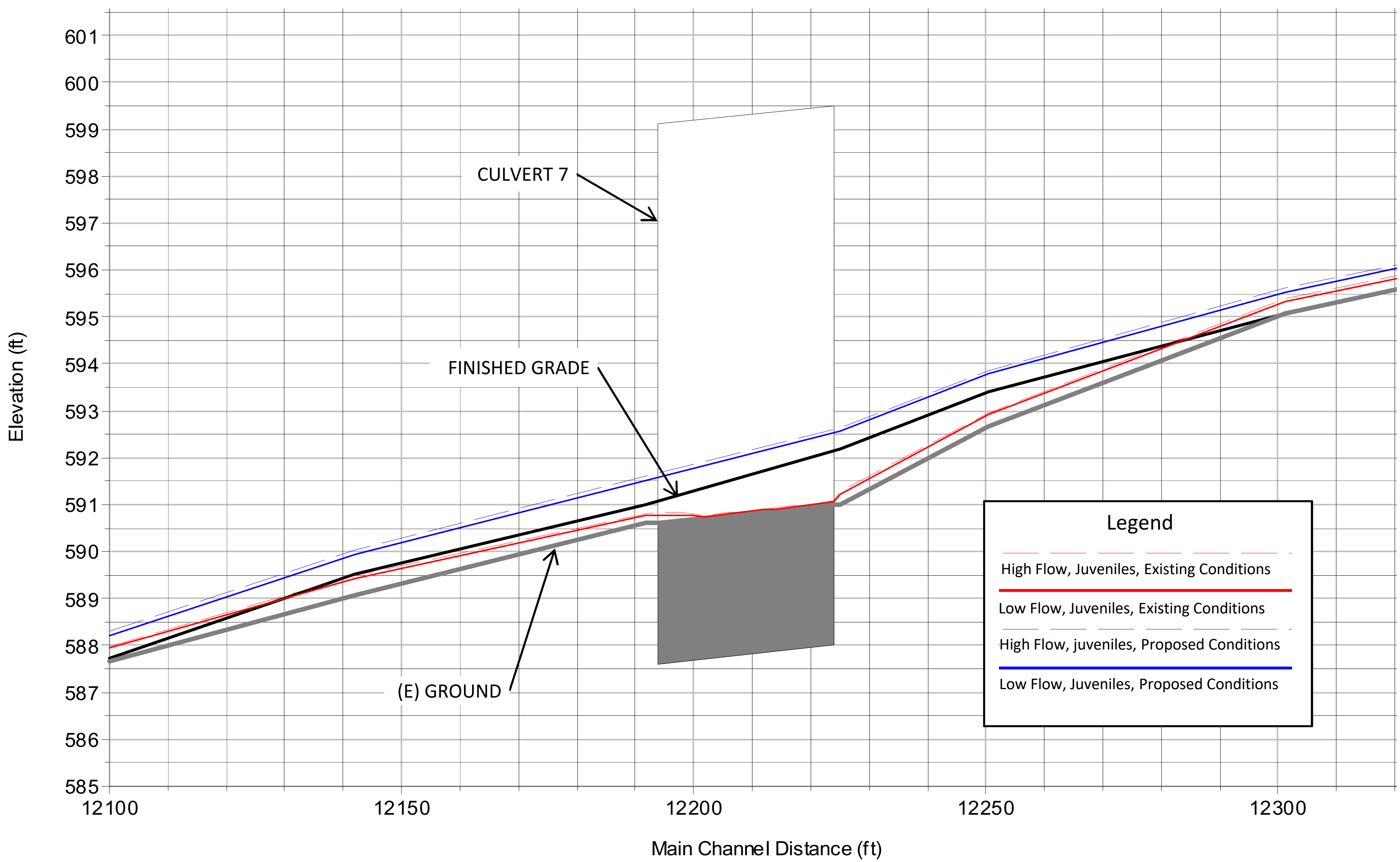


FIGURE F11	WATER SURFACE PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA | watways.com | Portland, OR



FIGURE

F12

WATER SURFACE PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.
Santa Cruz, CA | watways.com | Portland, OR

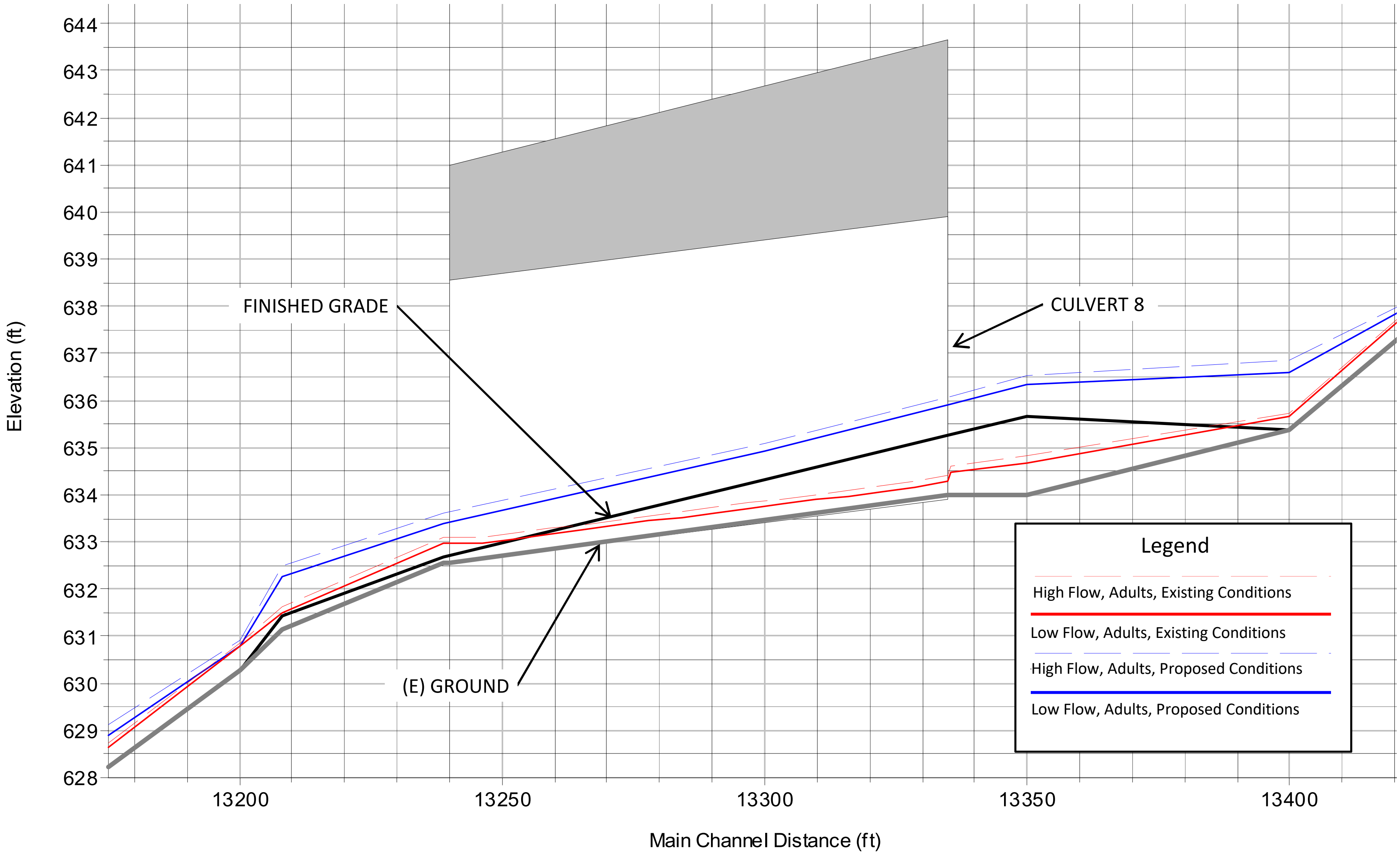


FIGURE **F13**	WATER SURFACE PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA | watways.com | Portland, OR

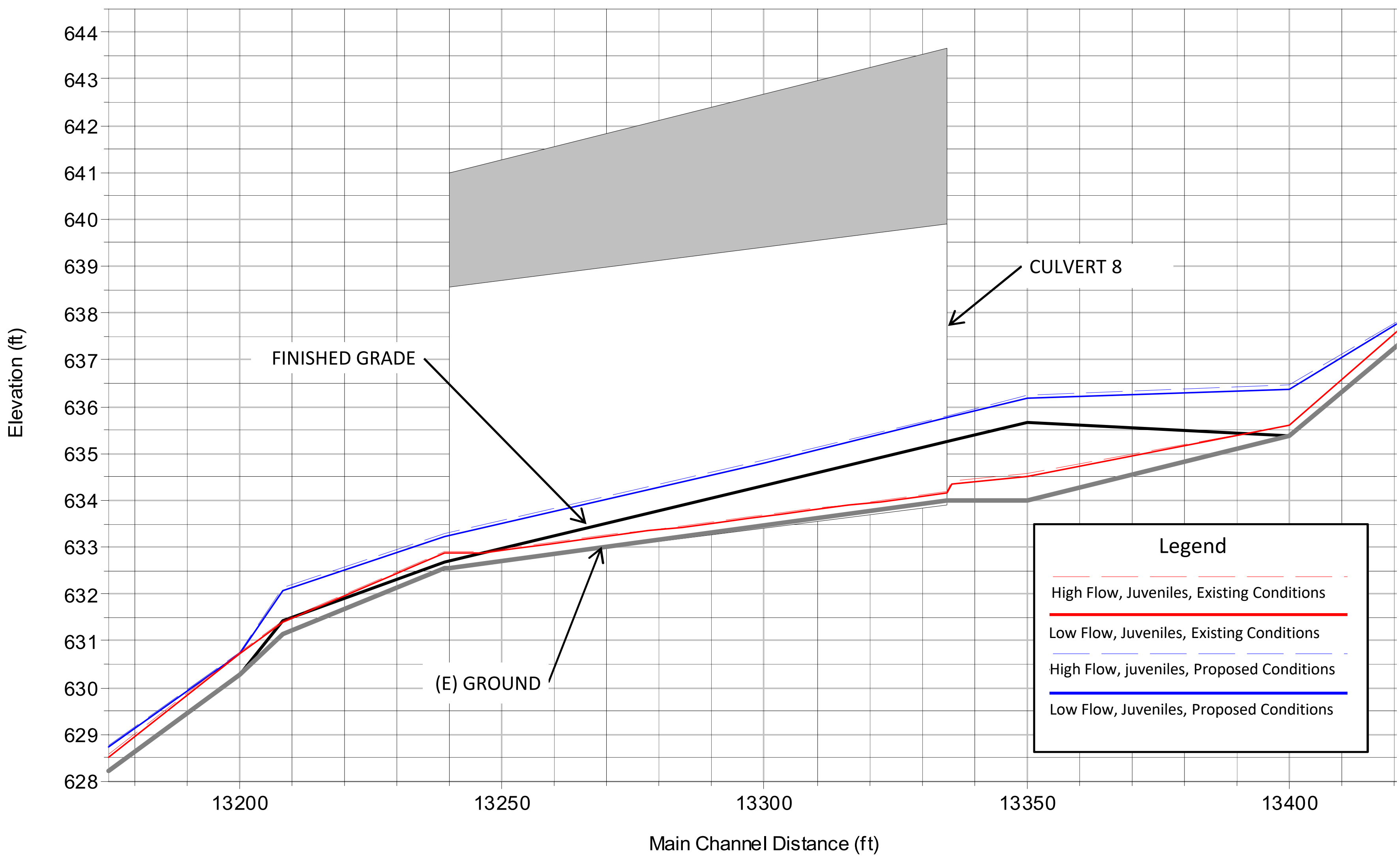
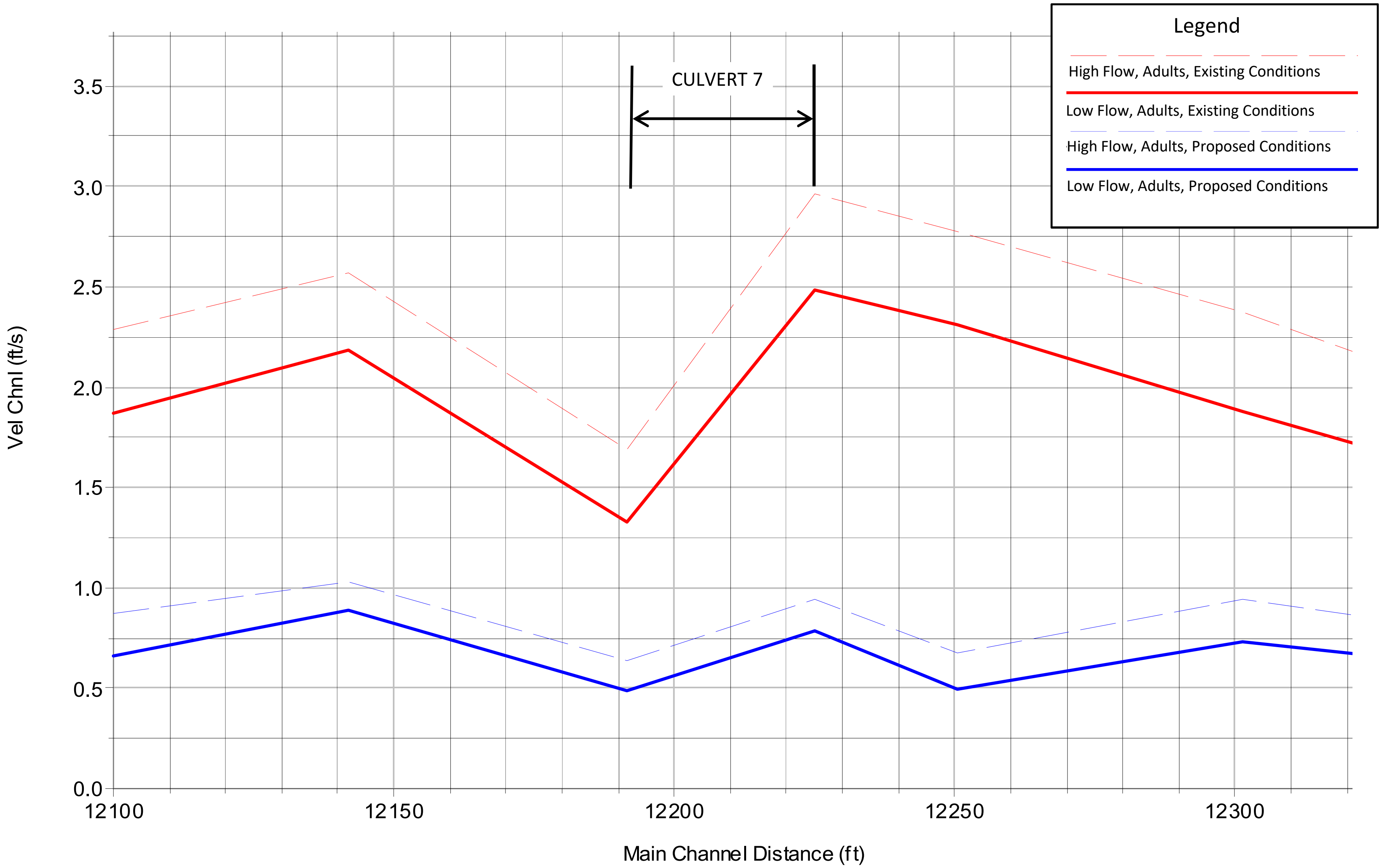


FIGURE F14	WATER SURFACE PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA · watways.com · Portland, OR



NOTE: Channel reconstruction is proposed from station 121+50 to 122+65 where Culvert #7 is removed.

FIGURE

F15

VELOCITY PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR

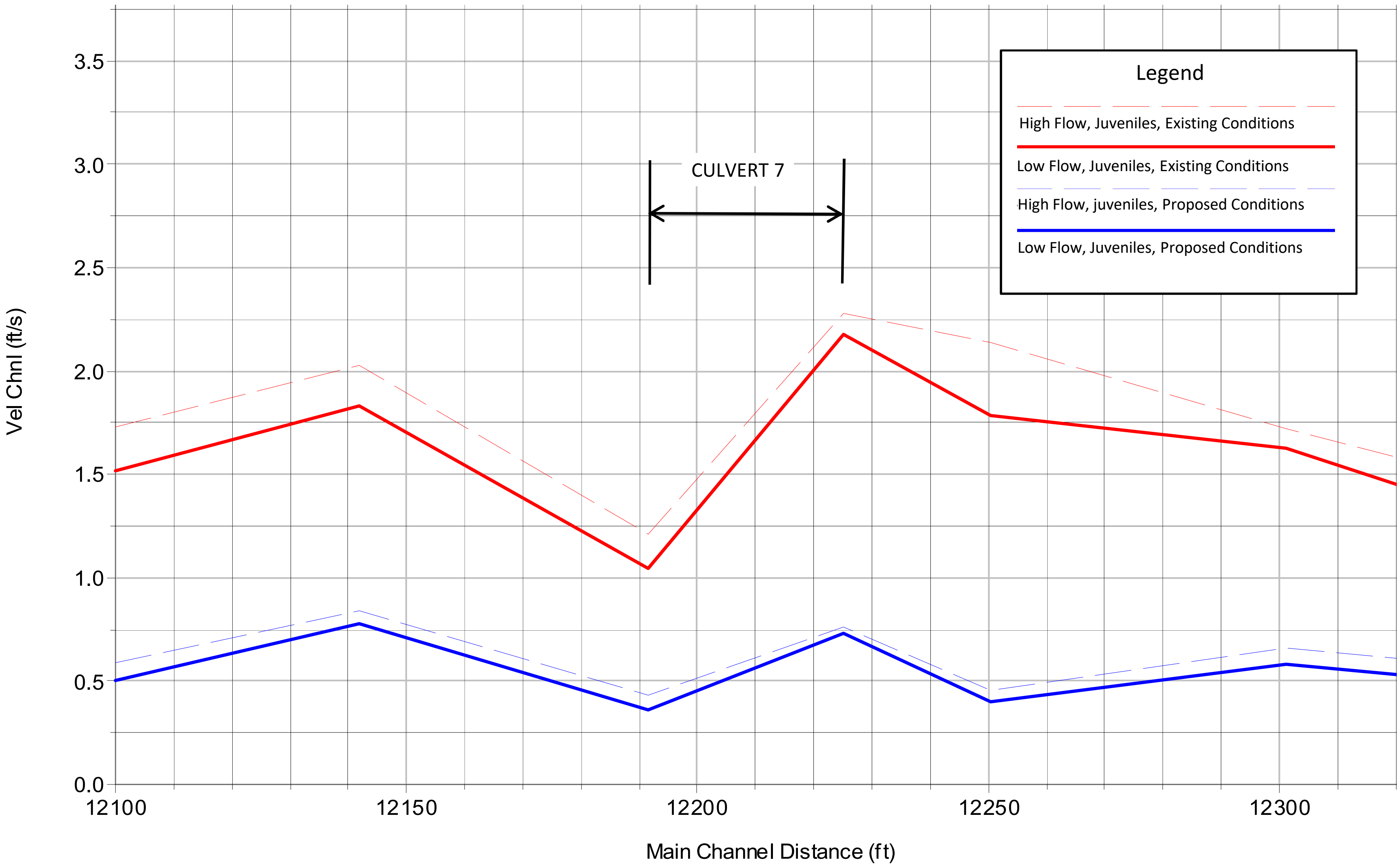
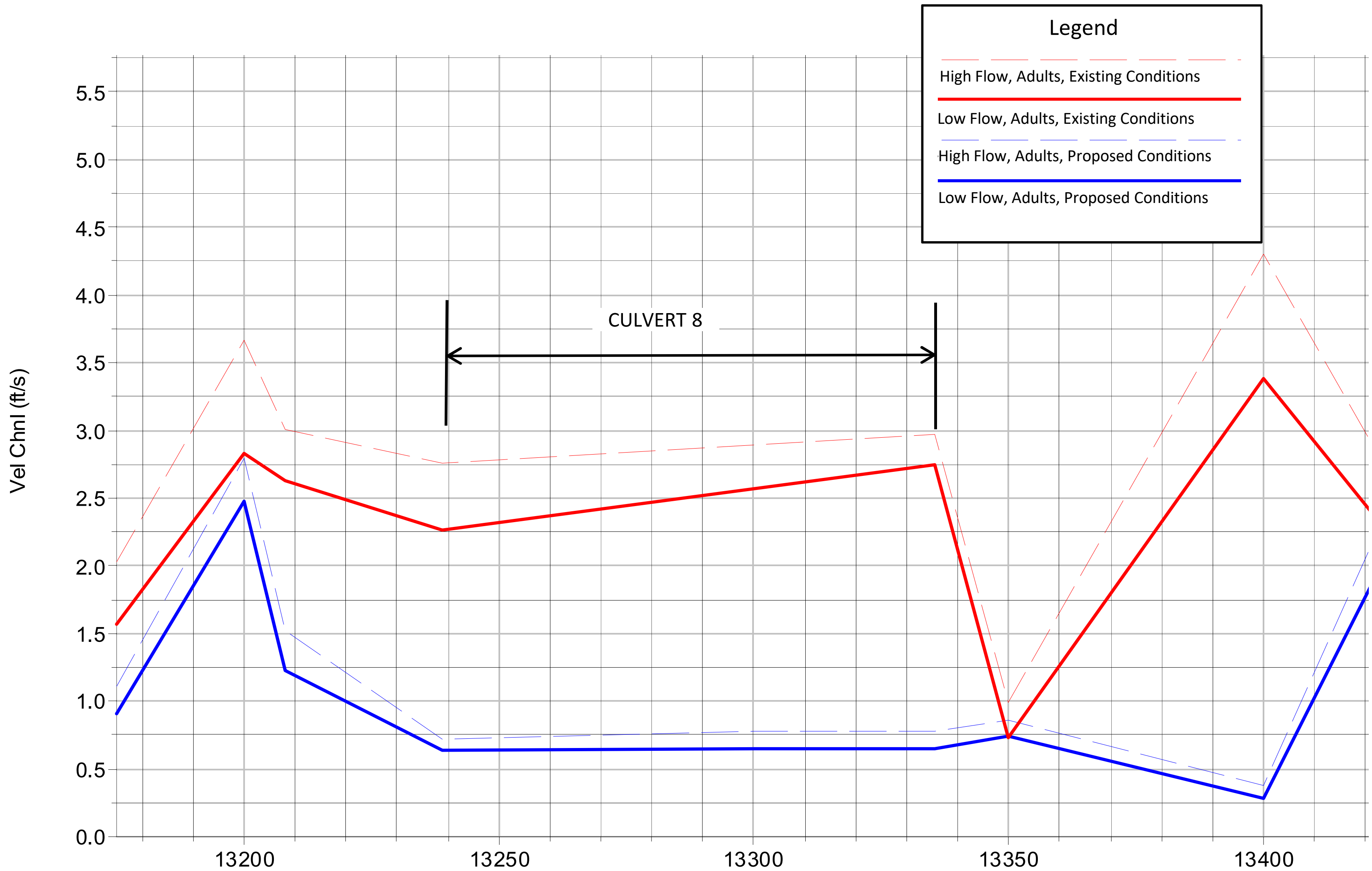
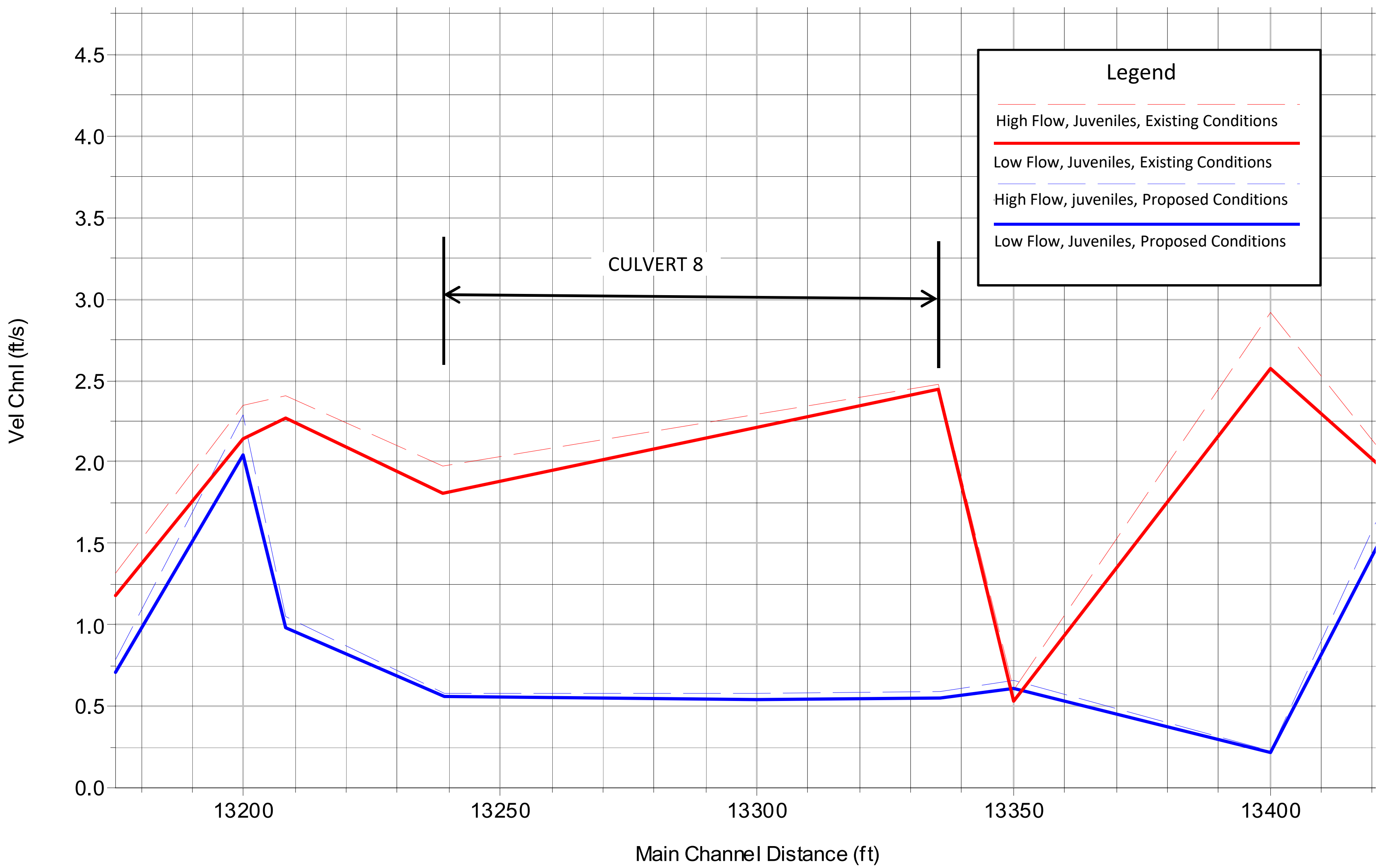


FIGURE F16	VELOCITY PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA	PERMANENTE CREEK 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA | watways.com | Portland, OR



NOTE: Channel reconstruction is proposed from station 132+30 to 133+90 where Culvert #8 is removed.

FIGURE F17	VELOCITY PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA	PERMANENTE CREEK / 90% SUBMITTAL	WATERWAYS CONSULTING, INC. Santa Cruz, CA · watways.com · Portland, OR



FIGURE

F18

VELOCITY PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS CONSULTING, INC.

Santa Cruz, CA | watways.com | Portland, OR

HEC-RAS MODEL RESULTS

Tabular Data

Channel Widening and Rock Pile Areas Material

Removal Area

Evaluation of Overtopping Flow along Vehicle Barrier

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

UPSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.015
DOWNSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.023

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	16150	Q100	Existing	1145	806.67	810.64	3.39	5.67	207	60.9		0.05	0.10	0.05
	16150	Q100	Proposed	1145	803.98	808.86	2.58	10.82	151	58.3	0.10	0.06	0.10	0.06
	16150	Q10	Existing	653	806.67	809.22	2.08	5.43	122	58.5		0.05	0.10	0.05
	16150	Q10	Proposed	653	803.98	807.96	1.85	8.84	100	54.1	0.10	0.06	0.10	0.06
	16150	Q1.5	Existing	219	806.67	808.05	0.97	4.02	55	56.4		0.05	0.10	0.05
	16150	Q1.5	Proposed	219	803.98	806.33	1.30	6.95	33	25.2	0.10	0.06		0.05
	16100	Q100	Existing	1145	805.24	810.65	4.53	3.85	305	67.4	0.10	0.05	0.10	0.05
	16100	Q100	Proposed	1145	800.19	804.08	1.72	16.32	99	57.2	0.10	0.06	0.10	0.06
	16100	Q10	Existing	653	805.24	809.20	3.22	3.17	209	64.9	0.10	0.05	0.10	0.05
	16100	Q10	Proposed	653	800.19	803.27	1.20	14.34	55	46.2	0.10	0.06	0.10	0.05
	16100	Q1.5	Existing	219	805.24	806.55	0.74	4.98	44	59.4		0.05	0.10	0.05
	16100	Q1.5	Proposed	219	800.19	802.14	1.29	9.84	22	17.3		0.06		0.06
	16050	Q100	Existing	1145	804.14	810.62	5.31	3.27	374	70.5	0.10	0.05	0.10	0.05
	16050	Q100	Proposed	1145	796.29	800.40	2.15	14.6	106	49.4	0.09	0.06	0.10	0.06
	16050	Q10	Existing	653	804.14	809.17	4.11	2.49	275	66.9	0.10	0.05	0.10	0.05
	16050	Q10	Proposed	653	796.29	799.66	1.50	11.96	70	47.1	0.10	0.06	0.10	0.05
	16050	Q1.5	Existing	219	804.14	805.94	1.26	3.01	73	58.1		0.05	0.10	0.05
	16050	Q1.5	Proposed	219	796.29	798.58	1.28	7.69	29	22.3	0.10	0.06	0.10	0.05
	16000	Q100	Existing	1145	802.84	810.61	5.98	2.74	450	75.3	0.10	0.05	0.10	0.05
	16000	Q100	Proposed	1145	792.29	796.45	2.38	14.94	97	41.0	0.09	0.06	0.10	0.06
	16000	Q10	Existing	653	802.84	809.16	4.79	2.01	344	71.7	0.10	0.05	0.10	0.05
	16000	Q10	Proposed	653	792.29	795.55	1.65	12.77	62	37.7	0.10	0.06	0.10	0.06
	16000	Q1.5	Existing	219	802.84	805.85	1.91	1.84	121	63.0		0.05	0.10	0.05
	16000	Q1.5	Proposed	219	792.29	794.29	1.32	9.45	23	17.5		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	15982.36	Q100	Existing	1145	801.83	810.60	5.48	2.68	498	90.9	0.10	0.05	0.10	0.05
	15982.36	Q100	Proposed	1145	791.02	795.19	2.38	14.83	100	42.3	0.10	0.06	0.10	0.06
	15982.36	Q10	Existing	653	801.83	809.15	4.93	1.94	378	76.7	0.10	0.05	0.10	0.05
	15982.36	Q10	Proposed	653	791.02	794.35	1.70	12.23	66	38.9	0.10	0.06	0.10	0.06
	15982.36	Q1.5	Existing	219	801.83	805.83	2.06	1.69	139	67.3	0.10	0.05	0.10	0.05
	15982.36	Q1.5	Proposed	219	791.02	793.32	1.12	7.62	29	26.4		0.06	0.10	0.05
	15950	Q100	Existing	1145	793.81	810.62	7.88	2.88	855	108.6	0.10	0.05	0.10	0.08
	15950	Q100	Proposed	1145	788.29	792.29	2.24	15.54	93	41.7	0.08	0.06	0.10	0.06
	15950	Q10	Existing	653	793.81	809.16	6.87	1.97	699	101.8	0.10	0.05	0.10	0.08
	15950	Q10	Proposed	653	788.29	791.50	1.59	12.89	61	38.6	0.09	0.06	0.10	0.06
	15950	Q1.5	Existing	219	793.81	805.85	4.67	1.1	398	85.3	0.10	0.05	0.10	0.08
	15950	Q1.5	Proposed	219	788.29	790.24	1.30	9.63	23	17.6		0.06		0.06
	15917.67	Q100	Existing	1145	791.85	810.64	9.23	1.04	1153	124.9	0.10	0.05	0.10	0.05
	15917.67	Q100	Proposed	1145	785.57	789.55	2.15	15.52	95	44.2	0.08	0.06	0.10	0.06
	15917.67	Q10	Existing	653	791.85	809.17	7.96	0.69	972	122.1	0.10	0.05	0.10	0.05
	15917.67	Q10	Proposed	653	785.57	788.79	1.54	12.81	63	40.7	0.09	0.06	0.10	0.05
	15917.67	Q1.5	Existing	219	791.85	805.85	5.66	0.37	600	106.1	0.10	0.05		0.05
	15917.67	Q1.5	Proposed	219	785.57	787.78	1.29	8.1	27	21.1	0.10	0.06		0.06
	15900	Q100	Existing	1145	791.72	810.64	9.20	1.01	1184	128.7	0.10	0.05	0.10	0.05
	15900	Q100	Proposed	1145	784.31	788.49	2.31	14.49	103	44.6	0.09	0.06	0.10	0.06
	15900	Q10	Existing	653	791.72	809.17	8.23	0.67	1000	121.6	0.10	0.05	0.10	0.05
	15900	Q10	Proposed	653	784.31	787.69	1.65	11.96	68	41.5	0.09	0.06	0.10	0.06
	15900	Q1.5	Existing	219	791.72	805.85	5.72	0.36	623	109.0	0.10	0.05		0.05
	15900	Q1.5	Proposed	219	784.31	786.49	1.38	8.31	26	19.0		0.06	0.10	0.06
Culvert #11	15878.42	Q100	Existing	1145	798.16	810.56	5.09	2.74	659	129.6	0.10	0.05	0.10	0.06
	15878.42	Q100	Proposed	1145	782.58	786.73	2.29	14.91	102	44.4	0.10	0.06	0.10	0.06
	15878.42	Q10	Existing	653	798.16	809.13	4.11	2.01	477	116.1	0.10	0.05	0.10	0.05
	15878.42	Q10	Proposed	653	782.58	785.88	1.58	12.54	65	41.3	0.10	0.06	0.10	0.06
	15878.42	Q1.5	Existing	219	798.16	805.82	2.92	1.41	189	64.9	0.10	0.05		0.05
	15878.42	Q1.5	Proposed	219	782.58	784.70	1.39	8.69	25	18.1		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
Culvert #11 (Half culvert in Existing Conditions modeled as open channel)	15850	Q100	Existing	1145	799.75	809.03	3.03	10.84	130	42.8	0.03	0.02	0.03	0.03
	15850	Q100	Proposed	1145	780.31	784.40	2.25	15.19	99	44.0	0.10	0.06	0.10	0.06
	15850	Q10	Existing	653	799.75	807.91	2.33	9.24	85	36.7	0.03	0.02	0.03	0.02
	15850	Q10	Proposed	653	780.31	783.59	1.57	12.63	64	41.1	0.10	0.06	0.10	0.06
	15850	Q1.5	Existing	219	799.75	804.06	3.22	10.15	22	6.7		0.02		0.02
	15850	Q1.5	Proposed	219	780.31	782.46	1.42	8.47	26	18.3		0.06		0.06
	15800	Q100	Existing	1145	800.05	808.60	3.25	11.13	131	40.3	0.03	0.02	0.03	0.02
	15800	Q100	Proposed	1145	776.33	780.46	2.30	15.15	99	43.1	0.10	0.06	0.10	0.06
	15800	Q10	Existing	653	800.05	806.81	1.97	10.91	65	32.9	0.03	0.02	0.03	0.02
	15800	Q10	Proposed	653	776.33	779.62	1.59	12.6	64	40.2	0.10	0.06	0.10	0.06
	15800	Q1.5	Existing	219	800.05	803.31	2.26	10.38	21	9.3		0.02		0.02
	15800	Q1.5	Proposed	219	776.33	778.46	1.40	8.61	25	18.2		0.06		0.06
	15750	Q100	Existing	1145	798.71	805.99	2.45	15.87	85	34.8	0.03	0.02	0.03	0.02
	15750	Q100	Proposed	1145	772.22	776.27	2.24	15.47	95	42.4	0.09	0.06	0.10	0.06
	15750	Q10	Existing	653	798.71	803.77	3.69	16.2	40	10.9		0.02		0.02
	15750	Q10	Proposed	653	772.22	775.47	1.58	12.83	62	39.3	0.10	0.06	0.10	0.05
	15750	Q1.5	Existing	219	798.71	801.47	1.90	12.73	17	9.1		0.02		0.02
	15750	Q1.5	Proposed	219	772.22	774.32	1.30	8.71	25	19.4	0.10	0.06		0.06
	15700	Q100	Existing	1145	797.35	803.97	2.21	17.92	73	32.9	0.03	0.02	0.03	0.02
	15700	Q100	Proposed	1145	768.08	771.95	1.82	15.16	95	51.9	0.10	0.06	0.10	0.05
	15700	Q10	Existing	653	797.35	801.84	3.53	17.53	37	10.6		0.02		0.02
	15700	Q10	Proposed	653	768.08	771.12	1.52	12.57	57	37.6	0.10	0.06	0.10	0.05
	15700	Q1.5	Existing	219	797.35	799.64	1.82	13.72	16	8.8		0.02		0.02
	15700	Q1.5	Proposed	219	768.08	769.97	1.25	8.59	25	20.4		0.06		0.06
	15650	Q100	Existing	1145	795.45	801.87	2.52	19.34	61	24.0	0.03	0.02	0.03	0.02
	15650	Q100	Proposed	1145	764.00	767.80	1.51	15.2	110	72.7	0.10	0.06	0.10	0.06
	15650	Q10	Existing	653	795.45	799.74	3.37	18.65	35	10.4		0.02		0.02
	15650	Q10	Proposed	653	764.00	767.15	1.28	12.21	69	53.9	0.10	0.06	0.10	0.05
	15650	Q1.5	Existing	219	795.45	797.67	1.74	14.39	15	8.8		0.02		0.02
	15650	Q1.5	Proposed	219	764.00	766.11	0.96	8.1	28	29.2	0.10	0.06		0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
Culvert #11	15600	Q100	Existing	1145	793.89	800.00	4.80	20.24	57	11.8		0.02		0.02
	15600	Q100	Proposed	1145	759.91	763.88	1.44	14.58	125	87.1	0.10	0.06	0.10	0.06
	15600	Q10	Existing	653	793.89	797.99	3.39	18.89	35	10.2		0.02		0.02
	15600	Q10	Proposed	653	759.91	763.17	1.14	12.33	72	63.2	0.10	0.06	0.10	0.05
	15600	Q1.5	Existing	219	793.89	795.98	1.77	14.13	15	8.8		0.02		0.02
	15600	Q1.5	Proposed	219	759.91	761.96	1.36	8.89	25	18.2		0.06		0.06
	15550	Q100	Existing	1145	788.69	794.69	4.59	24.88	46	10.0		0.02		0.02
	15550	Q100	Proposed	1145	756.06	759.77	1.42	14.84	127	89.5	0.10	0.06	0.10	0.06
	15550	Q10	Existing	653	788.69	792.75	3.26	23.27	28	8.6		0.02		0.02
	15550	Q10	Proposed	653	756.06	759.22	0.93	12.4	78	84.5	0.10	0.06	0.10	0.05
	15550	Q1.5	Existing	219	788.69	790.72	1.48	19.03	12	7.8		0.02		0.02
	15550	Q1.5	Proposed	219	756.06	758.23	1.15	8.11	27	23.8		0.06	0.10	0.05
CULVERT #10	15500	Q100	Existing	1145	781.80	787.68	4.37	27.6	41	9.5		0.05		0.05
	15500	Q100	Proposed	1145	752.25	755.99	1.62	13.69	128	79.0	0.10	0.06	0.10	0.06
	15500	Q10	Existing	653	781.80	792.44	6.09	6.77	97	15.9	0.03	0.05		0.05
	15500	Q10	Proposed	653	752.25	755.28	1.14	11.98	76	66.9	0.10	0.06	0.10	0.05
	15500	Q1.5	Existing	219	781.80	784.21	1.55	18.67	12	7.6		0.05		0.05
	15500	Q1.5	Proposed	219	752.25	754.24	1.19	8.65	25	21.3		0.06	0.10	0.06
	15450	Q100	Proposed	1145	748.42	752.41	1.80	13.6	123	68.1	0.10	0.06	0.10	0.06
	15450	Q10	Proposed	653	748.42	751.62	1.40	11.51	75	53.5	0.10	0.06	0.10	0.06
	15450	Q1.5	Proposed	219	748.42	750.55	0.94	7.99	28	29.9		0.06	0.10	0.05
	15400	Q100	Proposed	1145	744.50	748.75	1.78	14.22	118	66.2	0.10	0.06	0.10	0.06
	15400	Q10	Proposed	653	744.50	747.91	1.43	12	70	48.5	0.10	0.06	0.10	0.05
	15400	Q1.5	Proposed	219	744.50	746.62	1.34	8.71	25	18.8		0.06	0.10	0.06
	15350	Q100	Proposed	1145	740.46	744.48	1.69	15.39	108	64.1	0.10	0.06	0.10	0.06
	15350	Q10	Proposed	653	740.46	743.71	1.33	12.91	64	48.4	0.10	0.06	0.10	0.05
	15350	Q1.5	Proposed	219	740.46	742.60	1.41	8.54	26	18.2		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
CULVERT #10	15300	Q100	Proposed	1145	736.48	740.50	1.96	15.08	108	54.8	0.10	0.06	0.10	0.06
	15300	Q10	Proposed	653	736.48	739.77	1.31	12.53	68	52.2	0.10	0.06	0.10	0.05
	15300	Q1.5	Proposed	219	736.48	738.62	1.41	8.57	26	18.2		0.06		0.06
	15250	Q100	Proposed	1145	732.49	736.55	2.14	14.97	104	48.5	0.10	0.06	0.10	0.06
	15250	Q10	Proposed	653	732.49	735.74	1.45	12.66	66	45.5	0.10	0.06	0.10	0.05
	15250	Q1.5	Proposed	219	732.49	734.62	1.41	8.57	26	18.2		0.06		0.06
	15200			Culvert										
	15200	Q100	Proposed	1145	728.50	732.66	2.33	14.96	101	43.6	0.10	0.06	0.10	0.06
	15200	Q10	Proposed	653	728.50	731.78	1.61	12.55	65	40.3	0.10	0.06	0.10	0.06
	15200	Q1.5	Proposed	219	728.50	730.63	1.41	8.58	26	18.1		0.06		0.06
	15150	Q100	Proposed	1145	724.50	728.61	2.25	15.31	99	43.8	0.10	0.06	0.10	0.06
	15150	Q10	Proposed	653	724.50	727.79	1.58	12.64	64	40.5	0.10	0.06	0.10	0.05
	15150	Q1.5	Proposed	219	724.50	726.63	1.40	8.57	26	18.2		0.06		0.06
	15100	Q100	Proposed	1145	720.52	724.63	2.21	15.28	99	45.0	0.10	0.06	0.10	0.06
	15100	Q10	Proposed	653	720.52	723.81	1.54	12.66	64	41.4	0.10	0.06	0.10	0.05
	15100	Q1.5	Proposed	219	720.52	722.65	1.40	8.54	26	18.3		0.06		0.06
	15050	Q100	Proposed	1145	716.54	720.61	2.16	15.3	100	46.1	0.10	0.06	0.10	0.06
	15050	Q10	Proposed	653	716.54	719.79	1.52	12.66	64	42.1	0.10	0.06	0.10	0.05
	15050	Q1.5	Proposed	219	716.54	718.65	1.40	8.57	26	18.3		0.06		0.06
	15000	Q100	Proposed	1145	712.56	716.64	2.09	15.21	103	49.3	0.10	0.06	0.10	0.06
	15000	Q10	Proposed	653	712.56	715.86	1.45	12.56	66	45.6	0.10	0.06	0.10	0.05
	15000	Q1.5	Proposed	219	712.56	714.71	1.41	8.49	26	18.3		0.06		0.06
	14950	Q100	Proposed	1145	708.59	712.63	1.98	15.17	104	52.6	0.10	0.06	0.10	0.06
	14950	Q10	Proposed	653	708.59	711.83	1.42	12.67	64	45.3	0.10	0.06	0.10	0.05
	14950	Q1.5	Proposed	219	708.59	710.69	1.38	8.6	25	18.4		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
CULVERT #10	14923.42	Q100	Existing	1145	705.88	713.26	4.60	13.7	101	22.0	0.10	0.05	0.10	0.05
	14923.42	Q100	Proposed	1145	706.35	710.53	1.96	15.07	103	52.9	0.10	0.06	0.10	0.06
	14923.42	Q10	Existing	653	705.88	711.27	3.52	11.64	62	17.6	0.10	0.05	0.10	0.05
	14923.42	Q10	Proposed	653	706.35	709.66	1.52	12.65	62	40.9	0.10	0.06	0.10	0.05
	14923.42	Q1.5	Existing	219	705.88	708.25	1.72	11.59	19	11.0		0.05	0.00	0.05
	14923.42	Q1.5	Proposed	219	706.35	708.43	1.35	8.73	25	18.5		0.06	0.00	0.06
	14900	Q100	Existing	1145	704.46	710.45	3.64	16.92	77	21.1	0.10	0.07	0.10	0.06
	14900	Q100	Proposed	1145	704.78	708.26	2.01	15.55	95	47.1	0.10	0.06	0.10	0.06
	14900	Q10	Existing	653	704.46	709.03	2.85	14.05	49	17.4	0.10	0.07	0.10	0.06
	14900	Q10	Proposed	653	704.78	707.44	1.51	13	59	39.3	0.10	0.06	0.10	0.06
	14900	Q1.5	Existing	219	704.46	707.60	2.01	8.14	27	13.6		0.07	0.10	0.06
	14900	Q1.5	Proposed	219	704.78	706.43	1.22	8.37	27	21.8		0.06	0.10	0.06
	14850	Q100	Existing	1145	701.28	710.33	5.82	7.78	177	30.4	0.10	0.05	0.10	0.05
	14850	Q100	Proposed	1145	701.28	706.42	2.30	13.35	137	59.4	0.10	0.05	0.10	0.05
	14850	Q10	Existing	653	701.28	707.97	4.48	6.47	112	25.0	0.10	0.05	0.10	0.05
	14850	Q10	Proposed	653	701.28	705.50	1.62	10.94	85	52.7	0.10	0.05	0.10	0.05
	14850	Q1.5	Existing	219	701.28	704.90	2.59	4.76	46	17.9	0.10	0.05		0.05
	14850	Q1.5	Proposed	219	701.28	704.19	2.09	6.63	33	15.8	0.10	0.05		0.05
	14802.52	Q100	Existing	1145	700.05	708.01	4.54	14.32	121	26.7	0.10	0.05	0.10	0.05
	14802.52	Q100	Proposed	1145	700.05	704.87	2.24	14.51	156	69.9	0.10	0.05	0.10	0.07
	14802.52	Q10	Existing	653	700.05	705.97	3.48	12.2	73	20.9	0.10	0.05	0.10	0.05
	14802.52	Q10	Proposed	653	700.05	704.19	1.67	11.55	110	65.9	0.10	0.05	0.10	0.06
	14802.52	Q1.5	Existing	219	700.05	703.35	2.07	8.91	28	13.4	0.10	0.05	0.10	0.05
	14802.52	Q1.5	Proposed	219	700.05	703.33	0.92	6.9	55	60.0	0.10	0.05	0.10	0.05
	14794.09	Q100	Existing	1145	697.70	704.67	4.03	20.6	85	21.1	0.10	0.05	0.10	0.05
	14794.09	Q100	Proposed	1145	697.70	703.03	1.62	17.18	127	78.5	0.10	0.05	0.10	0.06
	14794.09	Q10	Existing	653	697.70	702.64	2.94	18.66	47	16.1	0.10	0.05	0.10	0.05
	14794.09	Q10	Proposed	653	697.70	702.39	1.10	14.36	80	72.6	0.10	0.05	0.10	0.05
	14794.09	Q1.5	Existing	219	697.70	700.24	1.54	15.49	16	10.2	0.10	0.05	0.10	0.05
	14794.09	Q1.5	Proposed	219	697.70	700.47	1.72	13.69	16	9.3		0.05		0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	14750	Q100	Existing	1145	696.69	702.06	3.62	19.66	68	18.7	0.10	0.05	0.10	0.04
	14750	Q100	Proposed	1145	696.69	701.15	1.83	14.8	152	82.9	0.10	0.05	0.10	0.06
	14750	Q10	Existing	653	696.69	700.81	2.82	15.62	46	16.2	0.10	0.05	0.10	0.04
	14750	Q10	Proposed	653	696.69	700.44	1.22	12.87	95	78.1	0.10	0.05	0.10	0.05
	14750	Q1.5	Existing	219	696.69	699.52	1.93	8.52	26	13.7	0.10	0.05	0.10	0.05
	14750	Q1.5	Proposed	219	696.69	699.60	0.78	7.75	37	47.3	0.10	0.05	0.10	0.03
	14700	Q100	Existing	1145	692.71	698.67	3.44	20.19	68	19.7	0.10	0.05	0.10	0.05
	14700	Q100	Proposed	1145	692.71	697.47	1.78	17.4	135	76.0	0.10	0.05	0.10	0.07
	14700	Q10	Existing	653	692.71	697.33	2.74	16.38	44	16.0	0.10	0.05	0.10	0.05
	14700	Q10	Proposed	653	692.71	696.78	1.13	15.18	83	73.4	0.10	0.05	0.10	0.05
	14700	Q1.5	Existing	219	692.71	695.33	1.63	12.78	17	10.6		0.05	0.10	0.05
	14700	Q1.5	Proposed	219	692.71	695.30	1.33	12.88	17	13.0	0.10	0.05	0.10	0.04
	14667.14	Q100	Existing	1145	687.94	692.19	2.72	24.05	49	18.1	0.10	0.05	0.10	0.05
	14667.14	Q100	Proposed	1145	687.94	693.05	1.24	18	79	63.8	0.10	0.05	0.10	0.03
	14667.14	Q10	Existing	653	687.94	691.18	2.02	20.42	32	15.9	0.10	0.05	0.10	0.05
	14667.14	Q10	Proposed	653	687.94	691.54	2.31	17.66	37	16.2		0.05	0.10	0.05
	14667.14	Q1.5	Existing	219	687.94	689.96	1.28	14.58	15	11.7		0.05		0.05
	14667.14	Q1.5	Proposed	219	687.94	689.97	1.30	14.46	15	11.7		0.05		0.05
	14650	Q100	Existing	1145	687.66	692.34	3.02	19.82	63	20.9	0.10	0.05	0.10	0.05
	14650	Q100	Proposed	1145	687.66	692.48	1.48	16.95	97	65.8	0.10	0.05	0.10	0.04
	14650	Q10	Existing	653	687.66	691.44	2.46	15.02	45	18.4	0.10	0.05	0.10	0.05
	14650	Q10	Proposed	653	687.66	691.62	1.52	13.51	54	35.9	0.10	0.05	0.10	0.04
	14650	Q1.5	Existing	219	687.66	690.38	1.76	8.03	27	15.6	0.00	0.05	0.10	0.05
	14650	Q1.5	Proposed	219	687.66	690.38	1.74	7.95	28	15.9		0.05	0.10	0.05
	14600	Q100	Existing	1145	685.80	691.86	3.48	11.94	159	45.7	0.10	0.05	0.10	0.06
	14600	Q100	Proposed	1145	685.80	689.95	1.65	16.82	125	75.6	0.10	0.05	0.10	0.06
	14600	Q10	Existing	653	685.80	690.29	2.72	10.21	97	35.6	0.10	0.05	0.10	0.06
	14600	Q10	Proposed	653	685.80	689.36	1.25	13.2	82	65.5	0.10	0.05	0.10	0.05
	14600	Q1.5	Existing	219	685.80	688.73	1.57	6.59	46	29.4	0.10	0.05	0.10	0.06
	14600	Q1.5	Proposed	219	685.80	688.68	1.18	6.59	46	38.8	0.10	0.05	0.10	0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	14550	Q100	Existing	1145	684.39	691.39	4.25	10.22	172	40.4	0.10	0.05	0.10	0.06
	14550	Q100	Proposed	1145	684.39	690.73	3.37	7.92	257	76.4	0.10	0.05	0.10	0.07
	14550	Q10	Existing	653	684.39	689.50	2.94	9.19	101	34.5	0.10	0.05	0.10	0.06
	14550	Q10	Proposed	653	684.39	689.30	2.35	7.35	156	66.5	0.10	0.05	0.10	0.07
	14550	Q1.5	Existing	219	684.39	687.38	1.22	7.45	34	28.1	0.10	0.05	0.10	0.04
	14550	Q1.5	Proposed	219	684.39	687.51	0.88	6.73	44	50.1	0.10	0.05	0.10	0.04
	14500	Q100	Existing	1145	682.99	689.58	3.82	12.58	118	30.8	0.10	0.05	0.10	0.05
	14500	Q100	Proposed	1145	682.99	689.05	3.04	11.41	158	52.0	0.10	0.05	0.10	0.06
	14500	Q10	Existing	653	682.99	687.95	2.89	10.67	72	24.9	0.10	0.05	0.10	0.05
	14500	Q10	Proposed	653	682.99	687.76	2.31	9.85	97	42.2	0.10	0.05	0.10	0.05
	14500	Q1.5	Existing	219	682.99	686.52	2.04	5.83	40	19.7	0.10	0.05	0.10	0.05
	14500	Q1.5	Proposed	219	682.99	686.16	1.22	6.84	38	31.3	0.10	0.05	0.10	0.04
	14450	Q100	Existing	1145	681.13	687.19	2.63	11	145	54.9	0.04	0.05	0.10	0.04
	14450	Q100	Proposed	1145	681.13	686.91	2.36	14.53	121	51.3	0.09	0.07	0.10	0.07
	14450	Q10	Existing	653	681.13	687.75	3.09	4.95	176	57.1	0.04	0.05	0.10	0.04
	14450	Q10	Proposed	653	681.13	686.19	2.22	11.31	88	39.8	0.10	0.07	0.10	0.07
	14450	Q1.5	Existing	219	681.13	684.96	2.04	9.59	34	16.5	0.10	0.05	0.10	0.05
	14450	Q1.5	Proposed	219	681.13	684.70	1.43	7.77	40	27.7	0.10	0.07	0.10	0.06
	14412.75	Q100	Existing	1145	679.63	686.06	2.97	10.82	158	53.0	0.04	0.05	0.10	0.04
	14412.75	Q100	Proposed	1145	679.63	685.33	2.90	13.78	135	46.6	0.10	0.06	0.10	0.07
	14412.75	Q10	Existing	653	679.63	685.68	3.50	13.01	87	24.7	0.10	0.05	0.10	0.06
	14412.75	Q10	Proposed	653	679.63	683.84	2.42	13.13	78	32.5	0.10	0.06	0.10	0.07
	14412.75	Q1.5	Existing	219	679.63	682.22	1.67	13.17	22	12.9	0.10	0.05	0.10	0.05
	14412.75	Q1.5	Proposed	219	679.63	682.18	1.20	10.22	30	25.2	0.10	0.06	0.10	0.06
	14388.99	Q100	Existing	1145	674.81	682.95	4.47	16.31	101	22.5	0.10	0.05	0.10	0.05
	14388.99	Q100	Proposed	1145	674.81	681.09	2.80	18.24	84	29.9	0.10	0.07	0.10	0.06
	14388.99	Q10	Existing	653	674.81	679.24	2.60	21.62	35	13.4	0.10	0.05	0.10	0.05
	14388.99	Q10	Proposed	653	674.81	679.76	1.97	16.2	48	24.2	0.10	0.07	0.10	0.06
	14388.99	Q1.5	Existing	219	674.81	677.31	1.44	17.25	13	9.1	0.10	0.05		0.05
	14388.99	Q1.5	Proposed	219	674.81	677.58	1.64	14.11	16	9.5		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	14350	Q100	Existing	1145	672.28	677.77	3.62	21.76	65	18.1	0.10	0.05	0.10	0.05
	14350	Q100	Proposed	1145	672.28	677.86	2.85	17.75	89	31.3	0.10	0.06	0.10	0.06
	14350	Q10	Existing	653	672.28	676.18	2.63	19.09	39	14.9	0.10	0.05	0.10	0.05
	14350	Q10	Proposed	653	672.28	676.74	2.09	14.58	56	26.9	0.10	0.06	0.10	0.05
	14350	Q1.5	Existing	219	672.28	674.80	1.68	11.31	20	12.2	0.10	0.05	0.10	0.05
	14350	Q1.5	Proposed	219	672.28	675.17	1.98	9.19	25	12.7		0.06	0.10	0.06
	14300	Q100	Existing	1145	667.57	673.70	3.91	23.95	71	18.2	0.10	0.05	0.10	0.06
	14300	Q100	Proposed	1145	667.57	673.41	2.82	16.65	85	30.2	0.10	0.08	0.10	0.07
	14300	Q10	Existing	653	667.57	672.35	2.86	19.27	48	16.6	0.10	0.05	0.10	0.05
	14300	Q10	Proposed	653	667.57	672.39	2.08	13.67	56	27.0	0.10	0.08	0.10	0.07
	14300	Q1.5	Existing	219	667.57	670.50	1.56	13.21	20	12.6	0.10	0.05	0.10	0.05
	14300	Q1.5	Proposed	219	667.57	670.71	1.69	10.26	22	12.9		0.07	0.10	0.07
	14250	Q100	Existing	1145	664.33	667.97	2.42	23.4	64	26.4	0.10	0.05	0.10	0.05
	14250	Q100	Proposed	1145	664.33	668.56	2.01	14.07	100	49.6	0.10	0.07	0.10	0.06
	14250	Q10	Existing	653	664.33	667.17	1.79	18.78	44	24.4	0.10	0.05	0.10	0.05
	14250	Q10	Proposed	653	664.33	667.82	1.45	11.21	64	44.2	0.10	0.07	0.10	0.05
	14250	Q1.5	Existing	219	664.33	666.21	0.98	11.74	21	22.0	0.10	0.05	0.10	0.05
	14250	Q1.5	Proposed	219	664.33	667.24	1.84	4.98	45	24.7		0.07	0.10	0.07
	14192.69	Q100	Existing	1145	662.17	667.79	3.76	12.41	108	28.6	0.10	0.06	0.10	0.06
	14192.69	Q100	Proposed	1145	662.17	667.52	2.84	10.76	145	50.9	0.10	0.07	0.10	0.07
	14192.69	Q10	Existing	653	662.17	666.50	2.78	10.08	72	26.0	0.10	0.06	0.10	0.06
	14192.69	Q10	Proposed	653	662.17	666.51	1.98	8.9	95	48.0	0.10	0.07	0.10	0.06
	14192.69	Q1.5	Existing	219	662.17	664.78	1.42	7.24	31	21.7	0.10	0.06	0.10	0.06
	14192.69	Q1.5	Proposed	219	662.17	664.80	1.42	7.14	31	21.9		0.06	0.10	0.06
	14150	Q100	Existing	1145	660.23	664.78	2.89	14.67	88	30.3	0.10	0.05	0.10	0.05
	14150	Q100	Proposed	1145	660.23	664.76	2.18	13.09	115	52.8	0.10	0.06	0.10	0.06
	14150	Q10	Existing	653	660.23	663.76	2.17	11.99	58	27.0	0.10	0.05	0.10	0.05
	14150	Q10	Proposed	653	660.23	663.85	1.40	11.14	68	48.8	0.10	0.06	0.10	0.05
	14150	Q1.5	Existing	219	660.23	662.64	1.30	7.39	30	23.3	0.00	0.05	0.10	0.05
	14150	Q1.5	Proposed	219	660.23	662.68	1.33	7.16	31	23.6		0.06	0.10	0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	14096.7	Q100	Existing	1145	658.49	664.23	4.07	11.08	178	43.8	0.10	0.05	0.10	0.07
	14096.7	Q100	Proposed	1145	658.49	663.75	3.04	7.9	195	64.1	0.10	0.07	0.10	0.07
	14096.7	Q10	Existing	653	658.49	662.61	2.64	10.04	109	41.4	0.10	0.05	0.10	0.07
	14096.7	Q10	Proposed	653	658.49	662.59	2.03	6.91	122	60.3	0.10	0.07	0.10	0.06
	14096.7	Q1.5	Existing	219	658.49	661.04	1.20	7.41	46	38.6	0.10	0.05	0.10	0.06
	14096.7	Q1.5	Proposed	219	658.49	660.93	1.10	5.98	42	38.3		0.06	0.10	0.06
	14081.95	Q100	Existing	1145	657.82	663.13	3.51	13.48	143	40.7	0.10	0.05	0.10	0.07
	14081.95	Q100	Proposed	1145	657.82	662.74	2.56	10.44	151	59.0	0.10	0.06	0.10	0.06
	14081.95	Q10	Existing	653	657.82	661.97	2.61	10.8	98	37.5	0.10	0.05	0.10	0.06
	14081.95	Q10	Proposed	653	657.82	661.70	1.84	8.95	93	50.3	0.10	0.06	0.10	0.06
	14081.95	Q1.5	Existing	219	657.82	660.29	1.07	8.46	37	34.8	0.10	0.05	0.10	0.05
	14081.95	Q1.5	Proposed	219	657.82	660.34	1.12	6.49	39	34.9		0.06	0.10	0.05
	14050	Q100	Existing	1145	657.20	662.81	4.09	7.31	170	41.6	0.10	0.08	0.10	0.07
	14050	Q100	Proposed	1145	657.20	662.24	2.94	7.47	182	61.8	0.10	0.08	0.10	0.07
	14050	Q10	Existing	653	657.20	661.30	2.94	6.22	111	37.6	0.10	0.08	0.10	0.07
	14050	Q10	Proposed	653	657.20	661.20	2.06	6.14	119	57.9	0.10	0.08	0.10	0.06
	14050	Q1.5	Existing	219	657.20	659.59	1.52	4.42	50	33.0	0.10	0.08	0.10	0.07
	14050	Q1.5	Proposed	219	657.20	659.54	1.48	4.56	48	32.7		0.08	0.10	0.07
	14000	Q100	Existing	1145	655.73	661.50	3.88	9.27	149	38.5	0.10	0.06	0.10	0.06
	14000	Q100	Proposed	1145	655.73	660.53	2.50	9.91	160	64.0	0.10	0.06	0.10	0.06
	14000	Q10	Existing	653	655.73	659.93	2.88	7.91	93	32.4	0.10	0.06	0.10	0.06
	14000	Q10	Proposed	653	655.73	659.49	1.61	8.46	96	59.3	0.10	0.06	0.10	0.05
	14000	Q1.5	Existing	219	655.73	658.15	1.63	5.5	42	25.6	0.10	0.06	0.10	0.06
	14000	Q1.5	Proposed	219	655.73	658.10	1.60	5.52	41	25.8		0.06	0.10	0.06
	13950	Q100	Existing	1145	653.77	659.47	3.79	11.89	108	28.5	0.10	0.06	0.10	0.06
	13950	Q100	Proposed	1145	653.77	659.13	2.83	10.79	152	53.7	0.10	0.06	0.10	0.06
	13950	Q10	Existing	653	653.77	658.04	2.80	9.99	70	24.9	0.10	0.06	0.10	0.06
	13950	Q10	Proposed	653	653.77	657.98	1.88	9.33	93	49.2	0.10	0.06	0.10	0.05
	13950	Q1.5	Existing	219	653.77	656.29	1.56	7.24	31	19.6		0.06	0.10	0.05
	13950	Q1.5	Proposed	219	653.77	656.28	1.56	7.3	30	19.4		0.06	0.10	0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	13900	Q100	Existing	1145	650.13	655.72	3.39	15.92	80	23.5	0.10	0.05	0.10	0.05
	13900	Q100	Proposed	1145	650.13	655.95	2.27	14.24	110	48.6	0.10	0.06	0.10	0.05
	13900	Q10	Existing	653	650.13	654.30	2.60	13.75	49	19.0	0.10	0.05	0.10	0.05
	13900	Q10	Proposed	653	650.13	654.77	1.80	12.41	58	32.3	0.10	0.06	0.10	0.05
	13900	Q1.5	Existing	219	650.13	652.64	1.44	10.31	21	14.9		0.05	0.10	0.05
	13900	Q1.5	Proposed	219	650.13	653.66	2.25	6.27	36	16.0		0.06	0.10	0.06
	13850	Q100	Existing	1145	649.64	654.70	3.27	13.44	101	30.8	0.10	0.05	0.10	0.05
	13850	Q100	Proposed	1145	649.64	654.19	2.19	12.04	133	60.7	0.10	0.06	0.10	0.06
	13850	Q10	Existing	653	649.64	653.75	2.68	10.06	73	27.1	0.10	0.05	0.10	0.05
	13850	Q10	Proposed	653	649.64	653.59	1.70	8.87	98	57.4	0.10	0.06	0.10	0.05
	13850	Q1.5	Existing	219	649.64	651.99	1.51	7.2	31	20.5	0.10	0.05	0.10	0.05
	13850	Q1.5	Proposed	219	649.64	652.00	1.46	7.03	32	21.7		0.06	0.10	0.05
	13800	Q100	Existing	1145	647.10	654.19	4.54	7.15	176	38.8		0.08	0.10	0.07
	13800	Q100	Proposed	1145	647.10	652.77	2.53	9.54	160	63.0	0.10	0.07	0.10	0.07
	13800	Q10	Existing	653	647.10	652.47	3.36	6.18	114	33.8		0.07	0.10	0.07
	13800	Q10	Proposed	653	647.10	651.82	1.82	7.77	103	56.5	0.10	0.07	0.10	0.06
	13800	Q1.5	Existing	219	647.10	650.47	1.86	4.33	52	27.9		0.07	0.10	0.07
	13800	Q1.5	Proposed	219	647.10	650.48	1.78	4.8	47	26.5		0.07	0.10	0.06
	13750	Q100	Existing	1145	646.00	651.86	3.74	12.4	127	34.0	0.10	0.05	0.10	0.06
	13750	Q100	Proposed	1145	646.00	651.41	2.50	10.62	181	72.2	0.10	0.06	0.10	0.07
	13750	Q10	Existing	653	646.00	650.54	2.66	10.23	84	31.6	0.10	0.05	0.10	0.05
	13750	Q10	Proposed	653	646.00	650.49	1.78	8.82	117	65.7	0.10	0.06	0.10	0.06
	13750	Q1.5	Existing	219	646.00	648.91	1.23	7.14	35	28.3	0.10	0.05	0.10	0.04
	13750	Q1.5	Proposed	219	646.00	648.98	1.30	6.75	37	28.5		0.05	0.10	0.05
	13700	Q100	Existing	1145	644.74	649.39	2.81	13.89	102	36.4	0.10	0.06	0.10	0.07
	13700	Q100	Proposed	1145	644.74	650.41	2.64	7.53	222	83.9	0.10	0.07	0.10	0.07
	13700	Q10	Existing	653	644.74	649.00	2.50	9.08	88	35.1	0.10	0.06	0.10	0.07
	13700	Q10	Proposed	653	644.74	649.37	1.86	6.51	139	74.7	0.10	0.07	0.10	0.07
	13700	Q1.5	Existing	219	644.74	647.58	1.36	6.02	41	30.5	0.10	0.06	0.10	0.06
	13700	Q1.5	Proposed	219	644.74	647.68	1.44	5.52	45	31.0		0.07	0.10	0.07

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	13657.14	Q100	Existing	1145	644.12	648.73	3.13	10.53	117	37.5	0.10	0.06	0.10	0.06
	13657.14	Q100	Proposed	1145	644.12	648.76	2.14	9.37	154	72.2	0.10	0.06	0.10	0.06
	13657.14	Q10	Existing	653	644.12	648.14	2.69	7.22	96	35.6	0.10	0.06	0.10	0.06
	13657.14	Q10	Proposed	653	644.12	647.71	1.45	8.28	85	58.9	0.10	0.06	0.10	0.04
	13657.14	Q1.5	Existing	219	644.12	646.50	1.40	5.32	42	29.9		0.06	0.10	0.05
	13657.14	Q1.5	Proposed	219	644.12	646.46	1.37	5.5	40	29.5		0.06	0.10	0.05
	13594.58	Q100	Existing	1145	642.80	648.34	4.31	6.38	228	53.0	0.10	0.06	0.10	0.06
	13594.58	Q100	Proposed	1145	642.80	646.47	2.25	10.91	132	58.8	0.10	0.05	0.10	0.05
	13594.58	Q10	Existing	653	642.80	648.23	4.20	3.73	223	52.9	0.10	0.06	0.10	0.06
	13594.58	Q10	Proposed	653	642.80	645.64	1.88	8.92	90	47.9		0.05	0.10	0.06
	13594.58	Q1.5	Existing	219	642.80	644.60	1.00	5.99	43	42.4		0.05	0.10	0.06
	13594.58	Q1.5	Proposed	219	642.80	644.60	1.00	6.04	43	42.4		0.05	0.10	0.05
	13560.62	Q100	Existing	1145	641.52	648.25	5.27	6.45	298	56.6	0.10	0.05	0.10	0.07
	13560.62	Q100	Proposed	1145	641.52	646.15	2.30	6.64	206	89.6	0.10	0.07	0.10	0.06
	13560.62	Q10	Existing	653	641.52	648.21	5.23	3.71	295	56.4	0.10	0.05	0.10	0.07
	13560.62	Q10	Proposed	653	641.52	645.35	2.00	5.06	142	70.8	0.10	0.07	0.10	0.06
	13560.62	Q1.5	Existing	219	641.52	644.01	1.58	4.53	76	48.4	0.10	0.05	0.10	0.07
	13560.62	Q1.5	Proposed	219	641.52	643.97	1.55	3.28	70	45.1		0.07	0.10	0.07
	13500	Q100	Existing	1145	640.53	648.09	5.28	5.9	338	64.0	0.10	0.05	0.10	0.07
	13500	Q100	Proposed	1145	640.53	645.20	2.10	7.24	253	120.5	0.09	0.06	0.10	0.07
	13500	Q10	Existing	653	640.53	648.15	5.33	3.33	342	64.2	0.10	0.05	0.10	0.07
	13500	Q10	Proposed	653	640.53	644.33	1.46	6.39	155	106.1	0.10	0.06	0.10	0.06
	13500	Q1.5	Existing	219	640.53	642.73	1.13	6.75	49	43.1	0.10	0.05	0.10	0.06
	13500	Q1.5	Proposed	219	640.53	643.07	1.41	4.51	66	46.7		0.06	0.10	0.07
	13450	Q100	Existing	1145	638.15	648.18	3.79	3.27	566	149.5	0.03	0.05	0.10	0.05
	13450	Q100	Proposed	1145	638.15	643.90	1.95	9.23	211	108.3	0.09	0.05	0.10	0.05
	13450	Q10	Existing	653	638.15	648.18	3.79	1.86	567	149.5	0.03	0.05	0.10	0.05
	13450	Q10	Proposed	653	638.15	643.01	1.50	8.08	127	84.5	0.10	0.05	0.10	0.05
	13450	Q1.5	Existing	219	638.15	640.88	1.53	7.6	29	19.2	0.10	0.05	0.10	0.05
	13450	Q1.5	Proposed	219	638.15	641.28	1.55	7.18	31	19.7		0.05		0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	13426.44	Q100	Existing	1145	637.86	648.20	4.62	2.26	651	140.7	0.03	0.06	0.10	0.05
	13426.44	Q100	Proposed	1145	637.86	641.93	1.82	13.21	132	72.3	0.10	0.06	0.10	0.06
	13426.44	Q10	Existing	653	637.86	648.19	4.62	1.29	650	140.7	0.03	0.06	0.10	0.05
	13426.44	Q10	Proposed	653	637.86	641.11	1.16	11.74	75	64.6	0.10	0.06	0.10	0.05
	13426.44	Q1.5	Existing	219	637.86	640.44	1.55	6.17	38	24.7		0.06	0.10	0.06
	13426.44	Q1.5	Proposed	219	637.86	639.97	1.24	8.13	27	22.1		0.06	0.10	0.05
	13400	Q100	Existing	1145	635.37	648.21	6.39	1.93	925	144.7	0.04	0.05	0.10	0.05
	13400	Q100	Proposed	1145	635.37	641.71	2.77	6.44	279	100.6	0.10	0.07	0.10	0.07
	13400	Q10	Existing	653	635.37	648.19	6.38	1.1	922	144.7	0.04	0.05	0.10	0.05
	13400	Q10	Proposed	653	635.37	640.49	1.74	6.07	160	92.3	0.10	0.07	0.10	0.06
	13400	Q1.5	Existing	219	635.37	640.73	2.37	2.22	152	63.9	0.05	0.05	0.10	0.05
	13400	Q1.5	Proposed	219	635.37	639.16	1.31	3.93	64	48.6	0.10	0.07	0.10	0.05
	13350	Q100	Existing	1145	634.00	648.19	5.92	2.45	841	142.1	0.04	0.05	0.10	0.06
	13350	Q100	Proposed	1145	635.68	641.10	3.14	6.73	250	79.6	0.10	0.06	0.10	0.07
	13350	Q10	Existing	653	634.00	648.18	5.92	1.4	841	142.1	0.04	0.05	0.10	0.06
	13350	Q10	Proposed	653	635.68	639.73	2.05	6.28	147	72.0	0.10	0.06	0.10	0.07
	13350	Q1.5	Existing	219	634.00	640.71	3.98	2.1	178	44.9	0.10	0.05	0.10	0.07
	13350	Q1.5	Proposed	219	635.68	638.31	1.04	4.89	53	50.9	0.10	0.06	0.10	0.05
CULVERT #8	13335.55	Q100	Existing	1145	634.01	647.84	5.15	6.27	326	63.3	0.10	0.05	0.10	0.07
	13335.55	Q100	Proposed	1145	635.28	640.89	3.17	6.55	229	72.3	0.10	0.06	0.10	0.06
	13335.55	Q10	Existing	653	634.01	648.09	5.31	3.42	342	64.3	0.10	0.05	0.10	0.08
	13335.55	Q10	Proposed	653	635.28	639.49	2.09	6.05	134	64.3	0.10	0.06	0.10	0.06
	13335.55	Q1.5	Existing	219	634.01	640.07	3.26	6.21	36	11.1	0.10	0.05	0.10	0.04
	13335.55	Q1.5	Proposed	219	635.28	637.93	1.07	4.98	45	41.8	0.10	0.06	0.10	0.05
	13300			Culvert										
	13300	Q100	Proposed	1145	634.82	640.28	3.40	7.51	195	57.4	0.10	0.06	0.10	0.06
	13300	Q100	Proposed	653	634.82	638.83	2.36	6.63	117	49.9	0.10	0.06	0.10	0.06
	13300	Q1.5	Proposed	219	634.82	637.09	1.57	4.94	44	28.2	0.10	0.06	0.10	0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
CULVERT #8	13238.93	Q100	Existing	1276	632.54	641.63	4.89	15	131	26.8	0.10	0.05	0.10	0.05
	13238.93	Q100	Proposed	1276	633.00	638.79	3.27	9.55	164	50.2	0.10	0.06	0.10	0.06
	13238.93	Q10	Existing	728	632.54	639.39	3.78	12.8	78	20.6	0.10	0.05	0.10	0.05
	13238.93	Q10	Proposed	728	633.00	637.89	2.73	6.98	121	44.5	0.10	0.06	0.10	0.06
	13238.93	Q1.5	Existing	244	632.54	636.43	2.28	9.41	29	12.6	0.10	0.05	0.10	0.05
	13238.93	Q1.5	Proposed	244	633.00	636.50	1.96	3.86	65	33.3	0.10	0.06	0.10	0.05
	13208.08	Q100	Existing	1276	631.15	636.50	3.15	21.83	81	25.7	0.10	0.05	0.10	0.06
	13208.08	Q100	Proposed	1276	631.43	637.81	2.87	12.07	161	56.2	0.10	0.06	0.10	0.08
	13208.08	Q10	Existing	728	631.15	635.26	2.37	18.54	51	21.7	0.10	0.05	0.10	0.06
	13208.08	Q10	Proposed	728	631.43	636.87	2.15	10.03	111	51.6	0.10	0.06	0.10	0.08
	13208.08	Q1.5	Existing	244	631.15	633.86	1.36	12.55	24	17.6	0.10	0.05		0.05
	13208.08	Q1.5	Proposed	244	631.43	635.71	1.17	6.87	54	46.0	0.10	0.06		0.06
	13200	Q100	Existing	1276	630.29	635.23	2.87	22.86	82	28.4	0.10	0.05	0.10	0.06
	13200	Q100	Proposed	1276	630.29	636.21	2.56	14.41	136	53.2	0.10	0.05	0.10	0.06
	13200	Q10	Existing	728	630.29	634.18	2.11	18.9	53	25.3	0.10	0.05	0.10	0.06
	13200	Q10	Proposed	728	630.29	635.05	1.65	12.94	78	47.3	0.10	0.05	0.10	0.05
	13200	Q1.5	Existing	244	630.29	632.85	1.07	12.78	22	20.9	0.10	0.05	0.10	0.04
	13200	Q1.5	Proposed	244	630.29	632.78	1.57	13.41	18	11.6		0.05		0.05
	13171.14	Q100	Existing	1276	627.89	635.77	4.93	8.9	229	46.4	0.10	0.05	0.10	0.07
	13171.14	Q100	Proposed	1276	627.89	635.57	3.95	7.89	244	61.8	0.08	0.05	0.10	0.06
	13171.14	Q10	Existing	728	627.89	633.76	3.27	8.03	139	42.6	0.10	0.05	0.10	0.06
	13171.14	Q10	Proposed	728	627.89	634.00	2.82	7.3	153	54.5	0.09	0.05	0.10	0.06
	13171.14	Q1.5	Existing	244	627.89	630.68	1.72	10.89	22	13.0		0.05		0.05
	13171.14	Q1.5	Proposed	244	627.89	630.76	1.40	10.45	23	16.7	0.10	0.05		0.04
	13150	Q100	Existing	1276	627.52	635.51	5.24	9.24	217	41.5	0.10	0.05	0.06	0.06
	13150	Q100	Proposed	1276	627.52	634.27	3.22	12	185	57.4	0.10	0.05	0.10	0.06
	13150	Q10	Existing	728	627.52	633.57	3.71	7.87	140	37.9	0.10	0.05	0.05	0.06
	13150	Q10	Proposed	728	627.52	633.06	2.28	9.89	119	52.1	0.10	0.05	0.10	0.05
	13150	Q1.5	Existing	244	627.52	631.00	1.48	6.64	49	33.2	0.10	0.05	0.05	0.05
	13150	Q1.5	Proposed	244	627.52	630.75	1.56	7.88	35	22.5	0.10	0.05	0.10	0.04

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	13112.96	Q100	Existing	1276	626.28	633.66	4.13	14.05	151	36.6	0.10	0.05	0.10	0.06
	13112.96	Q100	Proposed	1276	626.28	632.49	2.63	14.68	151	57.4	0.10	0.05	0.10	0.06
	13112.96	Q10	Existing	728	626.28	632.05	3.09	11.69	96	31.2	0.10	0.05	0.10	0.06
	13112.96	Q10	Proposed	728	626.28	631.27	1.98	12.74	88	44.4	0.10	0.05	0.10	0.05
	13112.96	Q1.5	Existing	244	626.28	629.79	1.69	8.58	35	20.9	0.09	0.05	0.10	0.05
	13112.96	Q1.5	Proposed	244	626.28	629.76	1.47	8.06	36	24.6	0.10	0.05	0.10	0.05
	13087	Q100	Existing	1276	624.08	630.09	3.06	17.96	88	28.6	0.10	0.05	0.10	0.05
	13087	Q100	Proposed	1276	624.08	630.31	2.77	16.32	112	40.5	0.10	0.05	0.10	0.05
	13087	Q10	Existing	728	624.08	628.62	2.10	15.98	49	23.4	0.10	0.05	0.10	0.04
	13087	Q10	Proposed	728	624.08	628.91	1.83	14.64	60	32.9	0.10	0.05	0.10	0.04
	13087	Q1.5	Existing	244	624.08	626.50	1.70	13.71	18	10.5		0.05		0.05
	13087	Q1.5	Proposed	244	624.08	626.58	1.76	13.13	19	10.6		0.05		0.05
	13050	Q100	Existing	1276	622.58	628.12	3.11	17.88	92	29.7	0.10	0.05	0.10	0.05
	13050	Q100	Proposed	1276	622.58	628.37	3.26	16.62	100	30.5	0.10	0.05	0.06	0.05
	13050	Q10	Existing	728	622.58	627.09	2.38	14.06	63	26.5	0.10	0.05	0.10	0.05
	13050	Q10	Proposed	728	622.58	627.03	2.34	14.31	62	26.4	0.10	0.05	0.05	0.05
	13050	Q1.5	Existing	244	622.58	625.81	1.69	8.08	33	19.5	0.10	0.05		0.05
	13050	Q1.5	Proposed	244	622.58	625.82	1.69	8.06	33	19.6	0.10	0.05		0.05
	13000	Q100	Existing	1276	619.73	627.46	4.16	14.19	118	28.3	0.10	0.05	0.10	0.05
	13000	Q100	Proposed	1276	619.73	627.61	4.23	13.62	122	28.9	0.10	0.06	0.10	0.06
	13000	Q10	Existing	728	619.73	625.53	3.05	12.48	69	22.5	0.10	0.05	0.10	0.05
	13000	Q10	Proposed	728	619.73	625.80	3.19	11.55	75	23.5	0.10	0.06	0.10	0.05
	13000	Q1.5	Existing	244	619.73	623.11	1.91	10.11	24	12.7	0.00	0.05		0.05
	13000	Q1.5	Proposed	244	619.73	623.18	1.93	9.73	25	13.0	0.10	0.06		0.05
	12950	Q100	Existing	1276	616.64	622.93	2.88	19.71	91	31.6	0.10	0.05	0.10	0.05
	12950	Q100	Proposed	1276	616.64	622.97	2.92	18.32	92	31.7	0.10	0.06	0.10	0.05
	12950	Q10	Existing	728	616.64	621.72	2.13	16.17	55	25.8	0.10	0.05	0.10	0.04
	12950	Q10	Proposed	728	616.64	621.80	2.15	15.08	57	26.6	0.10	0.06	0.10	0.05
	12950	Q1.5	Existing	244	616.64	619.83	2.11	10.8	23	10.7	0.00	0.05		0.05
	12950	Q1.5	Proposed	244	616.64	620.00	2.15	9.99	24	11.4		0.06	0.10	0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12900	Q100	Existing	1276	614.95	621.19	3.13	16.54	98	31.3	0.10	0.05	0.10	0.05
	12900	Q100	Proposed	1276	614.95	622.29	3.94	12.67	134	33.9	0.10	0.06	0.10	0.06
	12900	Q10	Existing	728	614.95	619.97	2.20	13.37	62	27.9	0.10	0.05	0.10	0.04
	12900	Q10	Proposed	728	614.95	620.61	2.70	10.96	80	29.6	0.10	0.06	0.10	0.05
	12900	Q1.5	Existing	244	614.95	618.18	2.25	8.47	29	12.8		0.05		0.05
	12900	Q1.5	Proposed	244	614.95	618.17	2.24	8.54	29	12.8		0.06		0.06
	12850	Q100	Existing	1276	613.16	621.61	4.69	10.06	162	34.6	0.10	0.07	0.10	0.07
	12850	Q100	Proposed	1276	613.16	620.04	3.30	14.04	115	35.0	0.09	0.06	0.10	0.05
	12850	Q10	Existing	728	613.16	619.73	3.50	8.5	102	29.2	0.10	0.07	0.10	0.06
	12850	Q10	Proposed	728	613.16	619.01	2.82	10.32	82	29.1	0.09	0.06	0.10	0.05
	12850	Q1.5	Existing	244	613.16	617.37	2.61	5.52	45	17.2	0.10	0.07	0.10	0.06
	12850	Q1.5	Proposed	244	613.16	617.19	2.62	5.86	42	16.0	0.09	0.06	0.10	0.05
	12800	Q100	Existing	1276	612.41	619.51	4.00	12.99	132	33.1	0.10	0.05	0.10	0.05
	12800	Q100	Proposed	1276	612.41	619.16	3.40	12.42	144	42.2	0.09	0.06	0.10	0.06
	12800	Q10	Existing	728	612.41	617.79	3.01	11	81	26.9	0.10	0.05	0.10	0.05
	12800	Q10	Proposed	728	612.41	617.72	2.59	10.51	89	34.3	0.09	0.06	0.10	0.06
	12800	Q1.5	Existing	244	612.41	615.39	2.23	8.43	29	13.0		0.05		0.05
	12800	Q1.5	Proposed	244	612.41	615.36	2.21	8.49	29	13.0		0.06		0.06
	12750	Q100	Existing	1276	610.30	615.61	2.85	17	88	30.8	0.10	0.05	0.10	0.05
	12750	Q100	Proposed	1276	610.30	615.98	2.41	14.87	111	46.3	0.10	0.06	0.10	0.05
	12750	Q10	Existing	728	610.30	614.35	2.48	14.31	53	21.2		0.05	0.10	0.05
	12750	Q10	Proposed	728	610.30	614.73	2.29	12.64	62	26.9	0.08	0.06	0.10	0.05
	12750	Q1.5	Existing	244	610.30	613.62	2.27	6.32	39	17.0		0.05	0.10	0.05
	12750	Q1.5	Proposed	244	610.30	613.84	2.33	5.79	42	18.3		0.06	0.10	0.05
	12700	Q100	Existing	1276	608.75	616.22	3.94	12.78	143	36.3	0.10	0.05	0.10	0.05
	12700	Q100	Proposed	1276	608.75	615.29	3.07	11.91	163	53.3	0.10	0.06	0.10	0.06
	12700	Q10	Existing	728	608.75	614.45	2.65	11.13	82	31.0	0.10	0.05	0.10	0.04
	12700	Q10	Proposed	728	608.75	614.17	2.26	9.72	107	47.2	0.10	0.06	0.10	0.06
	12700	Q1.5	Existing	244	608.75	612.00	2.02	8.34	30	14.7	0.10	0.05	0.10	0.05
	12700	Q1.5	Proposed	244	608.75	612.05	2.05	8.23	30	14.4		0.06		0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12650	Q100	Existing	1276	606.96	612.25	2.73	17.21	85	31.1	0.10	0.05	0.10	0.04
	12650	Q100	Proposed	1276	606.96	612.60	2.60	14.11	124	47.5	0.10	0.06	0.10	0.05
	12650	Q10	Existing	728	606.96	610.97	2.40	14.76	50	20.7	0.10	0.05	0.10	0.05
	12650	Q10	Proposed	728	606.96	611.40	1.71	12.32	70	41.1	0.10	0.06	0.10	0.04
	12650	Q1.5	Existing	244	606.96	610.52	2.48	5.87	42	16.8		0.05		0.05
	12650	Q1.5	Proposed	244	606.96	610.45	2.23	6.03	41	18.2	0.10	0.06		0.05
	12600	Q100	Existing	1276	605.60	612.46	3.75	9.61	170	45.4	0.10	0.08	0.10	0.08
	12600	Q100	Proposed	1276	605.60	611.63	2.88	11.66	162	56.4	0.10	0.06	0.10	0.06
	12600	Q10	Existing	728	605.60	610.82	2.49	9.01	100	40.3	0.10	0.08	0.10	0.08
	12600	Q10	Proposed	728	605.60	610.68	2.11	9.26	111	52.4	0.10	0.06	0.10	0.06
	12600	Q1.5	Existing	244	605.60	608.92	1.80	7.19	34	19.0	0.10	0.08	0.10	0.08
	12600	Q1.5	Proposed	244	605.60	608.83	1.87	7.63	32	17.1		0.06		0.06
	12590.0*	Q100	Proposed	1276	605.24	611.10	2.79	12.52	154	55.1	0.09	0.06	0.10	0.06
	12590.0*	Q10	Proposed	728	605.24	610.01	1.94	10.62	97	49.9	0.09	0.06	0.10	0.05
	12590.0*	Q1.5	Proposed	244	605.24	608.44	1.37	7.67	33	24.0	0.09	0.06	0.10	0.05
	12580.0*	Q100	Proposed	1276	604.88	610.32	2.51	13.32	133	52.8	0.09	0.06	0.10	0.07
	12580.0*	Q10	Proposed	728	604.88	609.37	1.79	11.21	85	47.4	0.09	0.06	0.10	0.06
	12580.0*	Q1.5	Proposed	244	604.88	607.96	1.32	7.86	33	25.2		0.06	0.10	0.05
	12570.0*	Q100	Proposed	1276	604.52	610.51	2.97	11.32	164	55.1	0.10	0.07	0.10	0.07
	12570.0*	Q10	Proposed	728	604.52	609.34	2.09	9.85	103	49.2	0.10	0.07	0.10	0.07
	12570.0*	Q1.5	Proposed	244	604.52	607.60	1.46	7.61	36	25.0		0.06	0.10	0.06
	12560.0*	Q100	Proposed	1276	604.16	610.00	2.90	12.06	157	54.2	0.10	0.07	0.10	0.07
	12560.0*	Q10	Proposed	728	604.16	609.00	2.13	9.94	106	49.5	0.10	0.07	0.10	0.07
	12560.0*	Q1.5	Proposed	244	604.16	607.22	1.62	7.47	39	24.0		0.07	0.10	0.07

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12550	Q100	Existing	1276	603.80	610.45	3.77	13.87	180	47.6	0.10	0.05	0.10	0.07
	12550	Q100	Proposed	1276	603.80	609.79	3.06	11.56	168	54.8	0.10	0.07	0.10	0.08
	12550	Q10	Existing	728	603.80	609.14	2.77	11.41	120	43.3	0.10	0.05	0.10	0.06
	12550	Q10	Proposed	728	603.80	607.73	1.57	14.16	65	41.6	0.10	0.07	0.10	0.06
	12550	Q1.5	Existing	244	603.80	606.86	1.81	8.67	41	22.9	0.10	0.05	0.10	0.06
	12550	Q1.5	Proposed	244	603.80	606.87	1.81	7.18	42	23.0		0.07	0.10	0.07
	12540.4*	Q100	Proposed	1276	603.47	609.47	3.08	11.12	169	54.9	0.10	0.07	0.10	0.08
	12540.4*	Q10	Proposed	728	603.47	607.34	2.03	13.83	65	32.1	0.10	0.07	0.10	0.07
	12540.4*	Q1.5	Proposed	244	603.47	606.44	1.77	7.28	41	23.0		0.07	0.10	0.07
	12530.8*	Q100	Proposed	1276	603.13	608.99	3.00	11.42	162	54.2	0.10	0.07	0.10	0.07
	12530.8*	Q10	Proposed	728	603.13	607.94	2.23	9.52	109	48.7	0.10	0.07	0.10	0.07
	12530.8*	Q1.5	Proposed	244	603.13	606.04	1.74	7.2	41	23.2		0.07	0.10	0.07
	12521.2*	Q100	Proposed	1276	602.80	608.61	2.98	11.33	161	54.1	0.10	0.07	0.10	0.07
	12521.2*	Q10	Proposed	728	602.80	607.39	2.15	10.01	100	46.6	0.10	0.07	0.10	0.07
	12521.2*	Q1.5	Proposed	244	602.80	605.65	1.73	7.11	40	23.4		0.07	0.10	0.07
	12511.6*	Q100	Proposed	1276	602.47	608.15	2.93	11.49	157	53.5	0.10	0.07	0.10	0.07
	12511.6*	Q10	Proposed	728	602.47	607.01	2.20	9.76	100	45.5	0.10	0.07	0.10	0.07
	12511.6*	Q1.5	Proposed	244	602.47	605.25	1.71	7.03	40	23.5		0.07	0.10	0.07
	12502.0*	Q100	Proposed	1276	602.13	607.81	2.95	11.2	159	53.8	0.10	0.07	0.10	0.07
	12502.0*	Q10	Proposed	728	602.13	606.52	2.17	9.96	96	44.2	0.10	0.07	0.10	0.07
	12502.0*	Q1.5	Proposed	244	602.13	604.87	1.71	6.9	40	23.6		0.07	0.10	0.07
	12492.4*	Q100	Proposed	1276	601.80	607.25	2.88	11.64	150	52.0	0.10	0.07	0.10	0.07
	12492.4*	Q10	Proposed	728	601.80	606.15	2.20	9.69	97	44.3	0.10	0.07	0.10	0.07
	12492.4*	Q1.5	Proposed	244	601.80	604.50	1.72	6.71	41	23.9		0.07	0.10	0.07
	12482.8*	Q100	Proposed	1276	601.47	606.92	2.92	11.24	153	52.4	0.10	0.07	0.10	0.07
	12482.8*	Q10	Proposed	728	601.47	605.63	2.18	9.95	92	42.1	0.10	0.07	0.10	0.07
	12482.8*	Q1.5	Proposed	244	601.47	604.00	1.63	7.04	39	23.6		0.07	0.10	0.07

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12473.2*	Q100	Proposed	1276	601.13	606.61	2.96	10.05	158	53.4	0.06	0.06	0.10	0.06
	12473.2*	Q10	Proposed	728	601.13	605.35	2.25	8.85	97	43.1	0.06	0.06	0.10	0.06
	12473.2*	Q1.5	Proposed	244	601.13	603.71	1.69	6.3	41	24.3		0.06	0.10	0.06
	12463.7	Q100	Existing	1276	600.80	605.38	2.81	17.51	104	36.9	0.10	0.05	0.10	0.05
	12463.7	Q100	Proposed	1276	600.80	606.16	2.95	10.84	155	52.7	0.10	0.07	0.10	0.07
	12463.7	Q10	Existing	728	600.80	603.97	2.10	15.88	59	27.8	0.10	0.05	0.10	0.05
	12463.7	Q10	Proposed	728	600.80	604.85	2.21	9.56	93	42.3	0.10	0.07	0.10	0.07
	12463.7	Q1.5	Existing	244	600.80	602.66	1.17	10.74	26	22.2	0.10	0.05	0.10	0.05
	12463.7	Q1.5	Proposed	244	600.80	603.41	1.74	6.12	43	25.0		0.07	0.10	0.07
	12411.83	Q100	Existing	1276	598.95	604.30	3.32	14.99	133	40.1	0.10	0.05	0.10	0.06
	12411.83	Q100	Proposed	1276	598.95	603.86	2.54	11.59	142	55.9	0.10	0.06	0.10	0.06
	12411.83	Q10	Existing	728	598.95	603.29	2.64	11.37	95	35.9	0.10	0.05	0.10	0.06
	12411.83	Q10	Proposed	728	598.95	603.18	2.20	8.45	107	48.7	0.10	0.06	0.10	0.06
	12411.83	Q1.5	Existing	244	598.95	601.47	1.54	7.91	40	25.6	0.10	0.05	0.10	0.05
	12411.83	Q1.5	Proposed	244	598.95	601.39	1.49	6.74	37	25.1		0.06	0.10	0.06
	12356.27	Q100	Existing	1276	596.53	603.15	3.54	13.18	140	39.4	0.10	0.05	0.10	0.05
	12356.27	Q100	Proposed	1276	596.53	602.84	2.67	9.83	172	64.4	0.08	0.07	0.10	0.06
	12356.27	Q10	Existing	728	596.53	601.82	2.83	10.52	91	32.3	0.10	0.05	0.10	0.05
	12356.27	Q10	Proposed	728	596.53	601.71	2.30	8.6	108	47.1	0.10	0.07	0.10	0.06
	12356.27	Q1.5	Existing	244	596.53	599.85	2.16	6.53	42	19.5	0.10	0.05	0.10	0.05
	12356.27	Q1.5	Proposed	244	596.53	600.24	1.57	5.15	52	33.2	0.10	0.07	0.10	0.05
	12301.23	Q100	Existing	1276	595.07	603.06	3.33	4.77	251	75.5	0.03	0.09	0.10	0.06
	12301.23	Q100	Proposed	1276	595.07	600.66	2.47	11.31	156	62.9	0.10	0.08	0.10	0.07
	12301.23	Q10	Existing	728	595.07	600.00	2.84	9.92	79	27.9		0.08	0.10	0.08
	12301.23	Q10	Proposed	728	595.07	599.68	2.23	9.51	103	46.4	0.10	0.08	0.10	0.08
	12301.23	Q1.5	Existing	244	595.07	598.09	1.83	7.43	34	18.8		0.08	0.10	0.08
	12301.23	Q1.5	Proposed	244	595.07	597.99	1.36	7.72	33	24.6	0.10	0.08	0.10	0.06

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12250.48	Q100	Existing	1276	592.67	603.15	5.33	2.53	458	86.1	0.04	0.08	0.10	0.06
	12250.48	Q100	Proposed	1276	593.40	598.95	2.94	9.75	168	57.0	0.10	0.06	0.10	0.05
	12250.48	Q10	Existing	728	592.67	599.77	2.49	4.37	187	75.1	0.04	0.08	0.10	0.06
	12250.48	Q10	Proposed	728	593.40	597.73	2.59	7.88	111	42.7	0.10	0.06	0.10	0.05
	12250.48	Q1.5	Existing	244	592.67	596.04	1.94	5.65	44	23.0		0.08	0.10	0.07
	12250.48	Q1.5	Proposed	244	593.40	595.99	1.85	5.41	45	24.4	0.10	0.06		0.05
CULVERT #7	12225.03	Q100	Existing	1276	591.00	599.28	7.10	15.27	86	16.6	0.10	0.05		0.05
	12225.03	Q100	Proposed	1276	592.20	598.28	2.60	10.88	160	61.4	0.09	0.06	0.10	0.05
	12225.03	Q10	Existing	728	591.00	596.98	4.80	12.68	58	14.4	0.10	0.05		0.05
	12225.03	Q10	Proposed	728	592.20	596.77	2.41	9.75	93	38.5	0.09	0.06	0.10	0.05
	12225.03	Q1.5	Existing	244	591.00	594.27	2.47	8.97	27	11.5		0.05		0.05
	12225.03	Q1.5	Proposed	244	592.20	594.82	1.75	7.72	32	18.1	0.06	0.06		0.05
	12200			Culvert										
	12191.69	Q100	Existing	1276	590.60	600.48	2.18	8.27	174	80.1	0.03	0.05	0.10	0.04
	12191.69	Q100	Proposed	1276	591.00	595.72	2.84	14.61	107	37.6	0.10	0.06	0.06	0.05
	12191.69	Q10	Existing	728	590.60	596.02	5.03	12.72	57	13.9		0.05		0.05
	12191.69	Q10	Proposed	728	591.00	594.68	2.01	12.24	69	34.5	0.10	0.06	0.06	0.05
	12191.69	Q1.5	Existing	244	590.60	593.52	2.60	8.41	29	12.1		0.05		0.05
	12191.69	Q1.5	Proposed	244	591.00	593.64	1.40	6.95	36	26.0	0.10	0.06	0.06	0.05
	12141.98	Q100	Existing	1276	589.06	593.20	2.67	21.32	81	30.1	0.10	0.06	0.10	0.07
	12141.98	Q100	Proposed	1276	589.51	594.63	3.15	12.77	158	50.1	0.10	0.06	0.10	0.07
	12141.98	Q10	Existing	728	589.06	592.57	2.14	15.64	62	28.9	0.10	0.06	0.10	0.07
	12141.98	Q10	Proposed	728	589.51	593.54	2.28	10.45	105	46.1	0.10	0.06	0.10	0.07
	12141.98	Q1.5	Existing	244	589.06	591.86	1.52	7.67	42	27.5	0.10	0.06	0.10	0.07
	12141.98	Q1.5	Proposed	244	589.51	591.98	1.53	7.45	44	28.5		0.06	0.10	0.07

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	12092.64	Q100	Existing	1276	587.42	592.96	3.42	13.43	161	47.0	0.10	0.05	0.10	0.07
	12092.64	Q100	Proposed	1276	587.42	592.11	2.41	14.8	154	63.8	0.10	0.06	0.10	0.07
	12092.64	Q10	Existing	728	587.42	591.80	2.56	10.88	109	42.7	0.10	0.05	0.10	0.06
	12092.64	Q10	Proposed	728	587.42	591.37	1.77	11.79	108	60.9	0.10	0.06	0.10	0.06
	12092.64	Q1.5	Existing	244	587.42	590.28	1.33	7.39	49	36.6	0.10	0.05	0.10	0.05
	12092.64	Q1.5	Proposed	244	587.42	590.22	1.27	7.54	47	36.8	0.10	0.06	0.10	0.06
	12033.91	Q100	Existing	1276	584.73	589.70	2.99	15.51	118	39.4	0.10	0.05	0.10	0.06
	12033.91	Q100	Proposed	1276	584.73	589.73	2.56	10.74	142	55.7	0.10	0.07	0.10	0.06
	12033.91	Q10	Existing	728	584.73	589.56	2.88	9.23	112	39.0	0.10	0.05	0.10	0.06
	12033.91	Q10	Proposed	728	584.73	589.33	2.23	7.14	120	53.9	0.10	0.07	0.10	0.06
	12033.91	Q1.5	Existing	244	584.73	587.10	1.08	10.31	27	25.5	0.10	0.05		0.05
	12033.91	Q1.5	Proposed	244	584.73	587.18	1.13	8.56	29	25.3		0.06		0.05
	11982.07	Q100	Existing	1276	581.86	588.60	5.38	0.82	640	119.1	0.03	0.07	0.10	0.03
	11982.07	Q100	Proposed	1276	581.86	588.50	5.55	1.01	660	118.8	0.03	0.06	0.10	0.03
	11982.07	Q10	Existing	728	581.86	587.20	3.40	10.81	70	20.5		0.07	0.10	0.07
	11982.07	Q10	Proposed	728	581.86	587.16	2.68	10.29	86	32.0	0.10	0.06	0.10	0.06
	11982.07	Q1.5	Existing	244	581.86	585.05	1.97	7.91	31	15.7		0.06		0.06
	11982.07	Q1.5	Proposed	244	581.86	585.05	1.92	7.92	31	16.0	0.00	0.06		0.06
	11932.45	Q100	Existing	1276	579.56	585.64	3.01	14.47	126	41.8	0.10	0.05	0.10	0.05
	11932.45	Q100	Proposed	1276	579.56	584.61	2.41	17.01	111	46.0	0.10	0.06	0.10	0.06
	11932.45	Q10	Existing	728	579.56	584.22	2.01	12.77	71	35.3	0.10	0.05	0.10	0.05
	11932.45	Q10	Proposed	728	579.56	583.70	1.68	14.08	71	42.0	0.10	0.06	0.10	0.05
	11932.45	Q1.5	Existing	244	579.56	582.42	1.84	8.81	28	15.1		0.05	0.10	0.05
	11932.45	Q1.5	Proposed	244	579.56	582.42	1.84	8.8	28	15.1		0.06	0.10	0.05
	11881.79	Q100	Existing	1276	576.99	582.87	3.08	15.22	104	33.7	0.10	0.06	0.10	0.06
	11881.79	Q100	Proposed	1276	576.99	582.87	3.05	13.11	134	43.8	0.10	0.06	0.10	0.06
	11881.79	Q10	Existing	728	576.99	581.67	2.29	12.96	67	29.1	0.10	0.05		0.05
	11881.79	Q10	Proposed	728	576.99	581.72	2.28	11.14	87	38.2	0.10	0.06		0.06
	11881.79	Q1.5	Existing	244	576.99	580.17	1.80	8.87	28	15.3		0.05		0.05
	11881.79	Q1.5	Proposed	244	576.99	580.30	1.10	7.88	36	33.3	0.10	0.06		0.05

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
	11827.76	Q100	Existing	1276	573.31	581.72	5.04	7.17	205	40.6	0.10	0.08	0.10	0.07
	11827.76	Q100	Proposed	1276	573.31	580.71	3.92	8.97	196	50.1	0.10	0.07	0.10	0.07
	11827.76	Q10	Existing	728	573.31	580.44	4.22	5.22	155	36.8	0.10	0.08	0.10	0.07
	11827.76	Q10	Proposed	728	573.31	580.01	3.46	6.06	163	47.0	0.10	0.07	0.10	0.07
	11827.76	Q1.5	Existing	244	573.31	578.14	2.62	3.24	78	29.9	0.10	0.08	0.10	0.07
	11827.76	Q1.5	Proposed	244	573.31	576.19	1.20	9.86	27	22.1	0.10	0.07		0.06
	11774.33	Q100	Existing	1276	571.58	581.25	5.65	6.59	211	37.3	0.10	0.07	0.10	0.07
	11774.33	Q100	Proposed	1276	571.58	580.69	5.23	5.26	321	61.4	0.10	0.07	0.10	0.08
	11774.33	Q10	Existing	728	571.58	580.19	5.25	4.42	174	33.1	0.10	0.07	0.10	0.07
	11774.33	Q10	Proposed	728	571.58	580.00	4.83	3.4	280	57.9	0.10	0.07	0.10	0.08
	11774.33	Q1.5	Existing	244	571.58	578.03	4.47	2.2	111	24.9	0.10	0.07		0.07
	11774.33	Q1.5	Proposed	244	571.58	575.08	2.18	5.04	49	22.3	0.10	0.06		0.06
	11724.31	Q100	Existing	1276	570.29	581.33	6.54	4.8	353	54.0	0.10	0.06	0.10	0.06
	11724.31	Q100	Proposed	1276	570.29	580.67	5.49	3.76	484	88.2	0.10	0.07	0.10	0.07
	11724.31	Q10	Existing	728	570.29	580.21	5.90	3.17	295	50.1	0.10	0.06	0.10	0.06
	11724.31	Q10	Proposed	728	570.29	579.99	5.75	2.39	430	74.7	0.10	0.07	0.10	0.08
	11724.31	Q1.5	Existing	244	570.29	578.03	4.59	1.51	195	42.4	0.10	0.06	0.10	0.05
	11724.31	Q1.5	Proposed	244	570.29	574.89	2.02	2.96	105	51.9	0.10	0.07	0.10	0.07
	11678.1	Q100	Existing	1276	568.65	581.39	7.64	3.09	509	66.6	0.10	0.08	0.10	0.08
	11678.1	Q100	Proposed	1276	568.65	580.64	5.50	2.81	600	109.1	0.10	0.08	0.10	0.07
	11678.1	Q10	Existing	728	568.65	580.24	6.81	2.06	434	63.8	0.10	0.08	0.10	0.08
	11678.1	Q10	Proposed	728	568.65	579.98	5.56	1.8	532	95.8	0.10	0.08	0.10	0.08
	11678.1	Q1.5	Existing	244	568.65	578.03	5.30	0.97	300	56.7	0.10	0.08	0.10	0.08
	11678.1	Q1.5	Proposed	244	568.65	574.84	2.96	1.75	163	55.1	0.10	0.08	0.10	0.08

TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

Culvert	RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
CULVERT #6	11620.76	Q100	Existing	1276	567.07	580.48	4.63	7.86	223	48.1	0.10	0.05	0.10	0.05
	11620.76	Q100	Proposed	1276	567.07	580.21	3.42	5.64	304	89.1	0.06	0.06	0.10	0.05
	11620.76	Q10	Existing	728	567.07	579.85	4.25	5.06	193	45.4	0.10	0.05	0.10	0.05
	11620.76	Q10	Proposed	728	567.07	575.41	7.89	16.25	45	33.2		0.06		0.06
	11620.76	Q1.5	Existing	244	567.07	577.91	2.96	2.66	112	38.0	0.10	0.05	0.10	0.05
	11620.76	Q1.5	Proposed	244	567.07	573.98	6.46	6.65	37	24.8		0.06		0.06
	11550			Culvert										
	11527.04	Q100	Existing	1276	565.75	575.25	3.17	9.37	130	41.0	0.10	0.07	0.03	0.06
	11527.04	Q100	Proposed	1276	565.75	575.35	3.22	9.96	134	41.5	0.10	0.07	0.03	0.06
	11527.04	Q10	Existing	728	565.75	573.94	2.40	9.02	81	33.6	0.10	0.07	0.03	0.06
	11527.04	Q10	Proposed	728	565.75	574.08	2.49	9.33	86	34.4	0.10	0.07	0.03	0.06
	11527.04	Q1.5	Existing	244	565.75	569.71	3.70	10.91	22	14.6		0.07		0.07
	11527.04	Q1.5	Proposed	244	565.75	569.71	3.70	10.91	22	14.6		0.07		0.07
	11476.78	Q100	Existing	1276	564.68	568.48	2.78	16.51	77	27.8		0.07	0.03	0.07
	11476.78	Q100	Proposed	1276	564.68	568.29	2.62	17.74	72	27.5		0.07	0.03	0.07
	11476.78	Q10	Existing	728	564.68	567.63	2.09	13.43	54	25.9		0.07		0.07
	11476.78	Q10	Proposed	728	564.68	567.40	1.91	15.04	48	25.3		0.07		0.07
	11476.78	Q1.5	Existing	244	564.68	566.64	1.29	8.14	30	23.3		0.07		0.07
	11476.78	Q1.5	Proposed	244	564.68	566.60	1.25	8.42	29	23.2		0.07		0.07
	11412.87	Q100	Existing	1276	561.20	569.31	4.98	6.79	190	38.2	0.10	0.07	0.03	0.06
	11412.87	Q100	Proposed	1276	561.20	569.29	4.97	7.27	190	38.2	0.10	0.07	0.03	0.06
	11412.87	Q10	Existing	728	561.20	568.31	4.13	4.82	153	36.9	0.10	0.07	0.03	0.06
	11412.87	Q10	Proposed	728	561.20	568.25	4.08	5.19	151	36.9	0.10	0.07	0.03	0.06
	11412.87	Q1.5	Existing	244	561.20	566.34	3.03	2.89	84	27.8	0.00	0.07		0.07
	11412.87	Q1.5	Proposed	244	561.20	566.34	3.03	2.98	84	27.8	0.10	0.07		0.06

HEC-RAS RESULTS FOR STATIONS 9739 TO 11363 NOT SHOWN ~ PROPOSED CONDITIONS SIMILAR TO EXISTING CONDITIONS

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
UPSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.01														
DOWNSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.025														
3300	Q100	Existing	858	1258.76	1262.41	2.64	1262.07	8.13	112.84	42.66	0.1	0.06	0.1	0.058
3300	Q10	Existing	489	1258.76	1261.66	2.11	1261.21	6.22	82.25	39.01	0.1	0.06		0.059
3300	Q1.5	Existing	164	1258.76	1260.76	1.41	1260.18	3.42	48.85	34.64	0.1	0.06		0.059
3250	Q100	Existing	858	1258.88	1262.29	2.87		4.42	198.84	69.36	0.1	0.06	0.1	0.058
3250	Q10	Existing	489	1258.88	1261.18	1.91		3.96	124.34	65.17	0.1	0.06		0.059
3250	Q1.5	Existing	164	1258.88	1260	0.85		3.26	50.29	59.3		0.06		0.06
3200	Q100	Existing	858	1257.70	1262.18	3.41		3.19	281.91	82.77	0.1	0.06	0.1	0.059
3200	Q10	Existing	489	1257.70	1261	2.4		2.68	187.3	78.05	0.1	0.06	0.1	0.059
3200	Q1.5	Existing	164	1257.70	1259.48	1.08		2.23	74.22	68.58		0.06	0.1	0.06
3150	Q100	Existing	858	1257.43	1262.03	3.79		3.18	270.13	71.33		0.06		0.06
3150	Q10	Existing	489	1257.43	1260.85	2.86		2.58	189.18	66.08		0.06		0.06
3150	Q1.5	Existing	164	1257.43	1259.28	1.54		1.81	90.83	59.09		0.06		0.06
3100	Q100	Existing	858	1257.05	1261.75	3.81		4	214.71	56.3		0.06	0.1	0.059
3100	Q10	Existing	489	1257.05	1260.63	3.01		3.16	154.78	51.35		0.06		0.06
3100	Q1.5	Existing	164	1257.05	1259.11	1.78		2.02	81.1	45.49		0.06		0.06
3050	Q100	Existing	858	1256.61	1261.64	3.8		3.13	274.38	72.16	0.1	0.06	0.1	0.06
3050	Q10	Existing	489	1256.61	1260.52	3.02		2.48	197.27	65.41		0.06		0.06
3050	Q1.5	Existing	164	1256.61	1259.01	1.87		1.56	105.33	56.28		0.06		0.06
3000	Q100	Existing	858	1256.56	1261.48	3.42		3.27	262.25	76.65		0.06		0.06
3000	Q10	Existing	489	1256.56	1260.37	2.68		2.68	182.19	68		0.06		0.06
3000	Q1.5	Existing	164	1256.56	1258.89	1.59		1.82	89.96	56.4		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2950	Q100	Existing	858	1256.22	1261.29	3.18		3.38	256.61	80.78	0.1	0.06	0.1	0.057
2950	Q10	Existing	489	1256.22	1260.17	2.43		2.85	171.72	70.61		0.06	0.1	0.06
2950	Q1.5	Existing	164	1256.22	1258.71	1.55		2.01	81.49	52.68		0.06		0.06
2900	Q100	Existing	858	1255.59	1260.89	2.7		4.44	194.8	72.24	0.1	0.06		0.057
2900	Q10	Existing	489	1255.59	1259.71	2.08		4.12	118.63	56.91		0.06		0.06
2900	Q1.5	Existing	164	1255.59	1258.31	1.38		3.13	52.39	37.96		0.06		0.06
2850	Q100	Existing	858	1254.37	1260.09	2.56		6.62	169.17	66.15	0.1	0.06	0.1	0.057
2850	Q10	Existing	489	1254.37	1258.64	1.87		6.39	87.14	46.66	0.1	0.06	0.1	0.054
2850	Q1.5	Existing	164	1254.37	1257.1	1.2		5.25	31.25	26.05		0.06	0.001	0.06
2800	Q100	Existing	858	1253.42	1259.88	3.22		5.1	206.69	64.18	0.1	0.06	0.1	0.055
2800	Q10	Existing	489	1253.42	1258.34	2.54		4.46	120.56	47.42	0.1	0.06	0.1	0.053
2800	Q1.5	Existing	164	1253.42	1256.39	1.67		3.46	47.42	28.38		0.06	0.1	0.06
2750	Q100	Existing	858	1252.81	1259.67	3.5		4.81	215.05	61.38	0.1	0.06	0.1	0.056
2750	Q10	Existing	489	1252.81	1258.07	2.76		4.18	128.51	46.59	0.1	0.06		0.056
2750	Q1.5	Existing	164	1252.81	1255.96	1.87		3.23	50.83	27.19		0.06		0.06
2700	Q100	Existing	858	1252.52	1259.25	4.06		5.44	159.62	39.27	0.1	0.06	0.1	0.057
2700	Q10	Existing	489	1252.52	1257.61	3.16		4.84	101.07	31.98		0.06		0.06
2700	Q1.5	Existing	164	1252.52	1255.4	1.91		3.93	41.77	21.85		0.06		0.06
2650	Q100	Existing	858	1251.56	1258.3	4.35		7.49	115.02	26.47		0.06	0.1	0.058
2650	Q10	Existing	489	1251.56	1256.76	3.45		6.31	77.51	22.49		0.06		0.06
2650	Q1.5	Existing	164	1251.56	1254.62	2.01		4.7	34.86	17.38		0.06		0.06
2600	Q100	Existing	858	1250.65	1256.05	3.63	1256.05	10.88	78.85	21.74		0.06		0.06
2600	Q10	Existing	489	1250.65	1254.68	2.8	1254.68	9.54	51.26	18.33		0.06		0.06
2600	Q1.5	Existing	164	1250.65	1253.06	1.73	1252.9	6.6	24.85	14.33		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2550	Q100	Existing	858	1248.71	1253.43	3.44	1253.7	11.66	73.58	21.4		0.06		0.06
2550	Q10	Existing	489	1248.71	1252.29	2.64	1252.37	9.68	50.52	19.11		0.06		0.06
2550	Q1.5	Existing	164	1248.71	1250.76	1.47	1250.76	6.95	23.61	16.04		0.06		0.06
2500	Q100	Existing	858	1243.85	1248.15	2.89	1249.25	15.25	56.26	19.48		0.06		0.06
2500	Q10	Existing	489	1243.85	1247.02	2.14	1247.91	13.61	35.94	16.78		0.06		0.06
2500	Q1.5	Existing	164	1243.85	1245.71	1.17	1246.21	10.28	15.95	13.61		0.06		0.06
2450	Q100	Existing	858	1238.99	1243.59	2.94	1244.61	15.23	59.66	20.3	0.1	0.06	0.1	0.055
2450	Q10	Existing	489	1238.99	1242.61	2.31	1243.18	12.13	41.08	17.77	0.1	0.06	0.1	0.056
2450	Q1.5	Existing	164	1238.99	1241.37	1.45	1241.51	7.79	21.07	14.58		0.06		0.06
2400	Q100	Existing	858	1230.99	1235.58	2.93	1237.3	19.06	45.01	15.34		0.06		0.06
2400	Q10	Existing	489	1230.99	1234.45	2.23	1235.8	16.9	28.94	12.96		0.06		0.06
2400	Q1.5	Existing	164	1230.99	1232.93	1.19	1233.82	14.09	11.64	9.78		0.06		0.06
2372.58	Q100	Existing	858	1225.04	1228.16	1.82	1229.94	20.43	42.04	23.04	0.1	0.06		0.059
2372.58	Q10	Existing	489	1225.04	1227.56	1.39	1228.77	16.99	28.78	20.72		0.06		0.06
2372.58	Q1.5	Existing	164	1225.04	1226.82	0.97	1227.39	11.06	14.83	15.3		0.06		0.06
2350	Q100	Existing	858	1216.16	1219.13	1.71	1220.94	21.65	39.63	23.16		0.06		0.06
2350	Q10	Existing	489	1216.16	1218.57	1.26	1219.85	18.12	26.99	21.47		0.06		0.06
2350	Q1.5	Existing	164	1216.16	1217.77	0.73	1218.52	14.58	11.25	15.34		0.06		0.06
2300	Q100	Existing	858	1208.34	1212.01	2.23	1212.99	14.16	60.59	27.16		0.06		0.06
2300	Q10	Existing	489	1208.34	1211.34	1.74	1211.92	11.36	43.05	24.8		0.06		0.06
2300	Q1.5	Existing	164	1208.34	1210.4	1.07	1210.62	7.58	21.63	20.22		0.06		0.06
2250	Q100	Existing	858	1204.37	1207.1	1.85	1207.66	12.19	81.82	44.12		0.06	0.1	0.067
2250	Q10	Existing	489	1204.37	1206.5	1.41	1206.83	9.88	56.61	40.23		0.06	0.1	0.067
2250	Q1.5	Existing	164	1204.37	1205.74	0.79	1205.84	6.47	27.92	35.28		0.06	0.1	0.069

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2200	Q100	Existing	858	1197.08	1198.55	1.34	1199.19	11.18	74.07	55.34		0.06	0.1	0.084
2200	Q10	Existing	489	1197.08	1198.08	1.06	1198.55	8.17	50.54	47.69		0.06	0.1	0.086
2200	Q1.5	Existing	164	1197.08	1197.4	0.77	1197.63	3.82	23.48	30.63		0.06	0.1	0.093
2150	Q100	Existing	858	1187.44	1191.56	1.5	1192.35	12.38	79.95	53.27	0.1	0.06	0.1	0.048
2150	Q10	Existing	489	1187.44	1190.67	1.69	1191.22	10.85	47.61	28.09		0.06	0.1	0.056
2150	Q1.5	Existing	164	1187.44	1189.35	1.2	1189.64	8.52	19.25	16		0.06		0.06
2100	Q100	Existing	858	1183.52	1186.38	1.28	1187.15	13.44	77.51	60.49	0.1	0.06	0.1	0.056
2100	Q10	Existing	489	1183.52	1185.92	1.08	1186.45	10.68	51.88	48	0.1	0.06		0.056
2100	Q1.5	Existing	164	1183.52	1185.32	0.84	1185.43	6.38	25.73	30.62	0.1	0.06		0.058
2050	Q100	Existing	858	1178.31	1181.28	1.98	1181.88	11.76	73.06	36.99		0.06	0.1	0.059
2050	Q10	Existing	489	1178.31	1180.6	1.43	1181.01	9.89	49.43	34.49		0.06		0.06
2050	Q1.5	Existing	164	1178.31	1179.75	0.73	1180.01	7.62	21.52	29.48		0.06		0.06
2000	Q100	Existing	858	1170.64	1174.61	2.6	1175.69	15.03	57.1	21.93		0.06		0.06
2000	Q10	Existing	489	1170.64	1173.68	1.91	1174.47	12.98	37.67	19.72		0.06		0.06
2000	Q1.5	Existing	164	1170.64	1172.64	1.07	1172.98	8.88	18.48	17.25		0.06		0.06
1950	Q100	Existing	858	1159.83	1163.56	2.18	1165.32	19.7	43.55	19.94		0.06		0.06
1950	Q10	Existing	489	1159.83	1162.73	1.74	1164.09	17.14	28.52	16.43		0.06		0.06
1950	Q1.5	Existing	164	1159.83	1161.55	1.06	1162.39	13.58	12.08	11.41		0.06		0.06
1900	Q100	Existing	858	1151.21	1154.62	2.34	1156.21	18.28	48.93	20.91	0.1	0.06	0.1	0.055
1900	Q10	Existing	489	1151.21	1153.83	1.85	1154.86	14.74	33.43	18.11	0.1	0.06	0.1	0.057
1900	Q1.5	Existing	164	1151.21	1152.81	1.16	1153.26	9.73	16.85	14.53		0.06		0.06
1850	Q100	Existing	858	1145.20	1149.59	2.38	1150.58	15.73	68.11	28.63	0.1	0.06	0.1	0.064
1850	Q10	Existing	489	1145.20	1148.87	1.8	1149.47	12.27	48.32	26.79	0.1	0.06	0.1	0.061
1850	Q1.5	Existing	164	1145.20	1147.76	1.07	1148.05	8.35	20.69	19.37	0.1	0.06		0.054

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
1800	Q100	Existing	858	1141.77	1146.45	2.7	1146.96	13.16	81.87	30.37	0.1	0.06	0.1	0.062
1800	Q10	Existing	489	1141.77	1145.47	1.97	1145.82	10.94	53.58	27.21	0.1	0.06	0.1	0.061
1800	Q1.5	Existing	164	1141.77	1144.32	1.04	1144.45	7.37	24.41	23.51	0.1	0.06	0.1	0.055
1750	Q100	Existing	858	1137.61	1141.97	2.51	1142.93	14.81	64.68	25.8	0.1	0.06	0.1	0.059
1750	Q10	Existing	489	1137.61	1141.04	1.88	1141.73	12.44	42.44	22.64	0.1	0.06		0.057
1750	Q1.5	Existing	164	1137.61	1139.72	1.3	1140.11	9.32	17.6	13.59		0.06		0.06
1685.16	Q100	Existing	858	1129.12	1132.69	2.34	1134.12	17.53	49.57	21.21	0.1	0.06	0.1	0.057
1685.16	Q10	Existing	489	1129.12	1131.91	1.76	1132.89	14.51	33.69	19.15		0.06		0.06
1685.16	Q1.5	Existing	164	1129.12	1130.84	1.11	1131.36	10.33	15.87	14.27		0.06		0.06
1631.51	Q100	Existing	858	1123.59	1127.42	1.53	1128.1	15.19	96.4	62.86	0.1	0.06	0.1	0.073
1631.51	Q10	Existing	489	1123.59	1126.96	1.27	1127.36	11.67	69.52	54.9	0.1	0.06	0.1	0.069
1631.51	Q1.5	Existing	164	1123.59	1126.15	0.77	1126.38	7.99	31.03	40.14	0.1	0.06	0.1	0.059
1558.62	Q100	Existing	858	1114.84	1120.21	2.6	1120.62	14.6	68.44	26.34	0.1	0.06	0.1	0.05
1558.62	Q10	Existing	489	1114.84	1118.46	2.92	1119.35	13.73	35.66	12.23	0.1	0.06	0.1	0.058
1558.62	Q1.5	Existing	164	1114.84	1116.38	1.36	1117.12	12.5	13.12	9.67		0.06		0.06
1514	Q100	Existing	858	1110.83	1115.72	1.78	1117.05	15.55	59.08	33.17	0.1	0.06		0.049
1514	Q10	Existing	489	1110.83	1115.07	2.54	1115.72	11.38	42.99	16.94		0.06		0.06
1514	Q1.5	Existing	164	1110.83	1113.67	1.69	1113.67	7.47	21.96	12.96		0.06		0.06
1485.63	Q100	Existing	858	1106.93	1110.66	2.33	1112.03	16.99	50.5	21.64		0.06		0.06
1485.63	Q10	Existing	489	1106.93	1109.79	1.59	1110.85	15.19	32.2	20.2		0.06		0.06
1485.63	Q1.5	Existing	164	1106.93	1108.5	1.14	1109.44	13.39	12.25	10.73		0.06		0.06
1451.92	Q100	Existing	858	1104.87	1109.36	2.38	1109.81	11.76	85.48	35.91		0.06	0.1	0.059
1451.92	Q10	Existing	489	1104.87	1108.65	1.74	1108.8	9.07	60.36	34.71		0.06	0.1	0.052
1451.92	Q1.5	Existing	164	1104.87	1107.17	1.41	1107.17	6.81	24.08	17.05		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
1418.62	Q100	Existing	858	1102.17	1105.89	1.85	1106.79	13.78	65.04	35.23		0.06	0.1	0.053
1418.62	Q10	Existing	489	1102.17	1104.96	1.7	1105.75	12.62	38.75	22.85		0.06		0.06
1418.62	Q1.5	Existing	164	1102.17	1103.89	1.08	1104.3	9.27	17.7	16.39		0.06		0.06
1362.71	Q100	Existing	858	1097.54	1101.8	2.45	1102.32	11.52	74.46	30.4		0.06		0.06
1362.71	Q10	Existing	489	1097.54	1101.05	2	1101.27	9.2	53.15	26.51		0.06		0.06
1362.71	Q1.5	Existing	164	1097.54	1099.83	1.26	1099.86	6.61	24.82	19.63		0.06		0.06
1308.81	Q100	Existing	858	1094.21	1098.37	2.04	1099.03	12.35	86.75	42.61	0.1	0.06	0.1	0.056
1308.81	Q10	Existing	489	1094.21	1097.47	1.6	1097.87	10.49	53.48	33.49	0.1	0.06	0.1	0.054
1308.81	Q1.5	Existing	164	1094.21	1096.35	1.08	1096.49	7.19	22.96	21.35	0.1	0.06	0.1	0.057
1243.78	Q100	Existing	858	1090.38	1094.43	2.43	1094.92	11.75	74.51	30.63	0.1	0.06	0.1	0.057
1243.78	Q10	Existing	489	1090.38	1093.74	1.88	1093.93	9.12	53.92	28.72	0.001	0.06	0.1	0.059
1243.78	Q1.5	Existing	164	1090.38	1092.66	1.18	1092.66	6.25	26.24	22.27		0.06		0.06
1172.3	Q100	Existing	858	1082.54	1087.59	2.84	1088.92	14.59	58.92	20.72	0.1	0.06		0.057
1172.3	Q10	Existing	489	1082.54	1086.22	2.4	1087.14	13.68	35.76	14.87		0.06		0.06
1172.3	Q1.5	Existing	164	1082.54	1084.48	1.34	1085.17	11.83	13.86	10.32		0.06		0.06
1126.39	Q100	Existing	858	1076.73	1080.07	2.3	1081.49	17.54	48.91	21.23		0.06		0.06
1126.39	Q10	Existing	489	1076.73	1079.36	1.68	1080.32	14.33	34.13	20.29		0.06		0.06
1126.39	Q1.5	Existing	164	1076.73	1078.53	1.1	1078.88	8.84	18.55	16.94		0.06		0.06
1063.6	Q100	Existing	858	1073.21	1078.42	2.94	1078.42	10.92	92.8	31.59	0.1	0.06	0.1	0.055
1063.6	Q10	Existing	489	1073.21	1077.11	2.3	1077.11	9.38	56.17	24.43	0.1	0.06	0.1	0.054
1063.6	Q1.5	Existing	164	1073.21	1075.47	1.51	1075.47	7.04	23.3	15.4		0.06		0.06
992.88	Q100	Existing	858	1069.14	1072.5	1.72	1073.46	14.5	59.57	34.73	0.1	0.06	0.1	0.058
992.88	Q10	Existing	489	1069.14	1072.05	1.39	1072.59	10.99	44.49	32.03		0.06		0.06
992.88	Q1.5	Existing	164	1069.14	1071.39	1.01	1071.47	6.44	25.48	25.16		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
965.98	Q100	Existing	858	1067.81	1072.71	2.48	1072.71	9.87	121.43	48.96	0.1	0.06	0.1	0.061
965.98	Q10	Existing	489	1067.81	1071.68	1.74	1071.68	8.5	73.54	42.28	0.1	0.06	0.1	0.055
965.98	Q1.5	Existing	164	1067.81	1070.18	1.61	1070.04	6.38	25.69	15.95		0.06		0.06
896.36	Q100	Existing	858	1065.69	1070.42	3.27	1069.71	8.01	120.03	36.7	0.1	0.06	0.1	0.058
896.36	Q10	Existing	489	1065.69	1068.53	1.79	1068.73	9.13	55.1	30.85	0.1	0.06	0.1	0.055
896.36	Q1.5	Existing	164	1065.69	1067.52	1.3	1067.4	5.76	28.49	21.89		0.06		0.06
863.1	Q100	Existing	858	1063.94	1070.05	4.28		8.47	149.47	34.93	0.1	0.06	0.1	0.07
863.1	Q10	Existing	489	1063.94	1068.02	2.86	1067.36	8.07	84.22	29.42	0.1	0.06	0.1	0.069
863.1	Q1.5	Existing	164	1063.94	1065.99	1.25	1065.99	7.03	30.01	24.07	0.1	0.06	0.1	0.064
828.53	Q100	Existing	858	1061.14	1067.83	3.5	1067.83	13.64	96.69	27.66	0.1	0.06	0.1	0.061
828.53	Q10	Existing	489	1061.14	1066.1	3	1066.1	11.53	57.82	19.26	0.1	0.06	0.1	0.061
828.53	Q1.5	Existing	164	1061.14	1063.94	1.65	1064.04	8.67	22.8	13.85	0.1	0.06	0.1	0.058
826.84	Q100	Existing	858	1060.76	1065.18	2.97	1066.62	17.16	51.18	17.23	0.1	0.06	0.1	0.055
826.84	Q10	Existing	489	1060.76	1063.92	2.35	1065.01	15.17	32.23	13.7		0.06		0.06
826.84	Q1.5	Existing	164	1060.76	1062.44	1.18	1063.12	12.12	13.54	11.44		0.06		0.06
803.52	Q100	Existing	858	1055.18	1059.39	3	1061.57	21.35	43.46	14.47	0.1	0.06	0.1	0.053
803.52	Q10	Existing	489	1055.18	1058.21	2.25	1059.74	18.16	27.63	12.26	0.1	0.06	0.1	0.055
803.52	Q1.5	Existing	164	1055.18	1056.86	1.31	1057.62	12.8	12.81	9.77		0.06		0.06
788.49	Q100	Existing	858	1052.86	1056.12	2.37	1058.14	21.75	41.1	17.33	0.1	0.06	0.1	0.056
788.49	Q10	Existing	489	1052.86	1055.39	1.78	1056.71	17.31	28.76	16.2	0.1	0.06	0.1	0.057
788.49	Q1.5	Existing	164	1052.86	1054.56	1.08	1055.04	10.3	15.93	14.75		0.06	0.1	0.06
752.92	Q100	Existing	858	1042.81	1046.27	1.89	1048.21	23.5	43.7	23.15	0.1	0.06		0.06
752.92	Q10	Existing	489	1042.81	1045.56	1.49	1047.09	19.36	28.64	19.25	0.1	0.06		0.057
752.92	Q1.5	Existing	164	1042.81	1044.45	0.97	1045.36	14.49	11.41	11.71	0.1	0.06		0.057

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
740.16	Q100	Existing	858	1041.85	1046.1	2.35	1047.54	17.98	55.96	23.82	0.1	0.06	0.1	0.057
740.16	Q10	Existing	489	1041.85	1045.37	1.83	1046.25	13.86	39.41	21.49	0.1	0.06	0.1	0.055
740.16	Q1.5	Existing	164	1041.85	1044.44	1.28	1044.6	7.87	21.25	16.6	0.1	0.06	0.1	0.055
709.95	Q100	Existing	858	1038.62	1044.11	2.77	1045.02	14.59	62.93	22.69	0.1	0.06	0.1	0.052
709.95	Q10	Existing	489	1038.62	1042.93	2.83	1043.48	12.09	40.45	14.27		0.06		0.06
709.95	Q1.5	Existing	164	1038.62	1040.92	1.5	1041.42	10.48	15.64	10.42		0.06		0.06
659.75	Q100	Existing	858	1036.65	1042.11	3.38	1042.22	11.68	76.31	22.58	0.1	0.06	0.1	0.054
659.75	Q10	Existing	489	1036.65	1040.84	2.79	1040.84	9.64	50.84	18.25	0.1	0.06	0.1	0.058
659.75	Q1.5	Existing	164	1036.65	1039.05	1.65	1039.05	7.35	22.31	13.53		0.06		0.06
597.67	Q100	Existing	858	1033.94	1038.55	3.36	1039.05	13.03	67.19	19.97	0.1	0.06	0.1	0.056
597.67	Q10	Existing	489	1033.94	1037.53	2.58	1037.72	10.31	47.57	18.42	0.1	0.06	0	0.059
597.67	Q1.5	Existing	164	1033.94	1036.13	1.64	1036.04	6.75	24.31	14.84		0.06		0.06
552.31	Q100	Existing	858	1032.03	1036.48	3.07	1036.85	12.21	74.45	24.26	0.1	0.06	0.1	0.055
552.31	Q10	Existing	489	1032.03	1035.48	2.44	1035.56	9.64	51.77	21.24	0.1	0.06	0.1	0.056
552.31	Q1.5	Existing	164	1032.03	1033.95	1.53	1033.95	7.03	23.33	15.28		0.06		0.06
500	Q100	Existing	858	1028.47	1033.33	3.07	1033.96	13.38	68.21	22.21	0.1	0.06	0.1	0.053
500	Q10	Existing	489	1028.47	1032.06	2.53	1032.45	11.37	43.37	17.14	0.1	0.06	0	0.058
500	Q1.5	Existing	164	1028.47	1030.49	1.51	1030.67	8.25	19.89	13.14		0.06		0.06
450	Q100	Existing	858	1026.39	1031.14	2.67	1031.65	11.75	77.1	28.86	0.1	0.06	0	0.054
450	Q10	Existing	489	1026.39	1030.2	2.45	1030.2	9.22	53.28	21.73	0.1	0.06		0.057
450	Q1.5	Existing	164	1026.39	1028.49	1.56	1028.49	7.14	22.96	14.71		0.06		0.06
400	Q100	Existing	858	1024.77	1028.21	2.06	1028.76	12.22	83.15	40.38	0.1	0.06	0.1	0.06
400	Q10	Existing	489	1024.77	1028.15	2.01	1027.89	7.15	80.82	40.25	0.1	0.06	0.1	0.06
400	Q1.5	Existing	164	1024.77	1027	1.09	1026.74	4.79	36.71	33.79	0.1	0.06	0	0.055

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
3300	Q100	Proposed	858	1258.76	1262.38	2.62	1262.10	8.57	111	42.5	0.10	0.06	0.10	0.06
3300	Q10	Proposed	489	1258.76	1261.63	2.08	1261.22	6.52	81	38.8	0.10	0.06	0.10	0.06
3300	Q1.5	Proposed	164	1258.76	1260.75	1.40	1260.18	3.51	48	34.6	0.10	0.06	0.10	0.06
3250	Q100	Proposed	858	1258.88	1262.32	2.90		4.45	201	69.5	0.10	0.06	0.10	0.06
3250	Q10	Proposed	489	1258.88	1261.15	1.88		4.08	122	65.1	0.10	0.06	0.10	0.06
3250	Q1.5	Proposed	164	1258.88	1260.00	0.85		3.27	50	59.3		0.06	0.10	0.06
3200	Q100	Proposed	858	1257.70	1262.22	3.44		3.15	286	83.0	0.10	0.06	0.10	0.06
3200	Q10	Proposed	489	1257.70	1260.96	2.37		2.72	184	77.9	0.10	0.06	0.10	0.06
3200	Q1.5	Proposed	164	1257.70	1259.43	1.05		2.35	71	67.5		0.06	0.10	0.06
3150	Q100	Proposed	858	1257.43	1262.05	3.81		3.48	272	71.5	0.10	0.06	0.10	0.06
3150	Q10	Proposed	489	1257.43	1260.80	2.82		2.82	186	65.9	0.10	0.06	0.10	0.06
3150	Q1.5	Proposed	164	1257.43	1259.19	1.46		1.98	86	58.7	0.10	0.06	0.10	0.06
3100	Q100	Proposed	858	1257.05	1261.75	3.81		4.54	215	56.3	0.10	0.06	0.10	0.06
3100	Q10	Proposed	489	1257.05	1260.55	2.95		3.57	151	51.1	0.10	0.06	0.10	0.06
3100	Q1.5	Proposed	164	1257.05	1258.98	1.67		2.29	75	45.0	0.10	0.06	0.10	0.06
3050	Q100	Proposed	858	1256.61	1261.66	3.81		3.59	276	72.3	0.10	0.06	0.10	0.06
3050	Q10	Proposed	489	1256.61	1260.45	2.96		2.82	192	65.0	0.10	0.06	0.10	0.06
3050	Q1.5	Proposed	164	1256.61	1258.86	1.75		1.77	97	55.4	0.10	0.06	0.10	0.06
3000	Q100	Proposed	858	1256.56	1261.49	3.43		3.78	263	76.7	0.10	0.06	0.10	0.06
3000	Q10	Proposed	489	1256.56	1260.28	2.62		3.07	176	67.3	0.10	0.06	0.10	0.06
3000	Q1.5	Proposed	164	1256.56	1258.70	1.45		2.14	79	54.9	0.10	0.06	0.10	0.06
2950	Q100	Proposed	858	1256.22	1261.35	3.22		3.32	262	81.3	0.10	0.06	0.10	0.06
2950	Q10	Proposed	489	1256.22	1260.10	2.39		2.94	166	69.6		0.06	0.10	0.06
2950	Q1.5	Proposed	164	1256.22	1258.42	1.36		2.46	67	49.1		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2900	Q100	Proposed	858	1255.40	1260.41	2.52		7.89	168	66.6	0.10	0.06	0.10	0.06
2900	Q10	Proposed	489	1255.40	1259.06	1.90	1258.66	7.26	91	47.8	0.10	0.06	0.10	0.06
2900	Q1.5	Proposed	164	1255.40	1257.52	1.29		5.21	34	26.2	0.10	0.06	0.10	0.05
2850	Q100	Proposed	858	1253.92	1258.70	2.69	1258.70	10.49	110	40.8	0.10	0.06	0.10	0.06
2850	Q10	Proposed	489	1253.92	1257.84	2.16	1257.59	8.04	77	35.8	0.10	0.06	0.10	0.06
2850	Q1.5	Proposed	164	1253.92	1256.59	1.31		4.95	37	28.3	0.10	0.06	0.10	0.05
2800	Q100	Proposed	858	1253.07	1258.02	2.72	1257.50	8.36	156	57.3	0.10	0.06	0.10	0.07
2800	Q10	Proposed	489	1253.07	1256.98	1.95		7.11	99	51.0	0.10	0.06	0.10	0.06
2800	Q1.5	Proposed	164	1253.07	1255.73	0.97		4.88	40	41.5	0.10	0.06	0.10	0.05
2750	Q100	Proposed	858	1252.22	1257.52	3.01		7.01	192	63.7	0.10	0.06	0.10	0.07
2750	Q10	Proposed	489	1252.22	1256.37	2.09		6.1	122	58.1	0.10	0.06	0.10	0.07
2750	Q1.5	Proposed	164	1252.22	1254.89	0.88	1254.41	4.86	41	46.8	0.10	0.06	0.10	0.04
2700	Q100	Proposed	858	1251.38	1256.47	2.97		8.48	147	49.3	0.10	0.06	0.10	0.07
2700	Q10	Proposed	489	1251.38	1255.42	2.12		7.03	97	45.7	0.10	0.06	0.10	0.06
2700	Q1.5	Proposed	164	1251.38	1254.06	1.11		4.82	40	36.0	0.10	0.06	0.10	0.05
2650	Q100	Proposed	858	1250.58	1255.80	3.11		7.82	163	52.3	0.10	0.06	0.10	0.07
2650	Q10	Proposed	489	1250.58	1254.73	2.21		6.48	109	49.0	0.10	0.06	0.10	0.07
2650	Q1.5	Proposed	164	1250.58	1253.40	1.11		4.38	47	42.3	0.10	0.06	0.10	0.05
2600	Q100	Proposed	858	1249.76	1254.13	2.53	1254.13	10.31	119	46.9	0.10	0.06	0.10	0.07
2600	Q10	Proposed	489	1249.76	1253.27	1.80	1253.27	8.47	80	44.3	0.10	0.06	0.10	0.06
2600	Q1.5	Proposed	164	1249.76	1252.04	0.87	1252.04	6.32	28	32.8	0.10	0.06	0.10	0.05
2550	Q100	Proposed	858	1247.32	1251.43	2.28	1251.86	12.19	96	42.2	0.10	0.06	0.10	0.06
2550	Q10	Proposed	489	1247.32	1250.54	1.51	1250.95	10.49	60	39.7	0.10	0.06	0.10	0.06
2550	Q1.5	Proposed	164	1247.32	1249.40	1.35	1249.54	7.32	22	16.6	0.00	0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2500	Q100	Proposed	858	1243.63	1247.22	1.92	1248.05	14.54	80	41.6	0.10	0.06	0.10	0.06
2500	Q10	Proposed	489	1243.63	1246.53	1.33	1247.15	12.03	52	39.1	0.10	0.06	0.10	0.06
2500	Q1.5	Proposed	164	1243.63	1245.55	1.13	1245.88	8.27	20	17.6	0.10	0.06		0.06
2450	Q100	Proposed	858	1234.43	1237.46	1.34	1238.89	19.89	56	41.4	0.10	0.06	0.10	0.06
2450	Q10	Proposed	489	1234.43	1236.83	1.01	1238.00	17.16	32	31.5	0.10	0.06	0.10	0.05
2450	Q1.5	Proposed	164	1234.43	1235.81	0.91	1236.67	13.62	12	13.2		0.06		0.06
2400	Q100	Proposed	858	1223.18	1226.18	1.35	1227.59	19.94	56	41.4	0.10	0.06	0.10	0.06
2400	Q10	Proposed	489	1223.18	1225.66	0.93	1226.71	16.15	35	37.7	0.10	0.06	0.10	0.05
2400	Q1.5	Proposed	164	1223.18	1224.81	1.09	1225.42	10.5	16	14.4		0.06		0.06
2372.58	Q100	Proposed	858	1217.59	1220.73	1.23	1222.11	19.4	59	48.0	0.10	0.06	0.10	0.05
2372.58	Q10	Proposed	489	1217.59	1220.08	1.12	1221.29	16.2	34	30.0	0.10	0.06	0.10	0.05
2372.58	Q1.5	Proposed	164	1217.59	1219.09	1.00	1219.73	11.57	14	14.1		0.06		0.06
2350	Q100	Proposed	858	1213.54	1216.14	1.02	1217.32	19.4	64	62.7	0.10	0.06	0.10	0.06
2350	Q10	Proposed	489	1213.54	1215.74	0.82	1216.63	15.64	41	50.2	0.10	0.06	0.10	0.05
2350	Q1.5	Proposed	164	1213.54	1215.10	1.00	1215.64	9.95	16	16.5		0.06		0.06
2300	Q100	Proposed	858	1203.29	1206.52	1.30	1207.73	17.55	67	51.2	0.10	0.06	0.10	0.06
2300	Q10	Proposed	489	1203.29	1205.87	1.13	1206.88	14.94	39	34.3		0.06	0.10	0.05
2300	Q1.5	Proposed	164	1203.29	1204.81	1.00	1205.49	11.56	14	14.2		0.06		0.06
2250	Q100	Proposed	858	1193.29	1196.26	0.90	1197.40	19.43	67	74.5	0.10	0.06	0.10	0.05
2250	Q10	Proposed	489	1193.29	1195.78	0.73	1196.83	16.07	37	50.2	0.10	0.06	0.10	0.04
2250	Q1.5	Proposed	164	1193.29	1194.90	1.07	1195.50	10.76	15	14.3		0.06		0.06
2200	Q100	Proposed	858	1184.02	1187.10	1.04	1188.24	17.77	72	68.7	0.10	0.06	0.10	0.05
2200	Q10	Proposed	489	1184.02	1186.55	0.89	1187.53	15.01	40	44.7	0.10	0.06	0.10	0.05
2200	Q1.5	Proposed	164	1184.02	1185.59	1.04	1186.24	10.85	15	14.5		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
2150	Q100	Proposed	858	1177.80	1181.22	1.16	1182.09	15.28	89	76.5	0.10	0.06	0.10	0.06
2150	Q10	Proposed	489	1177.80	1180.65	0.93	1181.47	12.71	51	55.2	0.10	0.06	0.10	0.05
2150	Q1.5	Proposed	164	1177.80	1179.68	1.25	1180.00	8.5	19	15.5		0.06		0.06
2100	Q100	Proposed	858	1172.74	1175.88	1.17	1176.70	14.62	88	75.2	0.10	0.06	0.10	0.06
2100	Q10	Proposed	489	1172.74	1175.34	0.86	1176.05	12.39	51	58.5	0.10	0.06	0.10	0.05
2100	Q1.5	Proposed	164	1172.74	1174.39	1.08	1174.78	8.83	19	17.1		0.06		0.06
2050	Q100	Proposed	858	1168.07	1171.44	1.51	1172.07	13.45	99	65.6	0.10	0.06	0.10	0.06
2050	Q10	Proposed	489	1168.07	1170.88	0.97	1171.41	11.37	62	64.2	0.10	0.06	0.10	0.05
2050	Q1.5	Proposed	164	1168.07	1170.01	1.01	1170.34	7.78	21	21.1	0.10	0.06		0.05
2000	Q100	Proposed	858	1163.49	1167.21	1.79	1167.91	13.62	90	50.4	0.10	0.06	0.10	0.06
2000	Q10	Proposed	489	1163.49	1166.47	1.14	1167.09	11.79	54	47.6	0.10	0.06	0.10	0.05
2000	Q1.5	Proposed	164	1163.49	1165.32	1.20	1165.67	8.91	18	15.3		0.06		0.06
1950	Q100	Proposed	858	1158.77	1162.03	1.38	1162.91	15.36	85	61.6	0.10	0.06	0.10	0.06
1950	Q10	Proposed	489	1158.77	1161.49	0.98	1162.15	12.76	53	54.2	0.10	0.06	0.10	0.05
1950	Q1.5	Proposed	164	1158.77	1160.69	1.26	1161.10	8.22	20	15.9		0.06		0.06
1900	Q100	Proposed	858	1153.17	1156.53	1.52	1157.39	14.94	83	54.7	0.10	0.06	0.10	0.06
1900	Q10	Proposed	489	1153.17	1155.91	1.03	1156.62	12.72	50	48.8	0.10	0.06	0.10	0.05
1900	Q1.5	Proposed	164	1153.17	1154.87	1.12	1155.43	9.71	17	15.1		0.06		0.06
1850	Q100	Proposed	858	1147.50	1150.88	1.42	1151.77	15.4	82	58.0	0.10	0.06	0.10	0.06
1850	Q10	Proposed	489	1147.50	1150.31	0.91	1151.04	12.93	50	54.8	0.10	0.06	0.10	0.05
1850	Q1.5	Proposed	164	1147.50	1149.37	1.23	1149.68	8.58	19	15.6		0.06		0.06
1800	Q100	Proposed	858	1141.76	1145.13	1.51	1146.07	15.6	79	52.3	0.10	0.06	0.10	0.06
1800	Q10	Proposed	489	1141.76	1144.52	0.96	1145.29	13.28	48	49.5	0.10	0.06	0.10	0.05
1800	Q1.5	Proposed	164	1141.76	1143.50	1.15	1144.00	9.58	17	14.9		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
1750	Q100	Proposed	858	1135.99	1139.36	1.52	1140.33	15.66	78	51.5	0.10	0.06	0.10	0.06
1750	Q10	Proposed	489	1135.99	1138.75	1.02	1139.49	13.16	48	47.0	0.10	0.06	0.10	0.05
1750	Q1.5	Proposed	164	1135.99	1137.81	1.21	1138.20	8.89	18	15.3		0.06		0.06
1685.16	Q100	Proposed	858	1128.19	1131.58	1.58	1132.59	16.02	74	47.1	0.10	0.06	0.10	0.06
1685.16	Q10	Proposed	489	1128.19	1130.92	1.13	1131.76	13.5	45	39.9	0.10	0.06	0.10	0.05
1685.16	Q1.5	Proposed	164	1128.19	1129.89	1.14	1130.40	9.66	17	14.8		0.06		0.06
1631.51	Q100	Proposed	858	1122.32	1125.56	1.33	1126.45	15.32	82	61.8	0.10	0.06	0.10	0.06
1631.51	Q10	Proposed	489	1122.32	1125.04	0.97	1125.72	12.59	51	52.7	0.10	0.06	0.10	0.05
1631.51	Q1.5	Proposed	164	1122.32	1124.13	1.03	1124.49	8.46	19	18.9	0.10	0.06		0.06
1558.62	Q100	Proposed	858	1114.01	1117.50	1.70	1118.41	15.2	78	46.1	0.10	0.06	0.10	0.06
1558.62	Q10	Proposed	489	1114.01	1116.82	1.12	1117.55	13	48	42.8	0.10	0.06	0.10	0.05
1558.62	Q1.5	Proposed	164	1114.01	1115.76	1.15	1116.21	9.56	17	14.9		0.06		0.06
1514	Q100	Proposed	858	1109.32	1112.91	1.71	1113.88	15.07	74	43.3	0.10	0.06	0.10	0.06
1514	Q10	Proposed	489	1109.32	1112.18	1.31	1112.94	12.59	45	34.6	0.10	0.06	0.10	0.05
1514	Q1.5	Proposed	164	1109.32	1111.18	1.23	1111.48	8.36	20	16.0		0.06		0.06
1485.63	Q100	Proposed	858	1106.89	1110.30	1.70	1111.18	14.68	77	45.3	0.10	0.06	0.10	0.06
1485.63	Q10	Proposed	489	1106.89	1109.68	1.24	1110.32	11.84	50	40.5	0.10	0.06	0.10	0.05
1485.63	Q1.5	Proposed	164	1106.89	1108.70	1.20	1109.00	8.09	20	16.9		0.06		0.06
1451.92	Q100	Proposed	858	1104.73	1108.63	1.80	1109.10	12.05	104	57.7	0.10	0.06	0.10	0.06
1451.92	Q10	Proposed	489	1104.73	1108.00	1.23	1108.36	9.76	68	55.6	0.10	0.06	0.10	0.05
1451.92	Q1.5	Proposed	164	1104.73	1106.88	1.31	1106.88	6.73	24	18.6	0.00	0.06	0.10	0.06
1418.62	Q100	Proposed	858	1102.38	1106.14	1.53	1106.82	13.34	98	64.4	0.10	0.06	0.10	0.06
1418.62	Q10	Proposed	489	1102.38	1105.46	1.08	1106.07	11.42	57	53.0	0.10	0.06	0.10	0.05
1418.62	Q1.5	Proposed	164	1102.38	1104.32	1.26	1104.58	8.26	20	15.8		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
1362.71	Q100	Proposed	858	1098.39	1101.88	1.61	1102.55	13.54	94	58.0	0.10	0.06	0.10	0.06
1362.71	Q10	Proposed	489	1098.39	1101.26	1.11	1101.80	11.37	59	53.3	0.10	0.06	0.10	0.05
1362.71	Q1.5	Proposed	164	1098.39	1100.43	1.08	1100.63	7.28	23	21.0	0.10	0.06		0.05
1308.81	Q100	Proposed	858	1094.26	1097.98	1.59	1098.64	13.08	101	63.5	0.10	0.06	0.10	0.06
1308.81	Q10	Proposed	489	1094.26	1097.33	1.07	1097.86	11.07	61	57.7	0.10	0.06	0.10	0.05
1308.81	Q1.5	Proposed	164	1094.26	1096.17	1.25	1096.46	8.37	20	15.6		0.06		0.06
1243.78	Q100	Proposed	858	1090.31	1094.19	1.90	1094.65	12.16	104	54.9	0.10	0.06	0.10	0.06
1243.78	Q10	Proposed	489	1090.31	1093.44	1.34	1093.88	10.36	65	48.5	0.10	0.06	0.10	0.06
1243.78	Q1.5	Proposed	164	1090.31	1092.53	0.82	1092.58	6.58	26	31.9	0.10	0.06	0.10	0.04
1172.3	Q100	Proposed	858	1082.95	1086.32	1.69	1087.43	16.58	68	40.4	0.10	0.06	0.10	0.06
1172.3	Q10	Proposed	489	1082.95	1085.64	1.10	1086.52	14.18	41	37.5	0.10	0.06	0.10	0.05
1172.3	Q1.5	Proposed	164	1082.95	1084.44	0.98	1085.20	12.18	13	13.7		0.06		0.06
1126.39	Q100	Proposed	858	1079.82	1082.07	1.84	1082.73	12.26	72	39.2	0.10	0.06	0.10	0.06
1126.39	Q10	Proposed	489	1079.82	1081.55	1.38	1081.91	9.54	52	37.8	0.10	0.06	0.10	0.06
1126.39	Q1.5	Proposed	164	1079.82	1080.93	0.88	1080.95	5.55	30	33.7		0.06		0.06
1063.6	Q100	Proposed	858	1073.21	1077.95	2.64	1078.43	12.45	80	30.1	0.10	0.06	0.10	0.05
1063.6	Q10	Proposed	489	1073.21	1076.78	2.11	1077.13	10.66	48	22.9	0.10	0.06	0.10	0.05
1063.6	Q1.5	Proposed	164	1073.21	1075.11	1.28	1075.47	9.11	18	14.1		0.06		0.06
992.88	Q100	Proposed	858	1069.14	1072.71	1.89	1073.46	12.96	67	35.4	0.10	0.06	0.10	0.06
992.88	Q10	Proposed	489	1069.14	1072.99	2.12	1072.59	6.46	77	36.3	0.10	0.06	0.10	0.06
992.88	Q1.5	Proposed	164	1069.14	1071.52	1.09	1071.48	5.68	29	26.5		0.06		0.06
965.98	Q100	Proposed	858	1067.81	1072.86	2.51	1072.86	9.99	116	46.3	0.10	0.06	0.10	0.06
965.98	Q10	Proposed	489	1067.81	1071.80	1.75	1071.80	8.58	69	39.6	0.10	0.06	0.10	0.05
965.98	Q1.5	Proposed	164	1067.81	1070.17	1.60	1070.04	6.45	25	15.9		0.06		0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
896.36	Q100	Proposed	858	1065.69	1070.43	3.31	1069.68	7.91	121	36.7	0.10	0.06	0.10	0.06
896.36	Q10	Proposed	489	1065.69	1068.37	1.75	1068.67	9.68	52	29.5	0.10	0.06	0.10	0.06
896.36	Q1.5	Proposed	164	1065.69	1067.52	1.28	1067.39	5.6	29	22.9		0.06		0.06
863.1	Q100	Proposed	858	1063.94	1070.05	4.28		8.47	149	34.9	0.10	0.06	0.10	0.07
863.1	Q10	Proposed	489	1063.94	1068.02	2.86	1067.36	8.07	84	29.4	0.10	0.06	0.10	0.07
863.1	Q1.5	Proposed	164	1063.94	1065.99	1.25	1065.99	7.03	30	24.1	0.10	0.06	0.10	0.06
828.53	Q100	Proposed	858	1061.14	1067.82	3.49	1067.82	13.64	97	27.7	0.10	0.06	0.10	0.06
828.53	Q10	Proposed	489	1061.14	1066.10	3.00	1066.10	11.53	58	19.3	0.10	0.06	0.10	0.06
828.53	Q1.5	Proposed	164	1061.14	1063.93	1.64	1064.04	8.69	23	13.8	0.10	0.06	0.10	0.06
826.84	Q100	Proposed	858	1060.76	1065.18	2.97	1066.62	17.16	51	17.2	0.10	0.06	0.10	0.06
826.84	Q10	Proposed	489	1060.76	1063.93	2.35	1065.01	15.17	32	13.7		0.06		0.06
826.84	Q1.5	Proposed	164	1060.76	1062.44	1.18	1063.12	12.12	14	11.4		0.06		0.06
803.52	Q100	Proposed	858	1055.18	1059.39	3.00	1061.57	21.35	43	14.5	0.10	0.06	0.10	0.05
803.52	Q10	Proposed	489	1055.18	1058.21	2.25	1059.74	18.16	28	12.3	0.10	0.06	0.10	0.06
803.52	Q1.5	Proposed	164	1055.18	1056.86	1.31	1057.62	12.8	13	9.8		0.06		0.06
788.49	Q100	Proposed	858	1052.86	1056.13	2.37	1058.17	21.73	41	17.3	0.10	0.06	0.10	0.06
788.49	Q10	Proposed	489	1052.86	1055.40	1.78	1056.73	17.26	29	16.2	0.10	0.06	0.10	0.06
788.49	Q1.5	Proposed	164	1052.86	1054.57	1.09	1055.05	10.25	16	14.7		0.06		0.06
752.92	Q100	Proposed	858	1042.81	1046.27	1.89	1048.21	23.47	44	23.2	0.10	0.06		0.06
752.92	Q10	Proposed	489	1042.81	1045.56	1.49	1047.09	19.34	29	19.3	0.10	0.06		0.06
752.92	Q1.5	Proposed	164	1042.81	1044.45	0.97	1045.36	14.49	11	11.7	0.10	0.06		0.06
740.16	Q100	Proposed	858	1041.85	1046.09	2.35	1047.54	17.96	56	23.8	0.10	0.06	0.10	0.06
740.16	Q10	Proposed	489	1041.85	1045.36	1.84	1046.24	13.86	39	21.4	0.10	0.06	0.10	0.06
740.16	Q1.5	Proposed	164	1041.85	1044.43	1.28	1044.59	7.88	21	16.6	0.10	0.06	0.10	0.06

TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
PERMANENTE CREEK RESTORATION PLAN

RiverSta	Profile	Plan	QTotal (cfs)	MinChEl (ft)	W.S.Elev (ft)	HydrDepth (ft)	CritW.S. (ft)	VelChnl (ft/s)	FlowArea (sqft)	TopWidth (ft)	Manning LOB --	Manning Chan --	Manning ROB --	Manning avg --
709.95	Q100	Proposed	858	1038.62	1044.52	3.14	1045.49	16.2	73	23.1	0.10	0.06	0.10	0.05
709.95	Q10	Proposed	489	1038.62	1043.03	2.89	1044.09	13.89	42	14.5	0.10	0.06	0.10	0.05
709.95	Q1.5	Proposed	164	1038.62	1040.94	1.51	1041.46	10.98	16	10.5	0.10	0.06	0.00	0.06
659.75	Q100	Proposed	858	1036.65	1041.33	3.07	1042.21	14.45	60	19.6	0.10	0.06	0.10	0.06
659.75	Q10	Proposed	489	1036.65	1040.57	2.62	1040.84	10.62	46	17.6	0.00	0.06	0.00	0.06
659.75	Q1.5	Proposed	164	1036.65	1039.05	1.65	1039.05	7.35	22	13.5		0.06		0.06
597.67	Q100	Proposed	858	1033.94	1039.05	3.73	1039.05	11.44	77	20.7	0.10	0.06	0.10	0.06
597.67	Q10	Proposed	489	1033.94	1037.72	2.73	1037.72	9.61	51	18.7	0.10	0.06	0.10	0.06
597.67	Q1.5	Proposed	164	1033.94	1036.13	1.64	1036.04	6.75	24	14.8		0.06		0.06
552.31	Q100	Proposed	858	1032.03	1036.19	2.90	1036.85	13.26	68	23.3	0.10	0.06	0.10	0.06
552.31	Q10	Proposed	489	1032.03	1035.31	2.32	1035.56	10.29	48	20.8	0.10	0.06	0.10	0.06
552.31	Q1.5	Proposed	164	1032.03	1033.95	1.53	1033.95	7.03	23	15.3		0.06		0.06
500	Q100	Proposed	858	1028.47	1033.48	3.13	1033.96	12.86	72	22.9	0.10	0.06	0.10	0.05
500	Q10	Proposed	489	1028.47	1032.18	2.60	1032.45	10.87	46	17.5	0.10	0.06	0.10	0.06
500	Q1.5	Proposed	164	1028.47	1030.49	1.51	1030.67	8.25	20	13.1		0.06		0.06
450	Q100	Proposed	858	1026.39	1031.01	2.63	1031.65	12.26	73	27.8	0.10	0.06		0.05
450	Q10	Proposed	489	1026.39	1030.20	2.45	1030.20	9.22	53	21.7	0.10	0.06		0.06
450	Q1.5	Proposed	164	1026.39	1028.49	1.56	1028.49	7.14	23	14.7		0.06		0.06
400	Q100	Proposed	858	1024.77	1028.14	2.00	1028.58	10.89	81	40.2	0.10	0.06	0.10	0.06
400	Q10	Proposed	489	1024.77	1028.11	1.97	1027.79	6.31	79	40.2	0.10	0.06	0.10	0.06
400	Q1.5	Proposed	164	1024.77	1027.07	1.12	1026.76	4.23	39	34.9		0.06	0.10	0.06

Project: Permanente Creek Restoration Project
Project #: 13-016
Date: 11/7/18
By: D.R.
Checked by: B.M.Z.
Location: Channel Widening Area

Table T3

Overtopping Flow Evaluation along Angular Rock Vehicle Barrier

Purpose: Evaluate areas where the 100-year flood overtops the bank adjacent to the access road and determine if the proposed 4 to 8 inch angular rock vehicle barrier will remain stable.

HEC-RAS Station	Road Edge Elevation (ft)	100-yr WSE (ft)	Depth at Road Edge (ft)	Velocity at Road Edge (ft/s)	Energy Slope (ft/ft)	Shear Stress (calculated) (lbs/sf)	Notes
145+50 and upstream	691.0	690.6	--	--			road above 100-yr WSE
145+00	688.0	689.1	1.1	2.2	0.019	1.3	
144+50	685.7	686.9	1.2	4.9	0.060	4.5	Maximum shear
144+12.75	684.4	685.3	0.9	4.2 to 5.0	0.039	2.2	
143+88.99 to 135+94	--	--	--	--			road above 100-yr WSE
135+60.62	645.7	646.2	0.5	1.2	0.017	0.5	
135+00	644.2	645.2	1.0	3.6	0.017	1.1	
134+50	642.5	643.9	1.4	5.5	0.016	1.4	max velocity
134+26	--	--	--	--	0.056	--	Fringe, negligable
134+00	640.7	641.4	0.7	1.0	0.011	0.5	
133+50	638.8	640.8	2.0	2.0	0.011	1.4	
133+35.55 to 124+82.8	--	--	--	--			road above 100-yr WSE
124+63.7	606.0	606.2	0.2	1.2	0.037	0.5	
124+11.83	--	--	--	--	0.039	--	Fringe, negligable
123+56.27	601.2	602.8	1.6	4.2	0.025	2.5	
123+01.23	600	600.3	0.3	4..2	0.047	0.9	shallow
122+50.48 to 117+74.33	--	--	--	--			road above 100-yr WSE
117+24.31	580.4	580.7	0.3	0.6	0.002	0.0	
166+78.1	579.7	580.6	0.9	0.8	0.001	0.1	
166+20.76	578.3	580.2	1.9	2.2	0.005	0.6	Just upstream of culvert

Notes:

*The maximum permissible velocity of a 6-inch diameter rock is 10 ft/s and the maximum permissible shear stress is 2.5 lb/ft^2

*The maximum permissible velocity of a 12-inch diameter rock is 13 ft/s and the maximum permissible shear stress is 5.1 lb/ft^2

Use 10 to 16-inch diameter rock to constructe the vehicle barrier from Sta. 144+25 to 144+75.

*Source: Fischenich, Craig. May 2001. Stability Thresholds for Stream Restoration Materials. USAE Research and Development Center, Environmental Laboratory. Vicksburg Mississippi.

WATERWAYS CONSULTING, INC.

APPENDIX G

Engineered Streambed Material, Floodplain Armor and Vegetated Rock Slope Protection Sizing Calculations

Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/30/2018
Calculated by: BMZ
Checked by: BMS

Caltrans RSP Design at Culvert #7

FHWC-CA-TL-95-10

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ \ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

Parameter	Value	Units	Data type	Description
Flow	1276	cfs		100-year Design Flow
RS u/s	122+25	ft	(enter)	River Station
V_{av}	**8.6**	fps	(enter)	Average channel velocity at Section A
SG	2.5	-	(constant)	Min. Specific Gravity (Caltrans 72-2.02)
r	70	-	(constant)	Constant for randomly placed rubble.
a	33.69	degrees	(enter)	Outside slope face angle (26.6 for 2H:1V)
sin(r-a)	0.59	-	(result)	
VF	1.33	-	(enter)	Velocity Factor (.67 for parallel and 1.33 for impinging)
V_{ss}	11.44	fps	(result)	Factored velocity (V_{av} x V_f)
W_{min}	**160**	lbs	(result)	Theoretical Min. Rock Mass that remains stable
RSP-Class	0.50	ton	(enter)	STANDARD Rock Size greater than W_{min} (T 5-1)
RSP-Class	1000	lbs	(result)	STANDARD Rock Size greater than W_{min} (T 5-1)
D_{min}	1.23	ft	(result)	Min. Rock Dia. based on a sphere, 165 pcf.
D_{50}	2.26	ft	(result)	Diameter of STANDARD (50-100%) rock size, 165 pcf.
t_A	3.39	ft	(result)	Thickness for Type A placement, t = 1.5 D_{50}
t_B	4.24	ft	(result)	Thickness for Type B placement, t = 1.875 D_{50}

Notes:
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 1/2 Ton RSP to assist with constructability

Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/30/2018
Calculated by: BMZ
Checked by: BMS

Caltrans RSP Design at Culvert #9

FHWC-CA-TL-95-10

$$W_{min} = \frac{0.00002\ (V_{av} \cdot V_f)^6\ SG}{(SG-1)^3\ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

Parameter	Value	Units	Data type	Description
Flow	1276	cfs		100-year Design Flow
RS u/s	143+50	ft	(enter)	River Station
V_{av}	14.7	fps	(enter)	Average channel velocity at Section A
SG	2.5	-	(constant)	Min. Specific Gravity (Caltrans 72-2.02)
r	70	-	(constant)	Constant for randomly placed rubble.
a	33.69	degrees	(enter)	Outside slope face angle (26.6 for 2H:1V)
sin(r-a)	0.59	-	(result)	
VF	1.33	-	(enter)	Velocity Factor (.67 for parallel and 1.33 for impinging)
V_{ss}	19.55	fps	(result)	Factored velocity (V_{av} x V_f)
W_{min}	3985	lbs	(result)	Theoretical Min. Rock Mass that remains stable
RSP-Class	2.00	ton	(enter)	STANDARD Rock Size greater than W_{min} (T 5-1)
RSP-Class	4000	lbs	(result)	STANDARD Rock Size greater than W_{min} (T 5-1)
D_{min}	3.59	ft	(result)	Min. Rock Dia. based on a sphere, 165 pcf.
D_{50}	3.59	ft	(result)	Diameter of STANDARD (50-100%) rock size, 165 pcf.
t_A	5.39	ft	(result)	Thickness for Type A placement, t = 1.5 D_{50}
t_B	6.73	ft	(result)	Thickness for Type B placement, t = 1.875 D_{50}

Notes:
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 2 Ton RSP

Engineered Streambed Material (ESM) Calculations

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

Calculations to determine the gradation and thickness of ESM for constructed floodplains throughout project area.

1. Inputs

	Proposed Conditions Site Data (Culvert #7)	Proposed Conditions Site Data (Culvert #8)	Sediment Fan Tributary	Material Removal Area Tributary	Rock Pile 7.7%	Material Removal Area 12%
Design Flow*	1087 cfs	1009 cfs	12.1 cfs	16.2 cfs	949 cfs	683 cfs
Channel Width =	20 ft	26 ft	6 ft	7 ft	18.5 ft	16.3 ft
q =	54.4 cu.ft./sec ft	38.8 cu.ft./sec ft	2.0 cu.ft./sec ft	2.3 cu.ft./sec ft	51.3 cu.ft./sec ft	41.9 cu.ft./sec ft
gravity, g	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2
Slope, S	0.039 ft/ft	0.027 ft/ft	0.249 ft/ft	0.141 ft/ft	0.077 ft/ft	0.120 ft/ft

***Portion of 100-year design flow that is being conveyed over the ESM.**

***Portion of 100-year design flow that is being conveyed**

2. Equations to Calculate D50 particle size

2. Equations to Calculate D50 particle size

Bathhurst (1987)

developed for: slope (0.23 to 9%)
particle dia. (0.35 to 11 inches)
$D_{50} = 3.56\ q^{2/3}\ S^{.75} / g^{1/3}$

Robinson et al. (1998)

developed for: slope (2% to 40%)
particle dia. (0.6 to 11 inches)
$D_{50} = [q_{design} / (8.07 \times 10^{-6}\ S^{-0.58})]^{0.529}$

Abt and Johnson (1991)

developed for: slope (1% to 20%)
particle dia. (1 to 6 inches)
$D_{50} = 0.436\ q_{sizing}^{0.56}\ S^{0.43}$
$q_{sizing} = q$ * sizing factor
sizing factor = 1.35

	Culvert #7	Culvert #8	Sediment Fan Tributary	Material Removal Area Tributary	Rock Pile 7.7%	Material Removal Area 12%
Bathhurst (1987) D_{50} =	1.4 ft	0.9 ft	0.6 ft	0.5 ft	2.3 ft	2.8 ft
Robinson q_{design} ($m^3/s/m$) =	5.05	3.61	0.19	0.21	4.77	3.89
Robinson D_{50} (mm) =	431	322	133	120	514	354
Robinson et al. (1998) D_{50} =	1.4 ft	1.1 ft	0.4 ft	0.4 ft	1.7 ft	1.2 ft
Abt and Johnson (1991) D_{50} =	1.2 ft	0.8 ft	0.4 ft	0.4 ft	1.6 ft	1.7 ft
Choose D_{50} =	1.4 ft	1.1 ft	0.6 ft	0.5 ft	2.0 ft	2.0 ft

3. Develop Grain Size Distribution Utilizing the Calculated D_{50}

Washinton Department of Fish and Wildlife Grain Size Distribution (WDFW, 2003)

D_{84}/D_{100} = 0.4
D_{84}/D_{50} = 2.5
D_{84}/D_{16} = 8

WDFW Substrate Gradation

	Culvert #7	Culvert #8	Sediment Fan Tributary	Material Removal Area Tributary	Rock Pile 7.7%	Material Removal Area 12%
D_{100} =	8.8 ft	6.9 ft	3.8 ft	3.1 ft	12.5 ft	12.5 ft
D_{84} =	3.5 ft	2.8 ft	1.5 ft	1.3 ft	5.0 ft	5.0 ft
D_{50} =	1.4 ft	1.1 ft	0.6 ft	0.5 ft	2.0 ft	2.0 ft
D_{16} =	5.25 in	4.13 in	2.25 in	1.88 in	7.50 in	7.50 in

__Note__: WDFW gradation above is based on wide variety of stream beds in different environments. The D_{84}/D_{100} ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}=2xD_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84} = 1.5D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the D_{84} calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

Resulting Floodplain Armor Gradation for Various Work Areas

Size Class	Particle Diamter (Culvert #7)	Particle Diamter (Culvert #8)	Particle Diamter (Sediment Fan Tributary)	Particle Diamter (Material Removal Area Tributary)	Particle Diamter (Rock Pile 7.7%)	Particle Diamter (Material Removal Area 12%)
D_{100} =	3.5 ft	2.8 ft	1.5 ft	1.3 ft	5.0 ft	5.0 ft
D_{84} =	2.5 ft	2.0 ft	1.0 ft	0.9 ft	4.0 ft	4.0 ft
D_{50} =	1.4 ft	1.1 ft	0.6 ft	0.5 ft	2.0 ft	2.2 ft
D_{16} =	2.0 in	2.0 in	2.0 in	2.0 in	6.0 in	4.0 in
D_{8} =	0.08 in	0.08 in	0.08 in	0.08 in	0.08 in	0.08 in

Note: Refer to Specifications for final size gradation

Justification

Choose largest size of Floodplain Armor to be equal to the D_{84} calculated using the WDFW gradation.

4. ESM Thickness

Thickness greater or equal to max($1.5XD_{50}$ or D_{100}) (ACOE EM 1110-2-1601)

5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

Floodplain Armor Calculations (Page 1 of 2)

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

Calculations to determine the gradation and thickness of Floodplain Armor for constructed floodplains throughout project area.

1. Inputs

	Channel Widening (Sta. 16+70 to 21+25)	Channel Widening (Sta. 21+25 to 23+00)	Channel Widening (Sta. 23+00 to 28+00)	Channel Widening (Sta. 30+75 to 31+75)	Channel Widening (Sta.31+75 to 40+50)
Design Flow*	577 cfs	174 cfs	326.9 cfs	381.3 cfs	115.9 cfs
Channel Width =	50 ft	14 ft	31.3 ft	35 ft	18.5 ft
q =	11.5 cu.ft./sec ft	12.4 cu.ft./sec ft	10.4 cu.ft./sec ft	10.9 cu.ft./sec ft	6.3 cu.ft./sec ft
gravity, g	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2
Slope, S	0.049 ft/ft	0.035 ft/ft	0.040 ft/ft	0.081 ft/ft	0.032 ft/ft

***Portion of 100-year design flow that is being conveyed over the floodplain armor.**

2. Equations to Calculate D50 particle size

Bathhurst (1987)

	Sta. 16+70 to 21+25	Sta. 21+25 to 23+00	Sta. 23+00 to 28+00	Sta. 30+75 to 31+75	Sta.31+75 to 40+50
developed for:	slope (0.23 to 9%) particle dia. (0.35 to 11 inches)	slope (0.23 to 9%) particle dia. (0.35 to 11 inches)	slope (0.23 to 9%) particle dia. (0.35 to 11 inches)	slope (0.23 to 9%) particle dia. (0.35 to 11 inches)	slope (0.23 to 9%) particle dia. (0.35 to 11 inches)
D_{50} =	3.56 q^2/3 S^.75 / g^1/3	3.56 q^2/3 S^.75 / g^1/3	3.56 q^2/3 S^.75 / g^1/3	3.56 q^2/3 S^.75 / g^1/3	3.56 q^2/3 S^.75 / g^1/3
D_{50} =	0.6 ft	0.5 ft	0.5 ft	0.8 ft	0.3 ft

Robinson et al. (1998)

	Sta. 16+70 to 21+25	Sta. 21+25 to 23+00	Sta. 23+00 to 28+00	Sta. 30+75 to 31+75	Sta.31+75 to 40+50
developed for:	slope (2% to 40%) particle dia. (0.6 to 11 inches)	slope (2% to 40%) particle dia. (0.6 to 11 inches)	slope (2% to 40%) particle dia. (0.6 to 11 inches)	slope (2% to 40%) particle dia. (0.6 to 11 inches)	slope (2% to 40%) particle dia. (0.6 to 11 inches)
D_{50} =	$[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$	$[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$	$[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$	$[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$	$[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$
q_{design} ($m^3/s/m$) =	1.07	1.15	0.97	1.01	0.58
D_{50} (mm) =	204	191	182	230	129
D_{50} =	0.7 ft	0.6 ft	0.6 ft	0.8 ft	0.4 ft

Abt and Johnson (1991)

	Sta. 16+70 to 21+25	Sta. 21+25 to 23+00	Sta. 23+00 to 28+00	Sta. 30+75 to 31+75	Sta.31+75 to 40+50
developed for:	slope (1% to 20%) particle dia. (1 to 6 inches)	slope (1% to 20%) particle dia. (1 to 6 inches)	slope (1% to 20%) particle dia. (1 to 6 inches)	slope (1% to 20%) particle dia. (1 to 6 inches)	slope (1% to 20%) particle dia. (1 to 6 inches)
D_{50} =	0.436 q_{sizing}^0.56 S^0.43	0.436 q_{sizing}^0.56 S^0.43	0.436 q_{sizing}^0.56 S^0.43	0.436 q_{sizing}^0.56 S^0.43	0.436 q_{sizing}^0.56 S^0.43
q_{sizing} =	q * sizing factor	q * sizing factor	q * sizing factor	q * sizing factor	q * sizing factor
sizing factor =	1.35	1.35	1.35	1.35	1.35
D_{50} =	0.6 ft	0.5 ft	0.5 ft	0.7 ft	0.3 ft
Choose D_{50} =	0.6 ft	0.6 ft	0.6 ft	0.8 ft	0.4 ft

3. Develop Grain Size Distribution Utilizing the Calculated D_{50}

Washinton Department of Fish and Wildlife Grain Size Distribution (WDFW, 2003)

	Sta. 16+70 to 21+25	Sta. 21+25 to 23+00	Sta. 23+00 to 28+00	Sta. 30+75 to 31+75	Sta.31+75 to 40+50
D_{84}/D_{100} =	0.4	0.4	0.4	0.4	0.4
D_{84}/D_{50} =	2.5	2.5	2.5	2.5	2.5
D_{84}/D_{16} =	8	8	8	8	8

WDFW Substrate Gradation

	Sta. 16+70 to 21+25	Sta. 21+25 to 23+00	Sta. 23+00 to 28+00	Sta. 30+75 to 31+75	Sta.31+75 to 40+50
D_{100} =	3.8 ft	3.8 ft	3.8 ft	5.0 ft	2.5 ft
D_{84} =	1.5 ft	1.5 ft	1.5 ft	2.0 ft	1.0 ft
D_{50} =	0.6 ft	0.6 ft	0.6 ft	0.8 ft	0.4 ft
D_{16} =	2.25 in	2.25 in	2.25 in	3.00 in	1.50 in

__Note__: WDFW gradation above is based on wide variety of stream beds in different environments. The D_{84}/D_{100} ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}=2xD_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84}=1.5D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the D_{84} calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

Resulting Floodplain Armor Gradation for Various Work Areas

Size Class	Particle Diamter (Sta. 16+70 to 21+25)	Particle Diamter (Sta. 21+25 to 23+00)	Particle Diamter (Sta. 23+00 to 28+00)	Particle Diamter (Sta. 30+75 to 31+75)	Particle Diamter (Sta.31+75 to 40+50)
D_{100} =	1.5 ft	1.5 ft	1.5 ft	2.0 ft	1.0 ft
D_{84} =	1.0 ft	1.0 ft	1.0 ft	1.3 ft	0.8 ft
D_{50} =	0.6 ft	0.6 ft	0.6 ft	0.8 ft	0.4 ft
D_{16} =	2.0 in	2.0 in	2.0 in	2.0 in	2.0 in
D_8 =	0.08 in	0.08 in	0.08 in	0.08 in	0.08 in

Note: Refer to Specifications for final size gradation (each work area)

Justification

Choose largest size of Floodplain Armor to be equal to the D_{84} calculated using the WDFW gradation.

4. Floodplain Armor Thickness

Thickness greater or equal to max($1.5XD_{50}$ or D_{100}) (ACOE EM 1110-2-1601)

5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

Floodplain Armor Calculations (Page 2 of 2)

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

Calculations to determine the gradation and thickness of Floodplain Armor for constructed floodplains throughout project area.

1. Inputs

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
Design Flow*	159 cfs	433 cfs	449 cfs	1145 cfs
Channel Width =	8 ft	14 ft	60 ft	22 ft
q =	19.9 cu.ft./sec ft	30.9 cu.ft./sec ft	7.5 cu.ft./sec ft	52.0 cu.ft./sec ft
gravity, g	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2	32.2 ft/sec^2
Slope, S	0.057 ft/ft	0.057 ft/ft	0.054 ft/ft	0.12 ft/ft

***Portion of 100-year design flow that is being conveyed over the floodplain armor.**

2. Equations to Calculate D50 particle size

Bathhurst (1987)

developed for: slope (0.23 to 9%)
particle dia. (0.35 to 11 inches)

$D_{50} = 3.56\, q^{2/3} S^{.75} / g^{1/3}$

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
D_{50} =	1.0 ft	1.3 ft	0.5 ft	3.2 ft

Robinson et al. (1998)

developed for: slope (2% to 40%)
particle dia. (0.6 to 11 inches)

$D_{50} = [q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
q_{design} (m^3/s/m) =	1.85	2.87	0.70	4.84
D_{50} (mm) =	238	359	170	473
D_{50} =	0.8 ft	1.2 ft	0.6 ft	1.6 ft

Abt and Johnson (1991)

developed for: slope (1% to 20%)
particle dia. (1 to 6 inches)

$D_{50} = 0.436\, q_{sizing}^{0.56} S^{0.43}$

$q_{sizing} = q$ * sizing factor

sizing factor = 1.35

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
D_{50} =	0.8 ft	1.0 ft	0.5 ft	1.9 ft
Choose D_{50} =	1.0 ft	1.3 ft	0.6 ft	1.9 ft

3. Develop Grain Size Distribution Utilizing the Calculated D50

Washinton Department of Fish and Wildlife Grain Size Distribution (WDFW, 2003)

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
D_{84}/D_{100} =	0.4	0.4	0.4	0.4
D_{84}/D_{50} =	2.5	2.5	2.5	2.5
D_{84}/D_{16} =	8	8	8	8

WDFW Substrate Gradation

	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 40+50 to 45+00)	Channel Widening (Sta. 45+00 to 48+75)	Rock Pile
D_{100} =	6.3 ft	8.1 ft	3.8 ft	11.9 ft
D_{84} =	2.5 ft	3.3 ft	1.5 ft	4.8 ft
D_{50} =	1.0 ft	1.3 ft	0.6 ft	1.9 ft
D_{16} =	3.75 in	4.88 in	2.25 in	7.13 in

<u>**Note**</u>: WDFW gradation above is based on wide variety of stream beds in different environments. The D_{84}/D_{100} ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}=2xD_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84} = 1.5D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the D_{84} calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

Resulting Floodplain Armor Gradation for Various Work Areas

Size Class	Particle Diamter: Channel Widening (Sta. 40+50 to 45+00)	Particle Diamter: Channel Widening (Sta. 40+50 to 45+00)	Particle Diamter: Channel Widening (Sta. 45+00 to 48+75)	Particle Diamter: Rock Pile
D_{100} =	2.5 ft	3.3 ft	1.5 ft	5.0 ft
D_{84} =	2.0 ft	2.5 ft	1.0 ft	4.0 ft
D_{50} =	1.0 ft	1.3 ft	0.6 ft	2.0 ft
D_{16} =	4.0 in	4.0 in	2.0 in	6.0 in
D_{8} =	0.08 in	0.08 in	0.08 in	0.08 in

Note: Refer to Specifications for final size gradation
Note: Refer to Specifications for final size gradation
Note: Refer to Specifications for final size gradation
Note: Refer to Specifications for final size gradation

Justification

Choose largest size of Floodplain Armor to be equal to the D_{84} calculated using the WDFW gradation.

4. Floodplain Armor Thickness

Thickness greater or equal to max($1.5XD_{50}$ or D_{100}) (ACOE EM 1110-2-1601)

5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

APPENDIX H

Floodplain Log Ballast Calculations

Wood and Ballast Calculations for Floodplain logs at Permanente Creek

Project: Permanente Creek Restoration Project
Project #: 13-016
Date: 10/25/18
Calculated by: B.M.S.
Checked by: B.M.Z.

Note: adjust values in red cells.

Alder/willow average dry density = 28 lbs/cuft

Ballast Estimate

Density of water = 62.4 lbs/cuft

Ballast in one cubic foot Small Cobble:

Average Dry Unit Weigh Cobble = 142.6 lbs/cuft
Ballast provided by one cubic foot of Cobble = 80.20 lbs/cuft

Log Dimensions

Diameter 1.5 ft average diameter along length of log

Bouyant Force on Log = 60.8 lbs/ft

Ballast of Cobble Over Log per Linear Foot

Width of trench = 1.5 Width of trench equal to diameter of log
Burial Depth (i.e. trench depth) = 1.5 Adjust burial depth as needed to calculate acceptible factor of safety

Ballast of rock in trench = 180.45 lbs/ft ballast force per linear foot of trench

Assume:

50% of log is burried by rock ballast to a minimum depth of 1.5 ft

Then

Weight of rock ballast per linear foot of trench = 180.45 lbs/ft

Unit weight of ballast per linear foot over entire log assuming 50% of log buried below ballast = 90.225 lbs/ft ballast force per foot of burried log

Factor of Safety = 1.5 for a 1.5 ft. diameter log

Note: Smaller diameter logs would have a greater factor of safety, larger diameter logs would have a smaller Fs for the specified burial depth.
Adjust calculations as required during construction to conform to available log sizes and species.

Calculations are conservative because they do not account for:

Friction forces of soil/ballast material on log that result pullout
Additional ballast weight from cone of influence of material outside of trench width

WATERWAYS CONSULTING, INC.

APPENDIX I

Geotechnical Plan Review – Permanente Creek Restoration Plan, 90% Design Submittal

GOLDER

TECHNICAL MEMORANDUM

DATE 11/15/18 **Project No.** 0637109942

TO Erika Guerra, Talia Flagan
Lehigh Southwest Cement Company

FROM Bill Fowler, PG, CEG **EMAIL: bfowler@golder.com**

GEOTECHNICAL PLAN REVIEW - PERMANENTE CREEK RESTORATION PLAN, 90% DESIGN SUBMITTAL, LEHIGH PERMANENTE QUARRY

1.0 INTRODUCTION

This technical memorandum presents an update to our plan review of the creek restoration plan set prepared for Permanente Creek at the Lehigh Hanson Permanente property (Site) located in Santa Clara County. Specifically, this memo is presented in support of the following plan set:

- Permanente Creek Restoration Plan – 90% Level Submittal, Waterways Consulting, Inc., dated 11/15/18 (90% Plan Set)

This memo is a follow-on to our previous plan review prepared for the creek restoration project entitled "Geotechnical Plan Review - Permanente Creek Restoration Plan – 70% Design Submittal" dated October 27, 2017 and our "Preliminary Geotechnical Recommendations for Conceptual Level Permanente Creek Restoration Plans" dated April 28, 2014. The purpose of our work was to complete a review of the 90% Plan Set to evaluate any changes in the project since our review of the 70% design submittal that would pertain to our geotechnical recommendations. We refer the reader to our previous Plan Review memo (Attachment 1) for a summary of the project, a description of the site geologic conditions, and our previous conclusions and recommendations.

Based on a telephone call with Lehigh Southwest Cement Company (Lehigh) and Waterways Consulting, Inc. (Waterways) on October 18, 2018, it is our understanding that no substantive changes related to the geotechnical conditions or our recommendations were made to the updated 90% Plan Set. This was confirmed based on our review of the 90% Plan Set.

However, we understand that an option to utilize an engineered gabion structure, or mechanically stabilized earth wall (MSE wall), along one reach of the project where existing constraints may potentially prevent laying back the creekbank slope to our recommended maximum inclination of 2H:1V is being considered by Lehigh and Waterways. Our review of this new element is provided below.

2.0 MATERIAL REMOVAL AREA CONCEPT DESIGN

The Material Removal Area (Reaches 17 & 18, Sheets C23-C26) includes existing improvements and infrastructure that are currently used in support of site operations. These improvements include: a water treatment system for treatment of quarry process water, an access road from the main quarry haul road down to the water treatment system, and a water storage pond (Pond 1250) located at the top of the slope (Sheet C10). These improvements were constructed in an area of the quarry where historic overburden materials of unknown extent effectively form the northern streambank of Permanente Creek. The restoration plan for this area includes a re-alignment of the centerline of Permanente Creek to the north, along with the creation of a floodplain bench; which, in turn, pushes the toe of the restored streambank to the north (i.e., approximately 25 feet northward as illustrated on Sheet C25). One effect of the re-alignment is that excavation and removal of the existing streambank materials is required, and this results in an overall flattening of the slope and a push back for the top of the slope.

A seismic refraction analyses was performed in this area to better define the top of bedrock along the stream channel and to assist Waterways with development of a more uniform profile gradient. Waterways has shown estimated upper limit depths, and lower limit depths, to the estimated top of bedrock surface in their plan set. Final grades will need to be determined in the field to best fit encountered bedrock grades. While we anticipate that the upper limit depths will most closely conform to the field fit bedrock surface, and this will help to limit the soil excavation required, it will not be possible to move the toe of slope 25 feet northward and flatten the northern streambank back to 2H:1V grades without removal or compromise of the existing improvements, in particular the access road and the 1250 Pond. The improvements are not considered permanent structures and it is possible that, depending on the timing of project implementation, the improvements may be removed and the slope flattened to meet our recommendations. If, however, the improvements are still needed for site operations, then an engineered retaining structure such as an MSE wall may be required to stabilize the slope.

To address this issue, Waterways provided “Concept Design Alternative, Permanente Creek Restoration Plan, Material Removal Area, Figures 4.0 and 5.0” for our review. The figures are included in “Updated responses to the March 5, 2018 County of Santa Clara, Department of Planning and Development, Grading Application Incomplete Letter” which is part of the 90% level submittal to the County. The figures show a conceptual design alternative for an MSE wall (or equivalent) to protect the existing improvements and allow for restoration of the creek channel in accordance with project requirements. Figure 4.0 shows the plan view location of the wall, which is located adjacent to the existing access road (and Pond 1250). The linear extent of the wall is approximately 750 feet with estimated heights ranging from approximately eight feet up to a maximum of 26 feet. Note the wall may need to be taller if bedrock is deeper than anticipated and the lower limit estimate of the channel invert is constructed.

Our review of the concept plan, and cross sections, indicate that an MSE wall (or equivalent) is a feasible concept should such a wall be required. Note that the wall should be founded on competent bedrock to be confirmed in the field by the Project Engineering Geologist or Project Geotechnical Engineer. In addition, a geotechnical investigation and report with appropriate design parameters for wall design and construction will be required (see Note 2, Figure 5.0).

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our review of the 90% Plan Set, and discussions with Waterways and Lehigh, there have not been any substantive changes to the 90% Plan Set that affect our Conclusions and Recommendations for the project that were previously provided as part of our 70% plan review. Therefore, the plan set is in general conformance with the applicable geotechnical recommendations outlined in our “Preliminary Geotechnical Recommendations for Conceptual Level Permanente Creek Restoration Plans” dated April 28, 2014.

In addition, the Material Removal Area - Concept Design Alternative (discussed above) is considered feasible; however, a geotechnical investigation is required to provide appropriate geotechnical design parameters should an engineered retaining structure be needed to implement the restoration plan as designed.

Please feel free to contact Bill Fowler at (408) 220-9239 if you have any questions.

c:\users\bfowler\onedrive - golder associates\permanente\creek restoration\final draft tech memo_perm creek plan review_11_13_2018_wlf r1.docx

TECHNICAL MEMORANDUM

Date: October 27, 2017
Project No.: 17-90186
To: Talia Flagan, Erika Guerra
Company: Lehigh Hanson SW Cement
From: Bill Fowler, P.G., Ken Haskell, P.E.
cc: Brent Zacharia, P.E.

RE: **GEOTECHNICAL PLAN REVIEW - PERMANENTE CREEK RESTORATION PLAN, 70% DESIGN SUBMITTAL**

1.0 INTRODUCTION

This memo presents the results of our plan review of the creek restoration plan set prepared for Permanente Creek at the Lehigh Hanson Permanente property (Site) located in Santa Clara County. Specifically, this report is presented in support of the following plan set:

- Permanente Creek Restoration Plan – 70% Design Submittal, Sheets C1 – C28 and L1-L3, Waterways Consulting, Inc. and WRA, dated 9/29/17.

This memo is a follow-on to our previous memo prepared for the creek restoration entitled "Preliminary Geotechnical Recommendations for Conceptual Level Permanente Creek Restoration Plans" dated April 28, 2014. The purpose of our work was to complete a review of the 70% plan set (Plan Set) to evaluate changes in the project since our original review, and to determine if the geotechnical recommendations provided were properly incorporated into the project design.

2.0 PROJECT DESCRIPTION

Based on information provided by Waterways Consulting, Inc. (Waterways) and review of the Plan Set, we understand that the project entails a restoration effort of Permanente Creek starting at existing property line at the east end of the facility, and extending upgradient just past the western limit of the quarry pit (Sheet C1 & C2). The Plans are divided into a series of 21 reaches with generally different restoration elements required for each reach. Note that the currently proposed Plan Set only proposes work up through Reach 18. The work varies by reach but entails a variety of tasks including:

- Removal of deleterious materials related to historic operations (i.e., rock fill materials, old culverts, concrete foundations, sediment accumulations, etc.)
- Removal of in-stream ponds and culverts
- Widening of the creek channel
- Re-alignment of the creek channel to approximate pre-mining location and grade
- Construction of engineered streambeds and flood plain benches
- Installation of erosion control measures and re-vegetation

Golder Associates Inc.
425 Lakeside Drive
Sunnyvale, CA 94085 USA
Tel: (408) 220-9223 Fax: (408) 220-9224 www.golder.com

We note that several construction elements that were included in the previous conceptual plan set including new creek channel crossings with structural concrete spans and retaining walls, and a Mechanically Stabilized Earth (MSE) wall to retain the rock surge pile area have been eliminated from the current Plan Set. This greatly simplifies the geotechnical elements of the project since it eliminates the main structural elements of the previous project. We also note that the existing concrete channel along the rail spur alignment (Station 20+00 to 40+00) is to remain as is with restoration elements limited to supplemental plantings.

3.0 SITE GEOLOGIC CONDITIONS

With respect to the proposed creek restoration improvements, key aspects of the assumed geologic conditions are summarized below.

- From Station 60+00 to the up-gradient end of the project (Figure 1), the channel bottom is expected to consist primarily of bedrock or shallow alluvial deposits (<5 feet thick) overlying bedrock. The alluvial deposits are comprised of a poorly-sorted mixture of cobbles, gravels, sand, silt and clay. Deposits range from a few inches thick in the upper reaches of the watershed where erosion has cut the channel down into bedrock, to tens of feet thick where the channel widens and deepens as it approaches the flatter terrain of the Santa Clara Valley. The sideslopes of the canyon are generally covered with colluvial deposits along the south side, and either colluvial deposits or mine-derived overburden or fill along the north side of the canyon.
- From Station 60+00 to the down-canyon property boundary (Figure 1), the channel bottom is expected to consist of Alluvium or Channel Fill greater than 5 to 10 feet thick overlying bedrock. In the lower reaches of the channel (i.e., reaches R1 through R7) extensive grading and filling activities occurred as part of the early development of the property (i.e., early 1940's) along the creek channel. Significant thicknesses of fill (> 20 feet(?)) were placed for development of the railroad right-of-way and associated infrastructure and crossings. The creek itself was channelized along the southeast edge of the canyon as shown on the plan set from approximate station 20+00 to 40+00.
- In the vicinity of the project site, the basement bedrock is part of the Franciscan Assemblage and is comprised of a series of intricately folded and faulted limestones, metabasalts (greenstones) and lesser amounts of graywacke. In general, the rocks are highly fractured and locally sheared from regional tectonics associated with the nearby San Andreas and Sargent Berrocal fault zones. Fault breccia is common throughout the region as determined by extensive rock coring. Weathering of the greenstones, in particular, has oxidized the rock and reduced the upper horizons near the ground surface to a clay-rich residuum with low rock mass strength.
- Slope performance of the various bedrock lithologies varies across the site. Limestone generally stands well at the overall inter-ramp angle (IRA) of 45 degrees in most areas of the quarry with bench face angles of about 70 degrees. Some localized failures have occurred where adversely oriented structure is mapped. Upper benches throughout the quarry are developed in weathered greenstone with slope angles ranging from 26 to 38 degrees over limited heights. Steeper bench faces in greenstone (60 to 70 degrees) tend to degrade over time. At depth, non-oxidized greenstone is exposed in slopes with a 45 degree IRA. These slopes are typically more degraded and looser than the limestone benches mined at the same angle, and produce more talus.
- Groundwater is anticipated to be relatively shallow in the upstream reaches of Permanente Creek as groundwater baseflow sustains perennial flow of the Creek. However,

groundwater is locally captured in the reaches of the stream adjacent to the Creek prior to being discharged at Pond 4a. In the immediate vicinity of the Creek (within ten to twenty feet) we would anticipate groundwater at depths less than five feet below ground surface in the upland bedrock terrain. Depth to groundwater information is not available for the filled portion of the Creek below Station 50+00. Observations of seepage in the vicinity of Station 35+00 (approximate) along the railroad tracks indicate groundwater may be relatively shallow.

- The site is subject to strong ground motions due to earthquake events. Using the 2008 Update of the United States National Seismic Hazard Maps (Peterson, et.al., 2008), Golder estimates that design peak ground accelerations should be approximately 0.57g for the Site for an earthquake event with a 10 percent probability of exceedance in a 50-year period.

4.0 GEOTECHNICAL CONSIDERATIONS

Preliminary geotechnical recommendations were provided in our previous memo for initial conceptual design purposes. With the simplification of the project, the main geotechnical considerations are limited to recommended slope angles for final slopes.

- **Rock Slopes**: For planning purposes, slopes greater than 20 feet in height in greenstone materials should not exceed slope angles of 2H:1V. Slopes less than 20 feet should perform adequately at 1.5H:1V; however, localized areas of instability may be encountered. Cutslopes in limestone and graywacke greater than 20 feet in height should not exceed 1H:1V and slopes less than 20 feet should be limited to no steeper than 3/4H:1V.
- **Fill or Soil Slopes**. For planning purposes, permanent slopes comprised of mining overburden, alluvium, colluvium or other site-derived fill should not exceed 2H:1V.

Based on our review of the Plan Set, the project primarily involves cutting and removal of man-made surficial deposits (i.e., mine waste and artificial fills) to restore the creek channel and creek banks back to a more natural state. As stated in the Notes (Sheet C28), the finished final grades were developed without full knowledge of subsurface conditions and therefore are estimates based on engineering judgement. The intent is to remove the man-made surficial materials down to bedrock while minimizing excavations/cuts into bedrock. This will entail engineering observation and field fitting of final profiles during excavation activities to best achieve the goal of restoring natural profiles while minimizing excavation of bedrock materials. In some locations along creek banks, it is anticipated that cuts will expose natural surficial materials (i.e., colluvium and slope wash) as opposed to bedrock and may require localized cuts steeper than 2H:1V in order to daylight the cuts into natural slopes. The Rock Pile Removal area presents the largest challenge due to the size of the excavation, and the steep natural terrain underlying and comprising the hillslope above the rock fill.

5.0 PLAN REVIEW NOTES

The following summarizes our notes from our review of the Plan Set with respect to final slopes and potential geotechnical constraints. Only sheets with geotechnical constraints are called out below.

- Sheet C7 – We note that Section B shows a 1H:1V slope approximately 12 feet tall along the south creek bank. This section shows a detail for vegetated rock slope protection. We concur with this stabilization measure. Other areas of the plan sheet incorporate exposed rock slope protection.
- Sheet C12 – Slopes are shown on Typical Section D and E with 2H:1V (min.). We interpret this to mean slopes no steeper than 2H:1V.
- Sheet C15 – The rock pile area excavation plan entails a large volume of excavation back to assumed natural grades. We note that the natural topography in the area is steep and final slopes will need careful attention to erosion control measures and management of stability.
- Sheet C16 – Natural slopes above the proposed removal areas on Typical Section B are approximately 1H:1V.
- Sheet C17 - Natural slopes above and in the proposed removal areas on Typical Section C, D and E are approximately 1H:1V.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The plan set is in general conformance with the applicable geotechnical recommendations as outlined in our "Preliminary Geotechnical Recommendations for Conceptual Level Permanente Creek Restoration Plans" dated April 28, 2014. We note that several structural construction elements that were included in the previous conceptual plan set have been eliminated from the current Plan Set, which simplifies the geotechnical elements of the project. With the simplification of the project, the primary geotechnical considerations are limited to recommended slope angles for final slopes.

The main geotechnical challenge for the proposed project is likely related to the Rock Pile removal area which entails a large stockpile of aggregate materials placed along the margin of the creek and up onto the hillside to a height in excess of 200 vertical feet. The estimated thickness of the rock pile ranges up to 100 feet. Estimated natural slopes angles below the rock pile are shown as steep as 1H:1V. We recommend inspection of these slopes by the project geotechnical engineer following the removals to evaluate the nature and stability of the exposed materials. If the removals expose bedrock, stability of the slopes should be adequate. However, if the cut exposes surficial materials or highly weathered greenstone, potential localized slope instability may be encountered. As stated in the Field Engineering Notes section of the project plan Notes (Sheet C28) stability of hillsides may necessitate:

- Field engineering and a field directed construction approach
- Final geometries to be directed in the field by the Project Engineer to account for unanticipated subsurface conditions
- Flexibility with respect to final gradients and defined "grading envelopes" for channel gradients
- A narrowing of floodplain widths in areas where the final design profile approaches the lower limit of the grading envelope
- Slope benching to reduce slope angles and lengths, control surface runoff and erosion while vegetation is established

We concur with the above recommendations, and the Field Engineering Notes in general, with respect to addressing and minimizing potential slope instabilities. We further recommend that the Project Geotechnical Engineer inspect all final cutslopes as the project progresses such that any potential areas of concern can be identified early in the process and remedial measures developed, if required.

Please feel free to contact Bill Fowler at (408) 220-9239 if you have any questions.

Bill